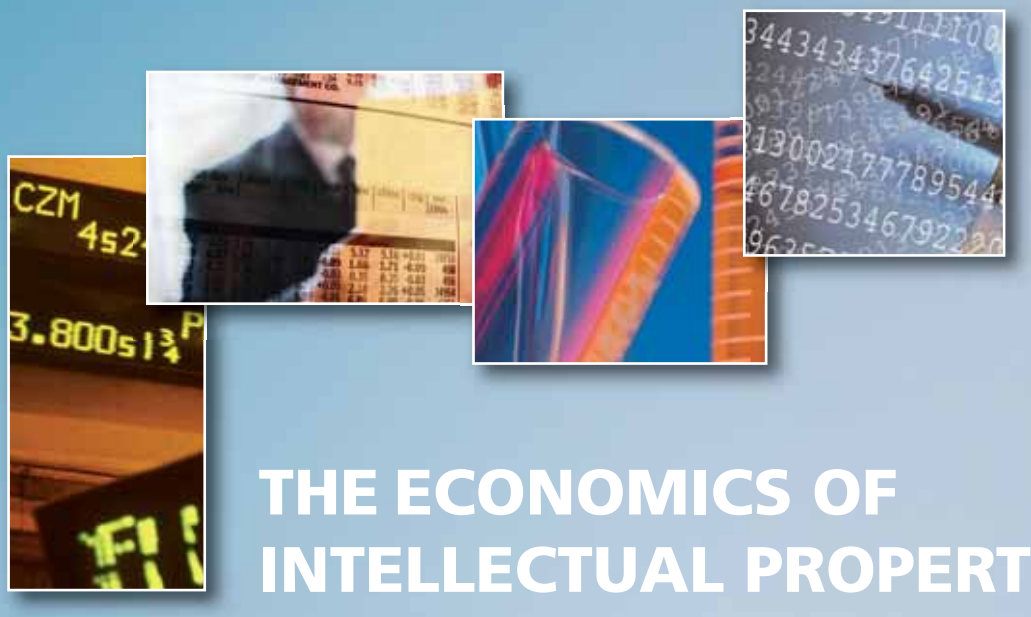

THE ECONOMICS OF INTELLECTUAL PROPERTY

Suggestions for Further Research in Developing Countries and Countries with Economies in Transition

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PREFACE

Over the past decade, there has been increasing interest by policymakers, academics, businesses and civil society organizations in understanding the economic and social impact of intellectual property (IP) rights. The growing importance of knowledge and innovation has placed IP rights under the spotlight and highlighted the need to clearly assess how intellectual property interfaces with development in different socio-economic contexts. Legislative reform in the field of intellectual property, and the modernization of the IP infrastructures of many countries has raised expectations on how the IP system can be used to promote economic development.

In the field of economics, the literature on intellectual property has been rapidly expanding over recent years, particularly in some developed countries. As access to data on IP has improved, methodological tools for understanding its role in the economy have become increasingly sophisticated, and our understanding of the economic trade-offs has been enhanced. Nevertheless, the empirical literature from developing countries and countries with economies in transition has remained very limited, which has constrained the ability of policy-makers to take evidence-based decisions on IP matters and choose between different policy options.

It is against this background that WIPO embarked on a series of projects, both at the national and international level, to promote more empirical economic literature on intellectual property in developing countries and countries with economies in transition. The series of papers in this publication were commissioned from renowned international economists from all regions. They review the existing empirical literature on six selected themes relating to the economics of intellectual property, identify the key research questions, point out research gaps and explore possible avenues for future research.

Drafts of the papers contained in this publication were discussed at the WIPO International Roundtable on the Economics of Intellectual Property, which was held in Geneva on November 26 and 27, 2007, and attended by international economists from all regions working on a wide range of IP issues. Given the richness of the comments provided by discussants at the Roundtable, the current publication includes them, along with the six papers.

I would like to thank all the economists who have contributed to this publication and hope that the papers will be useful to encourage and guide future researchers in developing countries and countries with economies in transition in undertaking empirical economic research on intellectual property. While economists are the main target audience of this publication, it is also hoped that it will be of interest to policy-makers who are interested in understanding the interface between intellectual property and economic development and exploring areas in which additional economic evidence could be useful to guide decision-making in this field.

Francis Gurry
Director General

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INNOVATION AND APPROPRIABILITY, EMPIRICAL EVIDENCE AND RESEARCH AGENDA

ANDRÉS LÓPEZ*

1. INTRODUCTION

Intellectual property rights (IPRs) have attracted increasing attention both in academic circles as well as in public policy debates over the past decades. This has gone hand-in-hand with their increasing use, particularly (but not only) patents, reforms in the national and international legal frameworks that have resulted in the strengthening of IPRs and the fast growth of sectors in which knowledge, innovation and appropriability play a key role (e.g. biotechnology, information and communication technologies and the cultural industries). Intense debates among researchers have taken place on a wide range of issues, including the reasons for the growing use of IPRs; the impact of the strengthening of IPRs on innovation; the role of IPRs in developing countries; whether there is a need for international harmonization of the laws regulating the matter and the consequences of IPR legislative reforms on poor communities in areas such as health or traditional knowledge.

This paper aims at exploring one of the main areas to which research efforts have been devoted, namely, the determinants of the use of different appropriability strategies at the firm and sectoral level. The origins of the empirical literature on the subject can be traced back to the seminal works on patents by Scherer *et al* (1959) and Mansfield *et al* (1981). However, a key turning point took place in the mid-1980s when Teece (1986) established a new theoretical framework for analyzing the relation between innovation and appropriability and Levin *et al* (1987) studied how firms used a variety of different appropriability strategies including, but not limited to, patents.

In the following years, research on the subject was spurred by the upsurge in patent applications, reforms in IPR legislation and the availability of innovation surveys with data on innovation at the firm level that allowed economists to apply more sophisticated research techniques. However, while there are some facts that have been more or less clearly demonstrated by the available empirical evidence, there are also many areas and subjects where disagreement or, more frequently, uncertainty prevails. This is particularly the case in non-manufacturing sectors as well as in developing countries, where very few studies on the subject have been undertaken.

More theory and more solid empirical evidence, including the development of new databases specifically aimed at inquiring about the use of IPRs and other appropriability mechanisms, would be needed, in order to achieve significant advances in our knowledge about the dynamics of innovation and appropriability in different countries, sectors and type of firms.

This paper reviews the empirical literature[1] on the use of appropriability strategies,[2] including the determinants of the propensity to patent, with a view to highlighting the main findings. It analyzes the strengths and weaknesses of the research that has been carried out so far on the subject and suggests a research agenda both for developed as well as for developing countries.

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Therefore, section 2 of the paper briefly presents a conceptual framework for organizing the discussion. In section 3 the available empirical evidence on the subject is surveyed. Section 4 summarizes the findings and analyzes the strengths, weaknesses and limitations of the empirical literature and section 5 suggests a research agenda, to address some of the research gaps and broaden our understanding of the issue, particularly in developing countries and countries with economies in transition.

Before proceeding with the paper, it is useful to note that it will not analyze the impact of patenting and other appropriability tools on variables such as profits or innovation activities. While part of the literature surveyed here considers these issues, this is not the focus of this paper. In the same vein, it is not going to discuss whether some appropriability mechanism is "better" than others at the firm or at the more general "social" level. Although these are clearly very relevant questions, their analysis falls beyond the reach of this paper.

2. INNOVATION AND APPROPRIABILITY: A BRIEF CONCEPTUAL FRAMEWORK

There is widespread agreement that in a perfect competition setting, that is, a situation in which, among other assumptions, no producer has market power, there is no product differentiation and all firms have immediate and perfect access to the same technologies, the rate of innovation in a market economy would be very low.

The problem was first stated in the early 19th century by Jeremy Bentham in his Manual of Political Economy and was later forcefully argued by Joseph Schumpeter (1942). Both stressed the need for entrepreneurs to expect supernormal profits by enjoying some kind of monopolistic power over their inventions. That expectation would encourage them to devote time and money to innovation activities.

As was highlighted in the seminal papers by Nelson (1959) and Arrow (1962), the main problem is one of appropriability and relates to the semi-public good characteristics of knowledge, for which exclusion is feasible but rarely or never perfect. If inventors or innovators could not rely on some means to protect the knowledge they create, they would be at a disadvantage *vis à vis* rivals who did not incur the often very high fixed costs of creating that knowledge. Such rivals would presumably be able to imitate it at a much lower cost or, in extreme cases, at zero cost.

As appropriability of knowledge is always incomplete, externalities arise, creating a difference between the private and the social marginal return of any new knowledge being generated, which could lead, under perfect competition, to under-investment in innovation activities. Furthermore, knowledge creation is affected by other market failures, since it is an activity that is subject to high levels of uncertainty and strong indivisibilities.

Hence, some kind of incentive is needed to spur private agents to devote resources to innovation activities. As stated above, one possible answer to this dilemma was provided by Schumpeter (1942), who argued that the promise of a (temporary) "monopoly power" was needed. However, as many authors have stressed, that is not the only possible answer. For instance, prizes or procurement (e.g. government-funded research) are alternative incentive schemes that are used in many situations and whose use could be further expanded (see Gallini and Scotchmer (2002)).

This paper, however, focuses on appropriability, i.e. the different means an economic agent may use to profit from its inventions or innovations by temporarily enjoying some kind of monopo-

listic power over the knowledge it creates. Brief mention will also be made of other strategies that are available to firms nowadays and that could allow them to reap more profits by sharing (rather than appropriating) the knowledge they create. This means that imitation may not always be harmful, since compatibility and network effects may also provide a source of profits (Hurmelinna and Puumalainen (2005)).

IPRs, including patents, copyright, trademarks, industrial designs, utility models[3] and plant breeders' rights,[4] are some of the appropriability mechanisms that may be used by innovators. However, as is well known, there are other available mechanisms, including the exploitation of lead time, moving rapidly down the learning curve, the use of complementary manufacturing capabilities and secrecy (see Cohen *et al* (2000)). Since labor mobility is also a form of technology imitation, labor legislation, contracts and human resource management practices are also very relevant appropriability mechanisms (Hurmelinna and Puumalainen (2007)), although some of those mechanisms could be included under the heading of secrecy. There are also a number of practical and technical means of protection, such as passwords, digital signatures, copy prevention mechanisms, etc. which are used in some industries.

The logic behind the variety of mechanisms employed by firms to protect their innovations can be understood in the light of the work by Teece (1986), who argued that profits from innovation depend upon the interaction of three groups of factors: appropriability regimes, complementary assets and the presence or absence of a dominant paradigm in the sector in which firms operate.

According to Teece, appropriability regimes are basically characterized by the nature of the technology and the efficacy of the available legal mechanisms for protection. Tight or loose appropriability regimes are defined by the capability of firms to retain greater or smaller profits from their innovations. Some technologies can be protected as trade secrets (this is often more feasible with process innovations than with products). Patents, in turn, are specially suited for inventions such as new chemical products and many mechanical inventions. The nature of the knowledge involved is also relevant. While codified knowledge is more easily replicable, tacit knowledge[5] is harder to articulate and transfer, since it is implicit and idiosyncratic and is often embedded in firms' routines and capabilities. Tacitness is in itself an appropriability mechanism for knowledge holders, but it is still subject to imitation – for instance, through hiring individuals/employees who have critically-important skills (Hurmelinna and Puumalainen (2007)).

The concept of complementary assets is a very relevant one since it highlights the fact that the successful commercialization of an innovation requires manufacturing, marketing and after-sales capabilities, among other factors. This means that appropriability cannot be entirely dependant on the more or less successful features of the technology to be protected, but is heavily based on the firms' other capabilities.

In turn, the dominant paradigm or dominant design theory (Abernathy and Utterback, 1975) suggests that in many industries there is a cycle that goes from a first pre-paradigmatic stage, in which firms compete through different designs in order to win pre-eminence in the market, to a second stage in which competition is more based on price, with economies of scale, learning and specialized equipment being more relevant. The nature of innovations and the type of appropriability mechanisms employed change during this trajectory. Hence, the means firms use to protect their innovations are also dependant on the stage in the life-cycle of the industry in which they operate (Dosi *et al* (2006)).

In light of the above, it comes as no surprise that innovating firms differ in the mechanisms they use to protect the knowledge they create, being those differences mainly related to firms' spe-

cific factors (such as size, capability or innovation strategies), knowledge-specific factors (tacit vs. codified), technology-specific factors (e.g. product vs. process innovations) and industry-specific factors (e.g. life-cycle stages and appropriability regimes). The country's legal environment is obviously another relevant factor, since it defines what can or cannot be protected through different legal mechanisms (and the level of effective enforcement of those mechanisms).

Moreover, the different appropriability mechanisms interact with each other in various ways. For instance, some mechanisms may be thought of as pre-requisites, derivative or supportive of other forms of protection. For example, technical means may be a requisite for keeping a trade secret. Patents or secrecy may help create lead-time advantages (Hurmelinna and Puumalainen (2007)). Different mechanisms may also be employed at the various stages of the innovation process. For instance, firms may initially rely upon secrecy prior to the commercialization of a new product, and later on apply for a patent and/or display aggressive marketing and lead-time strategies. In turn, lead time may be used to achieve advantages in manufacturing (moving along the learning curve and gaining economies of scale) and marketing (building up marketing sales and service capabilities), and to delay imitation by competitors (Harabi (1995)). Furthermore, more than one mechanism may even be employed at the same time for a given innovation when it comprises separately protectable components or features (Cohen *et al* (2000)), or when legislation allows for a "piling up" of IPRs over the same invention. Finally, the effectiveness of the different mechanisms varies over time; trade secrets may be revealed, patents expire and may be invented around, but trademarks, for instance, may increase their value dramatically and be renewed indefinitely (Hurmelinna and Puumalainen (2005)).

In this complex scenario, we cannot always make straightforward predictions regarding the relations between some firms, industries and technology features and the use of different appropriability methods. For instance, as stated by Arundel (2001), at the theoretical level, there are reasons to expect that small firms could find patents more valuable than large firms, but there are also arguments that could lead us to expect the opposite. While small firms could use patents to create a temporary barrier against competitors in order to build the manufacturing and marketing capabilities needed to become a successful innovator, it could also be that patent application costs and the costs of protecting patents from infringement could lead them to value secrecy more than patents. Furthermore, small firms could have fewer patentable innovations than large firms, since they could be mostly engaged in incremental improvements. Large firms often have IP departments or other similar organizational devices which could also lead them to display a higher patent propensity. At the same time, as shown in Giuri *et al* (2007), since they bear relatively lower costs in terms of patent applications and litigation, it comes as no surprise to find that large firms have a very high level of unused patents compared with small and medium-sized enterprises (SMEs) and may also patent minor innovations.

The analysis of the subject is further complicated by the fact that some IPRs, especially patents, are increasingly used for ends other than appropriating the returns from innovation. Most notably, "strategic" uses of patents – e.g. patent blocking, use in negotiations, prevention of suits, etc – are increasingly common (Hall and Ziedonis (2001)). Thus, when we observe a firm applying for a patent we cannot assume that its purpose has necessarily to do with the appropriability of the results of some innovation. In other words, there may be a divorce between the effectiveness of patents as appropriability tools and their rate of use since firms may use patents in order to attain other objectives.

As the reader will probably have noticed at this point, the issues discussed so far are mainly related to the dynamics of technological change in developed countries, where the bulk of the world's knowledge is created and a large number of firms have strong innovation capabilities; hence the appropriability issues are more acute.

What happens when trying to translate this debate to the reality of developing countries? First, it must be emphasized that the term "developing countries" comprises a wide variety of nations that are at very different stages of economic development and have very heterogeneous levels of technological capabilities. Hence, the innovation-appropriability dynamics will be very different, for instance, in advanced developing countries such as some Latin American or Asian economies where industrial, export and innovation capabilities are more or less strong, *vis à vis* most least developed countries (LDCs), which rely on traditional agricultural activities and have poorer productive and technological capabilities.

Second, it is often thought that developing countries are mainly imitators or adopters of technologies and knowledge developed elsewhere. Hence, the debate on IPRs in developing countries is often focused on whether lax or strong IPRs are more favorable for technological change in those countries. While lax IPRs are thought to favor imitation, copy and reverse engineering – and hence are seen by some authors as a favorable factor for the deployment of learning processes that could lead in the medium and long run to the creation of genuine innovation capabilities in those countries – it is often stated that strong IPRs are a condition for developing countries to receive updated technology transfers by means of licenses and foreign direct investment.

Although this is a crucial debate, it is often conducted at a mainly theoretical level, or on the basis of aggregate evidence (e.g. trying to relate foreign direct investment (FDI) flows with IPR legislation strength) or using anecdotal information. Micro-level studies are, on the contrary, relatively scarce, making it difficult to learn about the determinants of the use of IPRs in different types of firms and sectors in developing countries. In other words, very little is known about the appropriability strategies displayed by different groups of firms, or the ways in which different kinds of innovations are protected in these countries. Furthermore, there is a lack of sound evidence regarding the perception of domestic firms in developing countries about the role that IPRs play, or might play, in the context of their innovation strategies.

The question is that, contrary to the assumption mentioned above, although developing countries are in fact mostly dependant on foreign technology sources, domestic innovative activities also exist. *Strictu sensu*, as suggested above, even copying and making reverse engineering imply some kind of innovation efforts. However, innovation activities, at least in more advanced developing countries, go well beyond copying, as is clearly demonstrated by the available evidence that shows the existence of a wide range of technological capabilities in those countries, from the more widespread adaptive and incremental ones, to the rarer but far from negligible "genuine" innovative capabilities. The evolutionary trajectory of some East Asian countries such as the Republic of Korea, illustrates how economies that begin copying and adapting foreign technologies may gradually generate endogenous innovation capabilities as their firms progressively become world-class innovators.

The fact is that the relation between competition patterns, productive structures and innovation in developing countries is very different from that in developed countries, and hence we should also expect to find differences in the pattern of use of IPRs and other appropriability mechanisms (differences should also be found when comparing developing countries which are at different stages of industrial and technological development). Unfortunately, we often lack the theoretical tools to make clear predictions about the shape of these dynamics.

However, some very general arguments could be made. First, we could expect that the relevance of all (or most) appropriability mechanisms increases as the development process proceeds. Second, if SMEs are generally at a disadvantage for using some kind of IPRs (most notably patents), this trend could be even more pronounced in the case of developing countries, where SMEs are often weaker than their counterparts in the developed world.

Third, as frontier or world-first innovations are rare, it could be the case that, when they are allowed by the legislation, domestic firms could consider utility models more valuable than patents – which could be better suited for transnational corporation (TNC) affiliates that revalidate patents obtained in other countries. At the same time, the use of trademarks could be even more relevant than in developed countries as firms compete more through product differentiation than via continuous innovation.

Fourth, in many developing countries there is a widespread presence of TNC affiliates, and these affiliates often account for the bulk of the use of registrable appropriability mechanisms such as patents. Hence, there is a need to pay more attention to the influence of capital ownership on patenting decisions than is usually the case in studies undertaken in developed countries.

Finally, another relevant issue, which is also present in some developed countries, is related to the fact that for many firms in developing countries it is perhaps more relevant to patent abroad than to patent in their own countries (since the most interesting markets are those of developed countries, for instance).[6] The factors that influence the decision on where to patent, therefore, need to be carefully studied.

3. THE EMPIRICAL EVIDENCE

3.1 Some Introductory Remarks

When analyzing the available studies on innovation and appropriability it is important to distinguish them according to their scope, methodology and objectives. The studies reviewed for this survey have different aims and try to answer different questions. Furthermore, employed methodologies also vary; for instance, while there are many studies that employ econometric techniques, others are based on case studies or descriptive statistical analysis. The same goes for the type and number of firms included in each study, the number of years covered, the richness of the databases, etc.

In this regard, note must be taken of the fact that this paper surveys studies and papers that have different publication status – i.e. papers published in refereed journals, working papers, books, reports, etc. Although it could be argued that a review of the empirical literature should be restricted to studies that have been subject to referral procedures, we have adopted a more flexible approach, especially considering the fact that the body of literature on these issues is not as large as one would wish.

Economists prefer studies based on the use of econometric techniques (which are often the only accepted empirical method in most academic journals in the field of economics), since they allow for a greater methodological rigor. Economists assume that they can rely more on the true existence of relationships between different variables when they are found to be statistically significant through econometric tests than when they are merely the result of the observation of descriptive statistical tables. Furthermore, econometric methods allow us to estimate the amount of the effect that a change in a certain variable has on the variable of interest for the analysis (for instance, how much the propensity to patent increases when the size of a firm increases by 1 per cent) –these are the so-called marginal effects.

However, the use of econometric techniques also has problems. For instance, it is often the case that databases used for econometric studies were collected for purposes other than those pursued by the researcher engaged in those studies. Hence, the researcher must adapt his/her analysis to the existing data, which are not always the ones that he/she would need for a proper testing of the hypothesis he/she wants to confront.

Econometric methods are, on the other hand, heterogeneous regarding their strengths and weaknesses. In fact, econometric techniques have been subject to changing approaches in terms of those which are deemed as adequate or not over time. It is not always the case that the researcher is able to use the strongest or the more appropriate econometric technique since he/she is often dependant on the information contained in the database that is available to him/her at the moment the research is undertaken. Although this paper is not devoted to highlight the strengths and weaknesses of the econometric method used in the surveyed literature – notwithstanding the fact that in some specific cases mention will be made in that regard – the reader should be aware of the fact that not all those methods have the same properties and/or are equivalent in their robustness.

Furthermore, while econometric studies allow us to go beyond anecdotal evidence and avoid drawing false inferences based on the observation of apparent statistical associations between different variables, case studies can contribute with very relevant details about the decision of a firm to use different appropriability mechanisms. In this regard, case studies could, for instance, allow us to follow the decision-making process that leads a firm to use one or more appropriability mechanisms at different moments of the innovation process. More generally, if properly and systematically conducted, case studies could shed light on qualitative aspects that are involved in the innovation and appropriability strategies used by firms.

Another dividing line in the field of the studies on appropriability mechanisms is that between those that focus on a specific mechanism – usually patents – and those that explore the variety of appropriability methods a firm can employ (secrecy, lead times, etc.). The latter often aim at learning about the preferred appropriability methods, trying to find out which method is more used and/or considered to be more effective by innovative firms.

As will be seen below, there is not necessarily a linear relationship between the effectiveness of a certain appropriability method and its rate of use. For instance, while patents are often considered an ineffective method for protecting innovations, this does not mean that firms do not use them. In fact, while there are factors that may deter firms from using patents, as mentioned before, patents allow firms to pursue objectives different from protecting their innovations (this will be developed in the next section).

A related fact is that while in the case of patents we may have an "objective" measure of their use – since we may know if a firm applied for and/or was granted a patent – this is not often the case when speaking of the so-called "strategic methods" (e.g. lead time, secrecy, etc.). That is, we may ask a firm if it considers lead time an effective protection mechanism and/or it uses lead time as an appropriability method, but databases rarely allow us to know if that firm actually used lead time for protecting a specific innovation.

Another issue that needs to be carefully considered when undertaking a survey of the empirical evidence on this area is the fact that the definitions of innovation and/or of innovative firms also differ among available studies. This is important since usually only firms that innovate need to employ appropriability mechanisms – although this is not the case for trademarks. However, it is not always clear what we mean by innovation.

The problem is that while it is relatively easy to know if a firm spends money on research and development (R&D) activities (and also how much money it spends), the same is not true when we try to learn if the firm obtained or not an innovation – an innovation that could be the result of R&D activities but also of other kinds of learning activities, or even of pure chance.[7] Unfortunately, the main group of firms of interest when studying the use of appropriability mechanisms is not composed of R&D performing firms but those firms that managed to intro-

duce a new and/or improved product or process in the economy. Measures of innovation outputs are unfortunately not without problems; while counting innovations or asking whether a firm introduced or not an innovation during a certain period often does not make much sense in economic terms. Another often-used indicator – the percentage of sales corresponding to new products – is also not unambiguous and fails to consider process innovations.

Although available surveys on this subject frequently ask firms whether they obtained an innovation during a certain period, we often do not know what kind of innovation it is – and when there are answers to this question they are subjective ones, i.e. based on the firms' own perception.[8] This is important insofar as, for instance, only innovations that meet some specific requirements –novelty, non-obviousness and utility or industrial applicability – can be patented. More generally, different kinds of innovations (and in saying this we go beyond the traditional distinction between product and process innovations) may be protected by different appropriability methods, and this issue is rarely analyzed in available studies, mostly due to the lack of appropriate information on the subject. In this regard, as stated by Hussinger (2005), a frequent drawback of firm-level studies on appropriability tools arises from the fact that firms typically have more than one invention and, furthermore, tend to bundle different tools. Hence, it is difficult to know what innovations are protected by what appropriability mechanisms.

All these differences among the studies devoted to the analysis of appropriability mechanisms lead us to be aware of the need to be careful when comparing their findings, since answers may be different because questions were different or because they used non-comparable methods.

In addition, most studies on the issue under analysis are based on the manufacturing industry. Much less is known about services or agriculture, where specific protection mechanisms are in place. In other words, the evidence about innovation and appropriability is heavily biased towards industry, giving us an incomplete picture on the subject. Furthermore, some relevant legal appropriability mechanisms, such as trademarks, protection of plant varieties and copyright, have received much less attention than patents. While this could be the result of the fact that patents are often perceived to be more "important" in economic terms than other mechanisms – although not more used, since many more firms use trademarks than patents – it is perhaps also the case that it is the result of the availability of information – a fact that reminds us that economists do not always study the more relevant issues but those for which the required information is available.

Finally, very few studies are available for developing countries. The present survey includes some of those studies, but, as is emphasized below, there is a clear need for undertaking research projects in developing countries since there is an almost total absence of rigorous evidence on the subject. The promotion of new studies on innovation and appropriability in non-manufacturing sectors and in developing countries must, however, be accompanied by efforts to adapt the kind of research questions usually posed in studies for the manufacturing sector in developed countries to the different innovation and appropriability dynamics of other sectors and types of countries.

All that has been said in this brief introduction should be taken as a general warning for reading this section. When revising the strengths and weaknesses of the empirical literature produced so far and suggesting the research agenda, we will return to some of the points stressed above.

3.2 The Empirical Evidence: Main Findings

The findings of the literature reviewed for elaborating this paper could be organized along different axes. In our case, we have chosen to classify it under five headings, namely: (1) the ranking of the effectiveness of the different appropriability methods as perceived by private firms; (2) the determinants of firms' perceptions about the effectiveness of each appropriability tool; (3) the motives for patenting; (4) the determinants of firms' patent propensities; and (5) appropriability strategies in developing countries. In what follows the main results found for each subject in the available literature are surveyed.[9]

3.2.1 The Effectiveness and Use of the Different Appropriability Mechanisms

The pioneer studies on patents and appropriability (Scherer *et al*, 1959 for the US and Taylor and Silberston, 1973 for the UK) showed that patents were important as a means to profit from innovation only in the pharmaceutical industry. Later on, Mansfield (1986) found – based on the firms' own answers – that only in the pharmaceutical and chemical industries a large number of innovations would not have been developed or introduced in the market without patent protection, although, at the same time, the survey showed that firms patented most of their patentable inventions. A similar conclusion had already been reached in Mansfield *et al* (1981).

The limited importance of patents for innovative firms received further confirmation in a study by Levin *et al* (1987) who, in 1983, asked 650 R&D performing manufacturing firms in the US about their preferred methods to protect innovations. In 1994 a new study was made on a similar basis involving 1,478 US firms employing from 20 to more than 100,000 workers (Cohen *et al* (2000)). A distinctive feature of these studies was that they included other appropriability means such as secrecy, lead times, moving rapidly along the learning curve and complementary sales, services and manufacturing facilities.

A main finding was that firms valued secrecy, lead times or complementary sales, services and manufacturing facilities more than patents in most sectors. In fact, for the whole sample, patents only ranked above "other legal mechanisms" (such as trademarks) in terms of their effectiveness to protect innovations. In turn, secrecy and lead times were the preferred methods.

In the 1994 survey patents were not deemed to be the most effective protection mechanism in any industry, although they ranked high in drugs, medical equipment and special purpose machinery (for product innovations). As expected, patents were deemed not to be very effective in protecting product innovations in low-tech industries such as food, textiles and printing and publishing, or in traditional heavy branches such as steel. However, patents also ranked low in high-tech industries such as electronic components, semi-conductors, precision instruments and communication equipment.

In turn, it was found that secrecy and/or lead time were deemed as the most effective mechanisms in almost all industries, except printing/publishing, glass, concrete and cement and electronic components, where complementary sales and manufacturing capabilities were the most effective strategies.

Lead time was judged as the most effective mechanism for product innovations, followed by secrecy and complementary assets. In the case of process innovations, secrecy was much more important than lead time – it is easier to keep process innovations secret than product innovations – but complementary manufacturing capabilities also emerged as a very relevant appro-

priability tool. Patents were relatively more important for product innovations than for process innovations.

Cohen *et al* (2000) found that, in fact, there were three different appropriability strategies in the manufacturing industry: one based on lead time and complementary capabilities, another based on legal mechanisms (especially patents) and another based on secrecy. However, firms tended to use more than one appropriability method, simultaneously as well as sequentially.

Both 1983 and 1994 surveys asked about the reasons why firms did not use patents. Disclosure and ease of inventing-around were the most important reasons, together with lack of novelty of some inventions. In turn, the costs of applying and defending patents proved to be important reasons for not patenting among small firms – there was a correlation between firm size and whether the respondent indicated the cost of defending a patent in court as a reason for not patenting.

The availability of data similar to those generated by the 1983 and 1994 US surveys allowed the replication of the Levin *et al* (1987) and Cohen *et al* (2000) studies for many other countries. In the case of Europe this was possible to a large extent thanks to the launch of the Community Innovation Surveys (CIS).

Arundel (2001), for instance, analyzes the relevance of different appropriability methods on the basis of the results of the 1993 CIS for Belgium, Denmark, Germany, Ireland, Luxembourg, the Netherlands and Norway. The survey only covers innovative firms, that is, those firms that introduced a new product or process between 1990 and 1992, and the author concentrated, within this group of firms, on those that perform R&D on a continuous basis.

Lead time was the mechanism deemed by far the most effective, both for product as well as for process innovations. Followed in order of decreasing relevance by secrecy, design complexity,[10] patents and design registration. The reasons for not trusting in patents were similar to those mentioned for the US case.

Cohen *et al* (2001) undertook in Japan a study similar to those recently mentioned for the US and Europe, on the basis of a sample of large R&D performing manufacturing firms. The report shows wide differences in the use of appropriability methods in Japan *vis à vis* the US and Europe. All appropriability methods, except patents, were deemed as less effective than in the US. The ranking of methods also differed. Secrecy was judged as the least effective method for protecting product innovations, while patents were considered almost as effective as lead time and manufacturing capabilities. In turn, in the case of process innovations, complementary manufacturing was the most effective appropriability mechanism, while secrecy and lead time followed.

In the same vein, Laursen and Salter (2005) studied the use of appropriability methods in the UK industry dividing them into legal – design registrations, trademarks and patents – and first mover – secrecy, design complexity and lead time. Like the other studies mentioned above, they found that first mover mechanisms (which are similar to what we have called "strategic") were the most relevant. Trademarks and patents seemed to have, on average, the same effectiveness. The authors found differences in appropriability strategies by industry, but in all of them first mover mechanisms were deemed as the most effective. In turn, the relevance of appropriability mechanisms in general was higher in sectors such as chemicals (which include pharmaceuticals), machinery and electrical *vis à vis* food and drink, textiles, wood or paper and printing.

Harabi (1995) studied a panel of Swiss firms actively engaged in R&D activities, almost all of them in the manufacturing sector. Lead time ranked first for protecting process innovations and second in product innovations – for product innovations the preferred method was superior sales and service efforts. Patents were considered the least effective method both for process as well as for product innovations. The author found that only in some sectors – namely chemical products for plant protection, cosmetic products, chemical products (including drugs) and agricultural tools and equipment – was patent effectiveness relatively high. The ability of imitators to invent around patents was regarded as the most important constraint for patenting, followed by information disclosure.

Konig and Licht (1995) studied a sample of German manufacturing firms and found that non-legal IP mechanisms were more effective than legal tools. They found every non-legal IP protection tool more effective for protection of product innovations than patents.

Sattler (2002) analyzed a panel of German industrial firms that had introduced or planned to introduce new products. The descriptive analysis shows that the ranking of effectiveness was as follows: long-term employment relationships, lead time, design complexity, secrecy, patents and design registrations. A wide variance in the data was found, especially regarding patent effectiveness. On the basis of this finding, the author performed a cluster analysis and found that 20 per cent of firms deemed patents as the most effective method. In turn, chemicals (including pharmaceuticals), mechanical engineering and steel/basic metals were the industries where patents were perceived as more effective (and the magnitude of these sectoral effects was relatively high).

Blind *et al* (2006), on the basis of a survey of German firms significantly involved in patenting activities, studied the use of different appropriability mechanisms as well as the motives for patenting. The sample on which the authors based their analysis covered a wide range of appropriability methods, both formal (patents, abroad and domestic, trademarks, utility models, copyright, designs) as well as informal (lead time, long-term contracts with workforce, exclusive relations with customers, secrecy, suppliers' contracts). Although the sample was restricted only to firms with patents, lead time was still considered the most important protection mechanism. However, unlike other studies, patenting abroad and at home ranked second and third, respectively. Secrecy, in turn, ranked below exclusive relations with customers and at the same level as trademarks.

Gonzalez-Alvarez and Nieto-Antolin (2007) studied a panel of Spanish manufacturing firms. The mechanism that was mostly used was what the authors called continuous innovation (which, according to them, could be assimilated to lead time), followed by time and cost for imitation (related to the complexity of innovation), secrecy and patents.

Hurmelinna and Puumalainen (2007) studied a sample of Finnish R&D performing manufacturing firms. Descriptive statistics show that in terms of the effectiveness of appropriability mechanisms, the ranking was as follows: lead time, technical/practical means (secrecy, passwords, limited access), tacitness, contracts, IPRs (patents, trademarks, copyright, utility models, designs, trade secrets), labor legislation and human resource management.

Hanel (2005) studied a panel of Canadian manufacturing firms focusing on the use of legal IPRs, not including other forms of appropriability. Two-thirds of manufacturing firms in Canada used at least one form of IPR. Confidentiality agreements were by far the most popular IPR method, followed by trademarks. Patents and trade secrets were used by nearly a quarter of Canadian firms.[11] Although pharmaceutical firms made more intensive use of IPRs, in the case of patents, higher use was found in agricultural, construction and mining machinery followed by electrical

equipment and appliances. The top users of trade secrets were producers of semi-conductors and other electronic equipment, while in the computer industry confidentiality agreements were the preferred method. Low-tech sectors, in turn, relied more on trademarks. More generally, firms in high-tech sectors were more likely to be users of IPRs *vis à vis* those in low-tech industries. The study also showed that firms that introduced product and process innovations and only product innovations used IPRs more frequently (by "frequently" the author means the percentage of firms using IPRs within each group) than process-only innovators. This finding is observed even for trade secrets.

As mentioned before, there are very few studies that aim to learn about the usage of appropriability mechanisms in the service sector. One of those studies is that of Baldwin *et al* (1998) who analyzed the communications, financial and technical business service sectors. The study asked about the use of different appropriability devices as well as about their effectiveness. In terms of use, the report showed that fewer than half of the innovators in each industry reported using any of the IPRs available to them. In general, copyright and trademarks (specially employed in the financial services industry) are the more commonly used instruments. Trade secrets rank third in each industry, while patents are only used in the technical business service sector.

Regarding the perceived effectiveness of the different appropriability methods, the survey also included two "strategic" mechanisms, namely, being first to the market and complexity. Being first to the market is ranked as the most effective method in the three industries. Trademarks – which are key for attracting and retaining customers – ranked second in communications and financial services, while complexity occupied that place in technical business services and ranked third in communications and financial services. Patents were not seen as highly effective in any sector, while trade secrets were important in technical business services (a finding that Baldwin *et al* attributed to the fact that most firms in that industry were small) and the same occurred with copyright in communications.

Paallysaho and Kuusisto (2006) studied a sample of Finnish and UK firms in three knowledge-intensive service sectors: software consultancy and supply, business and management consultancy services and advertising. Most firms were small and medium-sized and their sales came mostly from tailor-made services. As expected, patents were used very little (software firms had a relatively higher rate of use), while trademarks and copyright dominated in the field of formal IPRs. However, by far the most used appropriability mechanism was restrictive contracts (85 per cent of the surveyed firms used contracts, against 36 per cent in the case of trademarks). These contracts included requiring employees to sign non-disclosure agreements or non-competition clauses.[12] The use of legal instruments was often complemented by informal means, such as secrecy (which was widely used by the firms sampled in this study), publishing, restrictions on access to information, enhancing personnel commitment and implementing schemes of fragmentation and rotation of duties.

Hipp and Herstatt (2006), studying a panel of service-intensive German firms, concluded that the preferred protection tool was internal lock-in (long term labor contracts), followed by secrecy, first-to-market, complex design and lock-in of customers and suppliers. Only 6 per cent of the firms used formal IPR strategies, mainly in the information and telecommunications and media cluster. Moreover, most companies used a combination of two or more protection mechanisms, especially secrecy and first-to-market with lock-in strategies.

Blind *et al* (2003), based on data from CIS-2, found that the propensity to patent as well as the number of patent applications was significantly lower in services compared with manufacturing. (According to the CIS-2, 7 per cent of service firms had applied for patents, compared with

25 per cent in the manufacturing industry.) The activities within the service sector where patenting was most common are R&D and business-related services and telecommunications. From case studies of 65 service companies across the European Union, the authors found that the protection mechanisms perceived as most important were trademarks, secrecy, customer relationship management and lead-time advantages, in that order, while patents were the least important formal method. However, in general both formal and informal appropriability tools had only average relevance in the innovation strategies of service companies. The most important reason for not patenting was that new services included tacit knowledge and were thus not eligible for patenting.

Mairesse and Mohnen (2003) compared the protection methods used by manufacturing and service firms drawing on data from the French CIS-3 survey. Trademarks, complexity and lead time were the most widely used appropriation methods in the service sector; patents ranked fourth along with secrecy. Although innovative service companies employed appropriability methods less often than those in high-tech manufacturing sectors, the contrary occurred when they were compared with innovators in low-tech sectors.

Beyond the literature based on quantitative evidence summarized so far, there are also a number of interesting papers based on case studies. Davis and Kjaer (2003a) studied patent strategies of small Danish firms in high-tech sectors (telecommunications, software and pharmaceutical-related biotechnology). Patents were a crucial appropriability means in the telecommunication industry, especially for products (processes were more prone to be protected by secrecy). However, patents were not enough to secure appropriability, and were complemented by other means such as R&D staff learning and experience (tacit knowledge). In contrast, patents were rarely used in the software sector. Lead time and continuous product development, along with sales and customer relations, were considered effective appropriation mechanisms in this sector. In the case of biotechnology, patents were considered the best means to secure appropriability. Other means were not considered feasible. For instance, lead time was not practical for inventions with long development times, subject to extensive testing and government approval, while complementary sales and marketing capabilities did not matter since, by the time the product was marketed, the innovating firm and/or the innovation had most likely been taken over by a larger firm. Regarding obstacles, the authors stated that size affected small firms in several ways, for instance, increasing the difficulties of detecting and pursuing infringers, and for using blocking patents. Davis and Kjaer's (2003b) findings in their study on the appropriability strategies of small biotech firms in Medicon Valley, a cluster of biomedical firms in Scandinavia, confirmed that in this sector patents were considered as the only effective means of appropriation. Patenting strategies were based on an international approach, securing protection in all markets of interest for the firms. Similar to the findings of the study mentioned above, although the authors dealt with small firms, they were not concerned about litigation costs and other factors that usually deter that kind of firm from patenting because, by the time the patented product was commercialized, it would likely be owned by a large pharmaceutical firm.

In turn, Dahlander (2004) focused on the software sector, but dealt with open-source firms in Sweden and Finland. The study was based on firms' interviews, and showed that patents were not used by those firms which relied on secrecy and copyright but mainly on lead time and network externalities (attracting a large user base and moving down rapidly through the learning curve).

3.2.2 The Determinants of the Perceived Effectiveness of the Different Appropriability Mechanisms

Arundel (2001), in his study based on firms from seven European countries, analyzed whether firm size influenced opinions about the relative importance of different appropriability mechanisms. His study showed that both for product as well as for process innovations, firms of all sizes considered secrecy more relevant than patents. In the case of product innovations, it was shown that the relative importance of secrecy declined with the increase in a firm's size, while no change was observed in the case of process innovations. If the analysis focused on R&D intensive firms,[13] it also found that firms of all sizes deemed secrecy more effective than patents. However, the author found that R&D-intensive SMEs gave more importance to patents than SMEs with small R&D expenditures.

Having found that SMEs deemed secrecy more effective than large firms, Arundel (2001) stated that this was not due to the fact that the former had less patentable innovations, since the study only covered firms with R&D expenditures. On the contrary, the author suggested that other factors could explain that finding, e.g. the lack of financial resources for lawsuits.

Other relevant findings of this study were as follows: (1) firms that spent a high percentage of their R&D expenditures on process innovations were more likely to use secrecy; (2) participation in cooperative R&D arrangements reduced the probability that a firm would prefer secrecy to patents, a fact that provided some evidence for the argument that patents help to clarify ownership in those arrangements; (3) firms tended to prefer secrecy when disclosure was a serious disadvantage for patenting.

Sattler (2005), based on a sample of German firms, in order to learn about the determinants of the probability for a firm to belong to the cluster in which patents are deemed as highly effective, used a number of predictors related to the degree of innovativeness of a firm's products and the R&D strategy of the firm. The author found that those predictors explained only a small fraction of the variance. In fact, only the variables related to the existence of cooperative R&D arrangements and the firm's R&D intensity had significant and positive effects on the perceived effectiveness of patents, while the degree of innovativeness of the firm's new products and the length of product life cycle had almost no explanatory power. Large firms also perceived patents as more effective than did SMEs. However, the factor that turned out to be the most relevant was the number of patent applications, meaning that patenting firms deem patents more effective than non-patenting firms.

Blind *et al* (2006) also based on a panel of German firms, showed that while only small differences in the importance attributed to patents were found when dividing firms by sectors, larger firms attached more relevance to patents than did SMEs. They also suggested that there was almost a linear relation between size and the existence of patent departments.[14]

Byma and Leiponen (2007) studied a panel of Finnish SMEs, mostly located in high-tech sectors. The authors found that as the firms' size increased so did the relevance attributed to patents. Firms that launched process innovations and were in high-tech industries were more likely to emphasize trade secrets, while speed (a concept close to lead time) was the preferred appropriability method for the smallest and for the highly R&D-intensive firms, as well as for firms operating in low-tech industries. The lack of relevance of patents for SMEs was shown, according to the authors, by the fact that even R&D-intensive small firms do not choose patents as their preferred mechanism to protect intellectual assets, but rely mainly on speed.

A distinctive contribution of this paper is that the authors found evidence that vertical innovation cooperation has significant implications for appropriability strategy. Firms engaged in that

kind of collaborative arrangement were statistically significantly more likely than other firms to rely on speed instead of secrecy. The authors interpreted this finding arguing that firms in their sample were most probably dealing with partners larger than themselves, in which case they are in a relatively weak position to appropriate intellectual outputs from joint work. Patenting may not be a feasible strategy due to lack of resources, while secrecy is not likely to work in collaborative agreements, which leaves speed as the only effective appropriation mechanism available.

Hurmelinna and Puumalainen (2007), also based on a sample of Finnish firms, tried to correlate the use of different appropriability mechanisms with differences in the availability[15] and the perception of the relative strength[16] of each one, as well as with the differences in firms' strategies. The authors confirmed the hypothesis of a relationship between the strength and the use of different appropriability mechanisms – i.e. the stronger the mechanism, the more it is used. However, they also found that in the case of IPRs, when availability was low, usage was low regardless of the strength, while when IPR availability was high, the level of usage depended on the strength.

On the contrary, the results for the relation between strategies and appropriability were not as clear-cut. A positive relationship was found between pursuing short-term value creation and the use of lead time, while IPRs were not used for that objective, perhaps because they were too time-consuming. The use of IPRs, in turn, was negatively associated with the creation of long-term value.

Gonzalez-Alvarez and Nieto-Antolin (2007), on the basis of a panel of Spanish firms, found that firms that use mostly explicit (codified) knowledge and those of larger size were more prone to using patents. Firms that employed tacit knowledge preferred secrecy, while those that develop complex technologies tended to choose imitation cost and time as their preferred protection mechanism, and those highly committed to more intensive human resource practices tended to choose ongoing innovation (lead time) – employees must be motivated in order to follow a strategy of continuous innovation.

The study of Combe and Pfister (2000) focused on patent effectiveness on the basis of data of innovative manufacturing firms, taken from a survey of the Statistical Department of the French Ministry of Industry (SESSI) on patents and appropriation tools. The authors found that patent costs did not exert a negative influence on patent effectiveness, with disclosure the only significant limit to patent effectiveness. Large firms tended to judge patents as being more effective *vis à vis* SMEs. The paper also found significant differences in the effectiveness of product *vis à vis* process patents, as follows: (1) process patents were more prone to be substituted by secrecy as a protection mechanism than product patents; (2) patent disclosure was seen as a more serious obstacle for product patents than for process patents; (3) the existence of an IPR department within a firm was complementary to patent effectiveness for process innovations but not for product innovations; (4) advertisement intensity and large market shares were more important for effectiveness of process patents than for product patents, while the opposite held for first-mover advantage and for strategies based on frequent innovations.

Hanel (2005), based on data from Canadian firms, found that the use of all IPR methods increased with firm size; the only exception being that small firms used trade secrets less frequently than medium-sized firms. R&D performing firms were more likely to use IPRs than other firms, while world-first innovators and, to a lesser extent, Canada-first innovators were also more likely users of IPRs than other firms.

Hanel also attempted to relate firms' strategies with the use of IPRs. Firms that base their competitive strategy on the development of new markets are likely to use IPRs such as trademarks, trade secrets and confidentially agreements, but not patents. In contrast, export strategies are not associated with the use of any IPR. In turn, firms receiving government assistance in the form of R&D subsidies or tax credits use IPRs more frequently than other firms.

Further extending his analysis, the author distinguished two groups of firms within his sample. One comprised firms that used patents and trademarks. Firms in this group received R&D government subsidies and introduced world-first innovations. Larger and high-tech firms within this group were most likely to use patents. The second group was that of firms which relied primarily on trade secrets. This comprised firms that introduce mainly Canada-first innovations and are less oriented toward product innovations than the first group. Larger firms were more likely to use trade secrets than SMEs.

Finally, Canada-first innovators tended to apply for patents exclusively in Canada. The only other factor that increased the probability of applying for a patent in Canada was size and conducting R&D. Firms that applied for patents in the US were world-first and Canada-first innovators that conducted R&D and were mostly US-owned firms. Most firms that patented both in Canada and the US were medium and large-sized firms and successful exporters that conducted R&D by contracting it out.

3.2.3 Motives for Patenting

Cohen *et al* (2000) also explored the reasons why firms patented beyond the aim of making profits through the direct exploitation of patented inventions. The ranking was led by prevention of copying, followed by patent blocking and prevention of suits. Reputation enhancing and use in negotiations were other reasons why firms patented, while earning licenses was the least important motivation – which means that selling knowledge in disembodied forms was not a main reason to patent. The authors also found that the motivations for patenting differed in "discrete" *vis à vis* "complex"[17] product industries. In the former, firms often use patents for blocking the development of substitutes by rivals, while in the latter, to force rivals to enter in negotiations is more common.

Other studies also aimed at analyzing the so-called "patent paradox" stemming from the gap between the relative ineffectiveness of patents as an appropriability mechanism and the sharp rise in patents applications. Hall and Ziedonis (2001) engaged in this task in the case of the semi-conductor industry. Their findings showed that the increase in patent propensity in this industry was the outcome of two trends related to the use of patents for "strategic" reasons: (1) large scale semi-conductor manufacturers engaged in patent portfolio races in order to reduce concerns about hold up by external patent owners and negotiating access to external technologies on more favorable terms; (2) newcomers have higher patent propensities since these rights are crucial for attracting venture capital and securing property rights in niche product markets.

Regarding studies for other countries, Cohen *et al* (2001) found that strategic uses of patents were more pervasive in Japan, but that compared to US firms, Japanese firms are less likely to use their patents as a means of exclusivity (what the authors call a "fence" strategy) and much more likely to use them as a means of gaining market access and freedom to operate and design (the "player" strategy). Cohen *et al* (2001) attributed the differences in patenting strategies to the differences in national regulations.

In turn, Harabi (1995), in his study based on a panel of Swiss firms, showed that although patent effectiveness for preventing imitation and securing license fees was not deemed to be very high, patents could enhance the patent holders' negotiating position with third parties.

Blind *et al* (2006), with data from Germany, found that the most important motive for patenting was not protection from imitation but securing European markets: defensive blockade of competitors (securing own technological flexibility); securing national markets; improvement of technological image and offensive blockade of competitors (hindering competitors from technological development) follow at a relatively close distance. The authors grouped the motives for patenting in five categories for undertaking factor analysis, and found that protective motives (protection from imitation and safeguarding markets) and blocking motives have almost the same relevance, followed by reputation motives. In turn, large firms are more prone to emphasizing new strategic motives for patenting, such as those labeled by the authors under the "exchange" (amelioration of position in cooperation arrangements, improved access to capital markets, exchange potential, licensing) and "incentive" (motivation of staff, internal performance indicator) categories.

Duguet and Kabla (1998) analyzed motivation for patenting by innovative French manufacturing firms. Almost all of them stated that preventing imitation was one of their motivations, while more than 60 per cent quoted motives such as avoiding litigation and using patents in technology negotiations.

Thumm (2003), (2004) analyzed Swiss biotechnology firms' motives for applying for patents, based on the results of a survey conducted by the Swiss Federal Institute of Intellectual Property. The author showed that the reasons firms gave for patenting their inventions included acquisition of venture capital (an important motive for small firms) and cooperation with other companies and research institutes (which is more relevant for large firms). As offensive patent strategies (such as patent blocking) are not widely diffused, the author stated that this could be due to the "discrete" nature of the biotechnology industry.

3.2.4 Patent Propensities [18,19]

In a paper with data for the Netherlands, Brouwer and Kleinknecht (1999) found that, given a certain innovation output, larger firms and firms belonging to hightechnological opportunity sectors and those which have R&D collaboration agreements had a higher propensity to patent (defined as the probability for a firm to apply for at least one European patent). However, given a firm with some patent applications, the number of applications increased less than proportionately with firm size. According to the authors, since they found that smaller innovators who do apply for patents had relatively higher numbers of patents, they could conclude that small innovators used the patent system as compensation for having less market power than larger firms.

Hussinger (2005) worked with a sample of German manufacturing firms that undertake R&D and are product innovators. The factors that explained patent propensities (measured in terms of firms' patent applications in the German Patent Office) were the patent stock – firms are seemingly committed to patenting – size, secrecy – apparently firms tend to use both appropriability mechanisms – and the fractions of firms in an industry that uses patents. R&D intensity has no impact on patent propensity.

Arundel and Kabla (1998) analyzed patent propensities – measured as the percentage of innovations for which a patent application is made – on the basis of a database comprised of large

European firms. Patent propensities for product innovations were higher than for process innovations. In the former case, the sectors with higher propensity rates were pharmaceuticals, chemicals and machinery, while textiles, clothing and basic metals had the lowest patenting rates. Patent propensity rates both for product and process innovations increased with firm size, with the perception of patents as being an effective protection method and with the intensity of the competition faced by the firm, while R&D expenditures had no effect. Secrecy was also positively correlated with patenting in the case of process innovations, meaning that both mechanisms could be protecting different types or aspects of process innovations. Exporting firms were also more likely to patent, especially in the case of product innovations.

In their study on the semiconductor industry, Hall and Ziedonis (2001) found that R&D expenditures had a positive impact on patenting, together with size and a firm's capital intensity (patent propensity is defined as the probability that a firm applies for a patent). The impact of R&D fell sharply when size effects were included – the latter being four times higher than the effect of R&D.

Licht and Zoz (1998), using data from the first wave of the Mannheim Innovation Panel, examined the connection between firm size and patent applications. As expected, their results showed that large firms were more likely to apply for patents and have more patents than SMEs. Additionally, large firms often applied not only to the German Patent Office but to the European Patent Office (EPO) as well, contrary to SMEs. Exporters also showed a higher patent propensity (both in terms of the decision to patent as well as of the number of patents). R&D expenditures also had a positive influence on patenting, with elasticity close to one, a result similar to that found by Crepon and Duguet (1996). No spillovers or patent rivalry effects were found (that is, other firms' R&D behavior did not affect patent propensity). In turn, firms which regarded scientific institutions as a relevant source of information for their innovation activities applied more often for patents.

Cincera (1997) studied a sample of 181 firms belonging to the group of the most important international firms conducting R&D. He found that R&D expenditures were positively associated with patent behavior (measured by patent applications at the EPO); when a firm spends 10 per cent more R&D in t-1, it applies for 6 per cent more patents in t, while an increase of 10 per cent of current R&D implies an increase of 3.5 per cent of patent applications in the same year. In turn, the author also found that technological spillovers (measured by the R&D performed by other firms) also had a positive impact on patent applications. However, it must be noted that the author was not able to control for other characteristics of the firms, such as size.

Nagaoka and Nishimura (2006) studied the effect of cross-licensing and patent thickets[20] on the propensity to patent with data for the Japanese manufacturing sector. The main idea is that in industries where one or both phenomena are relevant, patent propensities are higher, since a firm in that kind of industry will try to patent its inventions which will be used by other firms in the future so that it can use the other firms' technologies through cross-licensing. Their findings supported this hypothesis.

Chabchoub and Niosi (2005) studied the propensity to patent – measured as the probability of a firm to have a patent at the USPTO – in the software industry in the US and Canada. They found that firms located in clusters and those with a higher share of products (relative to services) in their revenues had higher probabilities of obtaining patents. In turn, large firms not only have a higher propensity to patent but also obtain more patents than smaller firms.

Duguet and Kabla (1998) analyzed patent propensities (defined as the number of innovations that are patented), on the basis of a panel of French manufacturing firms, and found that dis-

closure is the main reason why firms do not patent all their innovations. In turn, R&D expenditures have a positive influence on patent propensity. Costs, in turn, do not seemingly have an influence on patent decisions. The variables that have an influence on the number of patent applications are R&D expenditures, the use of patents to avoid litigation and the use of patents to strengthen technology negotiations. Size only has a positive influence when industry effects are not considered.

López and Orlicki (2007) analyzed patent propensities – defined as the probability for a firm having been granted a patent – in Argentina, using econometric techniques and found that size, foreign ownership and the skill intensity of the workforce were all factors that had an influence on the probability for a firm to obtain patents and on the number of patents obtained. Foreign ownership is the variable with higher impact, confirming the above-mentioned hypothesis that TNCs affiliates could be more likely to apply for patents in developing countries since they could revalidate rights obtained elsewhere. Sectoral specificities also have an impact on the probability of obtaining patents.

Faced with the almost universal finding of a positive relationship between firm size and use of patents, Jensen and Webster (2004) found that the common approach of those studies was flawed because it failed to take into account that it is the rate of usage and not the absolute level that is of interest; hence, we should investigate whether there are systematic differences in the number of IPRs per employee among firms of different sizes. The authors explored this issue with a database of Australian firms. The descriptive statistical analysis showed that SMEs had lower patent application rates and higher trademark application rates than large firms. However, econometric estimations revealed that size had an influence on patents not on trademark applications per employee (although large firms had a higher rate of design applications per employee). Nonetheless, their findings should be taken with care since they lack a number of control variables at firm level that could significantly affect the results (and they assume that the innovative potential of a firm is dictated by the number of employees; a strange assumption). Furthermore, the methodology applied by the authors is quite obscure and not very reliable, especially from the econometric point of view.

3.2.5 Appropriability Strategies in Developing Countries

Among the few studies with data for developing countries, there is one by Hu and Jefferson (2006) which analyzed the patent behavior of a sample of large and medium-sized manufacturing firms in China. The variable of interest is patent applications – although the authors stated that results do not change when they use patent grants. R&D expenditures have a positive influence on patenting, although the estimated elasticity was much lower than that reported for studies in the US and Europe. While R&D makes a significant contribution to patenting in Chinese firms, the same does not happen with foreign firms – this could mean that they file patents on behalf of their parent companies or that, even if they obtain patentable inventions, they assign them to their parent companies. The presence of FDI in an industry also stimulates patenting, both by foreign as well as by domestic firms. Patenting also increases with firm size. The authors also found differences in the factors explaining patenting rates by industry. R&D is important in electric and special machinery and electronics, while size effects are more noticeable in beverages, pharmaceuticals, electric machinery and electronics.

In turn, Basant (2004) quoted a study of 120 Indian information technology (IT) firms (Gupta (2004), in which firms were asked about the effectiveness of different appropriability mechanisms. The results suggested that better lead times and access to good marketing and distribution facilities were the most critical for profiting from product and process innovations, followed

by brand building. Patents and copyright were considered to be more effective than inimitability due to complexity and secrecy for both product and process innovations. As in other studies, patents were perceived as more effective for product than for process innovations.

López and Orlicki (2007) revised the scant empirical evidence on appropriability strategies in Latin America. As to the situation in the larger Latin American countries, the authors found that no more than 10 per cent of innovating firms used patents – a figure clearly below that observed in developed countries – and that among them larger and foreign-owned firms prevail as well as firms operating in sectors such as chemicals (including pharmaceuticals), machinery and the electric and electronic industries.

Trademarks are by far the most commonly employed IPR in Latin America, a fact that could reflect the predominance of a competition pattern more based on product differentiation than on genuine innovation. As for the so-called "strategic" mechanisms, only in Brazil is there data available, which shows that firms use them much less than their peers in developed countries – only in larger Brazilian firms is lead time relatively important as an appropriability mechanism. In turn, while small firms prefer secrecy to patents, the opposite is the case with medium and large firms (although in all cases trademarks are the device most often employed).

Latin American firms use all appropriability mechanisms less than their counterparts in developed countries, but differences are greater when it comes to "strategic" mechanisms. Furthermore, differences in the use of all appropriability mechanisms are greater for SMEs. The only exception seems to be trademarks: Brazilian innovators use trademarks more frequently than their peers in some European countries, but the percentage who use patents is half that registered in Spain or Italy, while in the case of lead time differences are at least 8 to 1.

Brazilian data allows us to learn more about sectoral features of the use of appropriability mechanisms. Sectors in which firms have a higher patenting rate are automobiles, pulp and paper and medical, optical and automation equipment. Only in the latter and in autoparts are patents the predominant appropriation method. Interestingly enough, in pharmaceuticals, only 14 per cent of innovators use patents, while 44 per cent use trademarks. Trademarks have a very high rate of use in other sectors such as informatics, beverages and automobiles – in all of them TNC affiliates have a dominant presence. Secrecy is often used in automobiles, a sector which also ranks high in the use of lead time, together with pulp and paper and informatics.

4. THE EMPIRICAL LITERATURE: SUMMARY OF RESULTS, STRENGTHS, WEAKNESSES AND LIMITATIONS

It is not an easy task to draw sound conclusions from the literature revised in this paper. There are significant differences in terms of objectives, questions, methodologies, types of firms, nature of databases, etc. which often make it difficult to compare the findings of the papers surveyed. When the same findings appear in many of these, often very different studies, we can be confident that they are relatively reliable. The problem occurs when results differ, since it is problematic to learn why these differences exist. However, in spite of these difficulties, there are a number of findings that, in our view, emerge as more or less "sound" from the literature reviewed.

(i) Firms tend to employ different appropriability mechanisms. Sometimes they do it sequentially – e.g. an invention is protected by secrecy at a early stage and later on is patented – and at other times simultaneously – e.g. because an invention comprises many elements that can be protected through different appropriability tools.

(ii) Lead time and secrecy seem to be the most relevant appropriability devices for most sectors and innovation types. Manufacturing and marketing capabilities – an appropriability mechanism which is not always considered in the studies surveyed – also provide a very relevant tool for protecting innovations.
(iii) Large firms have a higher propensity to patent and they judge patents as a more effective appropriability method than do SMEs. However, this does not necessarily mean that, once they decide to apply for patents, they have more patents than SMEs (since some studies show that larger firms have more patents than patenting SMEs, while others fail to find that result).
(iv) Although patents are not the most effective method for protecting innovations, many firms employ them anyway, be it jointly with other appropriability methods or not only as a means to protect their innovations but to achieve other objectives – i.e. "strategic patenting" (patent blocking, prevention of suits, reputation enhancing, cross-licensing, attracting venture capital, etc.).
(v) Disclosure and ease of inventing-around are the most important reasons for not patenting.
(vi) Patents are more relevant as an appropriability mechanism for product than for process innovations and for some sectors such as chemicals (especially pharmaceuticals), some machinery industries and biotechnology.
(vii) SMEs that display aggressive patent strategies often do not have the intention of exploiting their inventions but aim to license or sell them, among other factors, because they lack the production and marketing capabilities (complementary assets) needed for successfully commercializing these inventions.
(viii) There seem to be "patenting clubs" among manufacturing firms. That is, firms that have more patents and/or perceive patents as an effective appropriability device, tend to have higher patent propensities – in other words, patenting decisions would be related to the firm's patenting history and its perception of the strength of patents as a protection tool.

In turn, there are other issues for which some evidence exists but more research is needed since they have been analyzed only in a few studies. For instance, the relations between the decision to use some appropriability mechanisms and the existence of different cooperation strategies in innovation activities and/or the adoption of different technological and/or business strategies; the impact of the existence of patent thickets or cross-licensing strategies on patent propensities; the fact that while tacit knowledge is in itself an appropriability mechanism – which may need to be protected mainly through human resource management and labor contracts – codified knowledge is more protectable through patents.

The interaction among different appropriability mechanisms is another issue that has been addressed in the literature and deserves further attention. For instance, it has been found that firms use different protection mechanisms and that some of them may even be positively associated – for instance secrecy and patents – but the fact that most surveys inquire about the use of appropriability tools without asking which inventions are protected by each tool (and at what stage of the innovation process) make it difficult to learn more about the relations and interactions among the bundle of protection devices available to firms. The sequence in which different protection mechanisms are used, as they are more or less appropriate for the different stages of the life-cycle of an invention, is also an issue deserving more attention.

Furthermore, some other subjects have led to contradictory findings in the literature. This is the case of the relations between R&D and patenting, for instance, since some studies find a positive impact of R&D on patent activities – and even find relatively large elasticities – but others fail to detect such a relation.[21] Although this survey has not entered into detail about methodological issues, there is an aspect of the empirical literature on this subject that needs to be studied in more depth. Most studies assume that there is a relationship between contemporaneous

R&D and patent applications/grants. This is justified in the literature on the basis that the lags between R&D and patenting are poorly identified because of the high in-firm correlation of R&D spending over time. Besides, as stated by Hall and Ziedonis (2001), when many lags are included, the estimate of the sum of the coefficients is roughly the same as the estimated coefficient of contemporaneous R&D when no lags are included. However, although this could be the case for a number of firms that have routinized their R&D activities, this is not the case for most SMEs that may undertake those activities sporadically. Hence, in this case, it would be wrong to assume that the above-mentioned contemporary relation exists, since the observed patents could be the result of R&D activities undertaken many years earlier.

Although the research produced so far has provided us with some answers on many relevant issues, it has also opened up new questions that have not been systematically explored. For instance, while there are a number of studies produced for different countries, the lack of a common methodology and the fact that they have often been carried out separately do not allow us to learn about the determinants of why firms in different countries display heterogeneous appropriability strategies – i.e. it would be very relevant to learn if there is a relationship between choosing certain strategies or having different patent propensities and the nature of the legal environment in each country.

In the same vein, SMEs have a lower patent propensity than do large firms. However, while there are a number of hypotheses that could explain this behavior, so far the issue has not been addressed systematically in the empirical literature.

There are other problems in the available literature, such as the lack of common definitions for some very relevant variables. This is the case of patent propensity, for instance, the notion of which is included under the heading "secrecy" or the definition of what is an innovative firm. The issue as to where firms patent is also insufficiently explored, although it could be very relevant for many countries.

One source of confusion specifically regarding patents is the fact that they are used for reasons other than protecting the results of an innovation. Insofar as patents seem to be less employed for traditional reasons and seem to be more relevant as strategic business tools, comparisons with other devices that are only relevant as protection tools may not be very informative. More systematic research about why firms patent is therefore needed and the studies should be careful both in the form they are carried out as well as in drawing conclusions on the subject.

As for the areas in which insufficient research has been produced, the innovation-appropriability dynamics in the service industry need to be further explored since, as mentioned earlier, there are very few studies on the subject and they cover only a small fraction of the service universe (although the general picture is similar to that found in the manufacturing industry regarding the relatively low effectiveness of patents as an appropriability tool). Moreover, while in the case of the manufacturing industry there have been a number of studies based on econometric methods, in the case of the service industry the evidence produced so far is mainly based on descriptive statistics or case studies. The lack of evidence on appropriability strategies is even more pronounced for the agricultural sector.

Even in the manufacturing sector, and although most studies include firms in low-tech sectors, the attention is focused on medium and high-tech sectors. Hence, there is also a need to explore more systematically which type of appropriability devices are employed by firms in low-tech sectors.

The same applies to other IPRs, such as trademarks, copyright, plant variety protection or utility models. All these mechanisms are or could be very relevant for different types of innovations, sectors and firms, but so far we know very little about the determinants of their use.

As mentioned above, many researchers have suggested that at least for some sectors or types of innovation there could be advantages in sharing knowledge and technologies in order to create network effects that could be a tool for reaping profits from their innovations. However, very little is known about the use of these types of mechanisms.

The same applies to the impact of new open innovation paradigms,[22] more based on collaborative research, on firms' appropriability strategies (Hurmelinna and Puumalainen (2005)). As suggested by West (2006), there are still many unresolved issues regarding the relations between appropriability and IPRs – in their different forms – and incentives for firms to engage in open innovation strategies.

Finally, as seen above, there are very few studies covering developing countries. The scant evidence they provide suggests that while some findings are common to those observed in developed countries – e.g. larger firms have higher patent propensities, sectoral factors have an impact on the observed patenting rates – there are other specific factors that need special attention –e.g. the relevance of foreign ownership on appropriability strategies, the scarce use of strategic appropriability methods, etc. Some research avenues to close the wide gap that exists at present in our knowledge regarding the innovation-appropriability dynamics in developing countries are suggested below.

5. A SUGGESTED RESEARCH AGENDA

On the basis of the comments in the preceding section, we put forward a number of issues that, in our judgment, deserve special attention in a future research agenda regarding the use of appropriability methods by innovative firms. Although many of the research issues are applicable both to developed and developing countries, some specific questions that are of special interest for the latter are mentioned below. Both econometric and case studies are needed in order to make progress in our knowledge about the subjects listed below:

1) Some studies have suggested that the contrasting patterns regarding the use of appropriability strategies between countries are related, to some extent, to the different nature of the respective patenting laws (e.g. Cohen *et al* (2001) in the case of Japan vs. the US). This type of study should be further pursued including not only patent policies, but also the IPR system in general, and even the functioning of the country's legal environment, especially regarding the key issue of contract enforcement. To undertake this task there is a need to gather international micro databases with information on innovation activities, appropriability strategies and other firms' characteristics that could have an impact on those strategies. Ideally, research methodology should go beyond using dummies for each country, since in that case we would only know that there are national factors that impact on the election of appropriability strategies but we would not know what mechanisms are underlying that effect.
2) Why do SMEs have lower patenting rates than larger firms? In order to learn whether this is due to the type of innovations launched by SMEs or to factors related to the mechanisms of IPR protection, systematic studies should be undertaken to obtain information at the firm level.
3) What is the relationship between the adoption of different business and innovation strategies and the use of specific appropriability devices? The same question applies to the rela-

tionship between tacit/codified knowledge and the use of appropriability tools. To gain knowledge about these subjects, current innovation surveys are perhaps not enough, and more in depth studies with qualitative information that may allow elaborating taxonomies of firms' strategies and knowledge bases are needed.

4) Although Teece's analysis of the innovation-appropriability dynamics has had a deep influence on the theoretical and empirical research agenda on the subject, some of his insights have not been explored as deeply as would have been desirable. This is particularly so for the role of complementary assets such as manufacturing and production capabilities (a factor on which only some surveys touch). The same is true for the relation between the existence of "dominant paradigms" in some sectors and the evolution of the role of IPRs along the technological trajectory of those paradigms.
5) Further surveys and case studies are needed to learn more about the interaction between the different appropriability mechanisms. First, it would be advisable for future studies to try to link the use and/or effectiveness of each appropriability device to specific innovations. Second, it would also be useful to analyze how a specific invention is protected through different tools at different moments of the innovation process. Third, the interplay of legal and strategic appropriability tools for protecting innovations should also be further explored.
6) There is a need to further analyze the relevance of strategic patenting and to distinguish more clearly the role of patents as a traditional appropriability mechanism from the new functions that patents may play in business strategies.
7) Although secrecy emerges as a very relevant appropriability mechanism, it is often the case that we do not know how firms keep their inventions secret. Furthermore, in some studies, secrecy appears as an alternative to other mechanisms that in fact are used to conceal firms' information (such as labor contracts). It would be useful, therefore, to advance in the decomposition of the heading "secrecy" in the different ways in which secrecy can be maintained.
8) As the dynamics of innovation change, new appropriability mechanisms could become more relevant. This is the case of human resource management practices, or the creation of network effects through knowledge sharing. In this regard, it is particularly important to analyze empirically the impact of appropriability and IPRs on open innovation, following the lines suggested by West (2006) and West *et al* (2006).
9) What are the determinants and motivations of the use of other IPR tools such as trademarks, copyright, plant variety protection, etc? Studies similar to those aimed at learning about patent propensities are needed to discover more about the factors that are behind the use of these alternative legal protection mechanisms.
10) The role of appropriability mechanisms in services and agriculture should be explored through the elaboration of surveys similar to those available in many countries for the manufacturing sector. Even within the manufacturing sector, the use of appropriability mechanisms in low-tech industries should be further explored. Naturally, those surveys should be adapted to the different dynamics of innovation and appropriability in each sector. For instance, in the case of the service sector, the role of specific mechanisms such as reputation should be explored (see Dolfsma (2004)).

Although, as mentioned earlier, most of these issues are also relevant for developing countries, it is clearly the case that there is a dearth of information about the use of appropriability methods in those countries. This is a major shortcoming in view of the often fierce debates around the IPR legislation in developing countries insofar as, without solid evidence on the determinants of the use of patents and other appropriability tools in those countries, debates are often based on purely theoretical notions, or, worse, ideological and/or *a priori* positions.

As far as we have been able to learn, only in Brazil is there an innovation survey that examines the use of appropriability mechanisms other than formal IPRs. More surveys and databases of this kind should be elaborated in other developing countries, in which firms are asked about their innovation strategies and the use of appropriability methods, as well as about other characteristics that could be affecting their behavior in terms of the innovation-appropriability dynamics. As long as those databases are systematically updated, more rigorous econometric techniques could be employed. These databases should include questions about the firms' expenditures on R&D and other innovation activities (including technology acquisition), their innovative outputs, the use of different appropriability devices and the effectiveness attached to each of those devices. Naturally, the evidence gathered through these mechanisms should be complemented with case studies aimed at learning about the qualitative aspects of the firms' decisions and strategies regarding the use of appropriability mechanisms (such as those undertaken some years ago by WIPO in many Latin American countries).[23]

However, as innovation processes and outputs have a very different nature and dynamic in developing countries *vis à vis* developed countries, simply transposing the same questions asked in studies made in the latter to the former could fail to shed light on why differences in the relative and absolute use of each appropriability mechanism exist and they may also miss the existence of other appropriability tools that could be specific to firms in developing countries.

Furthermore, there are some specific issues that should be addressed in future studies on the use of appropriability methods in developing countries, including: (1) the role of TNC affiliates, especially regarding the use of patents; (2) the decisions on where to patent, since for many firms it could be more relevant to patent abroad than in their home countries; (3) the use of utility models; (4) the impact of the often weak institutional environments of developing countries on the decisions of using legal appropriability methods (this is particularly important, for instance, in light of the uncertainty regarding contract enforcement in many developing countries).

A very relevant issue which is in need of rigorous research is the relationship between the scope, strength and enforcement of IPR legislation in developing countries and the dynamics of technological change. As mentioned before, there is a debate on whether tight or lax IPR regimes help or hinder innovation in developing countries, but so far the issue has not been explored systematically. Hence, there is a need to learn more about firms' perceptions regarding the impact of IPR legislation on the magnitude and objectives of innovation activities in those countries.[24]

Finally, it is perhaps the case that we lack a sound theoretical framework on the innovation-appropriability dynamics in developing countries. Therefore, not only empirical studies are needed, but also a clearer conceptual framework to understand the specificities of the use of IPRs and other appropriability tools in developing countries. Empirical studies and theoretical work should feed each other in order to obtain more knowledge on this key subject, something that is necessary not only from an academic point of view but also crucial from the perspective of policy-making both at the national as well as at regional and international levels.

Notes

1. Although we searched in breath and depth, we may not have included some important papers or reports on the subject. However, we are confident that the bulk of the relevant literature is analyzed in our survey.
2. Our survey is restricted to the literature studying firms' behavior.
3. Utility models -which are sometimes referred to as "petty patents" or "innovation patents"- are more adapted to incremental or minor innovations since they grant exclusive rights to inventions that lack some of the requirements needed for patents – such as novelty or non-obviousness. Hence, they could be better suited for small and medium-sized enterprises (SMEs) and/or innovators in developing countries.
4. The International Union for the Protection of New Varieties of Plants (UPOV) provides an international framework for the protection of new plant varieties.
5. According to Langlois (2001), codified knowledge is that which has been or can be converted into symbols for easy replication, transmission and storage, while tacit knowledge cannot be articulated explicitly, but must be acquired through learning processes over time.
6. See Basant (2004) for this argument applied to the Indian IT firms.
7. For instance, Hanel (2005) mentions that almost one-third of manufacturing firms that introduced an innovation in Canada between 1997 and 1999 did so without conducting any form of R&D.
8. Sometimes surveys inquire whether the innovation is new for the world, for the country or for the firm.
9. In the annex, information is presented about the data sources, methodology, period, and type and number of firms on which each of the surveyed studies is based.
10. Design complexity exists when a product is comprised of many components or sub-systems.
11. This study updates the results of a previous survey undertaken in 1989-91 in which it was found that trademarks were the most popular form of protection, followed by patents and trade secrets, industrial designs and copyrights (see Hanel, 2006).
12. Non-competition clauses imply that the employee agrees not to pursue a similar profession or trade in competition with the employer. They are included in labor contracts in order to prevent the employee, at the end of the contract, from working for another employee or starting a business taking advantage of the knowledge or trade secrets learned in the original job.
13. R&D intensive firms are those which spend more than 10 per cent of their sales revenues on R&D activities.
14. Although the implications of this finding should be further explored, it is relevant to mention that the authors found that patent officers attribute greater importance to patents than do R&D officers, which at least means that when analyzing this type of survey one should be aware of who are the respondents.
15. Availability is defined on the basis of the firms' answers regarding which mechanisms are available, or not, for them.
16. Strength is defined on the basis of the surveyed firms' perception on the effectiveness of each appropriation method.
17. Discrete products are those comprised of a relatively small number of patentable elements (e.g. drugs, chemicals). Complex products are those that are or can be protected by numerous patents (e.g. computers, communications equipment).
18. Not all studies define patent propensity in the same way. We mention below the definition adopted in each case.
19. Although we have not been able to find it, a pioneer study for Canada (De Melto *et a*l, 1980) quoted by Hanel (2006) is worth mentioning, in which it was found that patenting propensity was higher in larger firms as well as in foreign-owned ones.
20. A patent thicket is a situation in which a firm is required to obtain the licenses for using many other complementary technologies patented by other firms when this firm produces and sells a product or undertakes research.
21. Note that we are not analyzing the inverse relationship, that is, from patents to R&D. In this regard, some studies such as Arora *et al* (2003) found that patents stimulated R&D activities. However, the evidence on the impact of patents on innovation is still ambiguous (see Hall, forthcoming and Hanel, 2006).
22. According to a recent definition, open innovation is the use of purposive inflows and outflows of external knowledge to accelerate internal innovation and expand the markets for external use of innovation (Chesbrough, 2006).
23. López *et al* (2005), Pinto García (2005), Portilla (2005), Salles Filho *et al* (2006) and Corrales (2006).
24. The above-mentioned study by López and Orlicki (2007) showed that in Latin American countries when firms are asked about the obstacles for innovation activities, IPR issues rank clearly below others such as macro-economic and institutional instability, the high costs of innovation activities, market failures (such as lack of credit) and the small size of domestic markets.

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Annex 1. Summary of Reviewed Papers

Authors	Paper	Country	Period	Data source	Methodology	Type of firm	Number of firms
Arundel (2001)	The Relative Effectiveness of Patents and Secrecy for Appropriation	European countries	1993	CIS	Ordered logit regressions	R&D performing firms	2849
Arundel and Kabla (1998)	What Percentage of Innovations are Patented? Empirical Estimates for European Firms	European countries	1993	PACE survey and SESSI survey	Simple ordered logit model	Largest R&D performing industrial firms	604
Baldwin et al (1998)	Innovation in Dynamic Service Industries	Canada	1996	Statistics Canada's Survey of Innovation	Descriptive statistics	Firms from three sectors of the service economy: communications, financial services and technical business services	Communications firms (excluding postal services): 895; banks and trust companies and life insurers: 160 firms; businesses engaged in computer or related services, offices of engineers, and other technical services: 3,830
Basant (2004)	Intellectual Property and Innovation. Changing Perspectives in the Indian IT Industry	India	2004	Gupta, 2004	Descriptive statistics	IT firms	120
Blind et al (2003)	Patents in the Service Industries	European countries	1998-2000 and 2001	Second Community Innovation Survey	Descriptive statistics and case studies	Service firms	65
Blind et al (2006)	Motives to Patent: Empirical Evidence from Germany	Germany	2002	Questionnaire to German enterprises which had applied for a minimum number of three patents at the EPO in 1999	Factor analysis and multivariate probit analysis	Firms that in 1999 had applied for a minimum number of three patents	Over 500
Brouwer and Kleinknecht (1999)	Innovative Output, and a Firm's Propensity to Patent. An Exploration of CIS Micro Data	Netherlands	1992	Dutch part of the Community Innovation Survey (CIS)	Multivariate analysis	Firms with 10 and more workers in all manufacturing sectors	1,300
Byma and Leiponen (2007)	Can't Block, Must Run: Small Firms and Appropriability	Finland	2002-03	Survey data collected by ETLA	Simple probit and multinomial logit models	Small and medium-sized firms in all economic sectors except agriculture, finance, and real estate	312
Chabchoub and Niosi (2005)	Explaining the Propensity to Patent Computer Software	US and Canada	2000-02	Different databases providing financial information and the USPTO data on software patents	Logistic regression analysis and linear regression	Computer software-producing companies	Over 1,700
Cincera (1997)	Patents, R&D and International Spillovers at the Firm Level: Some Evidence from Econometric Count Models for Panel Data	European countries	1983-91	EPO database, Compustat (Standard and Poor's) and the firms' annual reports	Poisson, count panel data, GMM panel data	International manufacturing firms investing substantial amounts in R&D	181
Cohen et al (2000)	Protecting their Intellectual Assets: Appropriability Conditions and Why US manufacturing Firms Patent (or Not)	US	1994	Survey questionnaire to R&D managers	Factor analysis	Manufacturing firms that perform R&D with at least 5 million US$ in sales or more than 20 employees	1,165
Cohen et al (2001)	R&D Spillovers, Patents and the Incentives to Innovate in Japan and the United States	US and Japan	1994	Survey of managers of R&D units of manufacturing firms in the US and Japan	Weighted logistic regression	Manufacturing firms that perform R&D (US) and firms with capitalization over 1 billion yen conducting R&D in manufacturing industries (Japan) with annual sales of 50 million USD or above	826 (US) and 593 (Japan)
Combe and Pfister (2000)	Patents Against Imitators: An Empirical Investigation on French Data	France	1993	SESSI appropriation survey	Multinomial ordered logit models	Innovative manufacturing firms	950

Authors	Paper	Country	Period	Data source	Methodology	Type of firm	Number of firms
Dahlander (2004)	Appropriating Returns From Open Innovation Processes: A Multiple Case Study of Small Firms in Open Source Software	Sweden and Finland	2004	Annual reports, company directories, business and specialist press, homepages and semi-structured face-to-face interviews	Multiple case studies	Small firms that attempt to commercialize OSS and generate revenues	6
Davis and Kjær (2003a)	Patent Strategies of Small Danish High-Tech Firms	Denmark		Semi-structured interviews	Case study	Firms that employ between 5 and 250 people from three high-tech industries: telecommunications, software and (pharmaceutical-related) biotechnology	34
Davis and Kjær (2003b)	Appropriability Strategies by Small Biotech Firms in Medicon Valley: Does Location in the Cluster Matter?	Denmark		Interviews with small biotech firms in the greater Copenhagen area (Medicon Valley)	Case study	Small biotech firms	Over 100
Duguet and Kabla (1998)	Appropriation Strategy and the Motivations to use the Patent System: an Econometric Analysis at the Firm Level in French Manufacturing	France	1990-92	French survey on appropriation (EFAT), Research survey and EPAT	Two equations model estimated by asymptotic least squares	Firms that applied for at least one patent	299
Gonzalez-Alvarez and Nieto-Antolin (2007)	Appropriability of Innovation Results: An Empirical Study in Spanish Manufacturing Firms	Spain	2002	Questionnaire	Factorial analysis and regression analysis	Large or medium-sized manufacturing companies	258
Hall and Ziedonis (2001)	The Patent Paradox Revisited: An Empirical Study of Patenting in the United States Semiconductor Industry, 1979-1995	US	1979-95	Interviews	Poisson-based econometric models	Large and medium-sized semiconductor manufacturers engaged in both process and product innovation, and smaller design firms engaged primarily in product innovation	95
Hanel (2005)	Current Intellectual Property Protection Practices of Manufacturing Firms in Canada	Canada	1993-99	Statistics Canada's Survey of Innovation 1993 and 1999	Logit models	Manufacturing firms with at least 20 employees and a gross business income over 250,000 US$	5,220
Harabi (1995)	Appropriability of Technical Innovations. An Empirical Analysis.	Switzerland	1988	Survey to R&D executives from selected firms	Descriptive statistics	Firms actively engaged in R&D, from 127 different lines of business, mainly in the manufacturing sector	358
Hipp and Herstatt (2006)	Patterns of Innovation and Protection Activities within Service Companies. Results from a German Study on Service Intensive Companies	Germany	2004	Questionnaire	Probit model	Service-intensive firms	99
Hu and Jefferson (2006)	A Great Wall of Patents: What is Behind China's Recent Patent Explosion?	China	1995-2001	Survey of large and medium-sized enterprises by China's National Bureau of Statistics (NBS)	Zero Inflated Poisson (ZIP) model	Large and medium-sized industrial enterprises	Over 500
Hurmelinna and Puumalainen (2007)	The Dynamics of Appropriability Regimes	Finland	2004	Questionnaire	Linear regression analysis	Companies with at least 50 employees from several industrial sectors engaged in R&D	299
Hussinger (2005)	Is Silence Golden? Patents versus Secrecy at the Firm Level	Germany	1998-2000	Mannheim Innovation Panel (MIP) - German part of the Community Innovation Survey (CIS) of the European Commission	Factor analysis, tobit and probit models	Manufacturing firms that conducted R&D in the year 2000 and are product innovators	626
Jensen and Webster (2004)	SMEs and their Use of Intellectual Property Rights in Australia	Australia	1994-2001	Australian Bureau of Statistics (ABS), IP Australia and Australia OnDisc, IBISWorld Australia databases	OLS estimation method	Small and medium-sized firms	166
Jensen and Webster (2006)	Managing Knowledge Flows through Appropriation and Learning Strategies	Australia	2001-04	Melbourne Institute Business Survey 2001-04	SUR method	Manufacturing and service firms	over 600

Authors	Paper	Country	Period	Data source	Methodology	Type of firm	Number of firms
Levin et al (1987)	Appropriating the Returns from Industrial Research and Development Companies	US	1987	Questionnaire to R&D managers	Principal components analysis	R&D performing manufacturing firms	650
López and Orlicki (2007)	Innovación y mecanismos de apropiabilidad en el sector privado en América Latina	Argentina	1992-2001	Argentina's Innovation Survey 1992-96 and 1998-2001	Probit model and count data models	Innovative manufacturing firms	186
Mairesse and Mohnen (2003)	Intellectual Property in Services: What Do We Learn from Innovation Surveys?	France	1998-2000	French CIS3 survey	Correspondence analysis and clustering analysis	Manufacturing and services firms	1,914 service firms
Nagaoka and Nishimura (2006)	An Empirical Assessment of the Effects of Patent Thickets	Japan	2006	Survey of intellectual property-related activities of Japanese firms collected by the Japan Patent Office	OLS estimation	Manufacturing firms	611
Päällysaho and Kuusisto (2006)	Intellectual Property Protection and management in KIBS Businesses	Finland and UK	2005	Telephone survey	Descriptive statistics	Small businesses in three knowledge intensive and innovative sectors of KIBS services: (1) software consultancy and supply (2) business and management consultancy activities (3) advertising	300
Sattler (2002)	Appropriability of Product Innovations: An Empirical Analysis for Germany	Germany	1990-95	Mannheim Innovation Panel and telephone survey	Logistic regression analysis	Innovative firms	1,844
Thumm (2003)	Research and Patenting in Biotechnology. A Survey in Switzerland	Switzerland	2000-02	Swiss biotechnology industry survey	Descriptive statistics	Biotechnology firms	53
Thumm (2004)	Strategic Patenting in Biotechnology	Switzerland	2000-02	Swiss biotechnology industry survey	Descriptive statistics	Biotechnology firms	53

COMMENTS ON
INNOVATION AND APPROPRIABILITY: EMPIRICAL EVIDENCE AND RESEARCH AGENDA

DOMINIQUE FORAY*

As Suzanne Scotchmer wisely wrote some years ago (2004), many discussions of appropriability begin from the premise that IP protection is the solution to the problem. However, as she pointed out, it is better to start from the problem (i.e. the difficulty to capture the rent produced by an innovation and the incentive deficit that such difficulty can create) rather than starting from the solution. Andrés López must be congratulated for starting from the problem rather than the solution and thereby having written a very complete, timely and relevant paper on the topic of appropriability. In spite of the many empirical studies produced, evidence on the nature and strength of conditions for appropriability and on the working of the patent system is scattered and unsystematic; a situation already described by Levin *et al* in the late 1980s. As observed by López, the lack of evidence in the case of developing countries is even more worrying.

Appropriability: the Origin of a Concept

The dual properties of non-rival usage and costly exclusion of others from possession define what economists mean when they speak of pure public goods. While the term has become familiar, confusion lingers around its meaning and implications. It does not imply that such commodities cannot be privately supplied. It does not mean either that a government agency should or must produce them, nor does it identify "public goods" with *res publica*, the set of things that remain in "the public domain". What does follow from the nature of pure public goods is the proposition that competitive market processes will not do an efficient job of allocating resources for their production and distribution (Aghion *et al* (2008)). Where such markets yield efficient resource allocations, they do so because the incremental costs and benefits of using a commodity are assigned to the users. In the case of public goods, however, such assignments are not automatic and they are especially difficult to arrange under conditions of competition.

The disclosure of even a commodity's general nature and significance (let alone its exact specifications) to a purchaser engaging in a market transaction can yield valuable transactional spillovers to potential purchasers, who would remain free to then walk away. Complex provisions in the contracts and a considerable measure of trust are required for successfully "marketing an idea". Both of these are far from cost-free to arrange, especially in "arms-length negotiations" among parties that do not have symmetric access to all the pertinent information. Contracting for the creation of information goods, the specifications for which may be stipulated, but which do not yet exist is fraught with still greater risks; and, *a fortiori*, fundamental uncertainties surround transactional arrangements involving efforts to produce truly novel discoveries and inventions. This leads to the conclusion that the findings of scientific and technological research, being new information, could be seriously undervalued were they sold directly through perfectly competitive markets, and the latter would, therefore, fail to provide sufficient incentives to elicit a socially desirable level of investment in their production.

The above describes what has come to be referred to as the "appropriability problem", the existence of which is invoked in the mainstream economics literature as the primary rationale for

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government intervention by means of various public policy instruments. The recommended policy response to the diagnosis of a chronic condition of under-investment in scientific and technological research by the private sector is that the public sector should first act to increase R&D expenditures, using general tax revenues for that purpose. A number of principles are advanced as guidance for such interventions, some of which turn out to be less compelling than would appear at first sight.

Survey Data…

Regarding the empirical methods that have been used to grasp the issue of appropriability, one must observe that most of the evidence comes from a sequence of surveys (Yale, Carnegie, PACE, CIS and its extensions). Survey research is a difficult research tool (Cockburn, 1992). Data produced through a survey are not the sort of data economists are familiar with (such as simple reporting of objectives, quantifiable information, etc.). People responding to a survey are asked to provide their opinion about something. They are asked to estimate the magnitude of abstract constructs rather than report concrete, objective facts. As Cockburn (ibid.) rightly observed, magnitude estimation is very difficult for survey respondents and behavioral researchers often have very limited success in obtaining consistent responses to simple objective questions which elicit quantitative estimates of physical properties ("which of these colors is the most blue?"). Economists playing with such data have to bear in mind the inherent difficulties of survey data.

…and Survey Questions: What is the Problem?

The typical question we find in many surveys is about the "effectiveness" of patents as an appropriability mechanism. But what does this question mean exactly; what is the problem? Do we want to know about patent effectiveness as a tool to limit spillovers? Well, limiting spillovers is a second order objective; i.e. a solution to a more generic problem which is about securing the rent from innovation. Limiting spillovers might be an obvious way to solve the generic problem but there are other options; maximizing spillovers, for example, in order to set a standard advantageous to the innovator. In this case he/she freely reveals the innovation in order to benefit from its increased diffusion. There are, indeed, cases in which some mechanisms, while being very ineffective in limiting spillovers, are actually very effective in securing the rent from innovation. The best case is of course "lead time" to which I will return later but the so called Hirshleifer effect provides another example.

These various cases show that it is important to decouple the objective of limiting spillovers and the objective of securing rents from the innovation; the latter being the fundamental appropriability objective while the former is likely to serve this fundamental objective well in certain situations but not so well in others.

And because the right question is not about limiting spillovers but securing rents, the answer to the question about the effectiveness of patents and other IP tools will show, not surprisingly, strong and persistent variations across sectors.

Lead Time: What do We Know About it as an Appropriability Mechanism?

Lead time appears very often as the most valuable mechanism to ensure appropriability. Lead time is based on the fact that even if unrestricted copying eventually drives the price of the marginal copy to 0, this does not happen so rapidly. The process of copying takes time and the sup-

ply of copies cannot instantly undergo infinite expansion. This is why lead time can work as an appropriability mechanism: the possession of the first copy (i.e. being the innovator) is an asset that can command positive prices under competitive conditions (Boldrin and Levine (2002)). The price reflects the present value of the future flow of marginal utilities that subsequent copies will yield to impatient consumers, because the process takes time. In a fictional world of total absence of IPR and unrestricted copying, lead time would appear as the only way of allowing competitive equilibrium with positive "first copy" prices.

However, in spite of these sound theoretical foundations of lead time as an appropriability mechanism, lead time remains a poorly understood strategy. It is difficult to know by reading and analyzing surveys whether the positive assessment of lead time by respondents is a description of a fact (every innovator enjoys a lead-time situation) or is taken as an explicit (not a default) strategy.

Historically, the effectiveness of lead time as an appropriability mechanism was supported by bad copies: copies of copies naturally were priced lower, for errors in transcription are cumulative (Plant, 1934). Today, copies of copies are perfect since this process no longer involves their degradation. The process of copying still takes time. However, there is an increase of productive activities shifting to an area of instantaneous infinite expansion of copies (area of digital products). It would be very useful to discuss what all this evolution means for lead time as an appropriability mechanism.

Appropriability and the New Modes of Innovation

Has the problem changed in nature because of innovation in the mode of innovation? Three new aspects of the innovation process are likely to affect the way appropriability is used and the relative effectiveness of the various mechanisms:

(a) **Routinization:** innovation is becoming a crucial capability in the knowledge economy; it has replaced price as the name of the game in a number of important industries (Baumol (2002)). Managers try, therefore, to make innovative activities a regular and even ordinary component of the activities of the firm and thereby minimize the uncertainty of the process. They try to routinize innovation. An obvious way to routinize it (to contain the risk they face in their innovation rivalry) is by coordinating their innovative activity through means such as research joint ventures, or engaging in technical cooperation through innovation trading or by licensing of proprietary technology even to direct competitors.

(b) **Open Innovation:** firms need to go beyond their own R&D and find the best technologies wherever they exist, combining them into integrated solutions. Important facilitators are the adoption of open standards in different areas as well as of a policy allowing diffusion of their own knowledge in return for low-cost absorption of the knowledge of others.

(c) **Innovation through Recombination:** this new model involves assembling a large number of pre-existing pieces of knowledge. New institutions are, therefore, required to contain the potentially increasing transaction costs of innovative activities in such a model. For instance, patent pools provide a regularized transactional mechanism in place of the statutory property rule baseline which requires an individual bargain for each transaction. They serve, therefore, to regularize technology transactions (patent pools, cross-licensing).

We see, therefore, that in each of these circumstances the strategy of limiting spillovers is weakened because it is subsumed by a superior objective dealing which involves the creation of prop-

er organizational and institutional conditions to maximize innovative performances in the new context.

What about Appropriability and Innovation in Developing Countries?

It is not true that in the realm of innovation there is only one game in town, in the sense of innovating for global markets. There are such things as local needs and local markets which are not necessarily well served and may require enhanced incentives from the government. Incremental and cumulative innovations, which are mostly informal (i.e. without R&D) and developed in the traditional sectors, are, thus, central to the innovative performance of developing countries. Although mostly dealing with low-level technologies, these innovations are generating local spillovers and, ultimately, will impact on the productivity of a wide range of sectors in the local economy.

So, even if a country could benefit from plugging some of its activities in the global market, this should not preclude supporting locally oriented innovation, which can be critical for growth and social well-being. The question is, therefore, what are the appropriability mechanisms which are the most adapted to appropriate rents from these kinds of innovation? As is well argued in the paper by López, we know very little on this issue.

Finally, a key role of entrepreneurs in developing countries is about learning what a given country is good at producing (Hausmann and Rodrick (2002)). For a developing country, there is great social value to discovering the relevant specialization because this knowledge can orient the investments of other entrepreneurs and can account for the emergence of a persistent pattern of change. This is mainly due to the fact that in developing countries the production functions of all extant goods are typically not common knowledge.

However, the initial entrepreneur who makes the "discovery" can capture only a small part of the social value that this knowledge generates. Other entrepreneurs can quickly emulate such a discovery. Consequently, entrepreneurship of this type, generating learning of what can be produced, will be under-supplied. There is, clearly, an appropriability issue. If learning what a country is good at producing requires investment and the return on this investment cannot be fully appropriated, we have a problem of appropriation which is not likely to be solved with legal protection. Indeed, entrepreneurs in developing countries are trying out technologies that already exist abroad and their discovery can be that an existing good can be produced profitably in their own country; although such a discovery does not normally get such protection, whether it has a high social return or not.

What has just been described is likely to be the most severe appropriability problem to be solved in developing countries and government policies should probably not just involve IP protection to solve such a problem.

Notes

1 For Hirshleifer (1971), innovators are the only ones to have information on future changes in the price of certain inputs that their innovation is likely to cause. Before revealing their innovation, they are, therefore, in a position to speculate on these factors. In this case, the free diffusion of knowledge is highly desirable. This mechanism makes it possible to reconcile in the best possible way the preservation of private interests and the maximization of spillovers.

2 Typically, firms are required to license into the pool all patents covering technology of use in the industry. In exchange, pool members are permitted to use any other member's technology.

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COMMENTS ON
INNOVATION AND APPROPRIABILITY: EMPIRICAL EVIDENCE AND RESEARCH AGENDA

KEVIN URAMA*.

The paper by Professor López sets out to identify the determinants of the use of different appropriability strategies at both the firm and sectoral levels. It provides a brief conceptual framework for understanding the dynamics of innovation and appropriability; reviews empirical evidence on the subject focusing mainly on case studies in developed countries: provides a synthesis of the results including the strengths, weaknesses and limitations of the literature; suggests a research agenda for developing countries.

Set within the context of the dynamics of technological change in developed economies, it argues that the rate of innovation in a perfectly competitive market economy would be very low due to the fundamental problem of excludability and appropriability of knowledge. Knowledge is a semi-public good and hence exclusion is feasible but rarely or never perfect. Without suitable appropriability strategies, innovators (and inventors) would therefore not have any means of protecting the knowledge they generate. They may therefore not recoup the fixed costs of knowledge generation as competitors are free to imitate the innovation cheaply. Such market failures and allied externalities which create differences between the private and social marginal return to knowledge generation would therefore lead to an under-investment in innovative activities.

The paper therefore reviews different appropriability strategies that enable economic agents to enjoy temporary pseudo-monopolistic power over the knowledge that it generates in order to profit from its innovations and inventions. A number of appropriability strategies were reviewed, including IPR mechanisms such as patents, copyrights, trademarks, industrial designs, utility models, plant variety protection, etc., as well as exploitation of lead time, rapid learning, complementary manufacturing sales and services, secrecy, labor legislation, employment contracts and human resource management strategies, passwords, digital signatures, copy prevention mechanisms, etc. It argues that profits from innovation depend on the interaction between three groups of factors: appropriability regimes, complementary assets and the presence or absence of a dominant paradigm in the sector in which a firm operates.

The author's review of the literature shows that knowledge appropriation strategies differ by (1) firm characteristics such as size, innovative capabilities, type of products, etc; (2) knowledge-specific factors (i.e. tacit vs. codified); (3) technology -specific factors (product vs. process innovations, etc.); (4) industry-specific factors such as life-cycle stages, appropriability strategies, etc; (5) geographical location and the prevailing institutional and legal environments. Knowledge appropriation strategies are also not mutually exclusive. This presents a complex scenario of interactions between firm characteristics, industry characteristics, firm location, type of knowledge, appropriation strategy, etc. that precludes straightforward prescription of appropriate appropriability strategies across firm types and/or trans-sectoral, regional or international transfer of appropriability strategies.

The paper therefore recognizes that translating the theoretical and empirical analyses from developed to developing economies presents huge challenges. Developing countries are at different stages of economic development presenting diversities in industry and firm characteris-

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tics and heterogeneous levels of technological capacities. This leads to very different innovation-appropriability dynamics. Yet, the potential benefits of reverse engineering have often led to the erroneous conclusion that developing countries ought to be (or even are) "imitators" of technologies/knowledge from the developed countries rather than "generators" of technologies and knowledge for development. Hence, current understanding of the genuine innovative capabilities and relevance of indigenous knowledge to development in the developing world is still very low. Current understanding of the suitable appropriability mechanisms for protecting indigenous technologies and knowledge generated in the developing countries have therefore remained weak. As rightly noted by the author, there is an almost total absence of rigorous evidence on innovation-appropriability mechanisms deployed by firms in developing countries.

Set within the premise above, the paper presents a systematic ranking of the perceived effectiveness of different appropriability methods as perceived by firms, the determinants of firms' perceptions about the effectiveness of each appropriability tool, determinants of firms' patent propensities, and the different appropriability strategies found in developed countries. The motives for using IPRs include: (1) making profits; (2) prevention of copying reputation; (3) patent blocking; (4) prevention of lawsuits; (5) reputation enhancement; (6) tool for negotiations; (7) blocking of the development of substitutes; (8) earnings from licenses, etc. Product innovations have a higher propensity to be patented than process innovations. Patent propensities for process and product innovations depend on firm size, the perceived effectiveness of the patents, and intensity of competition faced by the firm, firm ownership structure, skill requirements, level of R&D investments, and sectoral specificities. Large firms not only had a higher propensity to patent, but also obtained more patents than smaller firms. The paper finds that in developing countries, the level of research and development (R&D) expenditures, foreign direct investment, and firm size and type of industry were the main determinants of choice of appropriability strategies. However, the number of firms using patents was significantly lower, e.g. under 10 per cent in Latin American countries.

Overall, the main conclusions of the paper can be summarized as follows:

- Firms tend to apply appropriability strategies sequentially both in developed and developing countries.
- Lead times and secrecy seem to be the most relevant appropriability strategy for most sectors and innovation types.
- The propensity to patent increases with firm size with large firms showing more significant preference for patenting than SMEs.
- Although the perceived effectiveness of patents is relatively low, most firms apply it, albeit in conjunction with other appropriability strategies, often for reasons other than protection of innovations.
- Patents are more relevant for product innovation than for process innovation.
- SMEs that adopt aggressive patent strategies often do so, not for exploiting their innovations, but for licensing or selling their patents.

Based on these findings, the author recommends a number of relevant areas for further research on the subject. Some of the important research topics identified include:

- A study of the impact of legal and institutional frameworks on the nature, scope and enforcement of IPRs in developing countries. This study should be designed to gather international micro-databases on innovation activities, institutions and legal frameworks, appropriability strategies and other firms' characteristics that could have an impact on those strategies.

- A behavioral economics study of the motivations of the use of IPRs by firms in developing countries. This study should be designed to better understand both the economic and non-economic factors that motivate firms to use specific appropriability mechanisms in developing countries. The study should be comprehensive and transcend the standard neo-classical economic paradigms of firm behavior.
- A study of the innovation-appropriability dynamics in different types of firms in developing countries. This study should be designed to examine the interactions between different appropriability mechanisms and the impact of cooperation actions in innovation activities and choice of appropriability strategies in developing countries.
- A regional study of the relationships between R&D investments and the use of patents and other appropriability mechanisms in selected sectors including the small scale and service industries and agriculture.
- A baseline study to document the scope, strength and enforcement of IPR legislation and the dynamics of technological change in developing countries.

Overall, the paper presents a good review of the innovation-appropriability strategies in developed countries and identifies key areas for further research and policy interventions in developing countries. However, although the title of the paper suggests a focus on innovation and appropriability strategies in developing countries, very few studies in developing countries were reviewed. The limited empirical evidence reviewed shows that the innovation-appropriability dynamics in developing countries are very different from those of the developed countries. This underscores the need for home-grown research and policy intervention in this area in developing countries.

INTELLECTUAL PROPERTY RIGHTS AND THE INTERNATIONAL TRANSFER OF TECHNOLOGY: SETTING OUT AN AGENDA FOR EMPIRICAL RESEARCH IN DEVELOPING COUNTRIES

ASHISH ARORA*

1. INTRODUCTION

International technology transfer is a widely studied topic. The interest derives from the belief that technological progress is the engine of economic growth and high income countries tend to be technologically more advanced than developing countries. In turn, however, countries behind the technical frontier can accelerate their growth by acquiring technology from more advanced countries.

The possibility of this virtual "free lunch" has kindled interest in technology transfer. Inevitably, issues of IPR protection have come to the fore.[1] There is a large body of literature on the subject, too large to even attempt to review and classify here. My objective therefore is to suggest fruitful areas for empirical research in developing countries on the relationship between IPRs and technology transfer.

This paper is organized as follows. Section 2 briefly analyzes the concept of international technology transfer and raises some basic challenges. I summarize some quantitative estimates of the international flow of technology in section 3. Section 4 provides an analytical framework for how IPRs may condition the international flow of technology and provides a short discussion of the key conceptual and data-related challenges. This is followed by a very brief overview of empirical papers in economics on the relationship between IPRs and international technology transfer. In section 5, I outline potential areas for further research in developing countries on some of the topics outlined in section 4. Finally, section 6 concludes with suggestions on under-researched topics which could also be fruitful areas for future research.

2. INTERNATIONAL TECHNOLOGY TRANSFER

The standard model of economic growth predicts that while a country at the frontier can only grow (at a steady pace) at the rate of technical advance, countries behind the frontier (also called developing countries) should catch up – converge towards the high income countries in *per capita* income. Even more sophisticated models (e.g. Romer, 1990) in which technical progress requires investment in research and development, have a similar implication. Technology, once developed, can be applied broadly. The implicit assumption is that technology can be "transferred" with a lower expenditure of resources than were required to develop it in the first instance. Another is that the technologies developed elsewhere are indeed widely useful, which has given birth to the literature on "appropriate technology". Undoubtedly, technologies have to be adapted and modified, but few believe that technologies developed and used in technically advanced countries cannot be usefully applied in countries behind the frontier.

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However, the difficulty experienced by developing countries, albeit with some spectacular exceptions, in catching up in the half century since the Solow model was unveiled, has many causes, including misguided policies followed by the countries themselves, corruption and weak institutions. Nevertheless, the difficulties of the large mass of developing countries to "catch up" points to the weakness of the assumption that technology transfer is easily accomplished. Instead, from the time that sustained application of new knowledge to economic ends was accepted as the basis of modern economic growth, scholars have investigated the difficulties in technology transfer.

It was recognized immediately that for understanding technology transfer, the conceptualization of technology as ideas was inadequate. More precisely, it was inadequate to think of technology as merely blueprints and formulas. Neither was it adequate to think of technology as merely new and advanced equipment. The latter, especially, are easy to move from place to place. Yet, by themselves, blueprints and even machinery have proved inadequate to replicate the miracle of sustained economic growth, driven by advances in knowledge and its application for economic ends.

A richer conceptualization of technology includes materials and knowledge codified in patents, blueprints and manuals. It also includes know-how, much of it not codified and held as tacit knowledge. Tacit knowledge is costly to transfer and contracting for tacit knowledge is potentially subject to even greater contractual difficulties than for codified technology, which, in any event, is also believed to be difficult to contract over.

Another significant challenge is what is called the absorptive capacity of the recipient – the ability of the receiving country to evaluate and effectively use the technology. An issue which has not received attention is the question of demand for technology. For the most part, this neglect is understandable. Insofar as new (to the recipient country) technology will reduce costs or make available new goods hitherto unavailable, it is inherently valuable. Nonetheless, a little introspection reveals that this is not enough. First, the technology will be transferred only if the benefits outweigh the costs. These costs include not only the costs of transfer, but also the opportunity cost. Simply put, the fruits of the technology may be made available to the recipient incorporated in goods and services exported to the recipient, rather than the technology itself.[2]

These issues have been extensively discussed in the literature and I raise them principally because they also impinge upon the topic of this paper, namely the role of IPRs in international technology transfer.

3. TRENDS IN INTERNATIONAL TECHNOLOGY FLOWS

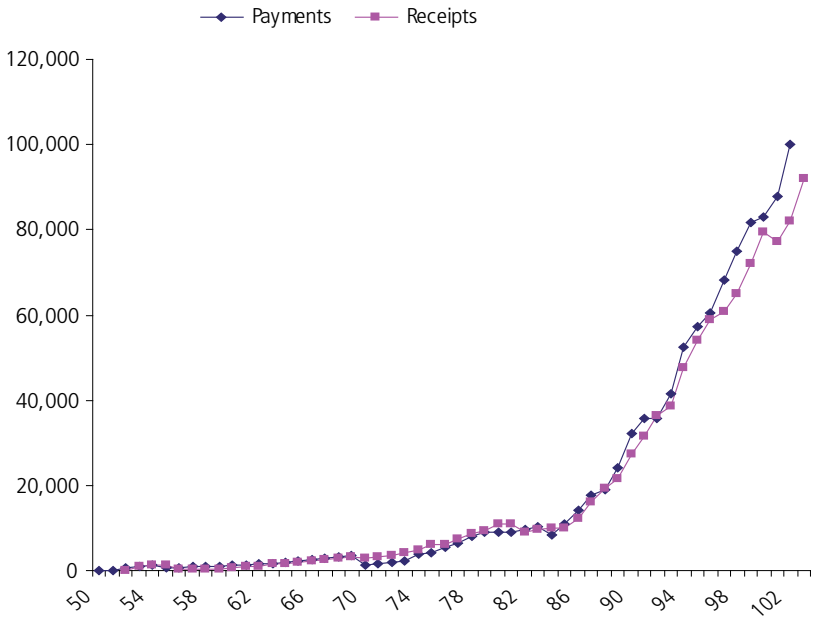
Technology markets have grown systematically over the past 20 years. There is evidence of growing international technology markets in the form of cross-border receipts and payments for disembodied technologies. Robbins (2006), using data from the International Investment Division of the US Bureau of Economic Analysis, estimated that US corporations purchased international industrial-process licensing and R&D and testing services totaling 12 billion US dollars in 2002, while they received 23 billion US dollars from foreigners for these items.[3]

Assuming that domestic US demand for technology licensing has a similar structure, Robbins estimated that US corporations received 67 billion US dollars in revenues from licensing industrial processes. Total R&D in the US in 2002 was about 280 billion US dollars and that performed by industry was 192 billion US dollars. Thus, transactions in technology account for a little less

than 25 per cent of total US R&D and about 33 per cent of the R&D performed by industry. Thus, markets for technology are large and substantial, and the evidence suggests that they have grown faster than total R&D over the last decade or so.

Interestingly, Robbins' (2006) estimates also indicated that more than half of the transactions involving US firms either as sellers or buyers of technology have an international counterpart. This fact points to the continued growth of international technology markets.[4] Other evidence also points in the same direction. Figure 1 is based on Athreye and Cantwell (2007). Using data from the World Bank's World Development Indicators, they found that international patent licensing and royalty receipts have surged since the mid-1980s. From around 10 billion US dollars in 1984, international patent licensing and technology receipts grew to more than 80 billion US dollars in 2002 (on current prices). Over 120 countries reported receiving such royalties and more than 130 countries reported making such payments in 2002. Similarly, Mendi (2007a) analyzed data from the OECD's Technology Balance of Payment (TBP) database. The TBP database covers technology transfers in the form of licensed patents, know-how, trademarks, and the like, but excludes licenses of software or designs (along with advertising, insurance, and, more typically, commercial transfers). Mendi (2007a) found that between 1970 and 1994 the total volume of international receipts and payments for technology deals in 16 OECD countries (comprising the leading European countries, the US and Japan) have increased more than 10-fold. Receipts increased from about 3.6 billion US dollars to 46 billion US dollars, using purchasing-power-parity exchange rates, and payments increased from about 3.1 billion US dollars to 33.9 billion US dollars.

Royalty and Licensing fees, World (1950-2003)



Source: Athreye and Cantwell, 2007

These estimates are imperfect in a number of ways. For one, they do not adequately capture technology transfer that is not captured by royalty statistics. Many multinational corporations may account for the value of technology transfer in other ways. Even so, it is apparent that there has been a significant increase in international technology transfer. Further, this appears to coincide with an overall strengthening in IP regimes, first in the rich countries but later in developing countries as well, although one cannot be definitive about the strength and direction of the relationship.

As expected, and as Table 1 indicates, these flows are largely confined to the developed countries and to developing countries that have experienced rapid economic growth over the last few decades. Though regrettable, this points to the very important role of demand in technology transfer. For present purposes, the point of interest is investigating how IPR protection affects the demand for technology transfer, a point I discuss in greater detail below.

Table 1. Indicators of the Importance of Licensing in LDCs and ODCs, 1996–2005 (Royalty and License Payments, Period Averages)

	Value ('000 US$)		License payments/ GDP (%)		Licence payments/ *per capita* (US$)	
	1996–99	2000–05	1996-99	2000-05	1996-99	2000-05
LDCs	29,044	33,250	0.02	0.02	0.07	0.07
Africa	20,231	23,308	0.03	0.03	0.07	0.07
Asia	8,605	9,779	0.02	0.02	0.06	0.07
Islands	207	163	0.03	0.01	0.34	0.24
Other developing countries (ODCs)	11,771,543	22,543,234	0.23	0.36	3.55	6.36
Africa	785,767	1,020,422	0.24	0.27	3.72	4.43
Latin America	2,698,636	3,253,528	0.15	0.17	5.82	6.53
Asia	8,287,140	18,269,284	0.28	0.47	3.14	6.49

Source: UNCTAD, 2007: Table 16

LDCs and regional aggregates are composed of the following countries: Angola, Bangladesh, Benin, Burundi, Cambodia, Cape Verde, Eritrea, Ethiopia, Guinea, Lesotho, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Samoa, Senegal, Sierra Leone, Sudan, Togo, Uganda, United Republic of Tanzania and Zambia.

4. ANALYTICAL FRAMEWORK FOR EMPIRICAL ANALYSIS

Intellectual property comes in many forms, trade secrets, copyrights, and patents being the most important in relation to technology transfer. The literature on trade secrecy and copyrights is sparse, especially for trade secrecy, and particularly as it relates to international technology transfer; much of the empirical evidence at hand deals with patents.[5] The principal reasons are that patent databases are widely available, it is much easier to link patents to technology and industry groups, and there is great variation in the extent and nature of patent protection across countries. Details of patent protection and its role in technology transfer are also of great policy interest.

In thinking about technology transfer to emerging economies, it is very important to distinguish between technologies intended to serve the domestic market (of the recipient country) vs. technology intended to produce exports for developed countries. Most of the literature has failed to make this distinction, perhaps because of difficulty in measurement. The consequences of this failure are conceptual confusion and, potentially, conflicting empirical results. A corollary is that there is relatively little attention paid to why IP protection should matter for technology transfer. Although the answer may appear to be obvious, a little reflection reveals that the matter is more complex.

If the technology being transferred is for producing goods and services for the export market, what matters is the patent protection the technology holder enjoys in the export market. In other words, consider the case where a new chemical process is being introduced into a country, where it will be used to produce plastics for export. If the process were illegally copied, typ-

ically the technology holder would be able to block exports into the most important export countries, provided the technology holder enjoyed patent protection in those countries. This implies that transfer of technology should be relatively insensitive to patent protection in the developing country; for instance, there are substantial export markets where the technology is not patent protected. Of course, as a practical matter, the technology holder may greatly prefer to prevent competition by preventing its use in production in one country rather than protect its importation in a number of markets.

Technology transfer can filter through a number of channels. Table 2, reproduced from Maskus (2004), itself derived from a variety of data sources, shows that these channels have increased in importance over time, consistent with the broad patterns described earlier. The major modes of transfer are imports of goods and services, especially of capital goods, foreign direct investment (i.e. via multinational corporations (MNCs)), licensing and joint ventures, foreign trade, and movement of people. The latter is different enough for me not to devote attention to it here, though it should be remembered that the first patent grant recorded in history was for the purpose of technology transfer, albeit in the form of attracting the technology owner to relocate.[6]

Maskus (2004) also points out that technology can be involuntarily transferred, via imitation. The technology holder does not participate in this transfer, and in many cases, may actually seek to restrict it. This point is worth noting for, as also discussed later, although the presumption is that IP protection may retard such transfer, patents in particular also disclose. Thus, there is an intriguing possibility that patents may facilitate such transfer. A second source of transfer is exports by recipient country firms: it is plausible that exports are a means of learning not only about demand conditions but also technology. Many large firms control supply chains. Firms in developing countries that participate in such supply chains may receive a variety of training and technology from their customers. A third major source of transfer is the diffusion within the recipient country of the transferred technology. This diffusion can itself take place through purchase of goods or licensing, but is more likely to take the form of movement of people or direct imitation or both. Here, trade secrecy (and related employment rules such as non-compete clauses) play a more important role.[7]

Table 2. Exports of Capital-Intensive, Skilled Labor-Intensive and Technology-Intensive Goods, Royalty Income Earned and Net FDI Outflows from High-Income OECD Countries, 1970 and 2001 (billion US$ and percentage)

	Capital-intensive		Skill-intensive exports		High-technology exports		Royalties exports		Net FDI outflows	
Value ($bn)	**1970**	**2001**	**1970**	**2001**	**1970**	**2001**	**1970**	**2001**	**1970**	**2001**
High income	45.8	1,108.0	43.7	736.7	25.8	739.3	2.8	71.2	6.9	472.1
Low income	2.8	32.8	2.4	13.1	1.2	16.1	0.0	0.02	0.3	8.1
Lower middle income	8.4	183.4	5.7	60.0	3.5	104.3	0.0	0.7	0.9	105.6
Upper middle income	7.7	318.0	5.2	126.9	3.8	200.0	0.0	1.8	0.6	69.4
Sub-Saharan states	1.5	10.6	1.5	6.0	0.7	5.6	0.0	0.02	0.1	5.5
Shares (%)										
High income	70.8	67.5	76.6	78.7	75.4	69.8	99.7	96.7	79.9	72.0
Low income	4.4	2.0	4.2	1.4	3.5	1.5	0.0	0.0	3.2	1.2
Lower middle income	12.9	11.2	10.0	6.4	10.1	9.8	0.0	0.9	9.9	16.1
Upper middle income	11.9	19.4	9.1	13.5	11.0	18.9	0.0	2.4	7.1	10.6
Sub-Saharan states	2.3	0.6	2.8	0.6	2.0	0.5	0.0	0.0	1.2	0.8

Source Maskus (2004: Table 1)

Country groups are as defined by the World Bank; high income = OECD countries minus Mexico, Republic of Korea and Turkey; Sub-Saharan states exclude South Africa. Capital and skilled labor-intensive goods are defined on the basis of factor intensity using the SITC classification. High-technology goods are defined on the basis of R&D intensity.

The key question is how IP protection affects the extent, form and channel of technology transfer. Within this broad area, there are several important sub-questions. First, how important is foreign direct investment as a source of international technology transfer as compared, on the one hand, with licensing, and on the other, with imports? A second theme is how IP protection affects these different modes of transfer. Here there are two related questions. First, how does patent protection affect technology transfer within a given mode? Second, how does patent protection affect the choice between these modes? *A priori* reasoning and some limited empirical evidence suggest both that the relative importance of the different sources may vary over time, and that IP protection may affect these sources differently. As noted earlier, there is relatively little evidence on the impact of non-patent IP protection on technology transfer. Virtually all empirical work has focused on patents instead.

There are several key challenges to empirical research. The first is to obtain a measure of patent protection. Many cross-country studies use some type of index, frequently the Ginarte-Park index, developed by Ginarte and Park (1997), or the earlier Rapp-Rozek index (1990). Their construction and properties are discussed in Maskus (2000). Despite being widespread, these measures, though acceptable if used mainly to control for the impact of patent protection, are problematic if used to study patent protection. For one, they are based on the available legal protection as it appears in the laws, rather than the actual level of protection. In regression-based studies, their use is additionally problematic if they are used, as is frequently the case, as cardinal variables, since the indices are ordinal.

Studies focusing on particular countries cannot use such indices because they are country-level measures. Industry-focused studies use variation in the effectiveness of patent protection across industries, sometimes using industry level effectiveness of patents reported in the Yale survey (Levin *et al* (1987)) or the Carnegie Mellon Survey (Cohen *et al* (2000)). Transaction-level studies use either industry-level effectiveness or simply whether a patent is present or not.

McCalman (2001) employed a more disaggregated set of measures using detailed information about patent institutions by summarizing the extent of coverage offered (e.g. are any sectors excluded from patent protection?), restrictions on the form of exploitation of patents (e.g. do imports satisfy working requirements?) and the availability of enforcement institutions (injunctions, burden of proof, etc.). This study is, however, an exception rather than the norm in not using a summary measure of the strength of IPR protection. However, unless one is fortunate, the use of multiple measures makes it difficult to empirically answer the impact of IPRs. Instead, one can only quantify the effect of this or that aspect of the IPR regime.

The second challenge is to measure technology transfer itself. Typically, the literature has used measures such as the total payments made for technology imports or technology licensing revenues. This poses a problem insofar as arguably stronger IPR protection may simply result in a higher price for technology rather than higher "quantity" or quality of technology. Some studies, that will be cited later, indirectly try to address this by investigating whether the recipient firm increases its own technology activities, indicating an increase in the extent of technology transfer, rather than merely a price increase. Other possibilities (which I have not seen implemented but are surely feasible with detailed data) include investigating whether the recipient firm increased profits or productivity or, better still, whether it introduced new products or lowered its costs.

Measurement is easier when the focus is on the mode of technology transfer (such as the choice between foreign direct investment and licensing) or the form of the technology contract. However, the key problem here is the counter-factual. Specifically, the empirical analysis is conditioned upon the transfer taking place, namely that given that it has been agreed to transfer

technology, is it transferred via FDI, arms-length licensing or some other form? Put this way, the problem is also obvious. It is possible that changes in IPRs may increase or decrease the total amount of technology transfer, in the process changing its share through FDI or licensing or imports. Few of the studies have adequately addressed this issue.

The final challenge, even more serious, is to find a source of variation in the measured patent protection that is exogenous – unrelated to the unobserved factors driving the variable being investigated, namely the extent or form of technology transfer or contractual provisions. Few studies have found a satisfactory solution to this, although there are exceptions.

A comprehensive survey of the literature is not undertaken here because several are available. Maskus (2004) provides a comprehensive overview of the literature on IPRs and technology transfer. Arora, Fosfuri and Gambardella (2007) explored international technology licensing. Maskus, Saggi and Puttitanum (2004) provided a survey of the theoretical and empirical literature on patents and technology transfer through direct foreign investment and licensing. The following brief review, therefore, simply illustrates these issues and also indicates the variety of data sources that have been used.

4.1 Patents and Technology Transfer

A number of empirical studies have looked at the relation between patents and technology transfer. Eaton and Kortum (1996), albeit studying productivity growth and technology diffusion in the OECD countries, found that the smaller and less-technologically advanced OECD countries derived most of their productivity growth from having foreign inventors patent in their economies. This finding may also apply to the more advanced developing nations. They control for the IPR regime using the Rapp-Rozek index. McCalman (2001) applied the Eaton and Kortum approach to a sample of developed and developing countries. He found that patent harmonization (which has *de facto* resulted in a strengthening of patent protection) leads to an increase in patent value (as reflected in the contribution to economic growth). Moreover, McCalman (2001) constructed an "enforcement" index, to capture the effect of patent harmonization.

Xu *et al* (2005) carried out a similar study of international technology diffusion through trade and patenting in a sample of 48 countries for the period 1980–2000. They used the Ginarte-Park index to measure strength of patent protection, together with actual patenting data from WIPO, and found that rich countries benefit from domestic technology and foreign technology embodied in imported capital goods; middle-income countries enjoy technology spillovers from foreign patents (patents filed in the country by foreigners) and imported capital goods; developing countries benefit mainly from foreign patents.

Bascavusoglu and Zúñiga (2002) used as their dependent variable the receipts in technology services flows exported by French firms to 19 countries over the period 1994-2000. These flows captured cross-border patent-licensing and trademark-licensing receipts, revenues from technical assistance and engineering services and income related to R&D services and R&D located overseas. The authors found a positive, although weak, effect of the degree of patent protection at the country level on the amount of such receipts. Patent protection seems to matter most for countries with strong imitative abilities and for industries with a medium level of R&D intensity.

Smith (2001) related US exports, sales of foreign affiliates and licensing fees to the Ginarte-Park patent index in several developed and developing countries. She found significant evidence that

stronger patent protection would increase affiliate sales and licensing payments, the result driven by the countries with strong imitative capacities (measured by a high percentage of engineers and scientists in the population).

McCalman (2005) investigated how Hollywood movie studies release motion pictures in 37 countries. The primary data source used in this analysis was the Internet movie database which contains information on the release dates of movies across countries. He found that moderate IPRs encourage the rapid diffusion of movies, whereas very weak or very strong rights are associated with delays. Interestingly enough, though copyrights rather than patents are the relevant rights for the movie industry, McCalman used the Ginarte-Park index as his measure of the strength of IP protection.

4.2 Patents, Trade and FDI Flows

Foreign direct investment is a major source of technology flows across countries. Seven hundred multinational corporations accounted for 46 per cent of the world's total R&D expenditure and 69 per cent of the world's business R&D in 2002 (UNCTAD (2005)). Indeed, the R&D budgets of the largest firms exceeded the entire R&D spending of virtually all developing countries.[8] A recent comparison showed that in 2003, the R&D spending of firms such as Ford, Siemens, Pfizer and Chrysler was around 7 billion US dollars each, greater than the combined R&D expenditures of all CIS states, or the newly admitted EU member states (see Javorcik, this publication). Not only does FDI itself introduce new technologies to developing countries, but this knowledge also spills over to other domestic firms in a variety of ways as discussed later. The literature on knowledge spillovers from foreign direct investment is extensive, the results unclear and a review of that literature would be of limited relevance to this publication. However, as discussed later, it is possible that one reason for the mixed results may have to do with differences in patent protection across countries.

For our purposes, the question is whether FDI flows and trade respond to patent protection. Maskus and Penubarti (1995) were the first to relate international trade flows to the cross-country strength of patent laws, using bilateral imports from OECD countries to other OECD countries and to a large group of developing countries in detailed manufacturing categories. The strength of patent rights was measured by the Rapp and Rozek (1990) index across importing nations. The authors found that import volumes were positively and significantly affected by increases in this patent index across most manufacturing categories, particularly in large and middle-income countries. Smith (1999) found that international firms would expand their exports to imitative (large and middle-income developing countries) nations significantly in response to an increase in the patent strength index. In supplementary regressions, Smith showed that patent rights strongly and positively affected the inflows of knowledge, measured as R&D expenditures undertaken on behalf of affiliates. Again, this finding applied only to recipient countries with strong imitative abilities; the impact was absent in countries with weak imitative abilities.

However, Primo Braga and Fink (1998) found no statistical relationship between patent rights, measured by the Ginarte-Park index, and international FDI flows or stocks. Blyde and Acea (2002) estimated the relationship between patent rights (measured with the Ginarte-Park index) and imports and FDI into Latin American countries. They found that imports were higher for higher values of the Ginarte-Park patent index for developed countries but were insensitive to patents in the developing countries. However, bilateral inflows of FDI from OECD countries were higher for higher values of the Ginarte-Park index, even after controlling for institutional variables, infrastructure, and human capital levels.

Ferrantino (1993) used data for 1982 on US exports and sales of overseas affiliates of US firms to identify the cross-country determinants of both exports and sales of multinational affiliates of these firms. Patent protection is measured by whether the country is a member of certain IP treaties. It found that membership in IP treaties increases the flows of payments and receipts for intellectual property as long as domestic patent protection is sufficiently strong. Parent companies in the US export more to subsidiaries in countries which do not adhere to such treaties, but their impact on arms-length exports and foreign investment is minimal. In other words, the author suggests that US firms export higher than expected volumes to their affiliates in countries that have weak IP regimes to limit technology leakage to their rivals abroad by confining production within the US.

A somewhat different approach is taken by Javorcik, who exploited differences in reliance upon patents across industries. She found that firms in industries relying heavily on IPR protection are *(ceteris paribus)* more likely to invest in transition countries with stronger IPR protection (Javorcik (2004)). This is an example of exploiting the differences across industries and countries.

4.3 Patents and Content of Technology Import Contracts

Nagaoka (2005) analyzed how the price of technology imported by Japanese firms depended on the strength of patent protection, using information over the period 1981-98 across 32 sectors. He found that high royalties are more likely to be observed when the licensing contract also includes patents. In short, stronger IPRs help increase the share of a technology's value the licensor can appropriate. The data was drawn from corporate reports filed by Japanese manufacturing corporations in 1999 under the Security Exchange Law, which requires public firms to disclose important contracts. In the case of licensing-out, 217 firms disclosed 1,458 contracts in total. Nagaoka (2002), using the same data, found that technology out-licensing contracts by Japanese firms were less likely to involve only a patent (rather than both patents and know-how) when the license country's IPR protection (Ginarte-Park index for patents, and the Business Software Alliance for software piracy) is weak.

Arora (1996) used a sample of 144 technology-licensing agreements signed by Indian firms to test the empirical relevance of patents. He employed the provision of three technical services – training, quality control, and help with setting up an R&D unit – as empirical proxies for the transfer of know-how. He found that the probability of technical services being provided was higher when the contract also included a patent license or a turnkey construction contract.

Mendi (2007b) used a sample of technology import contracts by Spanish firms in 1991. The dataset was taken from the records of the Spanish Ministry of Industry. All Spanish firms that imported technology were required, up to 1992, to report the terms of the technology purchase.[9] The paper found that shorter scheduled contracts were less likely to include the transfer of know-how. It also found that technical assistance was bundled together with the transfer of know-how. In another paper based on a dataset derived from the same Spanish administrative records, covering 925 licensing agreements, mostly for the years 1964-68, Villar (2003) found that when the technology is patented, the parties are more likely to agree on fixed payments.

4.4 Patents and the Mode of Transfer (FDI vs. Licensing)

Smith (2001), in the study cited earlier, found that US firms are more likely to export or invest in direct manufacturing facilities rather than license technology in countries with weak patent

regimes. Similarly, Nicholson (2002) and Puttitanun (2003), both of whom used data on the number of various kinds of contracts (exports, FDI, licensing) found that increases in the patent index significantly raised both FDI and licensing, but also that the mode of transfer tended to shift towards licensing. Puttitanun (2003) analyzed decisions on entry mode by US firms in 135 industries and 62 countries in 1995. Using a multi-nomial logit regression model, she showed that while stronger patent rights increase total entries by multinational firms, they especially enhance the location advantage of FDI and licensing vis-à-vis exports. However, strong patent protection is associated more with increases in FDI than licensing. Javorcik (2004) used data on FDI projects to Eastern Europe and found that weak patent protection shifted the composition of FDI away from technology intensive industries, and away from production towards distribution.

On the other hand, Fosfuri (2004) used a comprehensive database on investments in chemical plants during the period 1981-96, distinguishing between wholly owned operations, joint ventures and technology licensing in 75 countries. After controlling for several country characteristics, he did not find that higher values of the Ginarte-Park index were associated with greater levels of licensing or FDI, nor its ratio. Similarly, Pfister and Deffains (2005) found that patent rights exert only a negligible influence on the location choices of French firms among 17 developing countries.

Eapen and Hennart (2002) analyzed whether technology was transferred through joint ventures or licensing for a sample of Indian firms. Data was collected by means of a survey sent to 1,258 managing directors of Indian firms, which had taken technology licenses from, or had entered into joint ventures with, foreign firms. The population was identified from a database of over 7,000 Indian firms and from the listings of foreign chambers of commerce in India. Their final sample consisted of 126 Indian firms of which 75 were local partners in joint ventures with foreign firms and 51 were licensees of foreign firms. They found that whether the technology is patented in India or not their measure of patent protection did not influence the choice between licensing and joint ventures.

Yang and Maskus (2001) found that license fees for industrial processes paid by unaffiliated foreign firms to US firms in 26 countries in the years 1985, 1990 and 1995 were higher for higher values of the Ginarte-Park index. On the other hand, Fink (1997), using German data, found a very weak relationship between the strength of patent protection and the level of technology licensing.

Using the same dataset as Mendi (2007), Mendi (2005) analyzed a sample of contracts that included technology transfers to Spanish subsidiaries of overseas firms in 1991. He found that know-how is more likely transmitted within multinationals than between unrelated firms, but there is no difference in the transfer of codified knowledge.

This mixed evidence reflects a variety of factors, not the least of which involve differences across the transferring firms and differences across technologies. Arora and Ceccagnoli (2005) showed that stronger patent protection increased patenting, but that it does not increase licensing by large firms. Small firms, and firms lacking commercialization capability, are more likely to license in response to stronger patent protection. In other words, stronger patents may favor FDI when the technology is owned by large firms that are able to invest globally. If the technology is owned by smaller firms, this will increase licensing. As discussed in the final section, investigating the source of technology and its response to patent protection is a promising avenue for additional research.

A similar remark applies to differences across technologies. It is plausible that mature technologies diffuse through informal channels (perhaps embodied in plant and equipment), whereas more advanced technologies require mechanisms such as licensing or FDI. An obvious, and understudied, research question is the impact of IP protection on the transfer of technologies with varying levels of sophistication and complexity.[10]

5. POTENTIAL AREAS OF ADDITIONAL RESEARCH IN DEVELOPING COUNTRIES

5.1 The Determinants of IPR Protection and the Measures of IPR Protection

An important lacuna in the empirical research is the measure of IPR protection. As noted, commonly used measures, such as the Ginarte-Park index or the Rapp-Rozek index suffer from multiple problems. The two most important problems are first, that they are based on laws as written and not as they are enforced, and second, that it is not clear why there are systematic differences across countries in the strength of IPR protection. In particular, if a country with a higher demand for technology also has, as a consequence, stronger IPR protection, then it is possible that the country may also import more technology than other countries with a lower demand for technology (and weaker IPR protection).

The problem of measuring the strength of IP protection can be partially ameliorated by also developing measures of the extent to which laws are generally enforced in the country. Assuming that IPR laws are then enforced to the same extent as other laws, one could obtain a better measure of the strength of IPR protection by interacting the Ginarte-Park index with an index of overall law enforcement, such as the one developed by Kauffman *et al* (2005). From 1996 the World Bank has provided a variety of measures for a large group of countries. These include "government effectiveness", which measures the competence of the bureaucracy; measures of the "rule of law", which includes measures of the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence; an index for the "control of corruption", measuring the exercise of public power for private gain, including both petty and grand corruption and state capture.[11]

Finally, one can use survey-based measures of the extent of patent protection. This approach has been used with success in measuring the effectiveness of IPR protection across industries in two landmark surveys, the Yale survey (Levin *et al* (1987)) and the Carnegie Mellon Survey (Cohen *et al* (2000)). In these surveys respondents (typically high-ranking executives in firms in the Yale survey, and R&D managers in the Carnegie Mellon survey) were asked questions about the effectiveness of patents (along with the effectiveness of other strategies such as secrecy or first-mover advantage). They were also asked about various indirect, and possibly more useful, measures such as the speed with which patented and unpatented innovations were imitated.

One might imagine implementing similar surveys in developing countries. Respondents might be asked to estimate the importance of patents for technology suppliers, as well as more indirect questions such as the importance of patents in contracts (or the fraction of technology transfer contracts that crucially involve patents) and incidence of imitation for patented and unpatented imported technology. One could also ask potential technology suppliers about the importance of patents. As with the other surveys, it is likely that the more effective measures would be indirect, such as whether the firm had transferred technology to one country but not to another, similar, country and to correlate that to independent measures of the strength of IPR protection. Similarly, respondents of potential technology suppliers could be asked about the form of technology transfer. They could also be asked to directly estimate the speed with which their technology, transferred to different types of developing countries, was imitated, and whether this speed varied with whether the technology had enjoyed patent protection.

The second problem, namely that it is not clear why there are systematic differences across countries in the strength of IPR protection, is harder to deal with. This requires identifying a source of variation in the strength of patent protection that is not correlated with the unmeasured influences that condition technology transfer, such as the demand for technology. In econometric terms, one needs a source of exogenous variation. This problem is most acute in empirically assessing the role of IPR protection on technology imports. It is likely to be less of a problem when investigating the impact on the mode of transfer or of the composition of technology-import contracts, although the problem is not entirely absent either.

Developing a systematic approach to solve the problem will require an entirely new line of research on what factors determine the strength of IPR protection in a country. The political economy of IPR protection involves not only the analysis of self-interested parties participating in the legislative and political process, the usual focus of economists. One also needs a historical perspective, which will take into account the peculiarities of each country's history. Rather than treat such country variation as an unwelcome diversion, empirical researchers can take advantage of it, because historical factors may in fact be a valuable source of exogenous variation.

Until such time as a deeper understanding of the determinants of the strength of IPR protection emerges, one will have to rely upon more *ad hoc* approaches. One such instance is the study by Branstetter *et al* measuring the impact of IPR on technology imports. There, changes in patent laws were the source of exogenous variation, so that estimation was "within" a country, less vulnerable than the purely cross-country variation implied by the use of patent indexes such as the Park-Ginarte index. One might still wonder whether these changes were in fact responses to unseen forces that increased the value of technology. However, the evidence indicates that while stronger patent protection increased technology transfer to the affiliates of the US multinationals, there was little effect on technology transfer to unaffiliated parties.

An alternative might be to exploit cross-industry and cross-country variation. Here, one also uses differences in the extent to which patents matter for different types of industries along with variation in overall patent protection across countries. The only example of which I am aware that has tried to exploit country-industry differences in patent protection is Javorcik (2004). Javorcik compared whether firms in patent intensive industries were more likely to invest in transition economies with stronger patent protection than transition countries with weaker patent protection, using as a baseline investments by firms in industries that are not patent intensive. This type of "difference-in-difference" approach is common in applied empirical work and, though not without problems, is a useful strategy given the lack of exogenous variation in patent protection across countries.

A related type of difference-in-difference approach can exploit institutional facts about industries. For instance, we know from a variety of sources that pharmaceuticals are patent intensive. However, countries vary in terms of policies such as price controls for pharmaceutical products, or in the ability of firms to extend *de facto* patent protection through "evergreening".[12] This variation, which is specific to industries and countries, can be used to see how differences in patent protection affect the variables of interest.

Another possibility is to use court decisions or administrative regulations in countries to create variation in patent protection. For instance, Hall and McGarvie (2000) used landmark court decisions that weakened copyright protection for software and others that enhanced patent protection for software as a source of variation. Clearly, this strategy will more likely work for single-country studies rather than cross-country studies. Investigators could use changes in regulations, changes in the cost of filing for patents or changes in the enforcement of patents as sources of variation.

For the most part, such large-scale studies, though very attractive because of their wider coverage, are likely to be handicapped by the significant problems of the availability of comparable and fine-grained data. In the immediate short run, more focused studies are easier to envisage. In the same vein, research that provides measures of the actual effectiveness of the enforcement of IPRs for instance, by measuring the number of patent-related cases and the disposition of those cases across countries, will be invaluable and highly influential. It is also likely to be extremely labor-intensive, particularly if it covers many countries.

5.2 IPR Protection and Transfer Mode

Here, country-focused (e.g. Eapen and Hennert (2002)) or industry-focused research is possible (Fosfuri (2004)), as also single-source country, but multiple-recipient country and industry focused studies are possible (e.g. Maskus and Penubarti (1995), Smith (2001)).

5.3 Content of Technology Import Contracts

Since many countries have reporting requirements for technology imports, data from administrative records can be used to address issues of the extent of technology transfer (e.g. whether know-how is provided or not) and correlate it to whether the imported technology is patented in the source country, and whether it is patented in the recipient country or not (e.g. Arora (1996), Mendi (2005), Nagaoka (2002)). More detailed data on the patents themselves (such as the number of claims, the citations received) may also be linked. Similar data sources can be used to investigate contractual details.

6. SUGGESTIONS FOR FUTURE RESEARCH ON UNDER-RESEARCHED TOPICS

Perhaps more interesting avenues of research will involve under-researched topics. A standard issue is the impact of imported technology on the recipient country. This has been extensively researched in the context of the productivity impact of MNCs. But the role of IPRs has been under-researched.

Studies on the sources of spillovers from FDI flows or from multinationals themselves are many and results are mixed. For instance, Aitken and Harrison (1999) found that an increase in FDI presence reduces total factor productivity (TFP) of local plants in the same sector (relative to the baseline) in Venezuela. On the other hand, Haskel, Pereira and Slaughter (2007), using data from the UK found that an increase in FDI increased the TFP of local plants in the same sector, albeit by a small amount: a 10 point increase in the share of foreign plants leading to a 0.5 per cent increase in TFP. Javorcik (2004) found no effect of FDI on firms in the same industry in Lithuania. However, she found positive spillovers for firms in supply sectors: A one-standard deviation increase in FDI implies a 15 per cent increase in the TFP of firms in supply industries. This supports the idea that whereas passive or unintended spillovers of knowledge (such as through movement of workers and managers) from MNCs to local competitors may be small, MNCs can, in their own interests, transfer knowledge to their suppliers, from where knowledge may flow to others as well.

A related and important question is how these different channels of spillovers are conditioned by the IP regime in a country. Researchers could perform detailed case studies, tracing the movement of people from MNCs (or their domestic affiliates) to domestic firms, studying what steps

MNCs take to restrict the diffusion of technology and how, if at all, IP protection conditions this process. One could also undertake detailed case studies of technology being transferred inside global value chains, and relate it to the IP regime. For instance, is an MNC atop a global value chain more likely to locate suppliers in a country with stronger IP protection? Is it more likely to share technical information with the supplier in such cases?

A possible variant, in countries with extensive patenting, is to explore whether patents filed in those countries (or from those countries) cite patents filed overseas, and relate that to variables of interest. For instance, it is widely held that MNCs are less likely to cite technology-intensive activities in regions with weaker IP protection. Specifically, it has been suggested that MNCs are more reluctant to locate R&D operations in regions with weaker patent protection, because they fear that crucial proprietary technology could leak out. Though *prima facie* plausible, one could also provide alternatives that would imply the opposite. After all, insofar as the developing country is selected for R&D to support global production, not simply for sales in the developing country itself, what matters is patent protection in the target market, not patent protection in the country where R&D is conducted. As a case in point, Bayer, a pharmaceutical company, used patented research tools to conduct research overseas and to use the information generated to carry out follow-on research in the US. When challenged by the patent holder, Housey, Bayer successfully argued that this use was legal. The key is that in the country where the research was carried out, Housey had not filed for patents. Thus, certain types of research may be more attractive in countries with weaker patent protection.[13]

This suggests an obvious research opportunity. Even if it is the case that patent protection is important when deciding the location, the question is why. Is the concern that competing substitutes would be introduced (in the domestic market) with weak patent protection, or is it principally that somehow stronger patent protection in the recipient country will nonetheless protect against vital knowledge from leaking out, even when the patent protection is strong in the principal market? Indeed, Zhao (2006) studied the patenting behavior of MNCs, where she used USPTO data and found that patents filed by MNCs from inventors in countries with weak patents cite other patents of the MNC more heavily as compared to patents filed by the same MNC from inventors in countries with stronger patents. The inference is that MNCs locate only a selected part of their R&D activities in weak patent countries so as to minimize the chances of technology leaking out. This is a topic that calls for more extensive research, including more detailed case study research.

Another type of case study might be to focus on patenting by foreigners and to follow its impact. Are such patent filings accompanied by the introduction of new products or processes by the patent holder? How quickly do domestic firms follow suit? Are patent filings by an overseas firm followed by patents citing that patent, by implication, building on the initial patents?

In designing such studies, one faces a similar challenge of finding variations in the extent of IP protection, either across countries (if done for the same industry), or across industries (if done within a country). For instance, in studying the impact of patent protection on diffusion, one has to either compare across industries in a country or across countries in an industry. In the former, the problem is to control adequately for differences across industries in the nature of the technology itself which might condition diffusion. For instance, for technologies that are more codified, obtaining patent protection is easier but it may also be easier to diffuse. In the latter case, the problem is to control for unobserved differences across countries that might be correlated both with the strength of IP protection as well as diffusion. There are no silver bullets available.

6.1 IPRs and the Demand for Technology

Although it is widely recognized that IP protection would affect the value of the technology in the recipient country, this aspect has not been quantitatively studied in sufficient detail. Much of the discussion has been focused on the supply side, namely the willingness of technology holders to transfer technology, the form taken to accomplish the technology transfer and the contractual provisions and details. The literature has also devoted a great deal of attention to the absorptive capacity of the recipient country or firm. However, absorptive capacity is only one aspect, albeit an important one, of the demand for technology. For current purposes, I am proposing research on how IP protection affects the demand for technology. Another obvious research question is to explore what impact the IPR regime has on the nature of competition in the domestic market, and how market structure and the IPR regime together condition the value of technology.

Measuring the demand for technology separately from the supply of technology will pose additional data challenges. One interesting source of data is the stock market, the valuation it puts on R&D and how that valuation changes with changes in IP protection. For instance, Arora, Branstetter and Chatterji (2007) used data on publicly traded Indian pharmaceutical firms and found that the implied value of the capitalized R&D expenditures increased with the strengthening of the pharmaceutical patent regime. This study did not address technology transfer directly but one could imagine similar studies using the stock of expenditures on imported technology. Indeed, one could extend the analysis to separately analyze the value of R&D stocks and imported technology stocks, which would also enable one to estimate the relationship between indigenous R&D and technology imports.

Another useful method would be a case study of individual firms or industries, to understand in greater detail the role of IP protection in conditioning the demand for technology. One interpretation of the Arora *et al* study of the Indian pharmaceutical industry is that the change in the patent regime profoundly changed the strategies of the leading firms, moving them away from imitation towards innovation. In some industries, such a move might involve an increase in the demand for technology, where some or all of this increased demand may be satisfied by technology imports.

A virtue of the demand for the technology approach is that it will naturally lead researchers to look at the source of technology. Though we tend to think of technology, especially patented technology, as being unique, in reality there are many sources often offering close substitutes. For instance, in the oil-refining industry, technology may be obtained from pure technology suppliers such as UOP; from engineering contractors such as ABB/Lummus; licenses from oil companies themselves and from FDI. How does the strength of IPR condition the relative attractiveness of these different sources of technology? Extending this, one can examine, for a given industry, where the IPR regime varies across otherwise similar countries, the differences in the source of technology transfer and the consequences for productivity.

7. CONCLUSION

While the literature on international technology transfer has been growing over recent years, there remain a number of important gaps concerning the role of IPRs in international technology transfer, particularly in developing countries and countries with economies in transition. This paper has sought to identify ways in which those gaps might be partially filled by suggesting avenues for further research and exploring under-researched topics in order to obtain a better understanding of intellectual property and its impact on international technology transfer.

Notes

1 The focus on IPRs has been intensified by efforts to have developing countries recognize and protect such IPRs as part of an overall effort to negotiate reductions in trade barriers.

2 Arguably, this too is a form of technology transfer, but is widely seen as a lesser form. The hankering for self-reliance, never buried too deep despite the intellectual appeal of the theorem of comparative advantage, doubtless plays a part here. The belief that technology itself feeds further technical advances is perhaps a more justifiable basis for seeking the transfer of advanced technology rather than merely the fruits thereof.

3 As a point of comparison, Arora, Fosfuri and Gambardella (2001) estimated that the global market for technology in 1995 was about 35 billion US dollars. Based on Robbins's estimate, the US alone now accounts for that volume.

4 Patent-based technology transactions are certainly not new. Lamoreaux and Sokoloff (1998) documented the extensive trade in patent rights in the US in the late 19th century. Also, while data availability limits the focus of the present chapter to technology licensing, the market for technology has other dimensions as well, including strategic alliance and mergers and acquisitions.

5 For an overview of the literature on the economics of copyright see Watt, this publication.

6 In 1416 the Grand Council of Venice awarded one, Franciscus Petri, from the island of Rhodes, a patent for a superior device for the fulling of fabrics – giving Petri and his heirs exclusive rights for 50 years to build, alter, and reconstruct the apparatus he would erect for that purpose. Venice, in the 14th century, had adopted patents as a means of encouraging an inward flow of technology. As early as 1332 its Grand Council established a privilege fund, providing loans and other rewards for a foreign constructor of windmills who offered to bring knowledge of this art to the city (see Prager 1944: p. 713).

7 Our focus in this paper is on how, if at all, IP protection affects spillovers and the different sources of the spillovers.

8 For instance, firms such as IBM and Microsoft each spent over 5 billion US dollars in research and development in 2000. By comparison, the latest figures available from the National Science Foundation indicate that R&D in all of Africa was only 5 billion US dollars in 2000 and only 18 billion US dollars in all of South America.

9 The importer of the technology had to file a TE-30 form with the Servicio de Información y Transferencia de Tecnología (Technology Transfer Office), a branch of the Spanish Ministry of Industry. In some cases, in addition to this form, the firm included the actual contract, although this was optional. This type of control is no longer allowed by the EU, and thus filing was terminated in 1992.

10 The author is grateful to Albert Hu for bringing this point to his attention.

11 The author is indebted to Beata Javorcik for this suggestion.

12 See Cockburn, this publication.

13 For more details, see http://caselaw.lp.findlaw.com/scripts/getcase.pl?court=fedandnavby=caseandno=021598.

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COMMENTS ON
INTELLECTUAL PROPERTY RIGHTS AND THE INTERNATIONAL TRANSFER OF TECHNOLOGY: SETTING OUT AN AGENDA FOR EMPIRICAL RESEARCH IN DEVELOPING COUNTRIES

BEATA JAVORCIK*

Professor Arora's paper is a very useful summary of the current state of knowledge on the relationship between IPRs and international technology transfer. It points out shortcomings in the currently available measures of IPR protection, discusses methodological challenges facing researchers studying the link between IPRs and economic activity and suggests several areas for future research.

These comments will extend the discussion presented in his paper in three areas. First, they will suggest possible remedies for some of the shortcomings of the existing indices of IPR protection. Second, they will argue that the methodological challenges faced by studies of the relationship between IPRs and economic activity are unlikely to be resolved unless researchers put more effort into understanding the determinants of IPR protection. Finally, they will recommend studying spillovers associated with FDI as a fruitful subject of future research.

Starting with the first area, one of the main criticisms of the existing measures of patent protection, such as the indices compiled by Rapp and Rozek (1990) and Ginarte and Park (1997) is that they capture laws on the books but not their enforcement. Yet, as is widely known, not all countries enforce their IPR legislation to the same extent. However, if IPR laws were enforced to the same extent as other laws, one possible remedy would be to use the indices of patent protection in conjunction with indices of governance. For instance, the database by Kaufman, Kraay and Mastruzzi (2007) includes indicators covering 212 countries and territories and measures six dimensions of governance between 1996 and 2006. The indicators capture government effectiveness (the competence of the bureaucracy), rule of law (the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence) and control of corruption (the exercise of public power for private gain, including both petty and grand corruption and state capture). While employing these measures will not completely address the criticism, it will certainly give us more confidence in the results of empirical studies.

An alternative approach to relying on indices of patent protection is to focus on incidents of IPR reform, as done by Branstetter, Fisman and Foley (2006). The key advantage of this approach is the smaller data collection burden, but the disadvantages include inability to distinguish between various aspects of reforms and potential endogeneity with respect to outcomes of interest.

Yet another option is to initiate a new data collection effort. The World Bank's Doing Business Indicators may be a good model to follow. The basic idea is to create some hypothetical scenarios involving, for instance, patent or copyright infringement and ask law firms in countries around the world to provide information on the duration, available remedies and costs of resolving the case. The advantage of this approach is that it would capture the current state of laws and their enforcement and the information could be collected within a relatively short period of time. The main disadvantage would be the lack of time variation as it is difficult, if not impossible, to collect high quality historical data.

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Moving on to the second area, as Professor Arora discussed in his paper, a major shortcoming of most studies investigating IPR-related issues has been the failure to convincingly establish the direction of causality. To illustrate the difficulties involved with a simple example, let us assume a researcher is interested in asking whether sectors relying heavily on IPRs grow faster (or more slowly) in the presence of stronger IPR protection. Even if a researcher finds a positive relationship between growth in such sectors and IPR protection, this relationship will be difficult to interpret. It can be that IPR protection stimulates growth in these sectors, but it is also possible that fast development of sectors relying on IPRs encourages countries to adopt stronger protection. Disentangling the two scenarios is certainly not an easy task.

In my view, the first step towards establishing the direction of causality is to develop a deep understanding of the determinants of IPR protection. This will allow us to assess which IPR protection measures are appropriate in a given context and suggest ways of establishing the direction of causality. The list of potential determinants of IPR protection includes political economy factors, such as industrial composition in the country and, in particular, importance of domestic industries relying on IPR protection and existence of industries benefiting from weak protection. Another potentially important determinant is external pressure exercised through multilateral, regional or bilateral trade agreements, Section 301 of the US Trade Act or multinationals operating in the country.

Finally, as for suggestions for future research, focusing on spillovers from FDI seems to be a promising agenda for several reasons. First, almost all countries in the world are engaged in FDI promotion, and 59 out of 108 countries surveyed in the World Bank's census of investment promotion agencies offered FDI incentives in 2004 (Harding and Javorcik (2007)). The reason for this enthusiastic welcome is that FDI is viewed as one of the key channels of technology transfer across international borders. This is not surprising given that 700 multinational corporations accounted for 46 per cent of the world's total R&D expenditure and 69 per cent of the world's business R&D in 2002. Considering that there are about 70,000 multinational corporations in the world, this is a conservative estimate. In 2003, the gross domestic expenditure on R&D by the eight new members of the EU at 3.84 billion US dollars[1] was equal to about half of the R&D expenditure of the Ford Motor Company (6.84 billion), Pfizer (6.5 billion), DaimlerChrysler (6.4 billion) and Siemens (6.3 billion) during the same year. It was comparable to the R&D budget of Intel (3.98 billion), Sony (3.77 billion), Honda and Ericsson (3.72 billion each) (see UNCTAD (2005)).

Many host countries hope that the knowledge brought by foreign investors will not be limited to FDI projects but will also spill over to indigenous producers. This can happen when workers move from foreign companies to domestic enterprises taking with them knowledge and skills acquired while working for a multinational, when domestic companies observe actions of their foreign competitors and in this way learn about new technologies and marketing techniques or when domestic suppliers of multinational enterprises benefit from the knowledge acquired through such a relationship.

There already exists some evidence of FDI being responsive to IPR protection. For instance, Javorcik (2004) found that firms in industries relying heavily on IPR protection were *ceteris paribus* more likely to invest in transition countries with stronger IPR protection. Branstetter, Fisman and Foley (2006) demonstrated that strengthening of IPR protection in host countries leads to increased technology transfer to foreign affiliates located in these countries.

Therefore, it is likely that differences in IPR protection affect the extent of FDI spillovers. Differences in IPR protection could be one reason why studies focusing on different countries produce very different findings with respect to intra-industry spillovers (for a review of the liter-

ature on FDI spillovers (see Görg and Greenaway (2004)). In countries with weak IPR laws, multinationals may put more effort into restricting knowledge flows or may choose not to transfer their latest technologies to begin with. While studies of spillovers to local suppliers are more consistent in finding a positive effect (see Javorcik (2004), Blalock and Gertler (2008)), relationships between multinationals and local suppliers are also likely to be affected by the extent of IPR protection. On the one hand, weak IPR protection may discourage knowledge transfer from multinationals to local suppliers and may discourage suppliers from undertaking innovation in order to supply foreign affiliates. On the other hand, if local suppliers can provide cheaper inputs thanks to their ability to infringe on technologies patented in other countries, lower IPR protection can increase the volume of inputs sourced and stimulate spillovers. It would be instructive to examine these issues using firm-level panel data for multiple countries and relate the extent of FDI spillovers to IPR protection in host countries. Alternatively, one could perform a meta-study of existing empirical work taking into account host country conditions.

To sum up, studying implications of IPR protection for economic activity is a promising research area with potentially important implications. Much work, however, remains to be done to produce convincing evidence on this link. The first step towards doing so is to devise better measures of IPR protection and deepen our understanding on the determinants of IPR protection.

Note

1 Countries included are the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia. As the 2003 figures were not available for Lithuania and Slovenia, data for 2002 were used for these countries.

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COMMENTS ON
INTELLECTUAL PROPERTY RIGHTS AND THE INTERNATIONAL TRANSFER OF TECHNOLOGY: SETTING OUT AN AGENDA FOR EMPIRICAL RESEARCH IN DEVELOPING COUNTRIES

ALBERT G. HU*

Professor Arora has conducted an informative review of the economics literature on the relationship between IPRs and the international transfer of technology in the context of developing countries. The thoughtful research agenda that he set out will no doubt be a useful guide for empirical researchers working in this area. My comments will largely involve elaborating on some of the themes touched upon in Professor Arora's paper and also highlighting some of the conceptual and measurement challenges researchers often find themselves wrestling with in this literature. I will also try to bring in some empirical observations of the experiences of the newly industrialized East Asian economies and China.

International Technology Transfer: Scope and Measurement

The literature available is often ambiguous about the scope of international technology transfer. It ranges from pure technology spillovers to arms-length technology licensing. This relates to Professor Arora's plea for a more broad-based approach to the conceptualization of technology. Strengthening IPR protection in developing countries is likely to have different impacts on the intensity of these different types of technology diffusion across national borders. For example, stronger IPR may raise the private return to technology licensing or FDI, but it may restrict the scope and magnitude of technology spillovers. Since these channels of technology diffusion generate different welfare implications for both sides of the technology transfer, it is important to understand empirically how IPR reform changes the relative intensity of technology diffusion through different channels.

Kim (2003) observed that in the Republic of Korea's early stage of economic development, Korean firms obtained simple, mature technology through "informal" channels, in part because such technology had become non-essential to the competitive strength of Western companies; on the other hand, more sophisticated, intermediate technology diffused to Korea largely through licensing, FDI and personnel flow. It is obviously a huge measurement challenge to properly account for these different kinds of technology diffusion. An imperfect solution is to employ a multitude of indicators of technology transfer in assessing the impact of IPR on international technology transfer: FDI spillover, technology licensing, patent citations, and personnel flow.

IPR Regime and Economic Development

One of the most interesting findings of the literature on IPR and economic development (Maskus (2000) and Chen and Puttitanun (2005)) showed that there was a U-shaped relationship between the strength of a country's IPR regime and the country's *per capita* GDP using a cross-section sample of countries. If one is willing to give the result a temporal interpretation, it suggests that a country's IPR regime is not independent of its level of economic development.

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As countries develop, their IPR regime will weaken before it is strengthened. Thus, cross-country differences in IPR regime, which many studies in the literature exploit as an exogenous source of variation to identify the impact of IPRs on international technology transfer, require more careful interpretation. Changes in IPR regime may also be driven by other extraneous forces. Since the Agreement on Trade-Related Aspects on Intellectual Property Rights (the TRIPS Agreement) placed IPR protection front and center in trade liberalization negotiations, reform of a developing country's IPR regime and its expanded engagement with the global economy are likely to be driven by the same pressures from developed countries to strengthen IPR protection.

IPR, Market Power, Competition and Technology Transfer

The theoretical literature on the impact of IPRs on international trade differentiated the market power generation effect from the market expansion effect of IPRs (Helpman and Krugman, 1985). While stronger IPRs in the host country may lead to a broader range and larger volume of exports from countries that benefit from the more effective protection of IPR, the greater market power that the exporting firms acquired from their IPR may dampen their incentive to increase sales. Thus, *a priori*, it is unclear whether stronger IPR will lead to a higher rate of technology transfer since the return to the latter is correlated with trade. So, instead of transferring more technology to the developing market, multinational corporations may just charge a higher price for the same technology.

In order to restrain the static welfare loss from IPR, it is therefore, at least conceptually, in the interest of developing countries to review and strengthen their competition policy in conjunction with adopting a more rigorous IPR regime. This is an area that has been under-investigated.

Proponents of stronger IPR protection in developing countries often invoke, implicitly or explicitly, the dynamic efficiency hypothesis. It suggests that stronger IPR would lead to more resources committed to building up the indigenous R&D capability of the developing country firms while inducing a higher rate of technology transfer from developed countries to developing countries. The competence of conducting R&D that developing country firms acquire not only helps them to innovate but also to absorb technology diffusion from developed countries. In the end, they will be able to climb the technology ladder. The scant attention paid to this hypothesis in the theoretical and empirical economics literature is overshadowed by the enormously successful experiences of Japan and the newly industrialized Asian economies, where some version of the dynamic efficiency hypothesis may well have been behind their success with technical progress. It seems that illuminating industry case studies such as that of Mathews and Cho (2001) on the Asian semiconductor industry would be extremely informative to find out if and how IPR has played a role in such technological catch-up or leapfrogging.

The Chinese Experience

In the last part of my comments, I would like to briefly describe the Chinese experience with international technology transfer, which shows the peril of generalization of policy lessons. Technology transfer from developed country firms to China has accelerated in recent years despite the general perception of weak IPR protection in China. The semiconductor and the automobile industries are two notable examples (Hu and Jefferson (2008)). Both industries are highly integrated with the global industry value chain and have hosted large FDI inflows. The technological sophistication of these FDI flows has noticeably accelerated in recent years. China's experience demonstrates that IPR is but one of the concerns of transferors of technology. Market size, openness and competition also play important roles in changing the dynamics of international technology diffusion.

Many developed country firms are drawn to China because of its huge market potential. China's commitment to economic openness has reduced the barriers to enter the Chinese market for these firms. As *per capita* income rises in China and foreign and domestic firms aggressively compete for the potential of the market, the technological sophistication of the products sold in China increases, which induces foreign firms to transfer more sophisticated technology to the Chinese market despite concerns about the appropriability of such newly transferred technology. In examining the surge of foreign interest in Chinese patents, Hu (2007) found that the number of Chinese patents from foreign countries is highly correlated with that of another foreign country when the two countries engage in product market competition in China.

How IPR affects international technology transfer has become an increasingly pressing issue for developing countries given the mounting pressure that they face in bringing their IPR protection to the level of that in developed countries. The literature has produced interesting insights and policy implications but much remains to be done. An eclectic approach, both in terms of measurement and methodology, is likely to produce findings that would be useful in providing guidance for public policy.

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AN EMPIRICAL ANALYSIS OF THE ECONOMICS OF COPYRIGHT: HOW VALID ARE THE RESULTS OF STUDIES IN DEVELOPED COUNTRIES FOR DEVELOPING COUNTRIES?

RICHARD WATT*

1. INTRODUCTION

By most accounts, the exploitation of copyright forms a relatively large part of most developed and developing economies. A small but growing body of literature suggests that 5 per cent of GDP or more can be attributed to industries that are dependent (to a greater or lesser degree) upon copyright, and that this figure is increasing over time. (For an overview of this literature, and a discussion of the methodological issues involved, see the symposium papers in volume 1(1) of the Review of Economic Research on Copyright Issues, available at http://www.serci.org.) Clearly, if copyright can be properly managed and protected, the recent advances in digital technologies that allow for greater distribution opportunities for cultural products point to even more impressive figures in the future.[1]

The basic economic theory of copyright has been well understood for quite some time (see, for example, Landes and Posner (1989)). Generally, copyright is seen by economists as an attempt to achieve, simultaneously, a socially optimal production of, and a socially optimal consumption of, copyright material.[2] The idea is that copyright should balance at the margin the (assumed positive) effects on the incentives given to creators of copyright material against the (assumed negative) effects on the consumers of this material. It is normally hypothesized that the supply of copyright material should be increasing in copyright protection, while the demand for copyright material should be decreasing in copyright protection.[3] Thus, too much protection leads to an excess supply of copyright products (over-production and under-consumption), while too little leads to an excess demand for copyright products (under-production and over-consumption).

There has been a considerable amount of theoretical hypothesizing and general hand-waving regarding the exact amount of copyright protection that would be appropriate to equate supply and demand of copyright products. The outcome of this theoretical debate is rather confusing, mainly due to the fact that conflicting theories have been expounded, and defended, on apparently equally solid theoretical grounds. However, in general, it would be fair to conclude that it appears unlikely that either extreme (no protection at all, or total and absolute protection) is an optimal solution.

The heart of the problem can easily be seen to reside in the fact that, by its very nature, an optimal copyright law requires information that law-makers typically do not have, and may not even be able to approximate to any reasonable degree of accuracy. On the one hand, we require knowledge on the market demand curve for copyright products, and on the other, we require information on the private costs (both financial costs and opportunity costs) of creators of copyright products. Coming to grips with either of these concepts is an inherently empirical issue that has yet to be properly and fully addressed in the literature.[4]

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In lieu of the data necessary to directly calculate an optimal copyright law, it appears that the amount and nature of protection has largely been shaped by lobby group pressure. Since most of this pressure has come from the supply side,[5] often represented by lobby groups located in developed countries, the upshot has been constant increases in copyright duration, the most easily defined and understood dimension of protection.[6] This scenario leads directly to at least two interesting questions; how socially optimal are the current protection standards given by copyright law, and how robust is a given level of copyright protection as a socially acceptable standard to different countries? (Above all, is the protection standard that is appropriate in a developed country also appropriate for a developing one?)

In this paper I attempt to provide a synopsis of the empirical literature, in the field of economics, concerning copyright. The paper is not intended to be a full literature survey, but rather attempts to identify the main areas that have been studied, and to offer an overview of what the literature says by means of an analysis of representative publications. The principal objective is to attempt to provide guidance to economists interested in undertaking empirical research on the economics of copyright, particularly in developing countries and countries with economies in transition. I shall attempt to provide an identification of areas for further research and suitable methodological approaches that could be followed by economists, especially in developing countries and countries with economies in transition, to study the economics of copyright empirically.

To that end, the paper will address the following general topics: (1) papers dealing specifically with supply side effects (earnings from copyright royalties, the effect of copyright law on creativity, collective management of copyright); (2) papers dealing specifically with demand side effects (willingness to pay by consumers of copyright products, copyright infringement or piracy); (3) papers concerning emerging mechanisms for exercising rights over protected works. The paper concludes with a section that addresses directly the issue of copyright for developing countries.

1.1 The Scope and Nature of Copyright Products

Before beginning the paper proper, it is worthwhile to clearly set out the limits to the type of literature that it will consider. Here we are only interested in the realm of copyright, and not other types of intellectual property. This is an important restriction, as a huge amount of scholarly work bundles together issues related to copyright with those related to other IP regimes (patents, trademarks, trade secrets, etc.), under the general title of "intellectual property". The task at hand refers only to copyright, and so we shall not consider literature that is clearly more heavily slanted towards analysis of the other types of intellectual property, most importantly patents.

To be clear, "copyright products" are those that embody works of authorship generally defined. Such works will include things like the written word (novels, prose, poetry, etc.), musical compositions, artwork (including architectural design), audiovisual works, and certain aspects of computer software. As can be readily seen, copyright has much to do with the cultural sector of an economy, where certain outputs related to cultural richness, entertainment, and artistic appreciation are produced and consumed. However, although there is a clear spillover, "the economics of copyright" is not synonymous with "cultural economics" by any means. Copyright products are only a part of cultural output (and vice-versa) – specifically, copyright products can be thought of as that part of cultural output that persists over time in an unchanged state, as fixed to some physical support that functions as a specific means of delivery, with the ability to be consumed time and time again, and (normally) to be easily reproduced. A CD containing a

recording of a concert performance is certainly a copyright product, but a concert *per se* is typically not.[7] Similarly, a book containing a story is a copyright product, but a public recital of that story is typically not.[8] This distinction is important for the present publication, since there has been a significant amount of empirical work on cultural markets (artists' labor markets, supply and demand functions for cultural outputs etc.), some (but not all) of which is pertinent to a study of copyright products.

However, aside from very few exceptions, the demarcation between those aspects of cultural markets that should be earmarked as copyright-relevant and those that are not, is very rarely provided. Thus, we will be forced to include several studies within the present document, sourced from the field of cultural economics more generally defined, that may have only a cursory link to copyright as such. The alternative, which would be to only review the literature that locates entirely within the narrow bounds of the economics of copyright, would cut the number of relevant papers included significantly, but would also be guilty of ignoring a large body of work that is without doubt at least partially relevant (and where the degree of partiality is almost impossible to estimate with any reliability in general). Thus, here I have elected to include many studies from the realm of cultural economics, and I hope that my choice corresponds to those for which the relevance to copyright is the strongest. To ensure that I am not misunderstood on this issue, I will remind the reader from time to time when a particular paper that is being discussed might be classified as only partially relevant to copyright, for the reasons that I have just set out.

Copyright goods provide for a large amount of consumer utility, and as such are an important part of an economy, but they should (in almost all cases) not be confused with technological inputs to productive processes.[9] This is important, especially when we consider the case of economies in different stages of development. Economic growth and development is clearly associated with patented innovation, under which production processes are improved and modernized, but the link between growth and copyrighted expression is less clear.[10] However, the copyright industry is booming worldwide – huge media conglomerates provide employment for a great many individuals, and provide significant welfare improvements to the consuming public in general.[11] Again, going back to the data presented in the studies on the impact of the copyright industries alluded to above makes it clear that economic wellbeing and development are also linked to copyright products.

2. SUPPLY SIDE

As stated in the introduction, copyright law attempts to balance the welfare of the consuming public against the incentives provided for creators. Although copyright law does set out some provisions that are not financially motivated (for example, moral rights), there is a clear assumption that proper incentives are synonymous with proper financial remuneration,[12] and this is the assumption that we will retain in the current paper.

The standard economic theory on the supply side of copyright can be summed up briefly as follows. First, we assume that creative individuals (those who create copyright products and who are *de facto* the copyright holders) have a profit motive,[13] and thus are motivated to some degree by financial gain, in the sense that if they are offered higher pay for creating they will respond by exerting more effort in creating. Second, we assume that along with a greater level of copyright protection the copyright holder achieves a greater level of monopoly power in the market in which access to the copyright is traded. Along with that greater monopoly power comes a greater ability to extract willingness to pay from consumers, that is, the copyright holder achieves a higher level of profits. Thus, increased copyright protection leads to higher finan-

cial gain, and so under the first assumption, creative individuals respond by creating more (and better) copyright products. In short, following the argument through, we see that it purports to show that an increase in copyright protection will, in the end, lead to a greater supply of copyright products. Note that this is a dynamic argument – greater protection now leads to more creation into the future (in, of course, the expectation that the greater protection will still be present in the future).

In keeping with economists' general love of pointing out counter-intuitive results, the theoretical literature has identified several ways in which a strengthening of copyright law may have perverse effects upon the remuneration of authors. This literature was initiated in earnest during the 1980s,[14] with perhaps one of the best-known papers in the field of the economics of copyright, Liebowitz (1985). In this famous paper, Liebowitz pointed out that, if the sellers of copyright goods can distinguish users prone to copying from others, then a simple theory of price discrimination can allow them to "indirectly appropriate" the willingness to pay from consumers of copied units of the good without actually selling to them, thus turning copying in their favor. In such a scenario, a stronger copyright law could be damaging to the financial payoff to copyright holders. Liebowitz provided a small empirical study of library journal subscriptions to support his theoretical result.

Following on from the Liebowitz paper, a series of other papers followed that point out other ways in which copying can be favorable to copyright holders. For example, Takeyama (1994) used the possible existence of network effects to achieve this result. In an unpublished paper, Harbargh and Khemka (2001) showed that if a stronger copyright law does indeed imply more original creation, then there will also be more to copy, and so more copying may actually result. In this case it is unclear if stronger copyright protection does indeed favor the ability to price monopolistically.

There are even reasonable theoretical grounds for doubting the generally accepted idea that stronger copyright protection[15] implies a greater level of creativity. For example, Watt and Towse (2006) argued that if an increase in copyright protection implied a greater level of earnings on previously created works, then a standard income effect will imply that more leisure is sought, leading to less time spent in creative activity. This effect would have to be weighed against the substitution effect that occurs when a higher per-unit-time payoff for current creative activities is considered. The upshot of such a tradeoff would likely be that younger (less published) artists would likely spend more time creating while older (more published) artists would spend less time creating, when copyright law is strengthened.

While these types of argument are compelling theoretically, they should not be taken as being more than theoretical curiosities until they can be backed-up by some stringent and serious empirical evidence. I know of no papers that provide such evidence, but of course I would certainly welcome any efforts to advance on such an endeavor. Not withstanding a lack of convincing empirical evidence in support of such theses as indirect appropriability and network effects, what economists have certainly looked at empirically is the effect of changes in copyright law upon the earnings ability of authors from copyright royalties, and on the production (actually, the publication or registration) of copyright products. It is to these two topics that we now turn our attention.

2.1 Earnings From Copyright Royalties

Certainly the particular area of study, under the general topic of the empirics of the supply side of copyright markets, that has received most attention by economists is the ability of authors to earn money from copyright royalties. This aspect of copyright can be thought of in terms of both the demand side and the supply side. It is a demand issue since earnings are exactly equivalent to the revenue that is generated from the demand curve. However, most of the literature has looked at this from the slant of authorship and the decision to supply copyright and other cultural products. The overriding emphasis is to see how much of an author's total income is generated from copyright products, in an effort to then look into the purely supply issue of how creativity itself is affected. In a nutshell, the idea is to look first at how much income is earned from copyright royalties, and then to see if this income does actually provide sufficient incentives for creation and authorship to take place. The literature in general concludes that only a minority of authors actually receive a significant proportion of their total income from copyright royalties, thereby placing a shadow of doubt over the existence of a strong relationship between earnings and creative activity.

Of course, if we were not to restrict our attention to authors, but rather to look at income generated from copyright royalties more generally, we would quite possibly have a very different story. Indeed, as is clearly documented in the very informative writing of Bettig (1996), copyright law has provided the foundation for many of the great business fortunes, and has been used rather effectively to promote economic power and wealth. The benefactors of copyright are not, however, normally the creators of the copyright products, but rather they are the corporations (and principal executive officers of the corporations) that produce and distribute copyright products, most notably the entertainment industry. In any case, in the present study, we will abstract from corporate use (and misuse) of copyright to generate wealth, and instead look at the earnings abilities of individual authors and creators.

It is also worthwhile mentioning that copyright as an incentive mechanism has almost surely had a major impact upon the development of creative and cultural industrial sectors in most countries. This impact is certainly alluded to (but is not actually measured) by the studies that have estimated the macro-economic importance of the copyright industries, which were mentioned in the opening sentences of this paper. Outside of these "impact" studies, to the best of my knowledge there has been no real empirical work done on analyzing the links between copyright as a legal mechanism and the parameters of copyright more particularly, and the development of the industries that disseminate copyright products. This is not, however, an oversight by economists, but rather more likely an indication that any such study is at the very least daunting, and possibly even impossible to carry out in any reasonably convincing fashion.

As we have already mentioned in the introduction, earnings by artists in general do not do true justice to the idea of earnings from copyright royalties, as artists typically get their incomes from a variety of sources. Even if an artist does not earn money in non-artistic activities, royalties from copyright-protected products might not be a particularly important source of income. For example, in a major study of the music industry, Connolly and Krueger (2005) found that concerts provide a larger source of income for performers than record sales or publishing royalties. Of the top 35 income earners, only four made more money from recordings than from concerts, and some of that money was in the form of advances on new albums rather than royalties from past recordings. Overall, for the top 35 earners, income from touring exceeded income from record sales by a ratio of 7.5 to 1.[16] Of course, some of the income that is generated by activities other than recording royalties may still be attributable to the existence of an exclusive right over the work that is performed. In that way, copyright is still something that could be considered important for touring and concert income by singers. However it is likely impossible to sep-

arate the part of concert income that is due to copyright from the part that is not. We are, then, reduced to hypothesizing that copyright *per se* is more important for recording royalty income and less important for concert income, although its relative importance to each activity is unknown.

In a very early paper dealing with the earnings of creative individuals, Filer (1986) tested the often assumed idea that artists are, generally, underpaid relative to non-artistic income earners.[17] Here, the reader is forewarned of what was discussed above in section 1.1 – the Filer paper is concerned with artists' earnings, from all sources, only one of which might be copyright royalties.[18] Filer used data from the 1980 census in the US, and finds that in fact artists do not appear to earn less than other workers of similar training and personal characteristics. Thus, the conventional wisdom on the earnings of artists is found not to be true, although a caveat is in order – the data used by Filer does not distinguish between earnings from arts and non-arts sources. Artists are also found to be on average younger than workers in other professions, and (again, contrary to common perceptions) their employment patterns are more stable (i.e. in any given period, fewer workers leave artistic professions than non-artistic jobs). The variance of artists' earnings is found to be greater than in other professions (again, on average), although no strong evidence was found to support the hypothesis that artists earn less than they might expect to receive in other jobs.[19] Following on from Filer's work, McNertney and Waits (1988) reviewed the literature to date and considered that at best the data is ambiguous and researchers are divided over the issue of whether or not artists earn less than comparative non-artists.

Contrary to the findings of Filer (1986) and McNertney and Waits (1988), in a more complete review of the literature up to the early 1990s, and using data that does separate earnings from arts and non-arts sources, Wassall and Alper (1992) concluded that: "The popular conception of the struggling artist working at other jobs to make ends meet has some basis in fact". Indeed, close scrutiny of the studies on earnings of artists led Wassal and Alper to assert that "… artists' mean income is less than those of workers with comparable educational attainment". These results appear to be confirmed by studies on artistic labor markets in Australia carried out by Throsby (1997) and in Wales by Towse (1992), who estimated earnings functions of artists. In particular, the Welsh study revealed that artists' earnings increase in the amount of time spent on artistic work, with an elasticity of around 0.5.

In an important work on the general topic of artists' labor markets and their earnings from copyright, Towse (1999) has proven to be a cornerstone piece in the literature. The book covers a great many particular topics that are of direct interest to the supply side of the copyright products market, and offers many valuable insights for cultural and copyright policy in the informational age. Towse (p. 58) argues that artists' labor markets are characterized by several aspects, including (1) multiple employment, some of which is outside the arts to earn a living; (2) a reservation wage below which artists would not supply labor to the arts; (3) a willingness to take considerable risks in relation to their income (perhaps due to artists over-estimating their probabilities of success prior to entering the artistic labor market).

The empirical work presented in Towse (1999) on the earnings of artists relates to the UK, and is largely the result of surveys of artists during the latter part of the 1980s and the early part of the 1990s. The data shows that artists earn, on average, less than other workers of comparable characteristics in the UK, although of course there are cases of individuals doing significantly better than non-artistic counterparts. The data suggests that artists' earnings are very skewed, implying that averages may not be representative.[20] Income from artistic sources is also revealed to be particularly risky, suffering fluctuations from year to year.

More recently, a very large study of the earnings of authors from both copyright and non-copyright sources in Germany and the UK, Kretschmer and Hardwick (2007) looked at the particular case of writers. They concluded, after a monumental data analysis, that copyright royalties have not managed to produce an appropriate reward for writers. Specifically, they state that: "The rewards to best-selling writers are indeed high but as a profession, writing has remained resolutely unprosperous". Among the most salient findings of the survey information gathered by Kretschmer and Hardwick, it turns out that:

- Writing is the main source of income for less than half of the 25,000 authors[21] surveyed.
- Typical earnings of professional writers are less than half of the national median wage in Germany, and one-third below the national median wage in the UK.
- 60 per cent of professional writers hold a second job of some kind.

The analysis by Kretschmer and Hardwick also confirms the skewedness and riskiness, of earnings from copyright royalties. Specifically, Kretschmer and Hardwick calculated Gini coefficients for the distribution of earnings over authors, allowing them to compare the shape of these distributions to those of the national income distributions. In the UK, the Gini coefficient for authors is 0.63, compared with the national Gini coefficient of 0.33, while in Germany the authors' Gini coefficient is 0.52 compared with the national coefficient of 0.31. The significantly higher values of the coefficients for copyright earnings imply a far greater distortion of the distributions.[22]

It is also interesting to note that the Kretschmer and Hardwick data reveal that payment to authors from collecting societies is more skewed even than the general distributions of earnings of authors. Specifically, in the UK the Gini coefficient for payments from ALCS (the UK collecting society) is 0.78, while in Germany the coefficient for payments from VG Wort (the German collecting society) is 0.67. This, of course, reflects the fact that collecting society payments represent actual use, and suggests that copyright collecting societies exacerbate the income risk of their members.

Other results from the Kretschmer and Hardwick study that are worthy of mention are the following:

- Writers who bargain with publishers earn significantly more than those who do not.
- Female writers earn considerably less than male writers.
- The increased exploitation and use of copyright works via the Internet has not resulted in higher earnings for authors.

The findings that artists rely mainly upon non-artistic sources of income, and that the earnings of artists are very skewed seem to be quite robust across countries and across the different types of artists (writers, singers, performers, entertainers, etc.). For example, Matsumoto (2002) reported data from Japan that further confirms these characteristics in that country. However, interestingly, Matsumoto also provided certain details of earnings that are generated specifically from rental and secondary use of pre-recorded music formats (mainly CDs). Again, skewedness arises, but it is less marked than for the general income distribution, implying that those artists who do record and distribute their work on fixed supports are generally able to earn a more stable income stream from those recordings. Matsumoto also provided details of the use of CD music according to the year of publication, which is a direct test of how copyright is or is not providing remuneration for authors and performers over time. For rental purposes, almost all the CDs are used within a year of publication, but for radio broadcasting on AM only about a third of the use is music that is less than a year old, while the largest percentage share of AM radio use is for music recorded more than nine years ago. FM radio broad-

casting is different, with the most use being made of recent music, although the decline in use as the music gets older is very gradual. Finally, the use made by television broadcasting is also interesting, with music recorded between one and two years earlier being about five times as important as more recent output. Television also makes significant use of older music, again with a gradual decline as the music ages.

Similarly, Hansen *et al* (2003) presented the results of a thorough investigation of the situation of composers, lyric writers and arrangers of music in Finland. Again, the study showed that most Finnish music creators do not manage to earn their living from only creating music, but they rely heavily on other income sources (often related to music creation, like teaching music, writing about music and grants). Copyright remunerations are an important source of income only for a minority of music creators, with the exception of performance remunerations. Perhaps the most interesting feature of the Finnish study is that the source for the data was the National Board of Taxation, and so we can be sure that the data is reliable.

Finally, it is worthwhile to conclude this section with a mention of at least one study relating to a developing country economy. Domon and Nakamura (2007) looked at the particular case of Vietnam. The main focus of the paper was on the effects of copyright piracy and enforcement, but along the way they also provided a snippet of information on the earnings of singers in Vietnam. It turns out that pirated CDs play a major role in promoting singers, and so they are not eager to support copyright enforcement. Earnings from copyright royalties are insignificant compared to earnings from concerts and other live performances. Specifically, Domon and Nakamura found survey evidence that indicated that there are three tiers of singers in Vietnam; the top tier (containing about 20 singers) can earn about 2,000 US dollars per hour of live performing, the second tier (about 100 individuals) can earn about 1,200 US dollars per hour of live performing, and the third tier (containing "a considerable number of singers") can earn about 800 US dollars per hour. However, not only do the hourly equivalent rates drop over the tiers, but also the ability of the artists to command air-time also drops, so that while the top-tier singers can expect half-hour performances, the third-tier singers can only expect to get 15 minutes per performance. Clearly, it is also the case that the top-tier performers are also the most pirated, and so this analysis points to the (somewhat perverse) result that greater levels of piracy of a given artist lead to greater levels of earnings in live performances. Thus, copyright protection in this scenario did not provide a reward, but rather quite the opposite. Of course, no attention at all is given to the calculation of the royalty income losses of the artists due to piracy, and thus we still cannot conclude that artists in Vietnam are better off than if the copyright in their recordings could be appropriately protected.

In short, by almost all accounts, artists earn very little from the direct exercise of copyright through royalty income. There are several reasons for this, among which we could certainly list piracy of different types, but also surely we should consider the possibility that the majority of artists earn very little from copyright simply because there is very little demand for their work. After all, copyright provides a reward that is based on the social value of the creation, which is reflected in the demand for that creation. When there is little or no demand, there can also be little or no reward.

2.2 Effect of Copyright Law on Creativity

In the previous sub-section, we have considered the earnings of authors from copyright. However, higher earnings do not necessarily translate into more creativity. It is also necessary to look at the elasticity of supply of copyright products if we are to properly analyze the empirics of copyright. In a nutshell, if copyright law is indeed to work properly as a mechanism under

which the interests of the consuming public and the interests of creators are balanced, then it is important that a strengthening of the protection standard given under copyright law does indeed yield more creative activity (not just more earnings for creators). This is quite simply because when the protection standard is strengthened, it is usual to assume that consumers of copyright products are made worse off, normally through the higher prices and correspondingly lower consumption that would accompany the greater monopoly power afforded to copyright holders, but also (in the case of longer copyright duration) through a longer wait until copyrighted work falls into the public domain. Thus, a strengthening of the protection standard only makes sense if indeed it stimulates more creative activity, hopefully because it provides creators with a stronger financial motive for creating.[23]

The empirical relationship between changes in copyright law and the level of creativity is difficult to test, because "creativity" has no simple and obvious way of being measured. However, using certain proxies for creativity, economists have analyzed the relationship. Also, some authors have attempted to justify alterations in a copyright's duration by considering the current economic value of works whose copyright is about to expire. This is often done by looking at the percentage of such titles that are still in demand, as measured perhaps by being in print (books), by being demanded for current public broadcast (e.g. movie screenings on television), or for the purposes of publishing new versions (perhaps of old films or of old songs). The idea is that if it is true that there is no commercial value in a given work long before its copyright expires, then clearly there is no value in increasing the copyright duration on those works.

A good example of a paper that considered the current value of old works is Rappaport (1998), who looked at the current commercial value of copyright products that were first published over the period 1922 to 1941 (works whose copyright was soon to expire). Rappaport studied books, music and movies. As far as books were concerned, the annual royalty value of books originally published in 1922 to 1926 was still an astounding 46 million US dollars in 1998, while the figure was 74 million US dollars for books published between 1937 and 1941. For music (the focus here is on songs – lyrics and musical scores rather than performance rights, since the early recordings are of such low quality that they have little current value), the finding is that just over 11 per cent of the sample was still available in 1995. The 1998 annual royalties for music originally written in 1922-26 was 3.4 million US dollars, and for music from 1938-41, the 1998 annual royalties totaled 15.2 million US dollars. Finally, Rappaport also studied movies. He found, unsurprisingly, that the survival rates of movies diminished with time, so that the more recent ones were also the most likely to still be shown commercially. Only 11 per cent of movies that were first screened in 1926 to 1928 still had current commercial use in 1998, while that figure increased to 40 per cent for movies first released from 1929 to 1932, and to 65 per cent for movies first released between 1933 and 1941. Similarly, more recent movies have greater commercial value; those of the period 1926-28 had an average commercial value of 175,000 US dollars, those of 1929-32 had an average value of 250,000 US dollars and those of 1933-41 were valued commercially on average at 400,000 US dollars. At first glance, these results look surprising in that both the percentage and value of old films remains generally high,[24] clearly indicating that long copyright protection duration is justified.

Contrary to the findings of Rappaport that would tend to favor a long copyright duration, Landes and Posner (2003) looked at the time series of renewals of registrations with the US Copyright Office over the period 1910-91.[25] They found that while renewals were generally increasing (a low of only 3 per cent in 1914 to a high of 22 per cent in 1991) along with some lengthening of copyright duration,[26] about 80 per cent of titles (including books, music and graphic arts) had very little or no economic value after the initial term of copyright. Another figure calculated by Landes and Posner is that the elasticity of renewals with respect to the fee was about -0.2, implying that renewals are reasonably price sensitive. Considering that the fee is

low, this indicates that the authors saw very low future earnings from their copyright. It is interesting to compare the results of Landes and Posner with those of Liebowitz and Margolis (2005), who found that of a sample of 236 book titles from the 1920s, 41 per cent were still in print some 58 years later. Disaggregating the data, the survival probability of best sellers from the 1920s is, logically, significantly greater than that of non-best sellers.

Notwithstanding these studies, the main methodology of economists regarding the optimal structure of copyright law is to look for a moment of significant change in the law, and around that date to consider what happened in the copyright market. Above all, entirely due to data availability, it has generally been the case that economists have considered how changes in copyright law have affected the supply of copyright products, and from there they have argued whether or not the change was beneficial. The basic idea is quite simple – it is assumed that an increase in copyright protection is not beneficial to the demand side, and so it can only be socially beneficial if it transpires that with stronger copyright protection, the supply of copyright products increases. If the supply of copyright products were not to increase, or were to increase by a very small amount, then we have significant evidence that the particular change in protection that had occurred was not socially beneficial.[27]

Probably one of the most important alterations in copyright law in the last 50 years or so was the Copyright Term Extension Act (CTEA) in the US,[28] which (retroactively) extended copyright duration from life plus 50 years to life plus 70 years. This legislation led to a renewed interest by economists in arguing whether or not the new copyright term was justified. Specifically, at the 2002 US Supreme Court case of Eldred *et al* vs. John D. Ashcroft (normally known as the "Eldred" case), an *amici curiae* brief was submitted by a group of 17 very distinguished economists (including five Nobel laureates) that argued strongly against the copyright term extension (see Akerlof *et al* (2002)). Using simple but illustrative calculations of present expected value, the brief concludes that: "The CTEA's longer copyright for new works provides at most a very small additional incentive". However, in their reply to this work, Liebowitz and Margolis (2005) noted that while the financial incentive may be small, the effect on the creation of copyright products would depend not on this alone, but also on the elasticity of supply with respect to financial reward. Thus, possibly, a small financial reward is sufficient to provide an incentive for a reasonable scale of new creation.[29]

For the case of the production of movies, Png and Wang (2006) looked at how extensions of copyright duration affected the output of new movies in a sample of 18 different countries. Again, the principle change in duration that was considered by Png and Wang was the extension of protection to life[30] plus 70 years (applied retroactively) .[31] The results of the study indicated that the term extension generally led to an increase in production of movies (an increase of between about 2 per cent and about 13 per cent, but with a significant variation).

In earlier work on the same topic, Hui and Png (2002) looked again at the impact of economic incentives upon the international supply of big-screen movies in the US using the 1998 increase in the term of copyright protection as the change in the copyright standard.

The analysis of Hui and Png suggests that the CTEA did not stimulate the production of movies, and thus was "a giveaway to owners of existing creative work". On the other hand, Hui and Png also provide us with one of the only (as far as I know) estimations of the supply curve of a copyright product, albeit using a very rudimentary model (a linear model of supply, where the only explanatory variable is the price). They found that the supply of movies is elastic in price, that is, more is supplied at a higher price. This is interpreted as being support for the hypothesis that the supply of creative work does respond to economic incentives. Nevertheless, what would, of course, be of at least as much interest is how the supply of copyright products responds to the wealth or income of creators.

In a (currently) unpublished work, Baker and Cunningham (2007) used quarterly data on aggregate copyright applications from the US and Canada to estimate the effects of both changes in copyright law and the outcomes of major court cases. The paper finds that applications for copyright are affected positively by court decisions that broaden copyright protection. This effect is described as "small but significant". Specifically, for each court case that broadens copyright protection, we can expect the flow of copyright applications to increase by 0.4 per cent. Copyright applications are also decreased by increases in the application fee; they move counter-cyclically; they have a strong seasonal component; they may increase with the diffusion of computing technology. All of these are very reasonable and expected results, confirming to a certain extent the logical nature of the supply side of the market for copyright goods.[32] The Baker and Cunningham paper is interesting because it specifically concentrates on changes that involve the scope rather than the duration of copyright law.

Very recently, Pollock (2007) estimated that a socially optimal copyright duration is about 15 years, when any increases are applied retroactively (as has always been the case). To arrive at this figure, Pollock trades off the social value of new works that a term extension would generate against the negative value of existing works that will fall into the public domain later. However, Pollock's estimate is based on "plausible" estimates and assumptions of several variables and functions (the discount rate of creators of copyright products, the rate of cultural decay, the social deadweight loss function). Some of these estimates are calculated from past empirical work, but others are simply based on personal judgment. Nevertheless, Pollock's analysis is simple, and provides a methodology that could be quite valuable, if the true empirical values of the required data can be found.

In a related paper, Liebowitz (2007a) looked at the pricing of books that were still in print but had, due to passage of time, lost their copyright protection, and the prices of books that remained copyright protected. Controlling for the page size of books, as well as for other physical aspects (type of paper, type of binding, etc.) and eliminating some clearly outlying book sellers, Liebowitz found that the only clear difference between the two prices could be attributed to royalty payments to authors. Thus there appears to be very little deadweight loss involved in copyright protection, and whatever such losses that do exist are justified as rewards to authors. Liebowitz's paper points to copyright deserving a lengthy duration, since it does not involve excessive and unnecessary social distortions.

2.3 Collective Management

Certainly one of the most important aspects of the empirics of the supply side of copyright is the fact that for many types of use of copyright products, it is beneficial for copyright holders to join together into collective management societies. It is most often argued that collective management of copyright is an efficiency response to transaction costs, although it has also been suggested that copyright societies can provide significant risk-bearing benefits to members.[33] Perhaps the first empirical analysis of the functioning of copyright societies was Besen and Kirby (1989), who provided an in-depth description of how these organisms work in the US, also touching on aspects relating to treaties between societies in different countries.[34] However, unfortunately there appears to be a general lack of empirical work relating to the economics of copyright collectives.

The most important exception to the lack of empirical work on collectives is certainly Rochelandet (2003), who uses data envelopment analysis to compare the efficiency of collectives over different European countries. Rochelandet considers three aspects of the collective management of copyrights: (1) which organizations are characterized by the best performance?

(2) What relationship can be found between ownership structure, legal control and performance of collectives? (3) What legal system would be most conducive to better results for collecting societies? Since there are different ownership and control structures in place for different collectives throughout Europe, Rochelandet is able to compare the performance of each collective (in efficiency terms) to conclude which structure appears to be the most suitable. The analysis is based on data corresponding to the period 1991 to 1998.

The data envelopment analysis of copyright collectives reported by Rochelandet points to several interesting results. First and foremost of the European collectives and in general the most efficient appears to be GEMA in Germany. GEMA is also a society that functions under quite restrictive legal control. However, the data also shows that other collectives functioning with less restrictive environments (e.g. PRS in the UK) are more efficient than other more restricted ones (e.g. SACEM in France), and so it is hypothesized that no general correlation can be drawn between the intensity of legal supervision and the results of a copyright collecting society. Notwithstanding that, it does appear that "intermediary levels of supervision are imperfect and a source of inefficiencies". Nevertheless, while the results of Rochelandet's work are interesting and certainly a first step in a most promising line of research, it is difficult to ascertain any clear causality from legal control to efficiency results for such a small data set. Furthermore, the analysis is based upon a model that excludes many reasonable factors that could influence the behavior of copyright collectives, and thus a mis-specification bias could also be present.

Before ending this discussion on the empirics of copyright collecting societies, it is worthwhile reiterating that Towse (1999) and Kretschmer and Hardwick (2007), both mentioned above, do present some data referring primarily to earnings and distribution of earnings of authors from such societies. Towse (1999), for example, provided data on the state of performers rights earnings from collectives in the UK. The major share of the income of Phonographics Performance Limited (PPL, the collective that deals with licensing the performing and broadcasting right of record companies who own the copyright in sound recordings) goes back to the record companies, and the rest (just under half) of their income is dedicated to administration, combating piracy, paying session players and paying named performers. However, the limitation of this data for the purpose of understanding author remuneration from copyright lies in the fact that it only includes the amounts distributed by the collecting societies, and not income from all sources.

Finally, it is worthwhile recalling that the survey data of Kretschmer and Hardwick (2007) mentioned above, as referred to copyright collectives, indicated that collectives may be responsible for an increase in the riskiness of earnings of authors, since it corresponds to an even more distorted distribution of income than the overall distribution of income of authors, at least for the case of professional writers.[35] This result, while interesting, should not be surprising, and has in fact been alluded to theoretically. For example, Snow and Watt (2003) showed that because collectives base payments to their members on actual use rather than sharing among all members the risk that each individual member's uncertain income stream implies, the income stream that members receive from copyright collectives is more uncertain than need be.

3. DEMAND SIDE

Copyright law, being a social instrument, should not weigh the interests of either the supply side or the demand side above each other. Thus, not only should the amount of protection afforded under copyright be sufficiently strong so as to provide an incentive for authors, it should also be sufficiently lenient so as to ensure that consumers of copyright goods are not severely disadvantaged by excessively high prices.

While it has by no means been ignored, the demand side of the copyright equation appears to have been the subject of surprisingly few empirical studies. This is quite remarkable, given the interest that economists have for the demand conditions in countless other markets.[36] However, it would appear that, in the absence of strong empirical evidence on such things as the elasticities of demand[37] for copyright products, and of course in the absence of strong lobby organizations that represent the interests of the demand side, recent duration extensions to copyright protection have been largely the result of pressure from the supply side alone. Above all, most of the empirical work that we have concerning the demand for copyright products is, unfortunately, rather dated, and often refers to formats that are no longer in use (e.g. vinyl LPs and analog tapes).

We now go on to briefly mention these older studies, before we then consider two other areas of concern for the demand side of the market for copyright products, for which we do have more recent data and perhaps a better overall understanding. First, there is the issue of the willingness of consumers of copyright products to pay, and second there is the issue of the effect of piracy on legitimate demand.

3.1 Estimates of the Demand Function for Copyright Products

Perhaps the very first serious attempt to model the demand for pre-recorded music was Belinfante and Davis (1979). In their paper, they estimated the sales of record albums using Billboard's Top LP charts during 1977 in the US. They used a variety of independent variables, including proxies for music taste, artist status and exposure. They also, of course, included the price of the albums as an independent variable. Somewhat surprisingly, it was found that the sales of record albums are largely independent of price. The regression estimate coefficient on price revealed an elasticity of -0.52, but it turns out that the coefficient is, statistically, not significantly different from 0, implying that, as a number, it is unreliable. Indeed, as a rough comparison, Belinfante and Davis reported that when there was an across-the-board price increase of one dollar (from 5.98 US dollars to 6.98 US dollars) per album representing a 16.7 per cent price increase, the estimated loss in sales was 14 per cent. This corresponds to an implied elasticity of about -0.84, rather higher than that which was obtained in the demand estimation. In any case, perhaps the most significant aspects from the Belinfante and Davis paper are: (1) since records appear to be price insensitive, it would be optimal for record companies to increase (perhaps markedly) the retail price of records; (2) the effect of income upon record sales was totally ignored in the estimation. This is unfortunate, as logic would tell us that income is likely to be a significant determinant for what is after all a type of luxury consumption item, and it also implies that the demand equation estimated by Belinfante and Davis is likely to be mis-specified, leading to erroneous conclusions with regard to the other elasticities.

Following on from Belinfante and Davis, the paper by Burke (1994) also estimated the demand for pre-recorded music from a data set corresponding to 1975-88 in the UK. In this study, Burke found that indeed, as hypothesized above, the demand for pre-recorded music (on the vinyl format) is income elastic (i.e. vinyl recordings are a normal good, both for permanent and current income), and in contrast to the finding of Belinfante and Davis, Burke's results pointed to LPs having a price elasticity of around -1. However, also not surprisingly, one of the most salient features of the demand function estimated by Burke is the seasonal aspect – the demand for pre-recorded music spikes around Christmas time. Burke was also able to trace the effects on the demand for vinyl LPs of two close substitutes, cassette tapes and (for the latter part of the sample) CDs.

The introduction of CDs, although at a price about 40 per cent higher than the other two formats, eroded the demand for both vinyl LPs and cassettes to the point of their almost total demise. While CDs were in their infancy or non-existent, the price elasticity of demand for vinyl records was almost exactly -1, but over the period of the late 1980s during which CDs became the major pre-recorded music format, the own-price elasticity of demand for vinyl records dropped by 20 per cent to about -0.8.

Aside from these two now rather dated papers, I know of no other that attempts to model the demand for music on pre-recorded formats, outside of indirect results from the literature concerning copyright infringement (see below). However, there is a small quantity of literature dedicated to the study of the demand for printed books. Very recently Ringstad and Loyland (2006) modeled the demand for books in Norway. They found that the survey data that they gathered strongly supported the accepted hypothesis that books are both income and price elastic. These results confirm earlier published work by Hjorth-Anderson (2000) who found a price elasticity of -1.4 and an income elasticity of 1.8 for the Danish book market, and Bittlingmayer (1992) who found a price elasticity of between -2 and -3 in the German book market.

Aside from work directly related to the demand for copyright products, there have been considerable efforts to model the demand for other types of arts products. For example Cameron (1990) estimated the demand for cinema in the UK (pointing to a large negative price elasticity of about -1.5, and a large positive income elasticity of about +1.5), while Fernández-Blanco and Baños Pinto (1997) did the same for the case of Spain, also finding that cinema is a luxury good whose demand is elastic with respect to its price. Other papers also exist that study the demand for other art forms, e.g. orchestras (Lange and Luksetich (1984), who found an income elasticity of about 0.6), theater (Moore (1968), with an income elasticity of about 1, Bille Hansen with a price elasticity of -0.33), and performing arts as a whole (Throsby and Withers (1969), who found an income elasticity of 1.55 from 1949 to 1973, and 0.64 from 1929 to 1949). Finally, Schimmelphennig (1997) found that demand for tickets to the Royal Ballet is strongly elastic (price elasticity of between about -1.5 and -5-5, depending on the particular seating location. Indeed, Schimmelphennig calculated that "substantial margins for price cuts existed which would have increased both attendance and revenue", suggesting that the pricing of ballet performances is not optimal.

3.2 Willingness of Consumers to Pay for Copyright Products

Probably one of the most difficult problems for appropriate estimation of the willingness of consumers to pay is that almost all studies are based on survey data and contingent valuation methodologies. While certainly relevant, it is well known that answers to survey-type questions are not salient, and are almost certain to involve biases, the seriousness of which we can never know. A good example of such an effort is the paper by Papandrea (1999), which attempted to value the willingness of Australians to pay for the mandatory transmission of Australian programs by television stations. The results showed a mixed bag of responses, indicating that just over half (55 per cent) of the subjects had a positive willingness to pay to increase Australian television programming by 10 per cent. Of those who were willing to pay something, the value of their willingness to pay is distributed around 12 Australian dollars according to a normal bell-shaped distribution.[38]

However, there is at least one enlightening study that does overcome the saliency problem by attempting to measure willingness to pay by experimental methods, where subjects' decisions do impact upon their finances directly. The paper in question is Maffioletti and Ramello (2004), who ran auction markets for both legitimate and copied CDs.[39] Their experimental results clear-

ly indicate that there is a gap, in some instances a large gap, between the willingness of music consumers to pay and the retail price of a pre-recorded music CD. Indeed, the mean willingness to pay is only marginally greater than about half the retail price. It is reported that only "a small number of participants" actually had a willingness to pay that was close to the retail price, and so almost no participant would have purchased a legitimate CD. Naturally, however, the willingness to pay of almost every participant exceeds the marginal cost of production of a CD of pre-recorded music, and so the analysis of Maffioletti and Ramello points in the direction of a conclusion to the effect that perhaps the retail price-setting policies of companies selling musical CDs should be reviewed. In my opinion, the use of experimental methods to attempt to come to grips with proper estimations of both supply and demand of copyright products is extremely promising, although largely ignored thus far.

In very recent work, Audley and Boyer (2007) managed to calculate a kind of willingness-to-pay figure for the use of music by radio stations in Canada. Using a type of revealed preference argument, based on airtime given to different types of content (talk, music, advertising, etc.) Audley and Boyer estimated that the copyright royalty payments that are made in reality are significantly lower than what radio stations would, judging by their own behavior in content choice, be willing to pay. The authors argue that this methodology reveals a "competitive" price for music, since the revealed preference model is based on competitive assumptions. Specifically, Audley and Boyer found that radio stations would have been willing to pay about 265 million Canadian dollars for their music content, whereas in reality they were only charged about 44.6 million Canadian dollars, thereby arguing that creators of copyright products are underpaid relative to the true demand for their creations.

The methodology proposed by Audley and Boyer is novel in the extreme, and along the way a good deal of educated assumptions are required, but overall this is just the type of empirical analysis that is required if the pressing problem of properly tracking down the demand curve for copyright products is ever to be satisfactorily answered.

3.3 The Effect of Copyright Infringement on the Demand for Legitimate Copyright Products

It can frequently be observed that copyright holders argue that piracy is damaging to them, and often estimates of the economic value of the costs that piracy imposes upon them, and upon society in general, are presented. For example, concerning the industry for pre-recorded music, it is interesting to look at the data in the IFPI report on piracy (2003) with claims that infringement represents lost sales almost as great as the total legitimate trade itself.[40] However, the majority of these types of estimates are unrealistic, since they are based on incorrect assumptions of consumer behavior, as we shall see below. In spite of this, such estimates are widely believed and are openly presented as evidence in liability suits, and can even form the foundation for important changes in legal and political systems. It is of course not surprising that copyright holders will always lobby for legal and political change that favors them, and this often involves publicly citing inflated figures for the costs that piracy imposes upon them. This, in turn, implies that economists have had to take much of the publicly available data concerning the effects of infringement upon markets for copyright products with the proverbial grain of salt.

It is also interesting to note that econometric techniques, which are very frequently used to estimate the costs of piracy, allow for a significant degree of manipulation so that almost any required result can be found in a given data set. For example, in the US when the FCC cable television agreement was brought before the courts in 1972, the operators presented a report prepared by professional economists using econometric techniques that showed that the royal-

ty payments to copyright holders could not be any greater than 5 per cent of their annual income if bankruptcy was to be avoided. On the other hand, the copyright holders presented a second study, based on similar techniques (and presumably the same basic data) that showed that a royalty payment of 16 per cent of operating income would be fair and would not imply any serious probability of bankruptcy (see Bettig (1996), pp. 135-6).

Perhaps the greatest single misconception that is so frequently observed throughout the literature on the costs of copyright piracy is the idea that a pirated unit of a delivery good implies the loss of the sale of an original unit of the delivery good, and so the cost of copyright piracy can be reliably calculated by an estimate of the number of pirated copies that are circulated (see, for example, Hoffman (1990)). This basic assumption is incorrect for several reasons. It is true that copies are not always perfect substitutes for originals, and in fact in some cases they may not even be close substitutes. Hence the demand, and final sales, of both copies and originals may not be as interdependent as the literature makes out, resulting in the sales of one not affecting the sales of the other as directly as one might think.

However, even more obviously, there is the relationship between willingness to pay and the price at which pirate copies and originals are actually sold. Since pirated copies are produced without the additional royalty costs that originals must face, they are cheaper to produce and market, they may be of inferior quality and they are invariably sold more cheaply. The fact that a consumer purchases a pirate copy at a reduced price does not imply that he would have purchased an original at a higher price had the pirate copy not been available. It is perfectly feasible that the consumer would have simply gone without the good in question rather than purchasing an original.

There is a large and growing body of literature that attempts to estimate the effect of piracy on legitimate sales. This literature begins with an analysis of data from the 1980s, when the issue of online sharing and illegal downloading was non-existent. Of course the literature on the effects of copying on legitimate sales of copyright products was turned on its head with the development of the Internet, and online piracy in the form of downloading and file sharing appeared. The basic theory is still the same, but the parameters governing optimal consumption choices have been altered significantly – now copying takes virtually no time at all, a copy is practically identical to an original, and the probability of detection and prosecution is very low. Given the wide differences, it is probably useful to consider the two bodies of literature (pre- and post-Internet) separately.

3.3.1. Pre-Internet Studies of the Impact of Piracy on Sales

Very early on, Mannering (1994) estimated that, for the case of pre-recorded music, only 38 per cent of all pirated copies are in fact lost sales of originals. This estimate is very close to the 40 per cent that Warner Communications, Inc. (1982) presented for the same figure more than a decade earlier. Along the same lines, Besen (1987) cited research done by Alan Greenspan for the Recording Industry Association of America in which it is estimated that home taping of pre-recorded music represents losses to the industry of 32 per cent of total sales volume, and research done by G. Davis for the International Federation of Phonogram and Videogram Producers that estimated that 25 per cent of home taping of LP records represented lost sales of originals.

Note that there are actually two types of calculation here. Denote the total amount of pirate sales by P, and total legitimate sales by $S(P)$. That way, the (hypothetical) legitimate sales that would ensue had piracy not been feasible would be given by $S(0)$. It is assumed that $S(0)>S(P)$

for P>0, that is, piracy does indeed reduce legitimate sales. The percentage of pirate copies that represent lost sales of originals (Mannering, Warner Communications, Davis) is calculated as:

$$\frac{S(0)-S(P)}{P}$$

On the other hand, the percentage of legitimate sales lost to piracy (Greenspan) is:

$$\frac{S(0)-S(P)}{S(P)}$$

Assuming, as appears to be the case, that P<S(P), the former calculation should work out greater than the latter (if both are done with the same data).[41]

The case of piracy in the pre-recorded music industry was also considered by Widdows and McHugh (1984). The results of this paper indicated that it is not true that piracy has affected sales and profits in the industry nearly as much as had been claimed by the industry officials, and that other factors such as demographic change and the general state of the economy were much more likely to have been the cause of any recessions in sales than was piracy. In fact, contrary to the claims of the copyright holders, Widdows and McHugh estimated that up to 85 per cent of a downturn in sales in the late 1970s was due to factors other than piracy.

The economics profession of late has turned its attention more to the case of downloading and file sharing as new forms of piracy (see below), but there has been at least one recent influential study on the effect of piracy of pre-recorded music on legitimate trade – Hui and Png (2003). In their paper, Hui and Png looked at sales of music CDs and piracy thereof in 28 different countries during the period 1994-98. It was found that piracy did indeed reduce legitimate sales, and for the year 1998, it is estimated that unit losses amounted to 6.6 per cent of legitimate sales (a figure that should be compared with the 32 per cent estimated by Greenspan about 10 years previously).

Going back to the experimental paper of Maffioletti and Ramello (2004) mentioned above (section 3.2), we have already noted that almost all of the experimental subjects revealed willingness-to-pay figures that were significantly below the retail price of a pre-recorded music CD, and so would not have purchased at the retail price. However, almost all of the participants also revealed a willingness to pay for a pirated version of the same musical CD that was significantly greater than the marginal costs of supplying it. Thus, almost all of the subjects would have purchased a pirate copy, but very few (if any) of these sales would actually have displaced legitimate sales.[42]

Also, recently Bounie *et al* (2005) made an attempt to provide the separation of the substitution and complementary effects implied by piracy of music, using survey data from French university students. They found much interesting evidence relating to stated CD purchases, MP3 files, and the size of CD collections. Their statistical analysis shows that overall, the effect of using file sharing networks and MP3 files leads to an effect on sales of CDs of between -5.2 per cent and +9.7 per cent. The positive influence is due to the presence of "samplers", which is generally a smaller sub-group than the pure "pirates".

A second principal area of interest for economists with respect to the economic effects of copyright piracy has been the case of home taping of rented videos and movies from television emissions. The paper by Cronin and Wusterbarth (1986) made some estimates for the lost royalties of copyright holders due to this type of piracy, based on a survey of 1,620 North American

households. From their survey data, Cronin and Wusterbarth estimated that, in 1982 in the US 39 million home tapes of movies from commercial television broadcasts, 29 million copies of movies from pay television broadcasts, and about 7 million copies of rented or borrowed videos were made. Using these figures, the final estimates for the actual monetary amounts of lost royalties during 1982 are 2.7 million US dollars from tapes made from commercial TV, 1.9 million US dollars from tapes made from pay TV, and 1.1 million US dollars from tapes made from rented or borrowed videos.

Although they do not present such statistics, it is interesting to note that from the Cronin and Wusterbarth paper it is in fact possible to conclude that a massive 93.5 per cent of home taping of television broadcasts, and 74.3 per cent of home taping of rented or borrowed videos represent lost sales for the industry. On top of this, certainly home taping of movies also implies lower income at public movie theater box offices, and hence a second opportunity cost for copyright holders that is not taken into account in sales of home videos. When the Cronin and Wusterbarth figures for the effect of piracy on lost sales are compared with the 38 to 40 per cent reported previously for pre-recorded music, one must conclude that the home video and music industries show significant differences as to the substitutability between copies and originals. Of course, as is now extremely well documented, in spite of the adverse effects of movie copying using VHS and DVD technologies, the home movie industry has proven to be extremely profitable for the major producers and distributors of movies (see, for example, Liebowitz (2003)).

3.3.2. Post-Internet Studies of the Impact of Piracy on Sales

The literature on the effect of downloading on legitimate music sales was motivated, initially, by the Napster trial, in which the plaintiff commissioned a study (see Fine (2000)) to work out the effect of online file sharing on the sales of pre-recorded music on CDs. In the study, Fine looked at sales in record shops close to US universities, the assumption being that university students were responsible for most of the downloading. Sales of CDs both before and after the emergence of Napster were compared, and it was found that while nationwide sales grew by 6.6 per cent between the first quarter of 1999 (pre-Napster) and the first quarter of 2000 (post-Napster), the sub-sample of stores located near universities suffered a decrease in sales of 2.6 per cent. Although this might seem to be compelling evidence that file sharing causes a negative effect on physical CD sales, it transpired that very similar results were also found for the previous year, when Napster did not exist. Clearly, there is more to the file-sharing phenomenon than a cursory look at record sales can reveal.[43]

Using somewhat more sophisticated econometrics methodologies, most of the empirical work on the topic of file sharing on physical sales finds a negative impact. The exception to this rule appears to be, Oberholzer and Stumpf (2007) who used data obtained from a process of matching US record sales data to file-sharing data from a peer-to-peer network over a 17-week period during 2002 to estimate that the impact of downloads on album sales is indeed not distinguishable from 0. However, of all the studies to date, Oberholzer and Strumpf are the only authors to claim that there is no negative impact of file sharing on sales of sound recordings.[44]

A first set of papers uses countries or cities as the unit of analysis, comparing sales of sound recordings in different places over time, using a relevant proxy measure of file sharing over these regions. Liebowitz (2006) studied the change in the sales of CDs in 99 US cities, and looked at how these sales were impacted by file sharing as proxied by Internet access (among other variables). The data suggests that file sharing can explain the entire decrease in sales as well as a potential growth in sales that never occurred. Using data from 16 different countries over the period 1998-2002, Peitz and Waelbroeck (2004) found a 20 per cent decline in the sales of

music attributable to file sharing. Zentner (2005) used cross-country aggregate data from a large number of countries to show that without file sharing, overall sales in 2002 would have been about 8 per cent higher.

Another common method of evaluating the effects of file sharing on CD sales is by surveys. All of the papers that use survey data find that file sharing does harm record sales. Michel (2005) used data from the consumer expenditure survey in the US from 1998 to 2003, and found a negative impact to the order of 15 per cent. Zentner (2006) estimated that file sharing provoked a worldwide decline in sales of 15 per cent, and a decline in the US of closer to 30 per cent. Rob and Waldfogel (2006) based their analysis on data from a survey of college students. They found that each downloaded album reduced legitimate sales by at least 0.2 albums.

Aside from looking at the effect of Internet downloading on the demand for pre-recorded music sales, economists have also considered the related issue of Internet downloading on pre-recorded movie formats, above all, the DVD format. However, to date the studies involved have relied entirely on survey data, which as we have already noted, may lead to unmeasurable biases in the results. For example, Bounie *et al* (2006) used data gathered from a French university community (students and professors). It was found that approximately one-third of the subjects who declared having downloaded films from the Internet *al*so stated that this activity actually increased their demand for legitimate movie products,[45] above all, for rented and purchased movies. Indeed, the data indicated that internet downloading had no impact on movie theater attendance, but a strong impact on video rentals and purchases.[46]

3.3.3. Other Effects

As the literature surveyed in the previous sub-sections points out, a numerical estimate of the final effect of piracy upon legitimate sales is difficult to arrive at because piracy has both positive and negative effects on sales. The negative effect is obviously the most visible, and is normally the only effect alluded to by lobby groups. However, a positive effect, recently termed "creative destruction" (see Liebowitz (2006)) also exists. For example, Handke (2006) looked at the data on record companies during a period of severe recession (driven, most likely, by Internet file sharing) in the market for phonograms in Germany. In spite of the downturn in total sales, the data clearly showed that over the period in question (1982-2004, with greater emphasis on the last seven years of that period), there was a consistent and increasing growth rate of market entries by new record companies. Thus, one can conclude that while Internet piracy may well be detrimental to the interests of the "major" record labels, it provides a window of opportunity for new entrants, and so the scenario in the record industry may be described as one of re-organization rather than total recession.

4. EMERGING MECHANISMS FOR EXERCISING RIGHTS OVER PROTECTED WORKS

There are different mechanisms on which authors may rely in order to make their creations available to the public and/or obtain revenues from their protected works. Here we look briefly at four emerging mechanisms: digital rights management, open-source software, voluntary contributions and levies on blank supports and copy technologies. Not all of these topical areas have been rigorously analyzed in the setting of empirical economics, but all have received some attention from economists. They are worthwhile mentioning, even if only in the hope of generating interest in working on them empirically.

Aside from the protection and/or remuneration systems that we will look at here, the theoretical literature has also suggested a variety of other ways in which authors can appropriate earnings indirectly; for example from network effects and bundling, but (as far as I know) there have been no serious attempts to look at the empirical significance of these options. The interested reader could consult Liebowitz and Watt (2006) for a survey of these mechanisms, at least as far as compensating music creators is concerned.

4.1 Digital Rights Management

At the forefront of the emerging mechanisms is digital rights management (DRM), which basically takes advantage of the digital format in which many copyrighted products are stored, distributed and consumed, to introduce code that prohibits unauthorized usage, or at least makes unauthorized usage very costly. DRM is controversial,[47] since it may impinge upon certain legal rights of consumers, for example the right of private copy (in many countries, it is legal to copy music or software CD if the copy is for the copier's own use; for example to play in his/her car radio, or as a back-up copy, but never for sale or loan to others to copy).

DRM mechanisms are very popular as an added and parallel protection mechanism within the copyright system. In principle, DRM looks like some sort of substitute, that perhaps becomes more and more important when copyright law becomes less and less enforceable and manageable through standard means (for whatever reason). However, DRM relies on copyright law in as much as the underlying property rights need to be in place if they are to be protected via DRM, and so DRM really is only a (partial) remedy for enforcement issues. Thus, it is also easy to envisage DRM as a complement to copyright law, rather than a substitute. Although there are a great many papers on the general issue of DRM, most of which are of a legal rather than a strictly economics orientation, I know of none at all that address the issue of the relationship between DRM and copyright law empirically. I would, of course, welcome any steps taken in this direction in economists' research agendas.

It is not surprising that DRM is used significantly in the software industry. There is at least one study, Blind (2007), that looks at the relative importance of DRM and other options for protection of software. In his paper, Blind was principally interested in the recent push towards the use of patents for protecting software, but the data from a survey of German software firms in his paper points out that other mechanisms, including secrecy, lead-time advantages, trademarks, and a variety of DRM systems are all more popular than are patents and copyright. Indeed, for most of the data gathered, the strategy relating to DRM protection is about equal to copyright in popularity.

4.2 Open-Source Software

Notwithstanding the large body of DRM literature, there is an even greater body of literature on the issue of open source (OS) software, but again the great majority of this literature is framed within legal (or general interest) papers, rather than economics papers, and so is not really of interest to the present survey.[48] There have, however, been a series of publications that document the current use of open-source as a licensing mechanism for software. For a recent example, Koski (2007) looked at the usage of open source as a mechanism under which software firms located in five European countries license their products. She found that the General Public License (GPL) version of open-source licensing works as an efficient coordination mechanism for the leading developers of the OS community. However, software companies that supply the open source software tend not to use the GPL to coordinate the further development

of their own software, preferring instead to work with business strategies that involve more restrictive licensing models.

In a related paper, Koski (2005) used data from software companies in Finland to discover that the usage of different licensing strategies tends to depend on the ownership structure of the firms. Specifically, family-owned firms tend to rely heavily on traditional proprietary licensing models, while diffusely held companies are more likely to release products under OS licenses. The analysis also suggests that the more restrictive open source license, known as the copyleft license, is used more often by companies that have participated in open-source software development projects.

Marshall (2007) surveyed piracy in the computer software market, and, among other issues, she considered the open-source literature, and presented some empirical evidence on the open-source movement. For example, Marshall pointed out that some OS software projects have garnered a good reputation for innovation and reliability that has seen them capture a significant market share. It is estimated that Linux has 21 million users (Linux Counter 2006), and the Apache Web Server was used on 58 million sites, 63 per cent of reachable web servers (Netcraft 2006).

However, the economics of open source have not yet produced a significant empirical output. Most of the relevant work on this topic can be found in unpublished working papers. For example, using project records and a survey on employment, Hann *et al* (2004) studied contributions to the Apache OS project, and found that they have little effect on future salary. In spite of this, Haruby *et al* (2003) found that the promise of higher future earnings as an objective for participation in open source projects is an important driver of contributions to OS projects. In published work, Lakhani and von Hippel (2003) found that the principle driver of OS contributions is the need for individuals to solve their own specific programming needs.

Two of the most important contributors to the economic literature on open source are Josh Lerner and Jean Tirole (for a good overview of their work, see Lerner and Tirole (2005a)). In Lerner and Tirole (2005b), they presented a good deal of empirical information regarding the prevalence of the different types of OS licenses using data from about 40,000 OS projects registered with the SourceForge database. They found that applications geared towards end-users and system administrators (e.g. desktop tools and games) use more restrictive licenses. However, restrictive licenses are less common for applications aimed at software developers and for projects that either function in commercial environments or run on proprietary operating systems. Non-English-language based projects tend to employ restrictive licenses. Finally, less restrictive licensed projects attract more contributors.

4.3 Voluntary Contributions

As surprising as it may seem on the face of it, there has been a recent movement toward attempting to generate compensation and remuneration for copyright holders by simply asking consumers for voluntary contributions. Often, the contributions are also anonymous. In spite of the logical outcome of no payment at all being realized, this type of system has been used recently by the popular music group Radiohead to distribute their latest album.[49]

Borck *et al* (2005) analyzed voluntary payments for an electronic newsletter for authors that is supplied on the Internet. In contrast to the standard free-rider prediction that individuals would contribute less the greater the contributions of others, the paper found that readers of the newsletter were more likely to pay more when they expected others to pay. Individuals also con-

tribute more with age, and women contribute more than men. Surprisingly, income is an insignificant predictor of the level of voluntary contributions. It is, however, of note that the data used in the study was gathered from a survey of readers, and thus may be contaminated by the typical survey data bias problems.

4.4 Levies on Blank Supports and Copy Technologies

Perhaps of more interest to the economics of copyright *per se* is the use of levies on blank supports and copy technologies to generate funds from which copyright holders are compensated. Under such a system, copyright holders are compensated for certain private uses of their works onto blank material supports such as CDs and USB sticks: the consumer pays a levy on the purchase of the blank support, in exchange for which a specific exception in the copyright law allows him or her to engage in acts of private use. As such, levy systems are analogous to compulsory licensing arrangements. This type of remuneration system has been put into effect in several countries. However, we should note that such payments are simple transfers from consumers to copyright holders, and they imply that consumers will be charged copyright royalties, whether they use the copyright material or not, since the levies are paid when the blank support is purchased; but on the other hand imposes additional costs upon other members of society. There are no obvious reasons upon which one can base an argument as to why it is better to impose costs on consumers in order to avoid costs for copyright holders. This dilemma has resulted in not all countries adopting the levy "solution".[50]

Nevertheless, the amount of revenue that is generated in different countries from the levies is really quite impressive. The Copyright Levies Reform Alliance has tracked the amount of money that is received as revenue from levies on blank supports and copy technologies for a set of nine European countries (see Damuth (2006)). They calculated that the current levy collection total is between 1.5 and 2 billion euros annually over the nine countries surveyed. If one includes levies that are currently claimed but are disputed, then the figures climb to closer to 4 billion euros annually.

What is really of importance to economists is the final impact of the levies in the market-place. This was calculated for many countries, and totals for both Europe and worldwide are given, by Damuth (2006). In his study, Damuth took elasticity estimates from a variety of sources to calculate the overall welfare effects of levies on consumers and suppliers of copyright products. Both direct effects (in the markets for the goods that are subject to the levies) and indirect effects (other complementary markets) were calculated. The estimates are indeed frightening – for example, it is estimated that in 2005, in Europe, consumers and producers lost 2.1 billion euros because of the levies as applied. The figure balloons to 8.8 billion euros if one includes currently claimed but disputed levies and proposed extensions to the set of levied goods.

However, the raw numbers produced by Damuth should be analyzed a little more closely. Let us take only the case of levies actually imposed and not disputed. Damuth's data showed that for Europe, the total amount collected in 2005 was to the order of 1.2 billion euros. The loss in consumer surplus is calculated at about 131 million euros, and the loss in producer surplus is calculated at 753 million euros. The total loss in surplus in the market from the use of the levies is therefore about 884 million euros, or somewhat less than a billion euros. What Damuth does is to directly add in the total levy collection as a further loss to consumers[51] (for a total negative effect of just over 2 billion euros). However, the money collected in levies is not really lost to the economy in the same way as welfare losses in consumer and producer surplus are, but rather is redistributed to other people (copyright holders). For example, if we assume that consumers, producers and copyright holders all value money equally, and each is given an equal weighting

socially, then an aggregate calculation would reveal that the net effect of the levy system is in fact very slightly positive (about 0.2 billion euros). Of course, in reality, this impact should be compared to the negative impact of the alternative; say, that of not using levies and suffering the effects of private copying.[52]

The documents produced by the Copyright Levies Reform Alliance are interesting, but much of their content is either overly simplistic or purely statistical. True economic analyses[53] of taxes and levies on blank supports goes back to the well-cited paper by Widdows and McHugh (1984), although that paper is best known for the fact that it shows that the downturn in legitimate sales at the end of the 1970s could not be ascribed mainly to piracy, and simply proposes the use of taxes on blank supports as a possible remedy.

More recent literature on taxes on blank supports has been rather scarce. Perhaps this is a reflection on the controversial nature of this "solution" to the appropriability problem for copyright holders. However, Oksanen and Valimaki (2005) argued that it may be the only valid solution in the new digital environment. Indeed, while currently most levies are based on blank supports (CDs, DVDs, MP3 players, etc.) and on some copy technologies (CD burners, photocopy machines), Oksanen and Valimaki suggested that taxing broadband connections and mobile storage devices would also be appropriate (actually, this is already in practice in some countries). They provided some simulations of how such a proposal would, or would not, work in the Finnish market, and concluded that, on balance, any other system based on enforcement and punishment is totally unfeasible.

Of course, the main issue that needs to be addressed when considering the option of taxes on blank supports and copy technologies is the amount of revenue to be collected (i.e. the size of the tax to impose). This problem was discussed theoretically by Liebowitz (2005), but as far as I know, unfortunately there are no existing studies that provide any insights as to an appropriate answer.

5. DEVELOPING COUNTRIES: WHAT IS THE DIFFERENCE?

Finally, we now turn to the intriguing problem of copyright in developing countries. As can be seen by the previous literature analysis, there has been no significant work published in international peer-reviewed journals with the objective of specifically looking at the supply and/or demand for copyright products in developing countries. Given that, in this final section, we will not be concentrating on surveying the literature, but rather we will consider the question of what data and methodologies would be of use to determine the optimal copyright standard for developing countries, and above all, if the literature discussed above which refers largely to developed countries, is useful for the task of determining optimal copyright protection standards in the developing world.

5.1. The "Innovations and New Technology" Methodology

To begin with, it is perhaps worthwhile to say something about the theoretical framework that governs the problem for developing countries. Economists have largely taken a particular type of model, originally designed for looking at international diffusion of innovation and technology (i.e. largely patent subject matter), and have directly applied the conclusions to the case of copyright products. The type of model in question, perhaps expounded in its clearest form by Grossman and Helpman (1991), basically analyzes how technology and innovation that is transferred between countries through international trade, will affect the growth of the trading part-

ners' economies. If one of the trading partners is an innovation leader (often thought of as a developed country), while the other is not (typically a developing country), then the problem of protecting the IPRs that are inherent in the innovations traded becomes an issue.

The model works by assuming that growth is (at least partially) driven by adoption of innovations and technologies. By copying, the developing country can have access to innovations at a very low cost, which is perhaps all they can afford. If no copying is permitted, then there is the fear that new technologies will not be made available at all in developing countries, and this implies that these countries will be stuck in a sort of poverty trap, from which they may not escape since growth relies on technology, which it cannot afford. Of course, there may well be innovators in those developing countries who can make their own new technologies available for their countrymen, but there are several reasons to doubt that this would happen, unless firstly some imported technologies were available. The main reason is that the innovation process is cumulative, and thus requires a starting point. That starting point would be found in imported innovations, and so without these, there is no starting point and thus no dynamic innovation process. In a nutshell then, allowing some copying initially (i.e. a weak IPR regime) could be the only way in which an innovation track can be initiated within a developing country, paving the way to further (local) innovations and the implied growth benefits.

On the other hand, this argument fails once the innovation trajectory has begun, since local innovators will demand strong IP protection if they are to have the relevant incentive to create. If the IP protection standard is not strengthened, then all that will occur is copying and not autonomous innovation. So, the solution appears to be to start out with a weak IP protection regime and to strengthen it over time. This is an even more difficult problem to solve than that which is required for a developed country: not only must we determine an appropriate protection standard, but also an appropriate trajectory over time of the standard.

In any case, perhaps we should stand back and reconsider the applicability of the innovation and new technology argument to the case of copyright products. At this point, it is perhaps again relevant to separate out the particular case of software, which is an outlier from the general set of copyright-protected creations, since it does have an undeniable (and close) relationship with innovation and technology.[54] For other types of copyright product, however, the case is quite different. We mean here products related to entertainment and culture, which are not, *per se*, so directly related to the rate of growth of an economy as are technological improvements to industrial production processes.[55]

Thus, I feel that the argument of the innovation and new technology literature, implying an upward trend in the protection standard over time, is somewhat less relevant to the particular case of copyright products than what appears to have been assumed. Only if we are willing to accept that local authors take their initial inspirations from imported copyright-protected works (i.e. that creation of copyright-protected property is an equally cumulative process as is the creation of patent-protected property), which I personally doubt, then the spillover of the innovation and new technology literature to the case of copyright is not strong. That is not to say that allowing a certain degree of copying early on would not have a positive effect on economic growth. Clearly, if an industry based on copied copyright-protected products were allowed to function, then there would be creation of employment and correspondingly a certain generation of income locally, so long as the copied products were not depriving local authors of remuneration. However, I find this to be an unappealing reason for establishing weaker copyright protection in developing countries, as the same type of effect (probably on an even greater scale) could certainly be achieved by allowing any other "illegal" activity to flourish openly.

5.2. How Applicable are the Developed World Empirical Studies to the Developing World?[56]

First and foremost, we should recall that the underlying theory of copyright is one of balancing incentives. I firmly believe that people all over the world, regardless of the type of economy in which they live, respond to incentives in the same (or at least a very similar) way. Thus, independently of whether we are trying to establish an optimal copyright law in a developed country or in a developing one, the same basic theoretical tradeoffs need to be considered.

So just what is the difference between the developed and the developing world? One important difference is that individuals living in developing countries have a lower *per capita* income,[57] and thus have different budget constraints, and different opportunity costs to consider. This different parameter set should, in principle, imply that a different copyright standard would be socially optimal, and so it could be a mistake to simply take the standard that is used in developed countries (assuming that it is socially optimal for that country), and to apply it to a developing country. Nevertheless, certainly some of what we do know from the study of developed countries is bound to be relevant in the case of developing countries.

If only we could have a magic formula that determines the optimal copyright standard as a general mathematical function of a set of parameters that serve to define the state of development of different countries (such as, for example, the general *per capita* income level of a country, its current rate of economic growth, the level of unemployment, etc.), then we would only need to insert the parameters of any given country to find out its optimal copyright standard.[58] Right now, it appears that there is some evidence on the relationship between the demand and supply of copyright products as a function of some of these variables, but we are still lacking the final piece in the puzzle; the concrete relationship between the demand and supply curves and the level of copyright protection. Note that the causality here is a relevant issue to determine – we are generally aware of some of the effects of increased copyright protection on the supply and demand curves,[59] but really we need to know the opposite, that is, how do the supply and demand curves determine the copyright-protection standard?

On the supply side of the copyright equation, creators in the developing world would most likely be poorer, in absolute terms, than their developed world counterparts. Thus the opportunity cost of being an author is lower in the developing world, and this would tentatively suggest that a lower copyright protection standard is in order. However, by the same token, perhaps the case is more likely to be that creative individuals cannot dedicate their time to creating copyright works, since subsistence and a low hourly wage rate in non-copyright employment requires them to spend most of their time working outside of creative endeavors (i.e. they are in a corner solution, dictated by subsistence). This would tentatively suggest that a stronger copyright protection standard is in order. So what should it be? The answer lies in simply looking at exactly how much of their time creative individuals are spending in creative activities. If they are spending most time creating, then the opportunity cost that is relevant is that of the non-creative sector wage, and we could probably consider a weakening of the copyright standard. On the other hand, if they are spending most of their time in non-creative employment, then the relevant opportunity cost is the creative sector payoff, and we could consider that a strengthening of the copyright standard is required.

Thus, the first data point that would be of use for determining an optimal copyright standard in any country (above all, in developing countries), and that should be gathered, is the fraction of time that creative individuals spend creating copyright works. If that fraction is low (high), consider strengthening (weakening) the copyright standard.

Secondly, we need to consider the demand side of the copyright equation. Again, if the only fundamental difference between consumers of copyright products in a developing country and their developed country counterparts is wealth or income, then what needs to be determined is the elasticity of the demand for copyright products with respect to income. Of course, it is also likely that the own-price elasticity of demand is also affected by changes in income, and so this could be another issue to tackle. If we are willing to assume that income differentials are all that is fundamentally different between the developed and the developing world, then a good deal of robust and transferable information could feasibly be found in the demand studies in developed countries.

As an example, say the income elasticity of demand for a given copyright product in the developed world was found to be equal to 1 (i.e. a 1 per cent increase in income yields a 1 per cent increase in demand), and if the average level of income in a given developing country was, say, 20 per cent of the average income level in the developed country, then the demand for the copyright product in the developing country could be assumed to be only 20 per cent of the demand for the same product in the developed country at each given price. Of course, this is a rough estimate, but perhaps a reasonable initial guideline. It assumes, among other things, that the income elasticity of demand is constant in both price and income, which may or may not be true, but if we knew the approximate location of the demand curve for copyright products, then the problem of determining the appropriate protection standard could at least be addressed in an appropriate manner.

Thus, the second recommendation for required data is a greater emphasis on the income elasticity of demand for copyright products. Possibly a great deal of highly relevant information for the demand for copyright products in a developing country could be gained by studying the demand of the low income population in developed countries, who presumably face similar budget constraints and opportunity costs as the average individual in a developing country.

As we have seen above, economists have looked at the relationship between the supply of creative products and the strength of copyright law, but not the same relationship with the demand curve. Perhaps this is a more difficult curve to model, but it is also possible that the reason is that the effect is ambiguous. When copyright protection is strengthened, on the one hand consumers have less ability to use copyright products in so many different ways, which would likely reduce their demand. However, on the other hand, a certain proportion of current pirate copy users would likely switch to legitimate demand, as tighter copyright controls crack down on pirate markets. This would imply a positive demand effect. Which of these two effects dominates is an empirical question that has yet to be addressed. This point has not, I believe, been addressed even for developed countries, and so this appears to be quite virgin territory for economists to tackle.

Thus, the third data point that I believe is required, if we are to arrive at a reasonable analysis of an appropriate copyright law for a given country, is a treatment of the demand for copyright products in that country, along the same lines as the type of analysis that is commonly performed for the supply side.

As far as methodologies are concerned for the purpose of attempting to design an appropriate copyright protection standard, I am not an advocate for statistical analysis of macro-economic variables at the industrial level to attempt to judge the importance of copyright. Neither am I an advocate for the use of survey data, due to the usual bias that we should expect in data gathered in that way. Naturally, the very best source of data is from real-world markets, from which it is possible that some sort of revealed preference argument can lead to reasonable estimates of demand and supply side variables. Barring that, I believe that the second-best option, large-

ly ignored by economists studying copyright but very important to applied micro-economists in other areas, is to perhaps look at setting up experimental scenarios, with real subjects and with real money at stake, to simulate as closely as possible markets for copyright products, and to use the data thus generated to estimate supply and demand variables.

Well-designed and executed experiments could also be of enormous aid in clarifying the applicability of other empirical studies from the developed world to developing countries. All that would need to be done would be to repeat a given experiment in developed and developing countries and to compare the results. I believe that the use of experiments is perhaps the most promising methodology for throwing light on the problem of optimal copyright protection.

6. SUMMARY AND CONCLUSIONS

This paper has attempted to set out the results of the empirical research in the economics of copyright. Empirical studies of both the demand and supply sides of the markets for copyright-protected products have been discussed. The clearest message that emerges from the analysis is that not enough empirical research has been carried out. This is especially true compared with the amount of theoretical research that exists.

In terms of copyright industries, really the only empirical research we have are the macro-economic impact studies that point to the copyright industries being in rather good health relative to the economy in general, at least in most of the countries surveyed. This points to (but does not provide conclusive proof for) copyright being an important ingredient to economic wellbeing and development. On a more negative note, we are certainly lacking studies that consider the role that copyright, and perhaps more significantly the parameters of copyright law, may play for the development of copyright industries. The best we can do is perhaps to observe that these industries are often relatively under-developed (compared to the developed world) in the set of countries that we would group under the category of "developing countries".

On the supply side, the most active area of research has been on the issue of earnings, although much of that has not been directed to earnings from copyright royalties as such, but rather to earnings of creative individuals. The very few papers that do attempt to separate out copyright earnings from copyright royalties, from other income sources, generally conclude that copyright does not fare well as a source of financial prosperity. Copyright royalty income is generally lower, and more risky, than other sources of income.

The effect of copyright law changes upon the efforts of creative individuals to create new copyright-protected products is also rather inconclusive. However, those few papers that have looked at this have generally concluded that there is indeed a positive effect – the stronger the protection, the greater the creative effort – but by most accounts the effect is not great.

The demand side of markets for copyright-protected products has been studied less intensively than the supply side. Economists have concentrated their attention on the effects of the existence and operation of markets for pirate products upon legitimate trade. The introduction of digitalization, the Internet and file sharing have revolutionized the way illegitimate trade competes with legitimate trade, and have even challenged the very definitions of what constitutes illegitimate trade. However, almost all studies coincide in that the operation of pirate markets causes harm to the sellers of legitimate copyright-protected products. It remains an open question exactly how much harm is actually caused, with figures that range from about 6 per cent up to about 30 per cent of copies representing lost sales of originals.

Some of the emerging mechanisms for exercising rights over protected works that are available to sellers of copyright-protected products do not appear to have been the object of an excessive amount of empirical study by economists. Here we have briefly mentioned digital rights management systems; open-source software; voluntary contributions; taxes and levies on blank supports and copy technologies. Only open source and taxes and levies on blank supports and copy technologies have been studied to any reasonable degree.

While the general theoretical tradeoffs that copyright law is supposed to address are exactly the same in developed or developing countries, the studies that we have from developed countries are unlikely to be very relevant for the developing world, since the parameter set between countries at different stages of developmoent. However, as data constraints are likely to be even more of an issue in many developing countries, one option could be to look at data gathered from the low income segements of the population in developed countries.

However, at least in my opinion, the most promising research methodology for the near future is to analyze behavior, both of demanders for and suppliers of copyright products, in experimentally simulated environments. In principle, since data from experiments is salient (i.e. involves real financial consequences to participants), experiments might provide a convenient solution to the current empirical data-generating problems; often the required information is not available from real-world sources, and data from survey sources is unreliable due to not being salient. The use of experiments in the economics of copyright would involve a good deal of thinking about appropriate experimental design, but fortunately the general field of experimental economics is now well developed, and there are many excellent economists who are experienced in the problems of experimental design.

Notes

1 Indeed, there is a perception that copyright industries are growing in importance relative to other sectors of the economy. Although it clearly refers to both copyright and patents, take, for example, the following excerpt from Alan Greenspan's speech inaugurating the 2003 Financial Markets Conference of the Federal Reserve Bank of Atlanta; "In recent decades, for example, the fraction of the total output of our economy that is essentially conceptual rather than physical has been rising. Over the past half century, the increase in the value of raw materials has accounted for only a fraction of the overall growth of US gross domestic product. The rest of that growth reflects the embodiment of ideas in products and services that consumers value. This shift of emphasis from physical materials to ideas as the core of value creation appears to have accelerated in recent decades." The full text of the speech is available at http//www.federalreserve.gov/BoardDocs/speeches/ 2003/20030404/default.htm.

2 Liebowitz (2003) p. 2) states "The issue at the heart of copyright, indeed all of intellectual property law, is the degree to which the copyright holder can appropriate the value produced by the consumption, or appreciation, of his work by others and the degree to which this appropriation hinders consumption." Thus copyright looks at "the trade-off between consumption efficiency (maximising the net value consumers get of any produced intellectual product) and production efficiency (preserving incentives to create these products efficiently)" (Liebowitz (2003) pp. 2-3).

3 The first relationship is supposed to come about as copyright protection increases, as would the creator's income, leading to a greater willingness to supply. On the other hand, the second relationship is supposed to come about as increases in copyright protection lead to a greater monopoly on copyright products, and hence a higher price. The relationship then follows so long as demand is decreasing in price. Both of these relationships, however, are debatable for reasons that will be explained.

4 As we shall see in this paper, there is no shortage of empirical studies concerning copyright, but none to date (at least of which I am aware) that succinctly address the issue of estimating the true demand and supply side conditions.

5 A clear exception is the recent "open source" movement for software (see, for example, the writings of Professor Lawrence Lessig).

6 It is not clear how, or indeed if, the scope of protection has been significantly altered over time.

7 Of course, if the concert artists want to perform music that is protected under copyright, then indeed copyright is an issue, but the concert performance itself should not be thought of as a copyright product unless it is recorded onto some tangible media. Also, in most jurisdictions a public recital of a story or a musical concert might be considered a copyright product as far as performers' rights, and other related (or neighboring) rights are concerned, although again, these rights are only really interesting when the performance is recorded for future consumption. It is also fair to say that original expression that is recited once and not recorded for future consumption has never been an important issue for the economics of copyright.

8 Legal scholars might well disagree, as in principle there is no need for fixation to a physical support for copyright to be recognized in many jurisdictions. Thus a recital of a story that is not read from a tangible source (e.g. a book) might be considered a copyright product in some jurisdictions. Again, though, such fringe items have never been important to the economics of copyright, where the emphasis has always been on recorded expression, and will not be considered in the present survey.

9 Probably the most important exception to that rule is the case of software, which has historically been copyright subject matter, but more recently (in some jurisdictions) has been extended to patent protection as well.

10 Again, outside of the obvious case of software. A case could also feasibly be made for the use of copyright products as educational aids to promote literacy generally.

11 Bettig (1996) provided a wealth of information on the sheer size of the business operations of many large copyright-dependent firms.

12 There are many papers, going right back to the very origins of the economic discussion of copyright (see, for example, Plant (1934), that argue that, while financial motivation cannot be ruled out as a reason for creating, the creators of copyright products are also motivated by many other factors (personal satisfaction, peer esteem, etc.), and that indeed such factors may turn out to be more important than financial remuneration.

13 That is not to say that their only motive is for profit.

14 Earlier papers also exist, for example Plant (1934), Hurt and Schuchman (1966), and Breyer (1970), all of which found several reasons why a strengthening of copyright law may not lead to greater levels of authorship.

15 As opposed to "longer copyright protection".

16 It is interesting to note that in 2003 the total value of recording sales in the US was 11.8 billion US dollars, while the total value of concert tickets sold was 2.1 billion US dollars. Thus, the recordings market is mostly significant for consumers and record companies.

17 There is some very early literature to support such a claim (see, for example, Santos (1976), who found that singers and dancers earned between 10 and 31 per cent less than others with similar qualifications in the labor market. See also Waits and McNertney (1980) and Panasuk (1974)).

18 A similar comment is valid for many of the papers that follow in this section.

19 There may also be reporting biases (related to tax reporting and evasion) that make artists' earnings appear different from what they actually are.

20 Although, of course, if the income distribution in the non-artistic sector is equally distorted, the two averages are comparable.

21 For the purposes of the study, an "author" is defined as someone who allocates more than 50 per cent of his/her time to writing.

22 Interestingly, the earnings data for German writers points to lower and less skewed distribution than for UK writers. Kretschmer and Hardwick consider that this could be a result of a more regulated environment for copyright contracts in Germany, and/or the more global nature of English-language markets.

23 There are many theoretical reasons to suppose that this does not work. First, higher prices with lower consumption do not necessarily imply greater revenue for creators. Second, even if creators' income did increase, there would be an income effect (assuming leisure is a normal good) that would lead them to spend less time in creative activities (see Watt and Towse (2006)). Third, of course, creators may not be as financially motivated as is assumed (see, for example, Throsby (1992), (1994)). Finally, a strengthening of copyright protection hinders creativity when creative endeavors are sequential, with later authors building upon the efforts of earlier ones (see, for example, Landes and Posner (1989)).

24 It would be interesting to compare Rappaport's figures with movies created more recently, say in the last 20 years or so. The modern movie industry is much more active than the industry of 60 to 80 years ago, with a huge number of titles released each year compared to the first half of the 20th century. I would imagine that the variance of commercial value now is greater than before (some huge smash hits, some huge commercial failures).

25 Registration with the Copyright Office is not a necessary condition for copyright to be granted or legally conferred. However, it is of course a readily available data set, and also one would assume that those authors who were most interested in the commercial exploitation of their work would be the ones who register, since registering certainly improves the chances of a positive outcome in any future lawsuit.

26 In the US a major lengthening of copyright duration occurred in 1962, when duration was increased by 19 years.

27 Indeed, if the change led to a decrease in the supply of copyright products, then we would have evidence suggesting that the optimal change would be the opposite of what was done, but the author knows of no serious studies that have taken their conclusions that far.

28 Often referred to as the "Sonny Bono Act", because of the person who strongly lobbied for it. It is also sometimes referred to as the "Mickey Mouse Act", in reference to the fact that the well known Disney character was a particular copyright-protected work that benefited from an extension in copyright protection through this Act.

29 This was already noted earlier by Towse (2001) in the realm of the arts in general, who argued that estimates of the elasticity of supply of the arts indicate that small financial rewards can have greater than proportionate impacts on creativity.

30 For movies, copyright duration is linked to the life of the principal director, the screenplay and dialogue authors, or the music composer. When the last of these dies, the movie is protected for a further 70 years.

31 The law was passed in 1995 in Europe, and in 1998 in the US.

32 In related work, Baker and Cunningham (2006) found that changes in copyright law do have a significant impact on the stock market valuation of copyright intensive firms.

33 See Snow and Watt (2003), and Pérez (2007).

34 Towse and Handke (2007) provided a most informative survey of the economics of copyright collectives.

35 This is interesting since collective management may imply some degree of cross-subsidising from high-income members to low-income members. What the result points to, then, is that the revenue generated by collective management organizations is significantly more tilted towards high-income earners than towards low-income earners, since even after any cross-subsidization that may take place, the earnings distribution is still more skewed than the overall distribution of author income.

36 A proper understanding of the true demand function for copyright goods is, of course, also paramount for the task of pricing them under the monopoly conditions that are often ascribed to copyright-protected markets.

37 Of course, both price elasticities and income elasticities are important here.

38 As an example of the strange results that sometimes occur in survey data-based willingness-to-pay studies, Bille-Hansen (1997) reported that even non-users of the theater in Copenhagen have a substantial willingness to pay for it. Due to the way in which the willingness-to-pay numbers were generated, we cannot tell if non-users had a willingness to pay for any given function that exceeded the ticket price.

39 Interestingly, Maffioletti and Ramello also reported some results taken directly from survey questions (non-salient) of the same experimental subjects. The auction results show generally lower willingness-to-pay figures, emphasizing the possible bias that can be found in pure survey data.

40 Equally impressive figures can be found for the case of software copyright infringement (see, for example, the 8th Annual BSA Global Software Piracy Study, 2003, in which the piracy rate – the percentage of installed software without a valid user license – in the US was 24 per cent, and in Vietnam 95 per cent).

41 Thus, the outlier appears to be the figure calculated by Davis.

42 The results of Maffioletti and Ramello concerning the willingness to pay for pirated CDs could be contaminated by a perception among the experimental subjects that the copied CD in question was not as illegal as one purchased, say, on the back streets of their city, since it was being offered by reputable university professors in an open and public environment.

43 Indeed, economists have cited at least four possible impacts of file sharing on legitimate trade: (1) a pure substitution effect under which consumers use shared MP3 files instead of purchasing; (2) a sampling effect under which consumers use shared MP3 files to learn what music they would then like to purchase; (3) a network effect, under which shared files can increase the value of music on all formats to consumers; (4) an indirect appropriability effect. It is most likely true that the indirect appropriability option is non-existent for the case of online sharing (see Liebowitz (2003)).

44 Indeed, recently in a working paper, Liebowitz (2007b) has provided a lengthy critique of the Oberholzer and Strumpf paper, pointing out numerous factual errors, poorly-performed empirical tests and errors in logic.

45 A similar result can be found in recent work by Smith and Telang (2006) who estimated that a unit increase in *per capita* broadband penetration increases *per capita* sales of DVDs by 0.42.

46 In an unpublished work, Rob and Waldfogel (2005) found the same general result, also based on survey data of college students.

47 For example, see the discussion on Wikipedia, available at http://en.wikipedia.org/wiki/Digital_rights_management.

48 The reader should be warned that the apparently liberal usage of terms that we would associate with economics (for example, "efficient", "economics", "costs", "benefits", etc.) in the titles of many papers on open source, does not in any way imply that their actual content is heavily dependent upon any significant use of economic theory.

49 Only time will tell if the strategy is successful. However, the reader may recall a well-publicised effort by author Stephen King to do the same, writing chapters of a novel and supplying them online for voluntary donations. King never finished the work (at least using that channel of distribution), due to lack of financial support from readers.

50 For theoretical discussions on the issue of taxes and levies on blank supports and copy technologies, the interested reader can consult Gayer and Shy (2003) and Kinokuni (2005).

51 It is money spent that would otherwise have been available for other purposes; savings or alternative consumption.

52 The possibility that this type of compulsory licensing system would not work appropriately was brought up by Liebowtiz (2004); "…it is unlikely that a compulsory license would meet even the modest goals of a net positive impact, to say nothing of the claims of virtual perfection that have been attributed to it".

53 There are also, of course, a good number of legal-type studies. See, for example, Netanel (2003) for a widely cited paper.

54 Something that has, of course, been gradually recognised more and more openly with the extension of patents to software alongside copyright in the US. In Europe, although software has been declared non-patentable subject matter, patents have nevertheless been used to protect certain aspects of software. See Blind (2007) for more details. Thus the "innovation and new technology" argument may fit quite well for the case of software.

55 Here, I must insist, that I am only looking at a direct type of relationship. Indirectly, of course copyright industries do provide substantial opportunities for economic growth, through the well-known effects upon employment and additions to GDP that they imply.

56 We recognize here that the "developing world", and "developing countries" are very heterogeneous and perhaps subjectively defined categories, that include countries with very different income levels, legal systems, and market structures.

57 There are, of course, other differences, such as, political, cultural, health, social, etc.

58 Indeed, it would be an interesting theoretical challenge to determine if such a function could exist, or if the function itself would be different for different sets of defining parameters.

59 As noted above, most (but not all) of the literature suggests that there is a positive (although possibly loose) relationship between the strength of copyright protection and creativity, i.e. the supply curve of copyright products would move outwards with increased copyright protection. Much less is known about how the level of copyright protection affects the location of the demand curve.

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COMMENTS ON
AN EMPIRICAL ANALYSIS OF THE ECONOMICS OF COPYRIGHT: HOW VALID ARE THE RESULTS OF STUDIES IN DEVELOPED COUNTRIES FOR DEVELOPING COUNTRIES?

RUTH TOWSE*

In my opinion, this paper is comprehensive and meets the terms of reference very well indeed. I have to say that I would not have liked to write it – it is quite a challenge to put all this together. It is particularly interesting to see cultural economics viewed in this light but it makes me realize all the more how little work has been done on copyright in that particular field. I have some additional suggestions to make but I have no disagreement with the paper whatsoever.

General Points

As is well known, there has been a tremendous amount of hype surrounding the creative industries in the last decade and nowhere more so than in the UK. They account for 5 per cent of GDP or more in those countries where that has been measured, and outgrow manufacturing, with growth rates of 5 per cent plus. It is, therefore, worthwhile pointing out that the now widely held belief in the creative industries as drivers of growth might be somewhat dented by some recent work in the UK on trends. The UK seems to be the country that has consistently measured cultural (creative/copyright-based) industries over a five-year period and the recent evidence shows two trends: first, that their growth is slowing down and second, that they appear to be more sensitive to the trade cycle than other industries (DCMS (2007)).

A second general point is that of course, copyright is not one thing – it is a bundle of rights with very different values in different markets. For example, the film rights of a book could exceed the value of the publication rights and also the film rights of a book made into a film by Hollywood have far greater value than if the film studio were in the UK or Denmark. In a similar vein, it is also the case that copyright(s) have different impacts on large and small firms in the cultural industries and on well-established and new entrant creators and performers. Moreover, an economic good embodies several rights of many persons who contributed to its production; for example, a CD has author's rights for the composer, lyricist and the artist of any artwork, related rights for the performers and sound recording maker (and a DVD has even more). The value of these individual rights is not easy to disentangle.

I think it is very important to distinguish, as Richard Watt does, the earnings of authors and performers and the revenues or profits of the industries they supply with content (of which more later).

One question I have often considered is what might be called the indirect effects of copyright in artists' labor markets; specifically, what is the influence of copyright on artists' non-royalty earnings (wages or fees, prices, etc.). If performers did not have related rights, would they get paid more or less? It seems to me it can be argued either way: on the one hand, I have heard it argued that they are paid more because they are 'protected'; on the other hand, employers and others who are paying them a fee or wage (spot payment) may offer less because they know the performer is receiving remuneration or a royalty (future payment). Another question

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is whether the introduction of a new right, say for performers, is paid at the expense of another group, say composers (on both points, see Towse (2001)).

Moral rights may be an important incentive for artists who are not motivated by financial gain. Copyright also confers status on artists in their opinion, and protects their reputation.

Suggestions for Research Topics

1. The most important piece of research to be done is on what and how creators are paid and this may be very different in developing countries from the customs and institutions in developed countries. For example, performers may be rewarded by a king or chief as patron or given money and other valuables by the audience directly; they may be supported by the community, etc. One would expect to find big differences between the major cities and the countryside. There has been no study I know of artists' labor markets in developing countries that investigates all sources of earnings and it should be noted that there are only two such studies in the developed world that specifically identify copyright and other earnings (studies of artists' earnings usually look for earned and unearned income, the latter from grants, family, etc.).[1]

2. There has been no work on the valuation of copyright assets held by companies or corporations (record labels, film studios, publishers) or, indeed, of those owned by individual creators (David Bowie is an exception). I believe this work is important as it could give an insight into the degree to which creators are "exploited" by cultural industries. We know the industries in the developed world are typically oligopolies and bargaining power is unequal between an individual artist and the industry. I contend that copyright has exacerbated this, because it has unequal effects as between creator and company or corporation (Towse, op. cit.).

3. We do not know how much the copyright system costs to operate – its overall "deadweight loss".

   (a) How much do authors and performers "lose" in transaction costs collecting and protecting their copyrights?
   (b) How much do new creators have to pay to use the works of others?

4. Finally, probably the single most important piece of information a country (especially a developing one) would like to have before signing up to a full-on copyright regime is what the balance of payments (or of trade) is in copyright material, industry by industry.

Note

1 The 2007 US writer's strike was about residual payments not royalties. In the UK, royalties would be payable –different ways of payment in very similar settings.

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COMMENTS ON
AN EMPIRICAL ANALYSIS OF THE ECONOMICS OF COPYRIGHT: HOW VALID ARE THE RESULTS OF STUDIES IN DEVELOPED COUNTRIES FOR DEVELOPING COUNTRIES?

ROGER MELKI*

The paper has an ambitious objective which is to determine "an optimal copyright standard in any country (above all, in developing countries)".

The paper argues that the effect of copyright protection standards on the supply and demand for copyright materials is generally understood. What is less understood and needs more analysis is the opposite, that is, "how do the supply and demand curves determine the copyright protection standard?"

On the supply side, the author argues that it is important to consider "the fraction of time that creative individuals spend creating copyright works. If that fraction is low (high), consider strengthening (weakening) the copyright standard."

Thus in a developing country, if an author spends a small percentage of time writing books, then strengthening copyright-protection standards would be an incentive for the author to spend more time on writing activities, since that would increase the revenue generated from selling books. What the author did not include is non-monetary factors which drive people to be creative, such as the satisfaction in expressing one's creativity and the pride that a creative person feels after accomplishing and finishing a piece of creative work, which are not positively correlated with or dependent upon IPR laws. On the other hand, there is a lot of writing that goes on in the academic world not necessarily for financial gain, but rather for survival and for getting tenure.

On the demand side, Watt argues that "possibly a great deal of very relevant information for the demand for copyright products in a developing country could be gained by studying the demand of the low income population in developed countries, who presumably face similar budget constraints and opportunity costs as the average individual in a developing country". This is a controversial argument, because it assumes that the local culture does not affect a consumer's behavior. We believe that the income factor is not isolated and is strongly interrelated with other factors such as government enforcement of protection standards, as well as a consumer's feelings towards the country of origin of the pirated product.

Strengthening IPR protection standards is a double-edged sword. On the one hand it would reduce the illegitimate copying/demand for a protected product, but on the other hand it might lead to increased legitimate demand levels because people who were using pirated products and who needed such products to function would have no choice but to buy the original product. An example would be a professor who receives documents to review in Windows 2007: he/she needs to buy the original product to do his/her job. Thus, one would need to know the optimal level of protection standards that would result in a net positive increase in demand levels.

Watt argues against the use of statistical analysis of macro-economic variables or the use of survey data when designing an appropriate copyright-protection standard. Instead, he recom-

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mends studying real-world markets and spending real money to study various scenarios, presumably of the variation of supply and demand with different levels of protection.

An example of such an experimental study could be conducted on the cable sector in Lebanon, where the piracy of the airwaves has become big business, with an estimated 80 per cent of the population accessing pirated programming that is supplied by 600 to 700 cable workers, which results in about 7 million US dollars per month lost to legal broadcasters. The Lebanese government has been trying to regulate the cable industry by drafting new legislation that aims to bolster the fight against piracy. The law, however, has not been approved due to the ongoing political turmoil in the country. Even when/if it does pass, the law might not be fully enforced due to the slowness of the Lebanese court system.

Watt's recommendation of an experimental study might be possible and may have been tried when legitimate cable distributors launched a promotion offer for a period and lowered the cost of the monthly subscription fee to match, if not undercut, fees charged by pirate cable operators. However, there were not many people who went through the trouble of switching; part of it could be loyalty to the local distributor, and the awareness that this is a promotion which will be followed by a price increase, as well as the resistance to change. Another factor is the feeling that the small-scale distributor who usually lives in the same neighborhood is more worthy of receiving the financial gain than the actual cable company, particularly if it is foreign-owned or a franchise of a foreign company.

Thus it might be worth studying the impact of the national origin of a product on its illegitimate distribution in developing countries. This might suggest setting up different protection standards for local vs. international copyright products, a concept that we doubt many would welcome.

Watt recommends repeating the same experiment in developed and developing countries and comparing the results with the objective of identifying the optimal standard of copyright protection. However, we believe that any experiment should be tailored to the local country's economic, cultural, and regulatory conditions, which means that comparing the results of non-identical experiments would not be of much value.

COMMENTS ON
AN EMPIRICAL ANALYSIS OF THE ECONOMICS OF COPYRIGHT: HOW VALID ARE THE RESULTS OF STUDIES IN DEVELOPED COUNTRIES FOR DEVELOPING COUNTRIES?

JOSÉ L. ZOFÍO*

The contribution by Dr. Watt provides guidelines to researchers in developing countries and countries with economies in transition (hereafter denoted as DCs) on how to properly study and assess the copyright system and is of great importance to all stakeholders interested in understanding how to develop an optimal copyright standard. The profound and broad review of the empirical literature that he presents provides readers with an updated view on this and related issues. Of particular interest to me are his remarks on supply and demand of copyrighted works: on the demand side, willingness by consumers to pay and the demand for legal and illegal products and, on the supply side, the earnings of artists from royalties and their effect on creativity. My comments on these critical questions focus the attention of readers on what I believe is the most robust evidence that can be obtained from the surveyed empirical evidence.

It is well known that the purpose of copyright law is to encourage creativity among authors by awarding them, and/or the firms that represent them, the necessary monopoly power to exploit their work. The existence of such power provides higher profits than those that would be obtained in a competitive framework and, therefore, give both sets of agents extra revenue that would allow them to continue with their activities and spark copyright industries, which are critical for economic development as several recent studies have shown.[1] On the other hand, by raising prices and lowering the production of goods, copyright reduces the accessibility of consumers to these works. In this static scheme, the key issue is to find the right level of copyright protection that balances the tradeoff between encouraging creative activity by artists (supply) and market accessibility to creative work by consumers (demand) so as to maximize social welfare. As a result, the basic problem facing the design of an optimal copyright system is finding the optimal level of copyright protection that balances these opposing forces, i.e. the term and scope of copyright.

However, finding the right level of copyright protection that would strike the right balance is not an easy task. Dr. Watt remarks that there are several theoretical models on how to approach this issue from an industrial organization perspective, e.g. Landes and Posner (2003). However, there is not enough empirical evidence on critical issues that would help us to determine the optimal level of copyright protection, i.e. the "magic formula" to provide the right level. Nevertheless, the fact that we do not know what the optimal level is, not even in developed countries and much less in developing countries, does not preclude the analysis on how a change in the level of copyright protection would affect supply and demand of copyrighted products and its effect on social welfare, and what the empirical evidence tells us about the theoretical assumptions that we make when addressing this problem from a formal perspective.

Dr. Watt has surveyed the existing and inconclusive evidence on many of these issues, but if we were to guess whether current copyright protection in DCs is below, equal to or above the optimal level, many of us would agree that the available information points to the first possibility. Copyright protection has to do with term and scope, but, more important than the formal accession to treaties and agreements on copyright and related rights, is the actual level of

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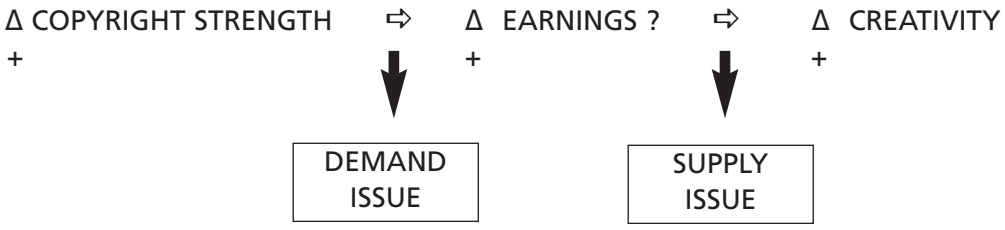
enforcement of copyright law. In what follows I start from the hypothesis that the copyright level in DCs is below the optimal level. In this case, social welfare would suffer as market access to consumers (by way of illegal products) is higher than it should be and, therefore, the level of creativity is lower than it should be, as artists would lack incentives to undertake their activity.

There are plenty of country reports and some empirical evidence that indicate that no matter what the optimal level of copyright protection should be (probably below that of developed countries), copyright infringement (unlawful sales) is pervasive across industries, and its scale is too large. It is well known that these reports are commissioned by the industries whose legal sales suffer most from piracy,[2] and that their estimated trade losses are inflated as they equate the sale of an unlawful copy with lost revenue from the legal retail price.[3] This reasoning implies that illegal copies are perfect substitutes for the legal ones – which may be valid for many copyrighted products such as sound recordings and business software – but also that demand is completely inelastic an assumption that is plainly incorrect. Nevertheless, even if the assessment that industries make of their losses is biased as a result of the price at which they choose to value the volume of unlawful sales, this last variable might not be far from reality, supporting the idea that market access is too high because the size of the illegal market is too large. From a theoretical perspective this calls for industrial organization models where two markets for legal and illegal products are interdependently connected by way of supply and demand. As we shall see below, a key aspect to study is how discriminatory pricing policies may influence each other.

Clearly, excessive market access in developing countries is possible because prices of pirated copyright products are much lower than those of their legally marketed counterparts. Correspondingly, the quantity of legally sold products, upon which revenues for firms and royalties for creators can be collected, is too low, bringing scarce compensation to creators and firms. This means that industries supporting either local or international productions struggle to survive and that lawful productions face important difficulties in poor legitimate markets. In this context, where excessive market access is signaled by widespread unlawful trading, increasing copyright protection would bring larger social welfare by balancing the playing field in favor of creativity. Of course, copyright protection refers to copyright scope and term, as well as to enforcement, which would have an immediate effect in the short run by avoiding unlawful transactions and educational practices, which aim to change consumers' preferences toward lawful products in the long run. In developing countries, legal and actual copyright levels diverge by a gap that is sensitive to enforcement and educational practices.

Then, should governments interested in raising social welfare in the short term enforce copyright law to a greater extent? Increasing copyright protection will certainly not benefit the demand side, but if it encourages creativity so as to offset this negative effect, then society will be better off. However, we should not take for granted that increasing copyright protection will indeed result in greater creativity by individuals, as a result of increasing earnings for copyright holders. The figure below shows the chain of events that should take place for the above reasoning to hold true.

Figure 1. Does Increased Copyright Protection Lead to Greater Creativity?



The first event deals with the assumption that increased copyright protection results in higher revenues and earnings for copyright holders, a question related to how consumers react to price changes, i.e. a demand issue. In DCs, where income distribution is so unequal, it seems quite likely that the majority of consumers are unwilling or unable to pay the legal price charged by the industry and, therefore, the owner of the copyright is not deprived of any revenue. However, this does not mean that demand is completely elastic at the illegal price, and consequently some of the industries' revenue is lost. Therefore, we assume that the elasticity of demand is positive, greater than zero a value corresponding to the industries' assumption when calculating their losses and smaller than infinite a value consistent with the assumption made by those who disregard copyright theft on the above grounds suggesting that piracy is harmless or, even, beneficial.

In this scheme, a critical question to examine empirically is the switching price from unlawful to lawful sales, i.e. the elasticity of legal products with respect to illegal pricing an issue that has not been addressed in the empirical literature. If the cross-price elasticity of demand for legal products is positive, then an increase in copyright protection that raises (illegal) prices will bring presumably higher (legal) revenues for companies and earnings to creators. The switching price depends critically on the difference between the legal and illegal prices. Increasing copyright protection raising illegal prices could then be accompanied, from the industries' perspective, by retail price reductions, as this would reduce the difference between willingness to pay and legal prices.

From the willingness to pay perspective, empirical evidence like that presented by Maffioletti and Ramallo (2004) is necessary, but substituting people in DCs for college students in developed countries. From the perspective of the inability to pay legal prices, studies that determine income elasticity in DCs are pertinent. These studies would allow us to determine if the above-mentioned cross-price elasticity is positive and to what extent, as well as the optimal price levels. I believe these research questions complement those given by Dr. Watt. In particular, as long as copyright infringement is high and illegal prices low people in developing countries will not have to make a choice between legal and illegal products, as the price difference will compel them to choose the latter given their willingness to pay and/or their low income. In short, we need to undertake studies that would allow us to know the demand characteristics for copyright products of the middle and low income segments of the population in developing countries.

The second circumstance that should take place in the stylized chain of events presented in the above figure is related to the supply of creative work. Specifically, it is related to the conditions that should be verified for an increase in copyright protection to result in higher earnings for creators through royalties and related compensation and ceteris paribus the particular skewedness of their distribution (Towse (1999)). So far, we have talked rather loosely of copyright holders, embracing both creators and large firms that publish and distribute their work, and which play the leading role in marketing and distributing the final work. On these grounds, it is clear that these groups may have conflicting interests when splitting their joint revenues and profits. From an analytical perspective, we need models that discriminate between these groups because putting them together would result in misrepresentation of the supply curve for original products, as stronger copyright protection may result in higher revenues for corporations but meager earnings for authors, who would then be unwilling to create original products (Bettig (1996)).

It is well known that corporate profitability does not always align with authors' earnings by way of royalties, particularly when their distribution tends to be biased against the latter, whose individual bargaining power is extremely low. This means that increasing copyright protection will raise firms' profitability but nothing ensures that the additional revenues are passed on to the

creators, and this is something that developing country authorities ought to keep in mind. It is a matter of the organization of each particular copyright industry and how creators and firms relate to each other. Additional empirical evidence on whether higher copyright protection increases creativity is necessary, but always related to how increasing revenues are shared between authors and their representatives, since it is assumed that copyright holders will see their revenues increased.[4]

Assuming that increased copyright protection results in higher earnings for creators, a subsequent question from the supply side is if this encourages them to allocate more time to the creative activity. More studies are needed in DCs to establish how artists allocate their time, and if current and increased royalties (after strengthening copyright protection) are a meaningful source of income that would drive them toward these activities. If current royalty levels do not motivate artists to spend more time creating original products (Wassal and Alper (1992)), the question is to what extent they should be increased so as to motivate them to behave as predicted by economic theory. That is, besides autonomous creation coming from inherent satisfaction rather than royalty payments, can copyright law reward creativity so as to encourage existing and new authors to commit themselves to these activities professionally? Kretschmer and Hardwick (2007) answered with an emphatic "no" for the case of developed countries. In light of this evidence, collective management may improve the situation for creators by increasing their bargaining power. However, recent studies do not support the fact that collective management increases earnings for creators, as they suffer from some of the same drawbacks as payments through royalties, e.g. a high degree of skewedness, plus additional disadvantages like increased risk among their affiliates. In our current analytical framework the question to be answered is what additional income for the average creator will bring increased copyright protection, and how it relates to their incentive to create. Assuming that creators in DCs present the same characteristics as in developed countries, albeit exacerbated (Towse (1999)): (1) multiple sources of income; (2) willingness to take risks as a result of their inherent satisfaction and hopes in succeeding; (3) a low reserve wage, all of them converging in discontinuous and limited time devoted to these activities, then the relevant opportunity cost of time corresponds to earnings in the creative sector, and an increase in copyright protection to raise their earnings will result in greater creativity.

My conclusion is that if copyright protection in DCs is below an optimal level and the chain of events presented in the figure occurs, then (1) it would be possible to nurture copyright-based industries (creators and firms), while (2) increasing social welfare, as the loss in consumers' access to copyrighted work (priced too low) is offset by the increase in creativity (result of increased earnings). The empirical evidence tends to support all the assumptions that we have made, particularly with regard to the current level of copyright protection being lower than optimal, and the effect that its strengthening would have on reduced and increased demand for unlawful and lawful products respectively, which in turn would bring higher earnings for copyright holders and for creators an increase in creativity. The weakest point in the chain of events we have described lies within the group of "copyright holders", and whether firms transfer enough earnings to creators to motivate them to carry out creative activities to a larger extent. The empirical evidence in developed countries suggests that it is not enough, let alone in DCs, and, therefore, the final goal of raising social welfare by strengthening copyright protection would be compromised.

I would like to conclude with some recommendations with regard to future research that may cast further light on how to foster creativity and innovation in DCs. Micro-economic research needs to be undertaken to determine to what extent current copyright protection is sub-optimal in DCs. For this purpose: (1) on-site data collection and analysis by way of econometric techniques is necessary to test hypotheses with regard to whether increasing copyright strength raises earnings and creativity (i.e. price, income and cross-elasticities of demand and supply); (2)

experimental evidence may also allow us to test whether individual preferences are as assumed in the above discussion, particularly willingness by consumers to pay and by creators to accept. Finally, even if macro-economic evidence does not help us to design the right optimal protection standard, it may show whether current levels are below or above what should be expected given a country's average level of income. In particular: (1) should we expect the contribution of copyright-based industries to GDP and employment in DCs to be smaller than in developed countries? If copyright products are a type of luxury commodity in DCs, it could be expected to be smaller, where this is aggravated by (2) the fact that high levels of copyright infringement imply that large amounts of (illegal) economic transactions remain unobserved (i.e. overlooked in official macro statistics (OECD (2002)). As a result, and with the usual caveats about data quality and availability, methodological shortcomings, and particular industrial structures, in countries where the contribution of copyright-based industries to GDP and employment is well below expected levels given their average income, copyright protection might be too low and therefore copyright infringement might be too high, signaling the need for further protection.

Notes

1 The role played by these industries in developing countries with regard to GDP and employment is currently being studied by WIPO in Brazil, Colombia, Jamaica, Mexico, Pakistan, Peru, Philippines and others. There are also two published reports on countries in transition, Hungary and Latvia, WIPO (2006).

2 See, for example, *http://www.iipa.com/countryreports.html.*

3 Here we dismissed the fact that "copiability" may enhance the value of the original so that the copyright owner indirectly appropriates some of the value of the copies, e.g. by accelerating the spread of the work, piracy may help the copyright holder to obtain network monopoly — an idea that permeates the fair use doctrine. In passing, we note that Internet-based piracy might be less of an issue in developing countries as Internet access measured by the percentage of users is rather low — i.e. the penetration rate in LDCs relates to 19 per cent of the overall population, a figure that is much lower when we consider subscribers to an ISP, e.g. *http://www.internetworldstats.com.*

4 We presume here that since copyright protection is too low in DCs, increasing it will not harm authors' remuneration by way of indirect appropriation, network effects, backward sloping supply curves, and other possible arguments see footnote 3.

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THE ECONOMICS OF GEOGRAPHICAL INDICATIONS: TOWARDS A CONCEPTUAL FRAMEWORK FOR GEOGRAPHICAL INDICATION RESEARCH IN DEVELOPING COUNTRIES

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1. INTRODUCTION

Over the past two decades, agrifood systems have experienced a significant move towards market differentiation and product proliferation in many parts of the world. This product proliferation and differentiation is associated with what Allaire (2003) described as "the immaterialization of food and the institutionalization of quality", which is translating into an increasing complexity of quality and new quality conventions. These institutions go beyond the neo-classical model of market pricing and quality signaling through price mechanisms, to instances where institutions that define and enforce quality standards and norms become key to the performance of market mechanisms. As stated by Sauvée and Valceschini (2003): "In the current competitive universe, the definition of quality and the information on qualities are from now on at the heart of the competitive strategies of economic actors".

The growing demand for and attention to the "qualities" of agrifood products is a result of a range of factors such as the increased awareness of food safety, the socio cultural status of consuming certain foods and renewed interest in and nostalgia for culinary heritage (Ilberry and Kneafsey (2000)). Origin-labeled products are an important example of this, as trends in the food sector over the past decade indicate that consumers are increasingly placing value on products they can associate with a certain place and/or special means of production (Ilbery and Kneafsey (1998)).

Given the global competitive environment characterized by declining agricultural commodity prices, this trend towards traditional and/or quality products with a strong cultural link provides producers of value added products with a strong link to a particular geographical origin, with the opportunity to move away from commodity markets into more lucrative niche markets through differentiation. As such, territorial origin becomes a strategic tool for differentiation in agrifood markets. However, the success of such a marketing strategy depends largely on whether there are measures in place that ensure localization of production. As a result, international rules for the regulation of origin-labeled products have become increasingly important in recent years. Geographical indication (GI) protection has, however, proved controversial with respect to the nature and the scope of the protection to be granted, as reflected by the divisive debate that ensued during the TRIPS negotiations where countries' desire to protect this IPR has largely been based on political pressures both domestically and internationally as well as the perceived economic impact of protection.

As with other distinctive signs, the economics underlying the protection of localized products is founded on the economic theories of information and reputation. These theories illustrate the

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importance of (1) preventing the market distortions that arise when there is asymmetry of information between producers and consumers and (2) averting the consequences of such asymmetry of information on the level of output quality (OECD (2000)). Reputation, as used in studies of markets characterized by imperfect information (Stiglitz (1989), Tirole (1988)), aids to an extent to overcome the market failure associated with asymmetry of information. However, the successful use of reputation to restore efficiency to the market through averting the consequences of information asymmetries requires that that reputation be protected through a process which can be viewed as the "institutionalisation of reputation" (Belletti (1999)). Distinctive signs such as geographical indications can achieve this by institutionalising the relationship between the product and the region and/or tradition through the use of legal instruments that prevent the misappropriation of benefits. Geographical indications can thus be viewed as the result of a process whereby reputation is institutionalized in order to solve certain problems that arise from information asymmetry and free riding on reputation. This highlights a fundamental feature of GI protection i.e. that it functions as both a consumer protection measure (through addressing information asymmetries and quality) and a producer protection measure (through its role in protecting reputation as an asset) (OECD (2000)).

Apart from, and partly as a consequence of, the economics underlying geographical indications, both European policies and the literature emphasize the potential of geographical indications to improve rural livelihoods based on local resources (Pacciani *et al* (2001)) and, thus, advance rural development. Worldwide, rural communities have developed typical products based on the interaction between local know how (including selection, production and processing) and particular environmental conditions such as the soil and climate (World Bank Report (2004)). However, the market does not necessarily reward the value added to these traditional products and when it does the added value does not necessarily accrue to the producers. This is to a large extent due to a lack of a well-defined and recognized characterization of the product or to a lack of regulations and enforcement mechanisms. The legal recognition of geographical indications provides an institutional tool through which to address these problems and consequently provide rural communities with the opportunity to valorize their local production and extract rents based on local savoir faire.

These dimensions highlight the three basic objectives pursued through GI protection, i.e. consumer protection, producer protection and rural development. Various related objectives are pursued under these broader objectives and include objectives that flow from GI categorization as an IPR. The different dimensions and objectives of GI protection give an insight into the multidisciplinary nature of the subject that includes legal, economic, social and political dimensions. Despite this, geographical indications have, to date, largely been studied from a legal perspective of reconciliation between alternative ways of granting protection to producers from usurpation of names and signs (O'Connor (2004)). Much research remains to be done on the underlying economic impact of geographical indications, especially in a developing country context. The central tenet of this paper is the identification of the different economic dimensions to GI protection and the methodologies and approaches that have been used to study these. The paper starts with a typology of the institutional frameworks facilitating GI protection. This is followed in section 3 by an exposition on the economic rationale for protecting geographical indications. The paper intends to arrive at an integrative approach to studying geographical indications and/or their potential in developing countries. To this effect, section 4 of the paper provides a synopsis of the different methodologies employed to assess the different economic dimensions of geographical indications. Finally, section 5 develops a conceptual approach to studying geographical indications in developing countries.

2. THE INSTITUTIONAL LANDSCAPE

2.1 Different Legal Approaches to Geographical Indication Protection

The different dimensions of geographical indications are closely embedded in the different legal and institutional frameworks that facilitate their protection. During the TRIPS negotiations a divisive debate ensued regarding the nature and scope of protection to be granted to geographical indications. Fundamentally, two different approaches to protecting them emerged. The first relies on existing intellectual property and unfair competition laws. Certain countries, such as the US, argued that geographical indications are sufficiently protected within this framework. The second approach to protecting geographical indications is through legislation specifically designed for this purpose. The European Union, for example, argued that they are not sufficiently protected within existing trademark laws and thus demanded *sui generis* protection and the establishment of a multilateral register.

The TRIPS Agreement is not prescriptive in its approach to GI protection and requires merely that member countries provide the "legal means" by which to prevent "(a) […] the use of any means […] which misleads the public as to the geographical origin of the good […] or (b) any use which constitutes an act of unfair competition […]". Countries are thus free to regulate the protection of geographical indications at national level, provided it complies with the minimum standards set by TRIPS. As a result, countries have elected to either follow the EU approach and promulgate *sui generis* legislation or implement the US philosophy of protection under existing trademark laws. Various developing countries have moved towards the protection of geographical indications through different legal approaches. India has, for example, promulgated legislation which allows for the registration of a geographical indication *per se*. Other developing countries, including South Africa, have thus far elected to protect geographical indications under trademark laws. The divergent approaches all differ with respect to the degree of government involvement, monitoring of use and enforcement. The merits of the divergent approaches have been widely debated and will not be explored in this paper.

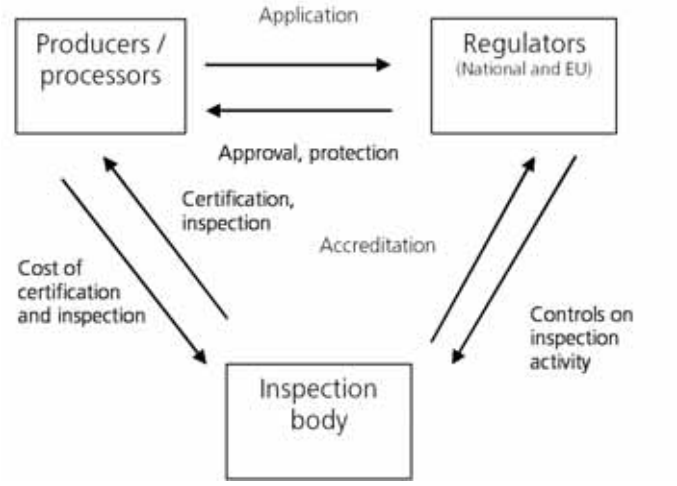
2.2 Organization and Control

Depending on the legal system granting protection to geographical indications, issues of control and organization are addressed differently. In contrast to trademarks, which are distinctive signs identifying goods of an enterprise and thus not limited by any territorial link, geography is at the heart of geographical indications (Marsden (1998)). This geographically intertwined nature of geographical indications has certain implications for the organization and control of origin-labeled supply chains. As Belleti and Marescotti (2002) mentioned, origin-labeled products are very often characterized by a "collective dimension" in the sense that they are linked not only with the skills of many producers and/or processors but also with locally created public goods and with the history, habits and culture of the local community. This requires the creation of collaborative networks through which many actors jointly manage the common product in the same way a single firm might do (Barjolle and Sylvander (2002)).

These actors can be highly heterogeneous in that they may or may not be directly involved with production and distribution activities. Also, they may be of an individual or collective nature and, if they are of a collective nature, they may be public institutions or producer/processor organizations (Pacciani *et al* (2001)). It is often assumed that the activities associated with producing an origin-labeled product are located within the territory. However, this disregards the many non-local actors who participate in the production of an origin-labeled product.

This diversity of actors leads to a diversity of objectives which are pursued through valorization of the origin-labeled product. Often these objectives go beyond the goal of profit maximization to include other socio-cultural objectives. This diversity is well-illustrated with reference to the valorization system in place in the EU. Protection for origin-labeled products under EU Regulation No. 510/2006 is structured around three groups of participants: producers/processors, regulators and inspection agencies (Figure 1).

Figure 1. EU-Protected Designation of Origin and Protected Geographical Indications System



Source: Hayes *et al* (2003)

Although these actors remain economically and legally independent while producing and marketing the common good, they are linked in that their activities result in a particular origin-labeled product whose main characteristics are determined in the code of production. This peculiar manifestation of independence/interdependence between producers of the common good, each pursuing its own objectives, emphasizes the fact that origin-labeled products stem from a collective process. Menard (2000) stated that there are various advantages associated with cooperation and collective production: (1) economies of scale in the acquisition of information; (2) risk-bearing among the group when facing unanticipated contingencies; (3) mitigation of adverse selection and moral hazard; (4) increased productivity due to a more developed "sense of responsibility". However, he highlighted that there are also limits and costs to cooperation, resulting from: (1) free-riding strategies through selection of members (*ex ante*) and malingering behavior once selected (*ex post*); (2) collective decision-making that may hamper the advantages of command; (3) incentives to collude and develop side payments; (4) the high cost of processing information and communicating in a team oriented organization.

These advantages and limits associated with collective action bring to the fore the importance of co-ordination and organization in producing an origin-labeled product, a point which is reiterated throughout the research on typical products (Barjolle and Chappuis (2000)). In this regard, Chappuis and Sans (2000) identified co ordination in the supply chain as a prerequisite for the success of origin-labeled products and for the competitiveness of the firms producing and marketing them. Factors indicated by research as contributing to the need for coordination in origin-labeled supply chains include the type of product, in that they are strongly differentiated and with high value-added; the seasonal nature of a number of origin-labeled products; the location of some producers in regions where production costs may be higher. The most compelling reason seems to be the need to arrive, at the end of the processing stage, at a product with specific characteristics. In order to achieve the latter, Chappuis and Sans (2000) referred to certain activities that need to be addressed at a collective level.

One such collective activity is the need of the relevant group of producers and/or processors to define the relevant product by achieving consensus as to its characteristics and the delimitation of the production area. Definition of the product should take place in accordance with the market and differentiation objectives. Consensus on the product definition can be considered the minimum level of agreement between participating actors as it determines the product characteristics as well as those entitled to produce it. Product specification will furthermore determine the possibility of innovation and could thus limit producers regarding product development. As such, it forms an important aspect of the negotiation between participants establishing the geographical indication. The product definition is embodied in a code of practice which constitutes the first collective activity within the supply chain. A liberal code will allow for the production of a wide range of products using the same designation. This strategy, however, should be avoided as it could lead to unfair competition and could mislead consumers. In contrast, a strict code strengthens the image of a unique product and reduces differences in production techniques between firms. Defining the product necessarily raises the issue of exclusion, further necessitating collaboration and coordination between all stakeholders in defining the common good.

A further activity that highlights the collective dimension of geographical indications is that of control. Once a code of practice has been agreed upon, consensus is needed on how to ensure conformity to the product specifications. The collective nature of the production process necessitates controls to prevent free riding and opportunistic behavior. Each of the firms entitled to use the designation is dependant on the good practice of all the other firms in order to guarantee the quality and reputation of the product bearing the designation. The control function can be undertaken by external or internal institutions.

According to Barjolle and Sylvander (2002), coordination in the context of origin-labeled supply chains should be understood as the ability of firms to achieve collective and efficient product and market management. In assessing how effective coordination and cooperation is with regard to product management, Barjolle and Sylvander (2002) considered two factors: (1) the capacity to bring out the product's differentiation potential; (2) the ease with which each actor can appropriate the collective process. The latter refers specifically to the ability of the actors to adapt their individual strategies to the collective strategy. The first step to be taken in this regard is the negotiation of a code of practice. Thereafter, they must comply with the constraints imposed by the code and submit to the inspections agreed upon.

In judging coordination with reference to market management, the main issue is that of consistency. Barjolle and Sylvander (2002), for example, highlight the fact that a promotional policy will not succeed if the product is not differentiated, poorly defined or inadequately controlled. They also mention that quality grading will only be effective if payment for the raw materials is directly dependant on compliance with the quality criteria agreed upon. A further issue regarding coordination with reference to market management is the relationship between collective action and the scope left for each firm to vary product quality to suit its own strategy, as this allows firms to manage competition in segmented markets. In conclusion, it can be said that effective coordination allows producers to collectively devise a common marketing plan and to develop a competitive advantage around the product's specificity. Coordination thus becomes both a condition for and a result of the agreement between actors. As such, the capacity of producers to effectively coordinate has been identified (Barjolle and Sylvander (2002)) as one of the most important factors enabling a product to benefit from protection as a geographical indication.

3. ECONOMIC RATIONALE FOR GEOGRAPHICAL INDICATION PROTECTION

The economic rationale for protecting geographical indications fundamentally derives from the fact that place of origin may be used as a quality signal and that the resources of the region may be captured in the origin-labeled product as quality attributes (Pacciani *et al* (2001)). In the first instance, the informative meaning of the geographical name is emphasized in order to reduce information asymmetries. Where place of origin is used as an attribute, resources of the region are used to increase the value of the product. These resources could include aspects such as production techniques, varieties and species, but also resources that are general to the region such as landscape, environment and culture (Pacciani *et al* (2001)).

The added value derived from these resources leads to a differentiation based on product "qualities" and consequently to the creation of niche markets. The collective monopolies which result from the institutionalization process provide producers within origin-labeled niche markets the opportunity to protect and enhance their market and to transform the value added into an economic rent. Although this premium may be small, a geographical indication, by differentiating products by its area of origin, restricting supply and creating barriers to entry, may act as a powerful marketing tool which could improve market access.

A study by the OECD (1995) identified a number of factors that influence the success of small, rural enterprises that target niche markets. While numerous factors have an influence, two main factors emerged: market access and differentiation. The study found that one approach to addressing these factors is to work collectively in order to develop a competitive advantage. This approach is well accommodated within an origin-labeled valorization strategy confirming the economic rationale for protecting geographical indications.

Geographical indications, furthermore, may provide a strong rural development tool which has been recognized by the EU, as reflected in various policies and regulations. This rural development potential could indeed constitute a very powerful rationale for developing countries to embrace and support origin-labeled products within their territory.

In order to understand the increasing importance of geographical indications in the EU and further afield, the discussion which follows summarizes the factors which form the basis of the economic rationale for protecting geographical indications (for a more detailed discussion on the topic the reader is referred to Grant (2005)). The discussion draws on different economic theories to illustrate how the objectives of consumer and producer protection and rural development can be achieved through the use of geographical indications, in order to provide a theoretical framework which will contextualize the empirical analysis in section 4.

3.1 Information Asymmetries and the Role of Reputation

Marks indicating the geographical origin of goods were the earliest type of trademarks used by traders as a means to exploit local reputation through the use of distinctive signs to evoke a particular geographical origin (Rangnekar (2003b)). Although distinct IPRs, this association suggests similarity in the economic rationale for protecting geographical indications and trademarks. The economics underlying the protection of these distinctive signs is founded on the economic theories of information and reputation (Rangnekar (2003b)).

These theories demonstrate the importance of (1) preventing the market distortions that arise when there is asymmetry of information between producers and consumers and (2) averting the consequences of such asymmetry of information on the level of output quality (OECD (2000)).

Nelson (1970) showed that consumers do not have perfect access to information regarding the prices of goods, and even less so to the quality of the goods.

He classified goods on the basis of how information is accessed by and/or conveyed to consumers as summarized in Table 1.

Table 1, Classification of Goods Based on Access to Information

Search goods	Consumers can ascertain quality prior to purchase through inspection and/or research
Experience goods	Consumers can ascertain quality after purchase through use and experience
Credence goods	Neither prior inspection nor subsequent use is sufficient to ascertain quality

Source: Nelson (1970)

The problem of asymmetric information, thus, stems from the fact that the producer knows the product attributes while consumers do not and can only determine them through search or experience, or cannot determine them at all (OECD (2000)). This information gap leads to typical market information problems in the form of adverse selection and moral hazard, originally described by Akerlof (1970) in his work on the market for second-hand cars. The relevance of these problems in the case of agricultural products is that food products, in terms of the categorization in Table 1, display characteristics of all three types of goods (Rangnekar (2003b)). As food markets are characterized by varying qualities, only the producer is aware of the product's quality in advance, while the consumer runs the risk of buying an inferior product due to adverse selection. It is clear that information asymmetry impacts negatively on the market: the quality of total supply drops, higher-quality products are driven out of the market and some consumers will no longer be able to satisfy their preferences (OECD (2000)). Producers maintaining the quality of their products are exposed to unfair competition from producers who sell lower quality products at the same price. In order to protect themselves against such behavior, consumers adopt various strategies. These include the making of repeat purchases, developing a strong sense of brand loyalty and a willingness to pay a premium for reputation. In response, producers adopt strategies for creating reputation in their products.

The concept of reputation, as applied to studies on markets where there is imperfect information (Stiglitz (1989); Tirole (1988)), aids in overcoming the market failure associated with asymmetry of information. In his model on reputation, Shapiro (1982) and (1983) analyzed the firm's choices regarding the quality level of its production with a view to maximizing profits in a situation where it is assumed that markets are perfectly competitive but information is imperfect. He stressed the importance of the dynamics between the following three elements: firm's reputation, consumer learning and the seller's choice of product quality. If product quality cannot be observed in advance, consumers tend to use the quality of products offered by the same producer in the past as an indicator of future levels of quality. According to Shapiro (1983) reputation thus embodies expected quality in that individuals extrapolate past behavior to make inferences about likely future behavior. This value judgment develops over time creating an intangible asset whose value is given by capitalization of future price premia (Belletti (1999)).

In instances where purchase decisions are based on product reputation, producers who decide to produce for the high-end market are forced to invest in reputation. Often this period of investment requires the producer to sell his product below production costs until reputation has been established (OECD (2000)). The need to make initial investments means that, in an equilibrium scenario, high-quality goods must be sold at premium prices (OECD (2000)). This premium represents the return on the initial investment to establish the reputation (Shapiro (1983). Given this, products which enjoy reputation earn a premium that is sustained even at equilibri-

um (Rangnekar (2003b)). Rangnekar (2003b) explained that the premium earned is proportional to the lags associated in consumers learning the true quality of a product. It follows from this that a producer will only be motivated to improve its product quality if consumers undergo a learning process regarding the quality of its products. The premium can thus be justified based on the role reputation plays in reducing information asymmetries as well as its role in preventing short-term compromises in quality. This allows a reduction in the actual price paid by reducing search costs for the consumer. In the context of information asymmetry, reputation thus becomes both an inducer and indicator of quality (OECD (2000)).

However, the successful use of reputation to restore efficiency to the market through averting the consequences of information asymmetries requires that reputation be protected through a process which can be viewed as the "institutionalisation of reputation" (Belletti (1999)). Distinctive signs such as geographical indications are one way of achieving this, by formalization of the relationship between the product and the region and/or tradition, achieved through the use of legal instruments that prevent the misappropriation of benefits. These signs embody reputation in that they signal a certain level of quality.

The collective nature of geographical indications as a quality signal means that use of the sign is not limited to a single producer but to all producers within the designation which adhere to the code of practice. Product reputation is thus the result of the actions of different agents active in the same area of production and is projected through tradition over a period of time (Marty (1998)). In conclusion, it could thus be said that geographical indications are the result of a process whereby collective reputation is institutionalized in order to solve certain problems that arise from information asymmetry and free riding on reputation (Belletti (1999)). As such, the above-mentioned theories of information and reputation highlight two important features of GI protection i.e. that it functions as both a consumer protection measure (through addressing information asymmetries and quality) and a producer protection measure (through its role in protecting reputation as an asset) (Rangnekar (2003b)).

3.2 Improved Market Access

Apart from its role in overcoming the detrimental effects of information asymmetries and free riding on reputation, geographical indications also reflect characteristics and values associated with a region and thus regional quality. As such, territory goes beyond its purely informative role and acquires the characteristics of an attribute (Pacciani *et al* (2001)). The resources of the region (landscape, cultural and historical resources and local savoir faire) become embedded in the origin-labeled product, thereby synthesizing the territorial attributes in the product name. It is this characteristic of territory as an attribute that translates into improved market access for products bearing a geographical indication, through the development of a sustainable competitive advantage.

As such, the economic value of geographical indications is to a large extent based on the economics of differentiation and niche marketing. This "socially constructed differentiation" allows small producers to create a competitive advantage similar to that of a trademark. However, Alavoine-Mornas (1997) warned that the originality a typical local area brings to a product can only lead to a differentiation if consumers recognize its value. This highlights the fact that in some instances niche marketing through origin-labeling may require an extensive awareness campaign in order to capture the benefits associated with differentiation. Also, it should be noted that various factors could weaken the territorial associations consumers have with a product. These factors include aspects such as packaging, processing, distribution and marketing. In certain instances technical aspects of production and/or processing can override features of the product that are intrinsically linked to its area of origin (Rangnekar (2003a)).

Geographical indications act as a strong differentiation tool through the creation of collective monopolies. Seemingly a *contradictio in terminis*, the existence of monopolies consisting of a group of firms was argued by Olsen (1962): "The concept of industry in pure competition, which is everywhere acknowledged, is based on assumptions that are perfectly parallel to those required for the concept of industry in monopolistic competition, which is often denied." (Thiedig and Sylvander (2000)). Cornes and Sandler (1996), as cited by Thiedig and Sylvander (2000), defined a club as "a voluntary group of individuals who derive mutual benefits from sharing one or more of the following: production costs, membership characteristics or a good characterized by excludable benefits".

These collectives further exhibit the characteristics of a monopoly in that they segment the production market and erect barriers on producers which limit entry at two levels. First, only producers within the demarcated area qualify for participation. This is followed by another barrier in that, within this region, only producers who comply with the code of practice fall within the collective. These institutional barriers which are created by limiting the use of the designation and defining the product and production process facilitate the formation of a monopoly which encompasses all producers within the designation who comply with the code of practice. As a result, protection of geographical indications imposes, with reference to producers outside the designation, a monopolistic market structure, given the causal link between a product and its origin which results in a proprietary right for those entitled to use it. The monopoly thus created is not unlike that which is legitimized under trademark law by allowing a "monopolistic right" to a trademark. However, for producers located within the designation, geographical indications retain local, public good characteristics of non-rivalry and non-exclusion. By limiting entry and functioning as a barrier to trade, these collective monopolies thus eliminate competition from similar products produced elsewhere, thereby improving market access for those producers entitled to use the designation. It is, however, important to bear in mind the exclusionary effects which flow from this monopoly formation. This aspect is of particular importance in the developing country context and potential difficulties associated with delimiting production areas should not be overlooked.

Various studies (e.g. Thiedig and Sylvander (2000)) allude to the fact that the collective monopolies which result from GI protection enable producers to capture a premium. That there is indeed a premium to be captured in locality is reflected by the fact that French origin-labeled cheeses earn an average of two euros per kilo more than French non-origin-labeled cheeses. French *poulet de Bresse* has a market price four times higher than regular French chicken. Producers of milk used for Comté cheese are paid 10 per cent over regular milk prices. Similarly, producers of Italian Toscano olive oil have managed to earn a premium of 20 per cent since registration as a geographical indication in 1998 (EU Background Note (2004)).

The size of the premium is dependent on a number of factors such as market size, degree of competition with substitutes, consumer perceptions about the linkage of an indication with product attributes and demand elasticity (Correa (2002)). However, in all instances the premium seems to favor authentic and distinctive products linked to a specific area (Correa (2002)). The premium captured by products displaying a geographical indication suggests that some form of value is embedded in the use of this IPR. This value is a mixture of economic, cultural and social values which derive from locality. Those actors using a geographical indication are thus pursuing a valorization strategy whereby intellectual property is harnessed in an attempt to appropriate these values which allow for the extraction of rent. It should be noted, however, that studies (Loureiro and McCluskey (2000)) indicate that some geographical indications, particularly those lesser known and of lower quality products, may earn small or insignificant price premiums and that a geographical indication does not in all instances result in a price premium.

3.3 Rural Development Potential

Apart from, and partly as a consequence of, the factors identified above, the most fundamental rationale for protecting geographical indications in the EU is found in the rural development potential of origin-labeled products. Both European policies and the literature highlight the importance of supporting origin-labeled products to achieve rural development objectives. Origin-labeled products, by definition, reflect a strict link between product and origin given that the product derives its unique characteristics from the climatic, human and technical environment of the region. As such, origin-labeled products are one of the most evident manifestations of locality and are often considered useful instruments through which to preserve local culture and traditions and to foster rural development, especially in disadvantaged areas (Pacciani *et al* (2001)).

In the developing country context, geographical indications could provide a tool by which rural producers can enter niche markets and attempt to extract a premium, thereby contributing to improving their living conditions through increased incomes. Furthermore, the link between an origin-labeled product and its territory derives not only from paedoclimatic specificities and its strong link with localized specific production assets; it also derives from local culture as it characterizes the "historical memory" of the local population and represents a catalyst of identity (Bérard and Marchenay (1995)). As such, geographical indications draw from both natural and human resources located within the territory, thereby stimulating all the components of the rural economy.

According to Pacciani *et al* (2001), the rural development impact depends on the extent to which local actors succeed in appropriating the rent with respect to actors located outside the territory. The potential of appropriating this rent is closely tied to the ability of local actors to create institutional processes that can regulate the use of these free goods (Pacciani *et al* (2001)). The possibility of enhancing rural development through the use of geographical indications is further dependent on exogenous factors such as the nature of the product as influenced by the level of elaboration, the characteristics of the production process, the marketing channels allowed by the nature of the product, the impact on the landscape and environment, the role of the product in the local culture as well as the structure of the supply chain (Pacciani *et al* (2001)). In addition, the possibility of activating sustainable rural development strategies based on an origin-labeled product depends on the strength of the link between the product and the local community. This would depend to an extent on the identity of the product and its importance in the region. Sylvander (2004) warned, however, that it is not the institutionalization of the resource origin *per se* that enhances development. Instead, the developmental impact of origin-labeled strategies is dependant on how the process is developed, and on the effectiveness of the valorization strategies built upon it (Sylvander (2004)).

In assessing the impact of origin-labeled products on rural development, a multifunctional approach should be followed, accounting also for "secondary" development objectives such as the preservation of biodiversity and traditional knowledge. As such, Sylvander (2004) advised that the assessment of the developmental impact should not be limited to the standard criteria (higher prices, increased sales and employment and income levels). Instead, the distribution of rents within the rural area, the level of participation of local actors, the sustainability and reproduction of the social system and the environmental impact are all factors which should be considered.

Finally, it should be kept in mind that the rural development potential of geographical indications is dependent on an inclusive and representative industry organization that ensures participation of local actors and an equitable distribution of rent. Of particular concern in a develop-

ing country context is the danger of large agribusiness capturing the rents embedded in the geographical indication without any benefits flowing to smaller, rural actors who are often the original custodians of the local resource. Policies around geographical indications should, therefore, provide for the potentially exclusionary effects flowing from GI protection.

4. EXISTING METHODOLOGIES TO STUDY THE ECONOMICS OF GEOGRAPHICAL INDICATIONS

The purpose of this section is to investigate the main methodologies for studying the economics of geographical indications in the context of the economic rationale for their protection. This section draws on the theoretical framework provided in section 3 and provides a discussion and review of some of the empirical studies done with respect to the economics of geographical indications.

4.1 Reputational Effects

Economic theory highlights the role of reputation in alleviating problems associated with asymmetry of information between producer and consumer. In the case of origin-labeled products, the literature makes reference to product reputation as a factor which can yield a "rent" based on the tradition and quality of the product (Belletti (1999)). A significant body of literature investigates the issues related to the establishment of a producer's reputation for quality when consumers have imperfect information. Although the theoretical literature on firm reputation is well developed, only a few empirical studies have been done. Of these, only a small number analyze the importance of collective reputation.

Belletti (1999) suggested the use of "quality premia" models of reputation developed by Klein and Leffler (1981) and Shapiro (1983) to explain the role of reputation in the case of typical products. The author departed from this frame of reference and reflected upon the mechanisms that give rise to the reputation of typical products. He investigated the importance of reputation in the process of development of typical products and addressed questions regarding instruments for protecting geographical indications under the EU Regulation. The case of Toscano extra virgin olive oil was studied and an outline provided of the process of constitution, crisis and institutionalization of the product's reputation. The limited role of individual reputation as reflected by the value of the key parameters of the "quality premia" model is highlighted. The author explained that the relevance of exogenous and social factors in determining the specificity of typical products causes reputation to assume the character of a collective asset, making it partially the outcome of a non-intentional event. This is in contrast to "quality premia" models in which reputation results exclusively from the choices of the individual firms. The analysis by means of "quality premia" models allowed the authors to go beyond the understanding of reputation as "notoriety", associating it to a set of product-specific investments sustained by the firms in the supply chain of a typical product. Analysis of the case of Toscano extra virgin olive oil demonstrates how the PGI contributes to a "recollectivization" of the reputation capital bound to the area of origin.

In their paper, Landon and Smith (1997) provided an empirical analysis of the extent to which consumers use reputation and current quality indicators when making purchasing decisions. The analysis is conducted by relating prices to the information that is available to consumers. Departing from the standard hedonic model of differentiated product price determination developed by Rosen (1974), the authors estimated and compared five models of price determination that differ only with respect to the quality-reputation information available to consumers. The authors estimated the models using data from the market for Bordeaux wine.

Collective reputation variables are based on government-determined Bordeaux regional designations and industry-determined quality classifications. A limitation of this approach is the fact that the results are based on data of only one product. The data set does, however, include a large number of observations. The study concludes that a model which combines individual reputation and collective reputation variables provides a reasonable description of the information used by consumers, with collective reputation being based on the quality of the product produced by an individual firm on the average quality of the goods produced by a group of firms with which the individual firm is identified. The result suggests that consumers place considerable value on mechanisms that provide information on past quality. The study further indicates that the price premium associated with the collective reputation variables is as large as that associated with individual firms' reputations. The authors point out that the high value that consumers place on the government-determined regional designations and on the industry-determined quality classifications suggests that both government and industry can meaningfully provide information product characteristics.

In a further study based on the same type of model in which price is a function of current quality and expected quality (where expected quality depends on reputation), Landon and Smith (1998) deepened their analysis and empirically estimated the magnitude of the impact of reputation and current quality on price, again using data from the market for Bordeaux wine. The analysis again distinguishes between the impact on price of both individual and collective reputation. In developing the model, the authors proceeded to jointly estimate the equations determining price and expected quality. The results indicated that the price of Bordeaux wine depends significantly on both expected and current quality, but that the marginal impact of expected quality on price is approximately 20 times higher than that of current quality. The results further indicated that consumers consider a long-term reputation for quality as a more significant indicator of current quality than recent quality improvements. The authors deduce from this that it may take a considerable time for a firm to establish a reputation for high quality that would result in a significant price premium. The results also indicate that collective reputation indicators play a significant role in price determination principally through their impact on expected quality. According to the authors, one explanation why both current quality and expected quality (reputation) are significant determinants of price may be that there are different types of agents in the market, some of whom are better informed about current quality than others. Alternatively, consumers may view observable quality as "noisy indicators" of actual quality and may thus rely to a greater extent on the accumulated evidence embodied in reputation.

Winfree and McCluskey (2005) equated the reputation of a product to a common property resource exclusive to the firms marketing the product. Their work is based on that of Tirole (1996) and his idea of collective reputation where it is assumed that the firms in the group share a common reputation based on the group's past average quality. Using a dynamic optimization framework that utilizes tools from differential game theory, they showed that with positive collective reputation and no traceability, there is an incentive to extract rents by producing at lower quality levels. The authors furthermore illustrated that the sustainable level of collective reputation decreases as the number of firms in the production area increases. The authors concluded by proposing the implementation of minimum quality standards to sustain collective reputation.

4.2 Supply Chain Analysis and Transaction Cost Economics

Various aspects of geographical indications lend themselves to a transaction cost economics analysis. In particular, transaction cost economics provide insights into contractual and organizational issues of relevance in the GI context. Information economics (Kirmani and Rao (2000))

furthermore highlight the value of brands as a signaling device in order to reduce transaction costs, an analysis which can be fruitfully applied to the use of geographical indications.

In this respect, Raynaud *et al* (unknown) provided a transaction cost explanation of brand value. The authors explained the critical value of a brand to a firm since, from the perspective of information economics, brands are valuable assets because they economize on consumers' transaction costs. The more the brand contributes to reducing transaction costs (and with that, increasing information on product characteristics), the higher the value of the brand.

Raynaud *et al* (2002) studied the governance of transactions in the supply chain as a way to support the credibility of quality signals. It is assumed that the governance structures that are designed in the vertical chain try to guarantee the quality to the final consumer and that there is co-variation between the characteristics of a quality signal and the governance mechanisms in the supply chain. The authors set out to characterize the diversity of organizational forms found in the case studies and to explain this diversity by the heterogeneity of quality strategies. It is hypothesized that different quality signals give rise to different credibility issues and contractual hazards that in turn imply different governance structures. A structural analysis of 42 case studies in three different agrifood sectors was conducted in seven European countries. Following transaction cost economics, the study is essentially comparative and allows for comparison of the different governance methods. In particular, the authors built on Williamson's (1991) and (1996) work on governance structures to describe and compare the several bilateral governance structures observed. In order to analyze the governance of transactions in the different supply chains, the authors drew from Williamson (1996) and designed a typology of bilateral governance structures for each transaction. This method makes it possible to (1) disentangle different contractual relations and (2) to rank these relations on a market-hierarchy axis. In this study, however, the authors presented a more detailed classification to account for the diversity of situations (different sectors, different products and different quality signals, etc.). The study shows that when an agent creates a quality signal whose value can be influenced by several other agents in the supply chain, he will design the governance of transactions in order to assure product quality and improve the credibility of his signal.

Barcala *et al* (2007) studied governance aspects of the vertical chain and its impact on product quality. Different mechanisms of governance such as hierarchy, quasi-integration and geographical indications were analyzed to determine how organizational forms impact on product quality. A case study approach was used and the authors found empirical evidence in a set of international cases of quality brand names in the agrifood sector. The study found that quality problems may be ascribed to the high transaction costs, and that mechanisms of governance thus affect product quality. The results indicate that the most market-oriented mechanism of governance in the sample (quasi-integrations and geographical indications) need to introduce (1) coordination-oriented mechanisms such as norms and routines to perfectly define standards and attributes and (2) a complementary set of quality control devices based on direct supervision. Finally, the study found that the average price premium paid by consumers for quality products is much higher for geographical indications than in hierarchy-type cases. The authors concluded that the vertical chain could be more efficiently organized as a geographical indication than in the case of hierarchy in order to promote high-quality products.

Wilson *et al* (2000) conducted two case studies to examine the key factors behind the differences in market performance of two PDO products; early potatoes from the UK and from the Netherlands. They showed the influence of the differences in co-operation and co-ordination between the supply chains of the two products, which result in significant differences in product specification and traceability systems, and are associated with different consumer awareness and brand promotion efforts. The material for the supply chain analysis was based on empirical

research. Semi-structured in-depth interviews were conducted with representatives from the actors within the supply chain itself and the surrounding social, economic and political system. Furthermore, qualitative consumer research was performed for both products.

4.3 Welfare Analysis

Since there will be losers and winners (domestic as well as international) in the process of introducing geographical indications, it implies that there can potentially be a redistribution of welfare that could involve conflicts. Assessing the welfare impact of geographical indications is therefore a critical area of research in this debate. A review of the literature indicates that various studies have attempted to answer the question as to whether quality assurance and certification schemes improve social welfare. Although many of the studies are not directly applicable to geographical indications, many of the proposed methodologies can be applied fruitfully in a welfare analysis on them.

The DG JRC/IPTS Analytical Framework Report (2006) describes equilibrium displacement models as models that can be used to evaluate the impact on market equilibrium (prices and quantities) of a change in an exogenous variable affecting one or several supply or demand curves. These changes in equilibrium make it possible to calculate the impact on welfare of the different factors. Thompson *et al* (2006) provided a methodological framework for the analysis of regional marketing programs which include regional origin-labeling as well as quality assurance and control measures. An equilibrium-displacement model for a segmented market with differential qualities was developed that could be applied to a variety of regional marketing programs. The objective was to model the economic implications of state-financed programs assuring both quality control at a superior level and the regional origin of an agricultural product. To assess the direct and distributional effects of such programs, the authors developed a commodity market model, segmented by both product quality and regional origin. It showed that the price impacts on high-quality and low-quality segments depend crucially on substitutive relationships between markets and the advertising elasticities. It also showed that welfare implications for producers in a program depend on the costs of participation including quality control and on the co-financing mechanism between government and producers.

In her paper, Jackson (2002) analyzed the impact of quality-based labeling on product prices, factor allocation and the resulting effects on producers within the context of an international trading system. Rather than using a partial equilibrium model, a general equilibrium model was used, calibrated to 1998 data, describing US and EU labeling regimes for genetically modified agricultural products. The results of the study indicated that the labeling choices of trade partners have large distributive impacts within national economies, as well as across countries and highlight the importance of using a general equilibrium framework to understand the system-wide impacts of segregation and quality labeling.

Zago and Pick (2004) considered the welfare impact of EU Regulation No. 92/1081 on markets where goods of different qualities are sold. A model of vertical differentiation was used showing the situation where consumers cannot distinguish between the different levels of quality from those instances where the Regulation allows consumers to recognize differing levels of quality. The authors calculated the effects on equilibrium and welfare levels by simulating consumer and producer surplus as well as the equilibrium quantities and prices that emerged. Their findings indicate that the introduction of the Regulation and the emergence of two distinct differentiated but competitive markets leave consumers and high-quality producers better off, while low-quality producers are worse off. With high costs and low quality differences, the total welfare impact of the Regulation can thus be negative. The study also considered the possible

impact on market power and showed that when product differentiation increases market power, then consumers can lose even when producers gain. This highlights the need for any economic analysis of geographical indications to take into consideration the market structure, both before and after obtaining GI status. The study concluded that the impact on both consumer and producer welfare is ambiguous and depends on the characteristics of the product, on technology conditions and on the extent of market power.

Lence *et al* (2006) used a simple model to explore the incentives of individual agricultural producers located in a specific region to collectively undertake a differentiation strategy to market their products. They assessed the welfare and market effects of different producer organizations that vary with regard to the intensity of supply control and used their findings to highlight implications of their results for the EU/US debate. The authors found that as fixed and marketing costs increase and the anticipated market size falls, the producer organization's ability to control supply should be enhanced to cover the fixed costs associated with the introduction of differentiated products. Legal systems allowing for supply control favor Geographically Differentiated Agricultural Product (GDAP) development and can be welfare enhancing as long as they do not allow for more supply control than required to develop the GDAP. The authors found that stronger property right protection for producer organizations may enhance welfare even after product differentiation. Legal systems that limit the producer organizations' market power can result in large technological distortions.

Table 2. A Summary of Studies analyzing the Welfare Impact of Quality and Origin-Based Labeling

Author	Method	Findings
Thompson *et al* (2006)	Equilibrium-displacement model	• Price impacts on high-quality and low-quality segments depend crucially on substitutive relationships between markets and the advertising elasticities. • Welfare implications for producers depend heavily on advertising elasticities, costs of participation including quality control and on the co-financing mechanism between government and producers.
Jackson (2002)	General equilibrium model	• Labeling choices of trade partners have large distributive impacts within national economies.
Zago and Pick (2004)	Vertical differentiation model	• Consumers and high-quality producers are better off, while low-quality producers are worse off. • With high costs and low quality differences, the total welfare impact of the regulation can be negative. • Impact on consumer welfare is ambiguous and depends on the characteristics of the product, on technology conditions and on the extent of market power.
Lence, Marette, Hayes and Foster (2006)	Simple model to assess welfare and market effects with three periods	• Legal systems allowing for supply control favor Geographically Differentiated Agricultural Product (GDAP) development and can be welfare enhancing as long as they do not allow for more supply control than required to develop the GDAP. • Legal systems that limit the producer organizations' market power can result in large technological distortions. • Increased fixed and marketing costs of GDAP systems lead to increased need for supply control.

4.4 Measuring Willingness to Pay for Geographical Indications

From an information theory perspective, products are conceived as consisting of an array of information cues. Each cue assists consumers in evaluating the product. Cues can be classified as either extrinsic or intrinsic (Olsen, 1972). Intrinsic cues refer to characteristics such as physical features of the product (e.g. shape, size, etc.) while extrinsic cues, although related to the product, are not part of its physical description (e.g. price, brand, region of origin).

Growing attention has been paid in marketing literature to the issue of country or region of origin of foodstuffs and its effects on how consumers perceive products originating from a particular region. Several studies underline the role of the region of origin as a quality cue. According to these studies, the region of origin has an indirect impact on consumer preferences as a quality cue that stands in for other product attributes. However, geographical origin plays other more direct roles in determining consumer behavior e.g. through symbolic or cultural values attached to the region.

Various European studies have shown, through analyzing buyers' willingness to pay for specific characteristics, that consumers place value on the origin of food products. Hannemann (1991) outlines the theoretical underpinnings of willingness-to-pay studies as a utility maximization problem subject to a budget constraint. Various methods have been employed in empirical studies to measure consumers' willingness to pay.

Hedonic pricing

Hedonic pricing is a useful approach to study the relationship between price and product quality and has been widely used in consumer economics to evaluate the characteristics of agrifood products. The method uses a regression analysis of the price on the characteristics of the product. The implicit price of a characteristic is defined as the derivative of the price with respect to the product attribute. The hedonic price function captures the relationship between the observed price and the amount of each characteristic contained in the product. The partial differential of the hedonic price function shows the shadow price of the characteristic xi. This differential represents consumer preference and one can make use of the information obtained from the hedonic price to evaluate the impact of place of origin on price

Combris *et al* (1997) applied hedonic pricing to the Bordeaux wine market and estimated a hedonic price function for Bordeaux wine to include both the label characteristics and the sensory characteristics. Data was obtained from widely available wine guides. However, the authors made reference to the inadequacy of these sources for estimating hedonic price equations as they do not verify the following conditions. First, all wines that are tasted should be included in the sample, regardless of whether the wine is considered good or bad. In wine guides the wines of inferior quality are often deliberately under-represented for commercial reasons. Second, bottles that are specially prepared to participate in a wine contest must be avoided as they are not, in general, representative of the overall production of the chateau. Third, in order to ensure objectivity, the bottles must be evaluated and tasted by independent experts. Fourth, blind tasting must be carried out. Finally, all the wines in the sample must be bought under the same conditions.

In contrast to previous studies using hedonic pricing,[1] the authors' data included detailed information on the sensory characteristics of wine. With respect to their model, the dependant variable is the logarithm of the price of Bordeaux wine and in the explanatory variables the authors included all the characteristics of the bottle (both objective and sensory variables). The empiri-

cal results indicate that the market price for Bordeaux wine can be explained primarily by the objective characteristics appearing on the label of the bottle. As it is expensive to obtain information about sensory characteristics (through tasting, learning and reading wine guides) consumers may decide to make their choice primarily on the basis of the objective characteristics, thus explaining the absence of almost all sensory characteristics in the hedonic price function.

Loureiro and McCluskey (2000) analyzed the consumer's willingness to pay for PGI label veal from Galicia using a hedonic price function. Data on consumption and attitudes toward meat was collected from a representative sample of 157 families. The results indicate that the presence of the label generates a high premium only in high-quality meat cuts while in cheap cuts as well as for the highest quality cuts, the label does not generate any extra premium. The study concludes that the impact of the PGI label is significant in combination with other quality cues. The authors point out that while the PGI label is a powerful tool to promote the quality and obtain a price premium when the collective reputation is good, its use on products that are not of high quality is not an efficient marketing strategy, and they suggest that it could impact negatively on the collective reputation. The authors cite cultural identification as well as perceived quality to account for premia found using the hedonic model.

A study by Teuber (2007) explored the economic impact of GI protection for coffee. Using Internet auction data for single-origin coffees, a hedonic pricing model was estimated. The results indicate that, in the specialty coffee sector, coffees from individual coffee-growing regions receive price premia due to their reputation and that country and region of origin already play an important role in price determination. The author however, pointed out that although these findings are similar to the findings of studies on the wine market, the case of coffee differs in that it is an intermediate good which is sold, and not a product which is ready for final consumption. The author adds that this holds implications for the scope of protection a geographical indication receives and that protecting the production process from harvesting to roasting would alter the whole supply chain and trade patterns.

Table 3. Empirical Studies utilizing Hedonic Pricing

Authors	Type of data	Products	Main results
Combris *et al* (1997)	Data on sensory and labeling characteristics. Data from wine guides and price data.	Bordeaux wine	• Market explained mainly by objective characteristics on label due to cost of obtaining sensory information.
Loureiro and McCluskey (2000)	Consumer survey on consumption patterns and attitudes.	Galician veal	• PGI as a powerful marketing tool in combination with quality indicators. • Marginal diminishing returns with respect to quality.
Teuber (2007)	Internet auction data for single-origin coffee	Single-origin coffees	• Single-origin coffees receive price premia due to their reputation.

Multinomal logit models

Bonnet and Simioni (2001) suggested multinomial logit models, as first introduced by Boyd and Mellman (1980) and Cardell and Dunbar (1980), as an alternative to hedonic price models. In their opinion, multinomial logit models provide a flexible specification for representing the distribution of preferences in the population and the choices of each consumer. In contrast to hedonic price models, multinomial logit models do not exhibit the property of independence of irrelevant alternatives. The authors estimated consumers' willingness to pay for PDO labeled French Camembert cheese using scanner data on purchases of Camembert brands in the French market. They estimated mixed multinomial logit models where the parameter associated with each observed product attribute is allowed to vary randomly across consumers and which is estimated using simulation techniques. The study's results suggest that consumers do not place significant value on the PDO label and that brand appears to be more relevant in the consumer's evaluation of alternative products.

Conjoint Analysis

In addition to the afore-mentioned methods, conjoint analysis is a particularly useful technique to estimate the consumer's overall preference for a product based on its most important attributes. It is a multivariate technique that allows the quality of a good to be analyzed and the product attributes' contribution to total willingness to pay to be calculated based on the assessment of the utility that consumers attribute to individual product characteristics. Monteiro and Lucas (2001) referred to Ness (1997) and Hair *et al* (1992), and pointed out the different possible uses of conjoint analysis:

- "To identify the combinations of the attributes which offer consumers greater utility;
- to evaluate the relative importance of each product attribute or feature for the consumer's utility or preference;
- to calculate the market share based on the consumer's evaluation of attributes and their respective levels in the product;
- to segment the market through the study of consumer preferences; and
- to evaluate market potential or opportunities by exploring unavailable attribute combinations."

Monteiro and Lucas (2001) carried out a conjoint analysis on consumer preferences for four main quality attributes of traditional cheeses: price, quality certification label, type of paste or texture and sale size unit and to identify groups of consumers with similar preference profiles according to those attributes. Data was collected from 269 consumers from six municipalities in Greater Lisbon who knew and bought PDO cheese using a stratified random sampling based on age and municipality of residence. They showed that the most important attribute for consumers of Portuguese traditional cheeses is the PDO protection, followed by price, type of paste or texture and then, sale size unit. By showing that the PDO labeling is more important to the consumer than the price, they supported the idea of a PDO benefiting from a price premium. Based on the attribute levels' utilities, they grouped consumers in three clusters, the first corresponding to the least price-sensitive with a preference for creamy cheese (28 per cent), the second to the very price-sensitive (16 per cent) and the third to include those consumers that consider both price and PDO protection as very important.

In their paper, Van der Lans *et al* (2001) tested the hypothesis that region of origin cues and PDO labeling influence regional food product preferences directly and not only indirectly through its perceived quality cue. The study was done by applying conjoint analysis to data on

Italian consumers' quality perceptions and preferences for extra virgin olive oils from Sabina and Canino, Italy. A total of 165 consumers were interviewed and asked to rate their overall perception of product quality and their product preference for 22 extra-virgin olive oils. The study concluded that the region of origin cue and the PDO label were both found to influence regional product preferences through perceived quality, although the effect was limited to specific consumer segments, especially those residents in the product's region of origin.

Fotopoulos and Krystallis (2003) set out to explore the effectiveness of PDO labeling and its acceptance by consumers through the use of conjoint analysis. The study explored whether consumers place more value on a food product with a quality label, through calculating Greek consumers' willingness to pay for PDO apples from Zagora, Central Greece. The results of the conjoint analysis indicated that the existence of the PDO label was more important than price only for certain segments of consumers.

Table 4. Empirical Studies utilizing Conjoint Analysis

Authors	Data used	Product	Results
Monteiro and Lucas (2001)	Portuguese consumer surveys	Portuguese traditional cheeses	• Between the price, the quality certification label, the type of paste or texture and the sale size unit, PDO protection is the most important attribute for consumers. • Three clusters of consumers were found based on the attribute levels.
Van der Lans *et al* (2001)	Consumer interviews on perceptions and preferences	Italian olive oil	• Region of origin cue and the PDO label both influence regional product preferences through a quality cue. • Region of origin also has direct impact on preferences of some consumers, especially those resident in the product's region of origin.
Fotopoulos and Krystallis (2003)	Full concept data collection method	Zagora apples, Greece	• Results indicate a preference for PDO-labeled apples. • Existence of PDO label is more important than price only for certain segments of consumers.

4.5 Rural Development Impact

Despite arguments supporting the rural development potential of geographical indications, few empirical studies measure whether they actually contribute to endogenous development processes. In measuring the impact of geographical indications on rural development, indicators such as increased rural incomes, market access and employment effects need to be studied. A further important impact is the potential exclusion dynamics which may arise from the institutionalization process associated with GI protection.

An attempt was made to study the link between territory-based product qualification processes and rural development by Tregear *et al* (2004). The paper aimed to investigate what happens in practice when actors in a local rural area pursue qualification for an agrifood product. A case

study analysis was conducted to show how three small-scale agrifood productions evolve, examining which actors are involved, what their motivations are and what is the development impact of qualification in terms of EU Regulation No. 2081/92. The authors made use of data gathered as part of the EU DOLPHINS[2] research project and found that product qualification may be utilized as part of a territorial strategy. However, the effectiveness of this depends on the presence of various factors. The results of the study are ambiguous on whether qualification processes *per se* can bring about development. The authors pointed out that the process of interaction and debate which lead to the creation of interest groups, holds certain advantages. However, conflict may also arise between the different actors, and decisions on codes of practice and exclusivity need to be addressed with circumspection so as to encourage the different actors to engage in activities that assist development. The authors concluded that product qualification may act as a mechanism for linking local and non-local actors and that it is a means by which local actors can signal and attract revenues from exogenous actors and institutions.

Callois (2004) investigated the assumption that quality labels may act as levers for inducing economic growth. He studied the consequences of quality labels on the redistribution of income and activities between rural and urban areas. The author not only took into account the income directly generated by producing under the quality label but also looked at the effect of this agricultural differentiation. In particular, he tested the assumption that higher income for farmers positively impacts the region through the multiplier effect. To test these assumptions and to determine under which conditions a differentiation strategy based on quality labels may lead to economic growth in a rural area, the author employed a new economic geography model, based on Krugman's (1991). Despite very specific functional forms, this framework was chosen for its ability to study how positive externalities in industry may lead to situations where all economic activity becomes concentrated in one region. Furthermore, as a general equilibrium model, the framework allows one to study indirect effects between sectors. The study's results strongly qualify the potential of quality labels to induce rural development. In particular, the study alludes to the potential exclusionary effects which may arise as the income of only some farmers increases while the region as a whole does not benefit. The author cautioned, however, that the results are model specific and should not be seen as conclusive evidence that quality labels only benefit a minority of farmers.

5. A CONCEPTUAL APPROACH TO STUDYING THE ECONOMICS OF GEOGRAPHICAL INDICATIONS IN DEVELOPING COUNTRIES

Having reviewed the various methodologies that have been used to assess the economics and economic impact of geographical indications, it is now important to consider the appropriateness of the above-mentioned methodologies for the study of geographical indications in developing countries. It is evident that most economic studies of geographical indications have been done in European countries where the concept is well entrenched. Before we can consider the most appropriate ways to study the economics of origin-based products in developing countries, it is important to identify the economic issues relating geographical indications that are particularly relevant to developing countries:

(a) Misappropriation

Many developing countries are at various stages of developing legislation for GI protection and are also considering the most suitable options for international protection for their important origin-based products such as *basmati* rice, Colombian coffee or *rooibos* tea. There is a strong international trade dimension behind the motive for 'international' protection, which may be

particularly important for developing countries. The move towards greater protection of geographical indications in developing countries is attributable to an increase in instances of misappropriation and usurpation, particularly in export markets, which may prevent local actors from capturing the rents associated with their traditional products and resources.

(b) Traditional and Indigenous Knowledge and Resources

Many developing countries are rich in traditional knowledge and often boast a large biodiversity. In this respect, concerns about "bio-piracy" have come to the fore, and developing countries could be inclined to use mechanisms such as GI protection as a way to preserve (and possibly benefit from) their national intellectual and cultural heritage as well as their biodiversity.

(c) Improving Market Access, Niche Markets, Protection of Reputation

Many unique products originating from developing countries have strong reputations usually linked to their health benefits, high quality and other unique attributes related to the country or region of origin. Being able to protect this reputation through a GI-type system could potentially be useful for farmers and traders in improving market access.

(d) Potential Income Effect

Preventing usurpation of origin-based products and protecting the reputation of these products could potentially have a strong developmental impact through an improved income effect. Ultimately this could contribute to increased employment and improved livelihoods. There is thus a strong argument related to the potential economic development role of protecting geographically based products in developing countries against exploitation and misappropriation by international traders. However, the possibility of effectively benefiting from potentially increased income for producers through GI protection is strongly dependent on their capacity to implement effective enforcement as highlighted by a study conducted in India (World Trade Report (2004)). This study looked at the effect of legal protection on the demand for and price of Darjeeling tea. The results suggest that GI protection increased the price of Darjeeling tea in total by less than 1 per cent in real terms over the 1986-2002 period, which indicates a very modest price premium effect as a result of GI protection (although an improvement in quality was observed that may be linked to GI protection). According to the authors, this is partly explained by a possible gap between the legal protection that has been given to Darjeeling tea in India and the quality of the enforcement procedures. This dimension appears as particularly relevant from a developing country perspective.

In the context of the current international debate on GI protection and the establishment of a multilateral register at the WTO, discussions on what might be most convenient for developing countries have attracted significant attention. Following Rangnekar (2004), the costs of developing the required domestic institutions for the effective implementation of GI protection, and for the different groups interested in acquiring and enforcing their rights, should be balanced against the increased efficiency that might be brought about by a centralized register (as opposed to multiple registrations in different countries that may not be feasible for resource-poor groups). However, another important dimension associated with this debate, which might benefit from empirical research, has been the issue of extending GI protection to a number of GIs already protected in certain markets (e.g., the "clawback list" of the European Union). In this regard, Kerr (2006) has suggested that in developing countries strong GI protection and reciprocity in protection could mean that local producers who used to market their products under a newly protected GI would have to build alternative marketing strategies. The debate, in this regard, is whether the benefits accruing to the extended group of beneficiaries of GI protection

would outweigh the costs associated with the restriction over the use of some product names. According to Rangnekar (2004), domestic market disruption provoked by these restrictions will have short-term implications. On the other hand, some authors, such as Kerr (2006), argue that, to raise the benefits of GI protection, producers from developing countries would in most cases need to invest significantly in marketing campaigns with little chance of being able to sustainably capture a rent. To support his argument, Kerr (2006) referred to Cardwell (2005) which showed that the effects of marketing campaigns for products such as Washington apples require long-term resource engagement to be sustained. This question is highly dependent on product specificity and actual reputation.

Thinking about the economics of geographical indications in developing countries is rather more complicated and more multifaceted than is usually appreciated. The reasons for this are: (1) the fact that the geographical indication concept is rather foreign and new to many developing countries; (2) the institutional and legal systems are not necessarily in place to ensure sufficient domestic and international protection; (3) the economic benefits of a geographical indication system often have more of an international and market access dimension; (4) the majority of the population is rather poor and will not normally respond to the niche market concept of geographical indications, so domestic willingness-to-pay studies will not necessarily be appropriate.

Given the interest that GI protection has generated among many groups of producers of origin-based products in developing countries, it is likely that many future studies on geographical indications in developing countries will investigate the feasibility of GI protection for a number of specific products. In such cases, some *a priori* assessment of the current and future potential of the product in terms of its volumes, distinctive quality, homogeneity, pricing and cost of managing the supply chain, the existence of a market demand for the unique attributes of the product and the existence (or potential) of unfair competition will be required. Apart from these aspects, the more fundamental issue to be addressed in developing countries is to determine the economic effects of introducing a specific geographical indication and in the process to distinguish between the economic effect on producers, rural areas, livelihoods, and food security.

Linked to the process of analyzing the benefits to producers, economic studies will also be needed to compare the costs and benefits of alternatives to *sui generis* protection of geographical indications, for example, via trademarks, certification marks, collective marks or unfair competition law. These economic studies would also need to integrate legal and institutional issues to weigh up the benefits of each alternative system. The purpose of the protection or certification and the markets in which protection is required will, however, to a large extent, inform the outcome.

With the reality of developing countries in mind and having the inventory of existing methodologies related to the study of economics of geographical indications in hand, it is evident that the economic studies of geographical indications in developing countries required to investigate the feasibility of GI protection for any specific product would need to adopt an interdisciplinary approach with less of a rigorous quantitative approach in terms of testing consumers' willingness to pay. There is clearly a need for a more integrative approach to studying geographical indications in a developing country context, which would, in most cases involve the combination of law, economics, and natural sciences.

The first obvious question that would need to be asked would be: Is there a need or potential for GI protection for a specific product? In the process it is necessary to ascertain:

- the unique characteristics of the product that are linked to the geographical area or the people of the region, i.e. the product specificity (here a combination of natural sciences,

social sciences such as ethnography, anthropology as well as consumer perception surveys would be necessary);
- the quality and reputation of the product (e.g. through consumer surveys);
- the potential for a price premium or the potential loss in price and income as a result of usurpation, etc. (e.g. through economic surveys of price trends and farm incomes).

If the need for GI protection is ascertained, the second question would focus on the appropriate legal and governance system necessary to protect the reputation and the regional specificity of the product (legal and institutional analysis). One would therefore also consider the merits of alternative systems such as protection under trademark law. In this process, the focus would be on:

- the costs of the different systems (certification and inspection);
- the benefits of each alternative system; and
- the need for, and the strength of, producer and region-based collective organization.

The third set of issues that would have to be studied and addressed is the welfare, distributional and exclusionary effects of such a geographical differentiation strategy. In light of the extreme poverty and inequality in most developing countries, this aspect would have to be addressed from a political economy point of view. Ideally, studies on these issues would be undertaken using rather sophisticated and data-intensive econometric models such as equilibrium displacement models, partial and general equilibrium models, although data availability is likely to be a major constraint.

A literature review reflects virtually no examples of empirical studies on the economics of geographical indications in developing countries. This is partly due to the current limited debate on the matter, the lack of research capacity, as well as the general lack of reliable price and volume data in these countries.

However, as we are currently involved in a research project funded by the French DURAS program looking at the potential implementation of a GI-type system of protection for agricultural products in South Africa we will briefly illustrate the methodology followed in two cases to give readers a feel for the approach we followed to assess the merits for a GI system in South Africa, as relates to these two products.

6. THE APPLICATION OF ELEMENTS OF THE CONCEPTUAL FRAMEWORK: CASE STUDIES FROM SOUTH AFRICA

6.1 Karoo Lamb

Windmills, sheep, farm homesteads, endless vistas, home-baked bread, hospitable nights… these images are engrained in the minds of many South Africans when they think of the Karoo. Because of these images, and the tranquility and honesty of the Karoo way of life, the "Karoo" concept has become synonymous with quality, tradition and wholesomeness. The reputation for quality which exists in words such as "Karoo" has significant marketing potential and is sought after by producers with little or no link to the region.

The Karoo covers almost 50 per cent of the total area of South Africa and is sparsely populated, far away from major urban and distribution centers. This lonely corner of the earth is home to one of South Africa's living treasures: flocks of sheep, grazing freely amongst the scattered shrubs. Their meat has been described as "mouth-wateringly succulent, imbued with the subtle, fragrant flavors of the Karoo bush". It is not surprising – they feed on wild herbs, thousands

of different species of them, where normally sheep live on one type of grass. It is a most exquisite lamb, the world-renowned free-range Karoo lamb.

Most people love Karoo lamb; it is spiced on the hoof and has a special flavor. It is argued that the bushes in the Karoo provide this taste but perhaps it is the way the farmers finish the animals in free-range environments. It is still not sure what the difference is and very few people have discovered the secret, but as some people argue "my palate knows the difference". By all accounts, most chefs agree that there is something special in Karoo lamb.

The Production Area

The great semi-arid area stretching North-eastwards from the Cape is called the Karoo. Typically, it is flat dry shrub land with grass-growth restricted to the moistness of the occasional mountain ranges. Rainfall is sporadic, less than 500 mm a year, in some places a great deal less. Periods of drought last for several years, affecting the region and its plant growth. Notable droughts occurred in the periods 1919-31, 1944-49 and 1962-73. Since 1974 it has been a relatively wet period.

Apart from Karoo lamb, the vast region of the Karoo produces little else of note. Total gross income from agriculture in the Central Karoo District Municipality (roughly representing the Karoo region) in 2002 was 147,9 million rand with sheep providing the largest share (54 per cent), followed by animal products such as wool or mohair (22 per cent).

Production Processes

The specific taste of Karoo lamb is largely due to the fact that the production is virtually organic except for minor doses for typical sheep diseases such as blue tongue. Karoo lamb is marketed straight from the field and no additional feed is provided. Sheep that are sent to a feedlot to be fattened do not have the same taste and lose the characteristic taste. It is for this reason that farmers have already agreed that fattening in feedlots is not part of the production process of Karoo lamb.

There is, however, some debate about whether the particular taste is only to be found in the Dorper breed or in the Dohne merino breed. The additional debate is whether certain bushes contribute to the specific taste which then makes the demarcation of the production region so critical. The demarcation of the region is, therefore, largely based on the vegetative and soil classifications.

The Product and its Existing Reputation (Product Exposure)

At present there is no existing scientific literature on the sensory qualities of Karoo lamb and/or mutton. As noted earlier, Karoo lamb/mutton has become associated with a unique and desirable flavor, being described as much sought after. In order to protect the geographical name of the Karoo, as well as the indigenous resources associated with Karoo lamb/mutton, the potential exists for the establishment of a geographical indication based on the reputation of quality and flavor in combination with the nostalgia generated by the perception of the Karoo region. However, it is critical to establish whether the perceived aroma and taste differences between Karoo lamb/mutton and lamb/mutton from other regions are scientifically measurable.

The product "Karoo lamb" has been part of South African culture for more than a hundred years. It is part of the Afrikaner and also Cape cuisine and many regions and towns in the Karoo market their towns, restaurants and guest houses as "the home of Karoo lamb". On the menu of most of the restaurants and guest houses in the Western Cape and Northern Cape the various dishes made from Karoo lamb can be noticed. With many Afrikaners being urbanized over the last 40 years and the connection to rural South Africa being diminished, the nostalgia around the traditional Afrikaner way of living is somehow satisfied through the association with Karoo lamb and to have a nice typical braai with a few good friends.

There is thus a strong geographical as well as cultural link in the Karoo lamb concept. However there is no insignia, no certification and no guarantee that the product truly originates form the Karoo when it is sold as Karoo lamb. Only one retail chain (Woolworths) has registered a trade mark for a Karoo lamb product: "Free Range Karoo Leg of Lamb".

In order to scientifically test the "taste" reputation of Karoo lamb and to determine whether there is a demand amongst consumers, we embarked on a number of studies (again illustrating the combination between biological and consumer sciences to verify the economic value of the product).

The primary objective of this part of our research was to compare the fatty acid profiles, sensory attributes and cooking-related properties of M. Semimembranosus (leg), cooked according to a moist heat-cooking method, of Age B mutton from fat class 3-4 of Dorper and Merino from the Karoo with that from other production areas using quantitative descriptive analyses.

The secondary research objectives were:

- to determine whether there is a sensory detectable difference between mutton produced in the Karoo region compared with mutton produced in other regions of South Africa and Namibia;
- to quantify the fatty acid profile of mutton produced in the Karoo region compared with mutton produced in other regions of South Africa and Namibia, as well as indigenous plants traditionally linked to the unique flavor compounds in mutton from the Karoo region;
- to determine whether there is a difference in consumers' degree of preference for mutton produced in the Karoo region compared with mutton produced in other regions of South Africa and Namibia in a blind evaluation experiment.

For our consumer research component of this study the main objectives were to establish consumer awareness and perception of South African mutton and to measure consumers' degree of preference for mutton linked to the geographical production origin of the meat. This was not a willingness-to-pay study but a survey to test consumer perceptions and general awareness to form an indication of the reputation of the product.

The research results are currently being processed but initial indications are that there are clear distinguishable sensory attributes of Karoo lamb – thus confirming the perceived reputation. A next step of the research is to estimate the potential premium that Karoo lamb can extract from the South African market for red meat.

6.2 Rooibos

Rooibos is an herbal tea made from Aspalathus linearis, which is an indigenous plant of the *fynbos biome* in South Africa. It only grows in the Cedarberg region of the Western Cape Province and the high-lying areas in the southern parts of the Northern Cape Province. Rooibos is also only processed in this region. *Rooibos* is the Afrikaans word for "red bush". Different qualities of *rooibos* tea are attributed to different soil and climate conditions, with some areas recognized for their superior quality.

Rooibos is known as a specific product from South Africa. It has become a popular tea worldwide, especially appreciated for its polyvalence and health benefits. Traditionally gathered in the wild, *rooibos* is nowadays mainly cultivated. It is carefully chopped, fermented and then dried and sifted. Through the fermentation process, *rooibos* gets its characteristic red color, its distinctive flavor and sweet aroma. It has a long history related to a specific territory: the processing stage still mainly relies on traditional methods, which trace back to the Khoi and San populations over 300 years ago. *rooibos* cultivation practices have been developed over the last century by the different settled populations. Its cultivation is now strongly associated with the landscape of the Cedarberg region and that is a key element of its identity. It has become a South African heritage.

Primary production involves between 300 and 450 farmers, both commercial (about 97 per cent of production) and small-scale farmers. Areas under cultivation range from a few hectares to over 5,000 hectares per farm, but these large-scale producers are in the minority. Most of the small-scale farmers are members of two cooperatives that grow, process and market *rooibos* mainly for the fair-trade market. *rooibos* processing is dominated by eight large companies mainly located in the Cedarberg production zone that collect and transform it and sell it to intermediaries who market it. Among these processors, *rooibos* Ltd[4] holds 75 per cent of market share, dominating in particular the national market through the National brands group.[5] The turnover of the *rooibos* tea industry was estimated at 180 million rand in 2004 (corresponding to 22.5 million euros). The export market represents more or less 60 per cent of the production against 40 per cent for the domestic market.

Rooibos is sold pure or in blends. The deployed qualification and certification strategies are diverse: fair trade, organic farming, "wild *rooibos* tea". These strategies can support strong differences in prices paid to the producers: in 2005, *rooibos* Ltd, whose production is mainly conventional (only 15 per cent organic) paid 1.9 euros for 1 kg of dried *rooibos* while the Wupperthal cooperative, whose production is all organic and certified through fair-trade channels, paid 3 euros per kg. However, this diversity primarily concerns the export market and is restricted to small niche markets. Most of the exporting (over 90 per cent) is done in bulk.

The Need for Protection

Rooibos is not currently produced anywhere else in the world, but with the increased international demand for *rooibos* tea, some producers feel there is a threat of possible delocalization of production outside the country. Another more immediate threat arose with the registration of trademarks on the name "*rooibos*" by different companies in different countries. This resulted in a major legal battle in the US that made *rooibos* famous. The term "*rooibos*" was registered there as a trademark in 1994 by a South African company to draw profit from its exclusive rights in marketing *rooibos* under this name in the US. In 2001, the company assigned its trademark to its US agent. Rooibos Ltd, assisted by the South African Department of Trade and Industry and the Western Cape Government, contested this registration for more than six years

and had to spend almost 6 million rand (750.000 euros) in legal fees before they achieved an agreement with the agent, which recognized officially in June 2005 the canceling of its registered trademark. This was made possible because the name *rooibos* was recognized as being a descriptive generic term, commonly used to refer to the herbal tea derived from the Aspalathus linearis plant and thus cannot be used to design a trademark (TRALAC (2005), Silver (2002)).

The increased demand and lack of quality standards on *rooibos* give rise to opportunistic behaviors both from South African processors and traders – who need to create their space in a market strongly dominated by Rooibos Ltd – and from European buyers, on export tea quality. A particularly important dimension is the quantity of stick in the *rooibos* tea, which increases the volume but can degrade the quality and is used in defining different grades. However, up to now, these grades are not equally shared among the industry. The subsequent risk of degradation of quality, and thus of loss of reputation, is perceived as an important threat by some actors. Furthermore, with the dynamics of innovation in the industry and the huge product range (not only the blended herbal teas but also cosmetics, soft drinks and other products), it also becomes more important for the commercial viability of the industry to make sure that it is *rooibos* that is used. With the expansion and opening up of new markets, need for standardization becomes critical. But with more than 90 per cent of the production sold in bulk and the European market being dominated by a few international tea brokers from Germany, control on overseas markets is very difficult.

Another challenge relates to equity issues and the relations between resource-poor farmers and commercial farmers with the power in the industry captured by the elites.

Research Perspectives around GI Development in the Rooibos Industry

Following the dispute in the US, interest in developing a geographical indication for the *rooibos* tea arose both at sectoral and governmental levels. A South African Rooibos Council (SARC) grouping producers, processors and traders has been established, mainly driven by the processors. The small-scale farming community has only recently joined it. Until recently, the efforts for organizing and improving coordination among *rooibos* producers and processors concerned mainly research aspects. However, this is evolving with the increased awareness of the need to protect their product and markets and the perceived risks of quality degradation. Futhermore they are encouraged by public institutions to cooperate; and they are exploring the potential for developing a geographical indication around *rooibos*.

If interest for geographical indications was already present, actual discussions about it took place mainly as a result of the research program we have been undertaking in consultation with the industry since the end of 2005. The broad focus of the research is essentially to consider the appropriate vehicle for IP protection. At the same time, seeking a governance structure that will minimize the transaction costs in a system that will protect the industry against misuse and usurpation of the name, ensure better control over quality and combine the GI and the biodiversity strategy. The first two points have already been well explored and debated; the third will be the object of a broad consultative process with farmers from the different areas of production. The committee has been established so as to ensure representativity of the different role players in the industry and was agreed at the last general assembly meeting of the SARC.

The advanced level of differentiation inside the industry, which has up to now been managed through individual or restricted collective strategies, could be nicely complemented by GI protection. Future prospects could be to consider a geographical indication as an umbrella under which could be defined different specifications to account for the different qualities and

processes of production. This could reinforce small-scale farming communities, for which market access and differentiation for their production is already well developed. Indeed, their access to market is very dependent on fair-trade trends, and communities have potential for strengthening their position in the market by benefiting from the recognition of their specific quality through geographical indications. Indeed, it is known that the areas of production of these communities offer very good conditions for producing high quality *rooibos*. They are settled in one of the best terroirs for *rooibos* production. However, it is worth mentioning that this has not yet been widely discussed inside the industry, which is first concentrating on properly establishing a geographical indication for *rooibos*.

If the GI strategy appears to offer an interesting perspective for the *rooibos* sector and is currently being defined through the consultation process based on the GI committee, it will clearly depend on the evolution of the legal framework. Two options exist: (1) relying on collective or certification marks and thus being primarily based on private strategies and initiatives from the industries, (2) GI benefiting from a *sui generis* system with public interests probably being fostered. The research program is well connected to the policy process and has been instrumental in the evolution of the policy arena from a clear lack of interest, or even a negative view on geographical indications, to a much more open attitude. In this regard, case studies such as the *rooibos* case are enriching the research process and thus the political debate.

7. CONCLUSION

In this paper, an exposition of the economic rationale for protecting geographical indications is provided as a theoretical framework from which to start with empirical research on the topic. The discussion illustrates that providing protection for geographical indications is more than just linguistic monopolization and that the economic underpinnings of geographical indications derive from considerations of value added and market access through differentiation. The collective monopolies which result from the institutionalization process provide producers targeting origin-labeled niche markets with the opportunity to protect and enhance the potential of these markets and to transform the value added into an economic rent.

The economic arguments presented in this paper provide a strong justification for the protection of geographical indications in the developing world. In contrast to more commercialized products, indigenous products with strong links to indigenous people have an advantage in establishing a geographical indication. The stronger the connection between the product and the region, as facilitated through its link with the indigenous people, the stronger the competitive advantage. This is in line with a study which found that geographical indications show the greatest potential to benefit local producers where traditional small-scale production is still present on the supply side, and where end-use products are marketed directly to consumers. In other words, they are less likely to be appropriate when the product is a commodity traded primarily in bulk (Downes and Laird (1999)). This confirms the potential of employing the economic benefits of geographical indications to enhance development for local communities throughout the developing world.

However, from a policy perspective much empirical work remains to be done to determine the direct and indirect impact of geographical indications in the developing world. Existing empirical studies are predominantly done within the European context and do not provide for the characteristics of origin-labeled supply chains in developing countries. As a point of departure, it should be kept in mind that the motivation behind GI protection in developing countries varies from that of their developed counterparts. For one, what is emerging is that developing counties' main objective with GI protection is often the prevention of resource piracy and misappro-

priation. Conversely, the consumer dimension is likely to be of less importance in the domestic market. A further consideration is ensuring an inclusive and a representative industry organization which can facilitate GI protection. Without this, there exists a danger that the larger-scale farmers and agribusiness firms could capture the economic benefits without any of those benefits (higher employment and higher income) flowing to the workers and small rural enterprises. The diversity in and/or lack of supporting institutions and the impact of this on governance and coordination within the supply chain also need to be taken into consideration in empirical studies in developing countries.

Apart from the importance of contextualizing empirical research in developing countries, measurement of the contribution of geographical indications, as reflected in the theoretical arguments mentioned earlier, poses certain difficulties. According to a report of the European SINER-GI project, the main methodological difficulties are linked to (1)"The choice of reference point; (2) getting reliable data; (3) choosing between objective quantitative data methods/subjective qualitative data methods with their specific limits; and (4) separating causes (many factors are working together)."

As the research focus in GI research extends from its origins in Europe to the evolution of origin-supply chains in the developing world, these methodological challenges will no doubt be increased. However, without a collective body of empirical evidence on the impact of geographical indications, policy decisions in the developing world will remain uninformed, potentially producing unintended welfare impacts.

Notes

1 See also Nerlove (1995) and Oczkowski (1994). For a review of the literature about hedonic wine studies see Viana (2006).

2 Development of Origin-Labelled Products: Humanity, Innovation and Sustainability. European Union Concerted Action Project QLK5-2000-00593.

3 This company results from the *Rooibos* Tea Control Board, created in 1954 in order to organize the production and the marketing of *rooibos*. Until the 1990s, this state organization was the only actor in processing and marketing *rooibos*. In 1993, it was voluntarily dismantled and its assets were shared among the producers who founded Rooibos Ltd. Even now, some 200 producers hold the majority of the company's shares and are its principal suppliers through a fixed annual price system.

4 Rooibos Ltd supplies 95 per cent of the local market.

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COMMENTS ON
THE ECONOMICS OF GEOGRAPHICAL INDICATIONS: TOWARDS A CONCEPTUAL FRAMEWORK FOR GEOGRAPHICAL INDICATION RESEARCH IN DEVELOPING COUNTRIES

JOHN WILKINSON*

Introduction

The paper by Cerkia Bramley, Estelle Biénabe and Johann Kirsten provides an excellent review of the literature on the economics of geographical indications, and the central questions identified are then admirably elucidated through the presentation of two case studies carried out in South Africa. The paper covers the principal theoretical issues relating to geographical indications, focusing on the economics of information, reputation, niche market formation, monopoly or club theory, and the creation of value added. It also provides a literature review of the main methodologies applied for the study of geographical indications – analysis of reputational effects, supply chain and transaction cost approaches, welfare analysis, and willingness to pay (hedonic pricing, multinomal logit models and conjoint analysis).

They draw attention to the fact that these methodologies have been applied to date only to geographical indications in the European context and argue for the need to focus on the specificities of those in developing countries: the concept itself is both foreign and new; the institutional and legal systems are not in place; the economic benefits more related to international markets; the populations are generally too poor to support niche strategies, questioning the usefulness of willingness-to-pay studies.

The central issue, nevertheless, is that of the feasibility of geographical indications in the developing country context, which means that there must be some analysis of the current and future potential of the product, an appreciation of market demand and an evaluation of the question of unfair competition. In addition, it will be necessary to assess the likely economic impact of GI introduction for different stakeholders. Geographical indications will also have to be analyzed in the light of alternative forms of protection (trademarks, certification marks). The authors then make the important point that in the developing country context methodologies will necessarily have to adopt a less rigorous quantitative and more interdisciplinary approach.

On methodological approaches appropriate for developing countries the authors rightly draw attention to three points: where a geographical indication does not already exist, a prior analysis of the product's potential is important since this might avoid wasteful investments; there should be an evaluation of the type of protection most suited to the context – trademark, certification, or geographical indication; if the latter is seen to be viable a preliminary analysis of likely impacts would be pertinent. We could add here the importance of evaluating the broader institutional context, which predisposes towards one or other system of protection with differential indirect impacts. In each case, however, levels of organization are crucial to a successful outcome and these should be the object of prior analysis. If we are dealing with a geographical indication there should also be an evaluation of the broader development impacts and the likely division of benefits.

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The authors then highlight three questions: is there a need for GI protection for the specific product under consideration (unique characteristics, reputation and potential for price premium)? What should be the appropriate legal and governance system (costs, benefits, collective action capacity)? What are the likely welfare, distributional and exclusionary effects of GI protection? The authors suggest that, in terms of methodology, priority should be given to the use of surveys. They seem to suggest, however, that such surveys are subjective in contrast to econometric studies which would be objective. In the case of developing countries the key point would seem to be the lack of data, particularly over time. It would be highly useful to establish base-line data at the outset but this would require the dedication of considerable research resources. It is also important to define control variables which would allow discrimination between the effects of the geographical indication and broader systemic influences.

The paper provides an excellent review of the literature and initial guidelines for the economic analysis of geographical indications in the developing country context. In our comments, we would like to focus on the following issues: the institutional/juridical context; the notion of reputation; the idea of consumer demand; the relation between products and services and the distinction between direct and indirect impacts; the domestic market; the centrality of collective action which includes the question of governance. We will then make some additional comments on methodological guidelines. Our remarks will naturally be influenced by the work we have been doing on geographical indications in Brazil and Latin America.

The Institutional/Juridical Context

Differently from Europe, geographical indications have been introduced into developing countries within the framework of the WTO/TRIPS provisions. As the authors point out, these provisions allow for their assimilation in existing protective legislation (trademarks) or for the creation of *sui generis* legislation. There is a fundamental ambiguity, therefore, as regards the type of right, which a geographical indication represents. Various countries use existing trademark legislation, reinforcing thereby the private nature of the right in question. Even countries which adopt geographical indications as a *sui generis* form of protection, may, however, consider the protection as a private right. In practice, this may mean that the institutional involvement of the state is very limited, that the conditions governing the concession of geographical indications are fundamentally procedural rather than substantive, and that, once conceded, there is little or no monitoring or provision for reconsideration of the right conceded. It is also probable that the developmental aspects of geographical indications, so central to their justification in Europe, will be less prominent to the extent that the private nature of the right is highlighted. It is likely that in the absence of strong state or public sector support, they will predominantly be promoted by large-scale producers. Analysis of geographical indications in developing countries, therefore, should pay attention to the institutional implications of the adopted juridical structure, which will certainly vary considerably from country to country, but will tend towards minimalism, making subsequent adjustments more difficult. This becomes central once we consider the speed with which GI claims can be conceded. Methodologically, this implies that much attention should be given to the process whereby the geographical indication is conceded, together with the implementation of monitoring systems.

The TRIPS legislation also makes provision for two types of GIs – indications of provenance (IP) and appellations of origin (AO) – whose dynamics may be quite different. In addition, therefore, to comparing geographical indications with other protection systems it is important to distinguish the differential impact of these two types. IPs refer basically to the reputation of the product without stipulating the exact relation between the product and the place. AOs, on the other hand, indicate that the specific characteristics of the product's confection are derived from the

place after which it is named. This distinction may be understood as referring to two qualitatively different systems of protection or, conversely, the IP may be considered a first stage to acquiring AO status. The dynamics of the geographical indication will be very different depending on the interpretation adopted. The rationale of demarcation decisions, for instance, is quite different, with much less rigor required in the case of IPs, understood as providing a different justification for protection than AOs.

Reputation

As a system of legal protection, geographical indications would seem to pre-suppose the existence of reputation. In many cases, however, they may be adopted as a strategy for the construction of reputation, given the reputational effects of the GI system itself. It may, in this sense, be only a component within a broader niche market segmentation strategy based on special quality characteristics. On the other hand, it may become adopted as a key strategy for territorial valorization, particularly by development agencies. The danger here is that local reputations may be too rapidly inflated and expectations of market growth exaggerated, leading quickly to disappointment and demobilization. International reputation is limited to only a limited number of products in developing countries but the growth of solid middle class markets in an increasing number of such countries opens up the perspective of consolidating reputation domestically, which may then become a springboard to the global market.

Consumer Demand

A similar point can be made about consumer demand. While willingness to pay is the decisive market test, it is not at all clear that a consolidated disposition to pay a premium characterizes the GI world as a whole. In addition, declared willingness to pay is not necessarily translated into purchasing decisions. Nor is it clear that consumer demand is best understood as a fixed disposition. There is a considerable body of literature today focusing more on the construction or formatting of demand. This is not simply a question of publicity but refers to the whole set of technologies which are put into play to filter supply prior to the moment of consumer choice, which is, itself, subject to considerable orchestration. Here again, geographical indications can become simply a component in the construction of quality markets. The central question then becomes the nature and extent of the network which the GI promoters are able to consolidate at the level of distribution and retail.

Products and Services – Direct and Indirect Impacts

Geographical indications emerged in the European context within a decisive focus on production, the product and its developmental impact. Today, food and the rural economy are increasingly absorbed within a shift to services. In this context, reputational effects are susceptible to much greater spillover and the indirect impacts of geographical indications can assume proportionately more importance. The promotion of origin products is today intimately related to tourism (eco, rural) which leads to the promotion of hotels, restaurants and related activities. In turn, this tends to attract inward migration – weekend homes, exclusive new residential areas. Land rents may become inflated not just or even primarily through the arrival of new would-be producers, but rather as a result of the associated services. In such a case, strict product-based demarcation may suffer internally from the emergence of new land uses and be more generally weakened to the extent that the spillover effects of service valorization do not coincide with the original demarcation. It may also be the case that the GI product emerges under the shad-

ow of a larger place reputation based on the culture and service sectors. Here again, demarcation may adjust to the larger reputational reference particularly if the geographical indication sought is of the IP variety. On the other hand, the differential benefits accruing to the service sector mean that geographical indications promoted by large-scale producers may nevertheless provoke considerable indirect benefits for small farmers and rural workers.

The Domestic Market

The authors emphasize that geographical indications in developing countries will be fundamentally oriented to international markets. This is clearly the case for some – including the South African *rooibos* which they discuss in their paper. The corollary to this for the authors is that there is little perspective for niche market creation in developing countries. This, however, would appear to be too sweeping a conclusion in the light of the rapid growth of a middle class in many developing countries which can now be counted in the tens, and in some countries, in the hundreds of millions. We can expect therefore to see the development of geographical indications which are primarily geared to the domestic market even though, within a globalized world, exports would be a natural complement to niche success in the domestic market. Before gaining global markets, many geographical indications will have to establish themselves first in the domestic market.

Collective Action

Collective action is a particularly sensitive question in the developing country context. Lack of organizational capacity and particularly the associated costs may lead to a dependence on outside actors, be they NGOs or the public sector. Conversely, the widespread discrepancy between the relative power of actors within the same territorial space, a consequence of polarized agrarian structures, induces a bias towards the appropriation of the benefits of a geographical indication by a small minority of particularly well-placed producers. Rules of participation may, therefore, not reflect the average possibilities of producers in the region.

Methodological Guidelines

Analysis should not be limited to the question of economic impacts or performance but should be guided by the way in which geographical indications are publicly justified. The bases of GI legitimacy have varied over time and place, but they are increasingly associated with sustainable forms of economic activity, whose social and environmental components will tend to become more important in the developing country context. Similarly, to the extent that they are forms of collective action, the nature and dynamic of the organizational forms assumed will be of central importance for any system of monitoring and evaluation. A pre-condition for evaluating geographical indications in developing countries would be the establishment of national systems of accompaniment: better still if these could be coordinated on a broader scale. The first task would be the design of comparable methodologies covering types of protection, forms of organization, the contextualization of the GI product/service, its dynamic as from year one. The very recent implantation of geographical indications in developing countries provides the opportunity for constructing a database as from year one. Given the precarious nature of data in many developing countries, such data would have to rely heavily on fieldwork surveys. Bramley, Biénabe and Kirsten's paper provides a very valuable contribution for such an undertaking.

COMMENTS ON
THE ECONOMICS OF GEOGRAPHICAL INDICATIONS: TOWARDS A CONCEPTUAL FRAMEWORK FOR GEOGRAPHICAL INDICATION RESEARCH IN DEVELOPING COUNTRIES

ROLAND HERRMANN*

Bramley, Biénabe and Kirsten have provided a thorough and comprehensive survey of the literature on the economics of geographical indications. They have captured most of the contributions available and I share almost all of their statements regarding the protection of geographical indications and the conceptual framework for studying their applicability in developing countries. The authors have also competently covered the methodological approaches which have been used when the economic impacts of geographical indications were analyzed in the past.

I see the objective of these comments to provide some additional arguments that seem important to me. These arguments refer to the following points:

(i) relevant additional research areas;
(ii) suggestions on the use of the methodologies proposed;
(iii) relevant additional aspects on the use of geographical indications in developing countries; and
(iv) some additional findings on the benefits of geographical indications for developing countries.

Relevant Additional Research Areas

The authors have already covered a very broad body of literature that is directly related to the economics of geographical indications. There are, however, some branches in the literature that are indirectly linked and which may provide additional important insights.

First, it is the literature on the economics of generic promotion of agricultural products which is a very well-established and relevant one (e.g. Kaiser *et al* (2005)or Alston *et al* (2003)). I would regard many aspects of generic promotion as rather similar to those of geographical indications. Why is this? Generic promotion has always been seen as an instrument to raise the value of agricultural products by shifting the demand curve to the right. The additional costs for producers in terms of financial contributions or additional costs of quality control have also been discussed there extensively. Both aspects, the shift in demand and the additional costs of introducing protection for geographical indications, are also important here. The literature on generic promotion or on the promotion of regionally produced agricultural products has come up with some results that seem very safe and uniform: probably the most uniform result is the very low advertising elasticity which ranges between zero and 0.1 in almost all cases. If this result is valid for geographical indications, too, this is a crucial result on the size of a demand shift that can be induced by promoting GI labels successfully. Large amounts of additional advertising expenditure would be necessary for a sizeable shift of demand for products protected by geographical indications. This might imply that their successful protection for developing countries' products does pay, mainly for the countries which are already rather successful on international markets.

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It has been elaborated in the generic-promotion literature that basic coefficients known from market analysis are crucial for the success of promotion. Price, advertising and cross-price and cross-advertising elasticities do matter. It is also important whether market imperfections on the demand or supply side do exist. These aspects will likewise have to be incorporated in studies on geographical indications and this is not an easy task. And what is often lacking in the generic promotion literature is the question "who gains more and who gains less in the marketing chain" from such a program and what the incentives are for farmers, processors and retailers of a firm to participate in such a system by sticking to its standards, making financial contributions, etc. It seems to me that all these questions, which are open in the much more developed literature on generic promotion, will become equally important in future work on the protection of geographical indications.

Another branch of the literature which seems relevant is related to the economics of organic vs. conventional agriculture and to the economics of labeling. It is a common feature with geographical indications that the objective of realizing a higher value on the market compared to either conventional agriculture or unlabeled products plays a major role here. There are contributions which even combine both arguments, e.g. the studies done at IFPRI on eco-labeling in developing countries and its potential to raise rural income in these countries (Basu *et al* (2003)).

There is an interesting trend towards high-value commodities in the export specialization of developing countries. Traditional export commodities have been substituted by high-value commodities to some extent. Fruit and vegetable and fish exports by developing countries are cases in point. The determinants of this structural change in agricultural exports of developing countries are those that might also be important for success stories in GI protection for developing countries (Swinnen and Maertens (2006)).

Suggestions on the Methodologies Proposed

The first suggestion regarding methodology follows directly from the former point. Analogies to the economics of generic promotion, organic agriculture, labeling or high-value commodities could be utilized and similar approaches could be applied. This seems promising as the economics of generic promotion is older, more settled and micro-economic approaches have been applied more often and have a longer tradition. It is my impression that the characteristics of the supply side have to be modeled in more detail than before. In order to derive the implications of geographical indications on producer gains and economic welfare it is crucial to know their effect on supply compared to the non-GI benchmark situation.

A second methodological comment refers to the widespread use of hedonic pricing models. Although we know since Rosen (1974) that a supply of and a demand for quality attributes does exist, hedonic pricing models are mostly used as reduced-form models, with the coefficients of the reduced-form models, i.e. the implicit prices of product characteristics, interpreted as indicators of consumer preferences. In many cases, this interpretation will not be correct. Suppose that the regional origin is protected by a geographical indication. On the wine market, we can expect that there is a positive impact of a geographical origin like Burgundy compared to an average wine region. There is, however, a supply effect, too. Many different wine production systems that stand for the terroir occur, thus leading to different marginal costs across regions. Transport costs towards a certain destination market will also vary across regions and yield differential marginal costs for various wines. The implicit price we would obtain from the reduced-form model would be a mixture of the impacts of a geographical origin on the demand (willingness to pay) and on supply (marginal costs).

I suggest substituting hedonic-pricing models, which are estimated in their reduced form, by estimating structural models of supply and demand including the effects of product characteristics on supply, demand, and equilibrium prices. Such structural models should properly incorporate the implications of geographical origin and other characteristics on consumer preferences and producers' marginal costs.

Relevant Additional Aspects on the Use of Geographical Indications in Developing Areas

Bramley, Biénabe and Kirsten argue that the economics of geographical indications in developing countries is more complicated and multifaceted. They view the GI system as being one of an international market access dimension. Two arguments should be added here:

(i) there are middle-income developing countries like Brazil, China or India with huge domestic markets. Geographical indications may be an instrument here to successfully gain market shares domestically;

(ii) a recent study in the Journal of Rural Studies (Tregear *et al* (2007)) showed that cooperation of producers under a protected GI system is key to the system's success.

Some Additional Findings on the Benefits of GIs for Developing Countries

There is some interesting new work on the benefits of geographical indications for developing countries. Grote (2007) as well as Teuber (2007) showed that strong price premia do exist for high-quality coffees from developing countries. Teuber used an Internet data set on coffee auctions and deduced that the implicit price of various regional origins is very positive compared with a "normal" coffee market.

Again, we have to be very careful here with hedonic modeling. We always talk about the price premium that can be captured by producing high-value commodities. However, we cannot directly compare the high-value price with the commodity price. Marginal costs rise under high-value production and it is necessary to compare the net price under a protected GI system with the commodity price. This is information which is normally unavailable.

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INTELLECTUAL PROPERTY RIGHTS AND PHARMACEUTICALS: CHALLENGES AND OPPORTUNITIES FOR ECONOMIC RESEARCH

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1. INTRODUCTION

The pharmaceutical sector has unusual prominence in debates about IP policy, and has served as the front line for national and international controversies about the relationship between IPRs, R&D incentives, pricing and access to medicines. Notwithstanding the intensity of debate, on some crucial questions there is relatively little empirical evidence to support policy-making. This paper surveys the empirical literature on intellectual property and pharmaceuticals, discusses methodological issues and key sources of data, and identifies some of the key research issues and major gaps in the literature.

The pharmaceutical sector is complex and highly regulated in most economies. Government price controls and purchasing, public and private insurance schemes, restrictions on marketing and promotion, and the involvement of "learned intermediaries" such as physicians and pharmacists powerfully influence demand for pharmaceuticals. On the supply side, stringent product safety review, regulatory oversight of manufacturing, and legal frameworks governing technology transfer between publicly-funded biomedical research institutions and commercial entities play an equally significant role in shaping competition. Importantly, since much of the research on pharmaceuticals has been focused on questions specific to the market institutions and regulatory framework of high-income economies such as the US and the EU, the extent to which this literature provides a firm foundation for evaluating the impact on policy changes in developing countries and countries with economies in transition is therefore unclear.

IPRs are generally understood to have two principal areas of impact in pharmaceuticals. First, there is the issue of pricing and access, where discussion focuses on the links between IPRs (particularly patent rights), exclusion of competitors and the availability and pricing of new medicines. Second, there is the issue of R&D incentives – that is to say, the role of IPRs in providing incentives to discover, develop and market new drugs – and the effect of IPRs on R&D expenditure and its allocation across diseases, countries and organizations. Obviously, these two issues are closely linked, and their interplay presents a series of very difficult economic issues and policy questions.

Even in a single-country context, the use of IPRs to reach an appropriate balance between "static" gains to consumers from low prices and competitive supply of drugs with "dynamic" gains from innovative new products presents serious challenges. On the one hand, industry feels acute financial pressure from rising R&D costs and decreasing effective patent life. On the other, notwithstanding very substantial economic and health benefits associated with innovation in pharmaceuticals, even in relatively wealthy countries high prices for on-patent drugs tend to raise difficult political questions relating to equity and access for low-income or disadvantaged groups, and for setting priorities in allocating public health care budgets.

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Looking cross-nationally, differences among countries in their approaches to these fundamental policy issues present additional challenges. The supply side of the industry operates globally. Industry R&D is conducted largely by multinational companies who operate R&D facilities in multiple countries, relying on and contributing to a transnational science base, and products are sourced and manufactured globally and are sold in essentially identical form in many different countries. Yet on the demand side, markets are essentially national, with significant heterogeneity across countries in IPR regimes and health care institutions.

In principle, IPRs could support substantial (and potentially global welfare-maximizing) differential pricing across countries that reflects differences in income and in sensitivity of demand to prices. However, these price differences may create additional domestic and international controversy: for example, efforts by governments in some developed countries to lower domestic prices of on-patent drugs through price regulation or monopsony purchasing tend to be perceived by countries that pay high prices as "free riding" and it is unclear whether this is sustainable in the long run. Differential pricing also creates incentives for parallel or "gray market" trade, particularly for products such as pharmaceuticals which are easily transportable. However, if substantial arbitrage-driven trade in pharmaceuticals takes place, while prices may fall in the importing country, they will also tend to rise in the exporting country. Thus, while parallel trade may provide access to cheaper drugs in certain contexts, it may also undermine producers' ability to charge lower prices in lower income countries and may affect their willingness to supply countries or distributors who serve as entrepôt facilities. Large volumes of arbitrage trade in legitimate products may also create additional opportunities for fraudulent or substandard production to enter the supply chain, particularly where repackaging of products or transhiping through a series of countries makes their origin difficult to determine. Counterfeiting of drugs – production of illegal copies of the products of approved manufacturers, often with misleading packaging and poor quality, incorrect, absent or impure ingredients, and as distinct from legal production of generics – is reported to be an increasing problem outside the most tightly regulated markets, though its extent is difficult to quantify.

Importantly, for any particular country, in this sector the tradeoffs inherent in IPR policy choices are highly contingent on the institutions and operation of its health care system, and the extent to which it has domestic pharmaceutical R&D or manufacturing capability. While much attention has been given to the IPR policy choices and evolving pharmaceutical markets of countries like Brazil, China, and India, and to the very difficult and very public debates about pricing and access to HIV/AIDS drugs in sub-Saharan Africa, we should be careful not to generalize from these specific cases.

The complexity of these issues demands careful empirical analysis. Yet, there are some very serious gaps in our knowledge, particularly as regards development of data that would support informative research into the impact of IPRs in this sector.

2. CRITICAL RESEARCH ISSUES

Formal welfare analysis of any policy instrument focuses on its impact on producer and consumer surplus, concepts which are well-defined in economic theory but not always straightforward to measure empirically. In this respect, the pharmaceutical sector presents some unusual challenges for assessing the impact of IPRs. Consumer surplus is particularly difficult to measure in this sector, since in many countries demand is strongly influenced by insurance schemes or government provision of drugs and "learned intermediaries"; i.e. physicians and pharmacists play an important role in consumption decisions.

Policy discussion of the impact of IPRs thus revolves around proxies for welfare, rather than direct estimates. On the supply side, these include trade and production statistics and indicators of the pace of technological change – i.e. development of new drugs. On the demand side, these include pricing and product introductions.

2.1 Characterizing IPRs

Any effort to quantify the economic impact of IPRs must recognize the complex nature of the legal framework that supports them. Subtleties in the language of statutes that create IPRs and govern their enforcement and in their interpretation by courts, administrative agencies, and other participants in the IPR system, can have major implications for the "strength" of IPRs – which are often felt quite differently across different sectors of the economy. IPRs also do not exist in a vacuum: in most countries: the legal framework of IPRs is interwoven with (and often constrained by) domestic laws and institutions governing competition policy and antitrust, international trade, labor relations, privacy and many other issues, as well as multilateral or bilateral agreements with other countries.

Consistent and comparable characterization of differences in IPRs across countries and over time is, therefore, formidably difficult. Following early efforts by Gadbaw and Richards (1988) and Rapp and Rozek (1990) to develop indexes of national IPRs, a pioneering study by Ginarte and Park (1997) constructed a summary index of the strength of patent protection for 110 countries over the period 1960 90 (since updated to 2005 in Park (2008)) by coding national patent laws according to the extent of coverage of different technologies, membership in international treaties, potential to lose protection, presence of enforcement mechanisms and duration. These data have been widely used in studies of growth, development and IPRs. However, notwithstanding the very significant effort required to construct such indexes, they pose a number of problems.

First, they focus almost exclusively on patents, ignoring copyright, trademarks, and *sui generis* IPRs, and do not speak to the effectiveness of other appropriability mechanisms such as secrecy and speed to market. Further, as pointed out by Lerner (2002) in his study 150 Years of Patent Protection, these composite ranking/rating schemes often bury important features of the patent protection regime, may obscure important sectoral differences in its operation, and do not control for complementary aspects of a country's legal regime. Perhaps most significantly, these indexes reflect the formal de jure status of patent protection, rather than an assessment of the *de facto* conditions facing holders (or prospective holders) of IPRs at a particular point in time.

Pharmaceuticals are an interesting case in point. In this sector, while patents are the most visible and perhaps most important form of intellectual property, other IP instruments also play a significant role. In the product market, these include copyright in supporting publications and materials, trademark protection of brands, and administrative mechanisms or *sui generis* provisions giving proprietary rights in clinical and manufacturing data used to support regulatory approval. In the R&D domain, contract law governing license agreements, collaborative ventures, disclosure of proprietary information, as well as statutes covering the rights of inventors vs. employers and the transfer of technology by publicly funded institutions, are critical to the operation of the "market for technology". Copyright and database protection may also be playing an increasingly important role as research relies increasingly on bio-informatics and other in silico research methods to analyze very large databases of genetic, clinical, and bio-physical data (Cockburn (2005)).

The scope of patent coverage in pharmaceuticals has, at least historically, been quite varied. In some countries, patent protection is available for pharmaceutical products, for production processes, for treatment protocols and dosage regimens, for the use of a drug in treating a specific disease, for packaging and delivery mechanisms, and even for metabolites of the drug produced in the body during treatment. In others, coverage is more restricted. Standards for obviousness, the level of the inventive step, and utility (or industrial application) of the claimed invention have implications for the type of drugs that are likely to be developed for a given market: very narrow scope of claims, for example, have historically promoted a proliferation of chemically very similar "me too" drugs in countries such as Japan (Aoki *et al* (2006)).

As innovation increasingly focuses on "large molecules", i.e. biotechnology, the availability of patent protection for these products, or processes for manufacturing them, has become an important issue. Many biotechnology products involve therapeutic or diagnostic use of proteins or other molecules found in nature, albeit in purified, isolated, or modified forms, or genetic modification of living organisms. While excluding such substances (or "naturally occurring processes" that create them) from patent protection may reflect well-founded public policy considerations, or efforts to lower the costs of very expensive products, these choices may affect some countries' access to such "leading edge" treatments, or reduce commercial incentives to develop these types of drugs for certain diseases or distinct patient populations.

Competitive pressure leads most pharmaceutical companies to file for patent protection on drug candidates very early in the development process, but the extraordinarily long development time for a typical product (7-10 years) leaves relatively little time to recover R&D costs through an exclusive market position. In some OECD countries, though not all, pharmaceuticals can, therefore, obtain patent-term extensions beyond the basic statutory term of 20 years to compensate for delays in the approval process. In some cases, additional periods of market exclusivity intended to promote policy goals such as development of drugs for "orphan" diseases, or testing of new drugs in children, are also available.

After the initial launch of a drug, further substantial R&D expenditures are often incurred for additional clinical testing in a wider set of indications (diseases) or patient populations, or in improving its pharmacological properties. Though such "lifecycle management strategies" are severely criticized by some observers, this type of incremental innovation may be an important source of benefits to patients. (See Berndt, Cockburn and Grepin (2006)). Availability of patent protection for new uses of existing compounds can therefore be an important consideration, though it is an open question as to whether the benefits of such incremental innovation outweigh any associated costs in any particular market.

In some countries, vigorous generic competition can be anticipated for almost all drugs. In the US, for example, under the Hatch-Waxman framework, generic manufacturers have been given strong incentives to challenge the validity or enforceability of patents (180 days of protection from subsequent generic entry if a patent is successfully challenged).

Exemptions from patent rights are available in many countries to allow testing of production processes or preparation of samples in order to satisfy regulatory requirements. However, such "Bolar" provisions do not normally extend to stockpiling of products in advance of patent expiration. Canada, for example, had an explicit provision in its Patent Act to allow this, which was found by the WTO to be in violation of Article 28.1 of the TRIPS Agreement. (Conducting independent clinical trials while a patent is still in force may or may not be covered by the "research exemption" present in the patent law of some countries.) Such rights can have a significant effect on the speed with which generics enter the market and the intensity of generic competition.

In countries where there is strong generic competition, processes for challenging/enforcing patents are critically important. From the perspective of patent holders, the ability to recover lost profits from infringers, or to obtain preliminary injunctions against alleged infringers while litigation proceeds are very important factors affecting the return on R&D. From the perspective of would-be entrants (and payers) the ability to have patents declared unenforceable or invalid, or to oppose applications for patents, or to counter-sue patent holders on the basis of violation of competition law or unfair trading practices are equally important. For both sides, the availability of timely, non-discriminatory, transparent and predictable processes for resolving patent disputes is also a material issue, as is "patent quality" – inconsistently or poorly applied standards for patentability are likely to raise the costs and uncertainty faced by all parties affected by patents.

For any product, the strength of patent protection in a country is also affected by the interaction between domestic IPRs and trade law. This is particularly important in pharmaceuticals, where transportation costs are very low relative to the value of the product, and high-quality manufacturing capacity is geographically concentrated. Provisions governing national exhaustion of IPRs, "reimportation" and parallel trade are one important area, as is the ability of patent holders to use customs procedures and trade dispute mechanisms to exclude competitors. A subsidiary trade-related issue is the extent to which a country allows "product by process" protection, namely the right to exclude imports of an unpatented or unpatentable drug product (for example, a naturally occurring protein) if it has been produced abroad using a process that is patented in the domestic market.

Finally, patent protection for pharmaceuticals is affected in some countries, at least in principle, by provisions to issue compulsory licenses in public health emergencies, or in furtherance of other national priorities. (The US has an interesting, but thus far unutilized, provision for "march-in rights" on inventions arising from publicly funded research.)

It is clear, therefore, that a meaningful effort to characterize the strength of IPRs across countries, or to track changes within a given country over time needs to account for many factors. At a minimum, these include the following:

A Non-Comprehensive List of Indicators that may Affect the Strength of Biopharmaceutical IPRs

Term of market exclusivity	Patent term Market exclusivity provided by regulatory approval Patent/exclusivity extensions to compensate for regulatory review delays Extensions for pediatric investigation Extensions for orphan drugs Extensions for drugs targeting specific diseases
Patentability standards	Scope of claims Obviousness/inventive step Utility/industrial applicability Novelty (and grace periods) Priority rules
Patentable subject matter	Products Manufacturing processes Manufacturing intermediates Alternative salts and esters of previously patented compound Use of a product in treating specific diseases Treatment protocols, dosing Packaging/delivery mechanisms Metabolites Naturally occurring substances

	Genomic or biophysical data Physiological pathways Targets/receptors Transgenic organisms
Restrictions on imitators	Ability to block "product by process" imports Ability to block testing of production processes Ability to block stockpiling of patented products by generics in advance of patent expiration Ability to block reimportation/parallel trade
Obligations of patentees	Disclosure requirements (depositing microorganisms or cell cultures, genetic sequences, best mode etc.) Compliance with competition policy (or exemptions) Disclosure of the origin of genetic resources or traditional knowledge
Enforcement/challenge mechanisms for all IPRs	Preliminary injunctions: availability/standards Presumption of validity Recovery of lost profits Recovery of "reasonable royalty" Punitive damages: how much, when awarded Judicially applied limitations on enforcement Criminal counterfeiting: penalties, burden of identifying, prosecuting, etc. Incentives to challenge patents e.g. Hatch-Waxman Pre/post grant opposition
Trademarks	Protection of brand names Protection of "trade dress"
Copyright	Marketing/training materials
Data exclusivity	When/if imitators can rely on innovator's submission of safety/efficacy data When/if imitators can rely on innovator's submission of manufacturing data
Database protection	Proprietary collections/linking of physical, genomic, epidemiological data
Special provisions	Government rights in inventions arising from publicly funded research Research exemptions Prior user rights Compulsory licensing in public health emergencies Compulsory licensing for other reasons Exclusive marketing rights under TRIPS
Bilateral treaty provisions	Other restrictions or exemptions specific to products of certain countries

To my knowledge, only Pugatch (2006) has worked on an index based on such a comprehensive set of indicators for assessing the strength of IPRs in this sector. Since the passage of the TRIPS Agreement, many countries have made significant changes to their patent laws in various of the dimensions listed above, and the diversity of these changes across countries presents interesting potential opportunities to identify their effects. Obviously, though, the effort required to collect data on all of these items is high: Pugatch has computed his index only for eight countries. There are also a number of methodological issues, as with all such indexes. First, to be useful in empirical analysis, component items must be aggregated to some extent, and such aggregation involves applying weights to the components and categories. Pugatch proposes an ad hoc scheme, based on his assessment of "core", "significant" and "added-value" components, though clearly the most informative weighting is a matter of empirical investigation. Second, there is the question of whether to score the components based on *de facto* vs. de jure criteria: "paper" availability of rights or procedures may mean very little in terms of practical, concrete implications for patent holders or consumers.

It should, therefore, be a priority to construct (and publish) this type of index for a wide range of countries; to do this both on a "look back" and continuing basis, e.g. 1990, 1995, 2000, 2005, 2010, and to use a similar methodology to construct indexes relevant to other sectors, e.g. the complex/cumulative technologies such as software, telecommunications, semiconductors.

In addition, it would be helpful to supplement this type of index with a more subjective, summary approach based on surveying stakeholders. Surveys of R&D managers in the US and other OECD countries (Levin et al, Cohen et al, EU Community Innovation Survey) have been very informative about business decision-makers' evaluations of the competitive impact of IPRs, and remain the only way of assessing (a) the importance of other appropriability mechanisms and (b) stakeholder perceptions of the *de facto* strength of IPRs. It would surely be helpful to collect such data on perceptions of the strength of IPRs in this sector and others on a regular basis by surveying/interviewing stakeholders in a range of countries. (See, for example, the surveys conducted by Lanjouw and Cockburn (2001) and Lanjouw and MacLeod (2005) and Gehl Sampath (2005) in India). An alternative and very interesting approach is that of Sherwood (1997) who presented subjective estimates of the strength of IPRs in 18 different developing countries in the mid-1990s based in large part on his personal experience working as a practitioner in this area.

2.2 Pricing

Remarkably little is known about international differences in the pricing of pharmaceuticals and their relationship to IPRs. Reliable data are very difficult to find outside the OECD countries, and even within the OECD, cross-country comparisons are difficult to perform. Danzon and Kim (1998) highlighted the substantial methodological difficulties inherent in comparing drug prices across countries, concluding that highly misleading results could be obtained unless comparisons are based on a comprehensive or representative sample of products, and price differences are appropriately weighted using standard index number methods. However, because of variation in packaging, formulation, dosage forms and strength, assembling large enough representative samples of comparable products is very difficult and most published research has focused on small numbers of drugs and small numbers of countries.

Critically, "list" prices of branded products are likely to be a very poor guide to prices actually paid by consumers and other payers in both developed and developing countries. Government procurement or negotiations by other large purchasers such as insurers are known to result in very substantial "invisible" discounts. Even where discounts are not present, manufacturers' selling prices are only one component of the prices faced by end-users which often include substantial distributor and retailer margins, import duties, taxes, etc. Yet, data on actual transaction prices (and sales volumes) are not easy to obtain. Commercial market research firms such as IMS and Frost & Sullivan attempt to collect this type of data for a wide range of countries, but, as they are not easy for noncommercial users to obtain, their reliability is very difficult to assess.

The World Health Organization (WHO) and some nonprofit organizations have supported collection and publication of prices of selected drugs. Once such effort is the "spectrum of prices" of essential drugs published in the International Drug Price Indicator Guide (MSH (2007)) since 1986. Other initiatives are limited to specific drug classes, such as MSF's Guide on ARV Prices, or the various catalogs and price-reporting mechanisms sponsored by WHO for tuberculosis, malaria, and HIV/AIDS. As an alternative, WHO has endorsed an effort in conjunction with an NGO (Health Action International) to assemble a database on prices of a relatively small "core list" of drugs in a wide range of countries, built from voluntary surveys conducted by NGOs,

government agencies, academic researchers and other interested parties (WHO/HAI (2003)). This project is potentially very useful, and reports submitted to date by participants provide interesting and valuable information on price dispersion, notwithstanding the difficulty of assessing the reliability and comparability of data collected from such heterogeneous (and self-selected) sources. Unfortunately, the complementary data on consumption volumes needed to construct price indexes – the most economically meaningful basis for making price comparisons across countries – from either of these sources are not readily available.

Even where price data have been obtained for a wider range of countries, great care must be taken to control for institutional differences in procurement, distribution and price regulation schemes. For example, Borrell (2007) conducted an unusually careful study of pricing of drugs used in ARV "cocktail" therapy for HIV/AIDS in 34 countries, finding substantial variation across and within countries, but was unable to fully control for "noise" in prices induced by off-invoice discounting by manufacturers and the impact of subsidized or donated supply and other factors. Notwithstanding these measurement difficulties, Borrell found that prices of these drugs were higher in countries with product patents for pharmaceuticals. This paper is exemplary in using a "quasi-experiment" methodology (see Meyer (1995)) based on assigning drug-country pairs to treatment and control groups which minimizes potentially important biases induced by the endogeneity of patenting decisions, and in carefully controlling for certain types of omitted factors using country and year fixed effects and interactions. It would certainly be worthwhile to test the robustness and generalizability of these findings by extending this study to more drug classes and more countries, and with price data obtained from alternative sources.

One important source of evidence on the relationship between patent protection and prices may be the impact of patent expiration and generic entry. In countries such as the US, with relatively little price regulation and a very competitive generic industry, patent expiration normally results in rapid entry by generics and substantial losses in market share for the brand. (See Caves, Whinston and Hurwitz (1991), Griliches and Cockburn (1995), Frank and Salkever (1997), Grabowski and Vernon (1992), Reiffen and Ward (2005), Scott Morton (2000) and others.) The substantial brand-generic price differences that emerge in these circumstances suggest that pharmaceutical prices may be much higher when protected by product patents than would otherwise be the case. But it is critically important to be careful about the counterfactual: almost all of these studies are of the US market, and reflect a specific competitive environment, regulatory provisions that promote generic entry (the Hatch-Waxman framework, see Grabowski and Vernon (1996)) and substitution of generics for brands, limited government purchasing or price regulation and a very large market size. In other developed countries with different institutions and industry structure, generic competition is often muted, and brand-generic price differentials can be much smaller (see Pammolli, Magazzini and Orsenigo (2002)). Unfortunately, very little is known about industry structure, regulation, and generic pricing and entry outside the OECD countries.

In some countries, an important source of competition for branded products is supply under compulsory licensing provisions, or imports of the branded product by third parties through parallel trade or "reimportation" (Scherer and Watal (2002)). These mechanisms – or the threat to resort to them – are occasionally used by governments to try to lower domestic prices and improve access. Compulsory licensing can also occur as the outcome of enforcement of competition policy provisions. However, the impact of these mechanisms can be difficult to gauge. Where issuance of compulsory licenses results in a highly competitive supply of generics, substantial price declines can be expected. Watal (2000) suggested price declines of 90 per cent for some drugs in India under a compulsory licensing regime. However, if issuance of a compulsory license does not result in vigorous generic competition, then the outcome can be that prices are somewhat lower, but not substantially lower, than those set by the patent holder – and the primary impact of the compulsory license being to shift profits among suppliers.

Parallel trade is also a potentially powerful way to reduce domestic prices by allowing imports from lower-priced markets. Again, the impact of parallel trade can be difficult to assess. In some cases, parallel trade does appear to have lowered prices of some drugs in some countries quite substantially. But arbitrage between markets does not necessarily drive prices down to the level of the lowest-priced market unless the manufacturer is willing to supply unlimited amounts, and there is some evidence that the major beneficiaries of parallel trade in pharmaceutical products are intermediaries and arbitrageurs rather than final purchases in the importing country (see Kyle (2007a), Ganslandt and Maskus (2004) and Kanavos *et al* (2004)). Most of the work in this area has focused on the developed countries, and beyond some highly publicized cases, mostly involving HIV/AIDS drugs, there is relatively little systematic evidence on the impact of compulsory licenses and parallel trade on pharmaceutical prices in developing countries and smaller markets.

For some countries and diseases, donated or subsidized supply may be a significant portion of the total market. IFPMA (2007) catalogued large numbers of programs in which commercial entities supply free or low-cost products. There are also significant efforts by governments and private philanthropic entities to supply drugs and vaccines in various countries. These efforts may have significant economic impacts on the pharmaceutical market, for example by effectively segmenting the market on the demand side, or by impacting the commercial environment for for-profit distributors.

Data on these demand-side factors is not widely available. Donated or subsidized supply is very difficult to track in conventional economic data since it does not flow through normal commercial channels. The same holds for government procurement, which is rarely transparent. Assessing the nature, and impact of price regulation schemes is particularly challenging. Jacobzone (2000) is one of the only published sources to systematically catalog and compare price regulation schemes across countries (though confined to the OECD countries). Lanjouw (2005) collected summary information on price regulation for a wider range of countries. However, it is very difficult to characterize price regulation schemes without in-depth country-specific knowledge of the relevant institutions and practices, and even more difficult to construct measures of their impact on prices that are comparable across countries.

While prices are likely to be an important determinant of access to drugs, consumption may also be stimulated by marketing and promotional efforts or constrained by other demand-limiting factors. Marketing and promotion of pharmaceuticals is generally believed to have a significant influence on consumption, but is a complex phenomenon: many countries regulate marketing of pharmaceuticals. For example, in some countries, marketing is only permitted if directed solely at physicians and other prescribers; in others consumers can also be targeted. Some countries closely monitor the content of advertising messages. Almost all the research on this topic has focused on the influence of marketing on the behavior of physicians in high income countries. Very little is known about the impact on drug consumption patterns of marketing by commercial and non-commercial entities in middle- and low-income countries (see the comprehensive review by Norris *et al* (2004)).

While marketing may increase drug consumption, a variety of institutional factors can restrict it. These include restrictions on what drugs are provided by national health care systems or are eligible for reimbursement under public or private insurance, limits on access to health care providers, the pricing and availability of complementary technology and services (e.g. diagnostic equipment or testing services) and the pricing and availability of substitute forms of treatment.

Finally, very little is known about the economics of the distribution system for pharmaceuticals. The supply chain for these products is complex and subject to varying degrees of regulation in different countries. The competitiveness and efficiency of wholesale and retail distribution may be very important determinants of the price of drugs to end-users: in general, it can be expected that a highly regulated and highly concentrated supply chain will result in very high markups and inefficiencies, leading to high retail prices regardless of the patent status of products flowing through it.

Economic studies of the welfare impact of higher prices of pharmaceuticals (the assumed consequence of strengthened IPRs), therefore, face a number of challenges. Critical parameters in many of the studies which have attempted to predict the impact of introducing IPRs on both price levels and consumer welfare are price elasticities, about which very little is known. Subramanian (1994), Maskus and Eby Konan (1994), Watal (2000) and Fink (2001) attempted to compute the welfare impact of introducing IPRs for pharmaceuticals using varying degrees of sophistication in modeling industry structure, but rely crucially on assumptions about substitution between patented and non-patented drugs that would need to be tested empirically.

Very few studies have attempted to estimate price elasticities econometrically, and almost all of these have used data on the US market (see for example, Ellison *et al* (1997), Cleanthous (2003), Crawford and Shum (1999), Rizzo (1999)). For emerging markets, the single exception of which I am aware is the ambitious paper by Chauduri, Goldberg and Jia (2006) which takes on the challenge of estimating a demand system for a set of closely related drugs (fluoroquinolones) using Indian data. The very substantial negative impacts on welfare predicted by the model have attracted much attention. But it is important to note that these estimates were obtained using quite restrictive assumptions on functional form and identification, suggesting that additional econometric demand studies in emerging markets would be very helpful to put this result in context. Particularly useful would be studies of a wider range of drugs (e.g. those used for chronic as well as acute conditions), exploration of different functional forms (e.g. logit), and use of natural experiments or convincingly exogenous supply shocks for identification.

It may also be important to recognize consumer heterogeneity in these models. It has been suggested, for example, that in low- or middle-income countries "open market" transactions are priced based on demand from a small number of wealthy consumers, and that income distribution within a country is, therefore, an important factor (Wong (2003)).

2.3 Access and Availability

In addition to any effect on pricing of pharmaceuticals, IPRs may also have an important effect on health and consumer welfare by promoting more rapid diffusion of new drugs across countries. Studies of the timing of new drug launches across countries such as Kyle (2006) and (2007b) and Lanjouw (2005) show that there can be long delays before newly approved drugs become available outside the country in which they are first approved. Indeed in many instances, new drugs are never launched in a country. Kyle (2006) looked at drug approvals in the G7 countries and found that fewer than 4 per cent of "opportunities" (i.e. distinct instances of country/molecule/therapeutic class) to launch drugs were actually exploited. Lanjouw (2005) examined this phenomenon for a much larger set of countries, and focused on the influence of IPRs and price regulation, finding that in countries with weak IPRs and aggressive price regulation new drugs become available for sale (if at all) only with substantial delays.

However, identification of these temporal and geographic "gaps" in availability of new drugs is not straightforward. Because a single new active ingredient may be sold in a variety of chemi-

cally distinct yet clinically highly similar variations, or sold in combination with other drugs, or sold under different names, simply establishing whether or not a new drug is being marketed in a given country can be formidably difficult. Neither is it clear how to establish the timing of when a drug becomes available: historical records on regulatory approval are difficult to access, and regulatory approval may not correspond to the drug actually being distributed.

Even if these data issues can be resolved, it is important to control carefully for differences across countries on a number of dimensions other than IPRs and price regulation: "market size" in the sense of income, population and health care expenditure clearly affect incentives to launch products, and at the level of specific diseases, prevalence, national conventions for medical practice, and availability of complementary technology also play an important role. Kyle (2007b) also identified an effect on the extent and timing of drug launches of variation in the capabilities and experience of the innovator company.

Conclusions about the impact of changes in IPRs on pricing and demand are difficult to reach without (1) reliable data on pricing and consumption across a wide range of drugs and (2) adequate controls for other factors affecting demand. There are a large number of open, important and factual questions about international differences in pricing, distribution and consumption of pharmaceuticals. What is the price of large "baskets" of directly comparable pharmaceutical products (appropriately weighted to reflect actual consumption patterns or "public health weights") in high-, middle- and low-income countries, and how has the price of these baskets changed over time within countries? Are these price levels and trends different for off-patent vs. patented products? How much intra-country dispersion is there in pricing, and how much does pricing vary across different distribution channels (retail pharmacy, hospital, public/voluntary sector)? To what degree do manufacturers or other participants in the distribution chain engage in intra-country price discrimination, and on what basis? Within a given country, what are the components of prices (manufacturer selling price free on board (FOB) at the shipper's location) and (inclusive of carriage insurance and freight (CIF) to the customer), local wholesaler acquisition price gross of tariffs or customs duties paid on imported products, distributor margin, retailer margin, dispensing fees, retail sales taxes, etc.)?

In addition to these factual questions about pricing, it is very important to identify aspects of the regulatory and policy environments which influence pricing and consumption. These include price controls or other forms of price regulation which can take a wide range of forms, such as direct price controls or regulation of margins at various points in the distribution chain, regulation of rates of return, price controls based on benchmarking of manufacturer prices against comparator countries ("international reference pricing"), therapeutic reference-based pricing schemes (such as those used in Australia, Germany and some parts of Canada) which cap insurance reimbursement within a therapeutic class at the price of a reference drug. Other important aspects of domestic pharmaceutical policy or market institutions include limits on access or consumption of drugs via formularies or other constraints on prescribing under government health plans or private insurance, utilization caps or reimbursement limits placed on specific drugs and operating on prescribers or patients, legal or regulatory frameworks that permit or encourage therapeutic substitution among drugs or brand-generic substitution within drugs by dispensing pharmacists.

2.4 Research and Development

As with the demand side of the pharmaceutical market, a paucity of reliable, detailed data has limited research on the impact of IPRs on R&D in pharmaceuticals. At least as far back as Taylor and Silberston (1973) surveys of industry participants about the impact of patents on R&D incentives have found the pharmaceutical industry to be critically – and almost uniquely –

dependent on patent protection.[1] Other such surveys include Mansfield (1981), and more recently, Levin *et al* (1987) and Cohen *et al* (2000) and the various Community Innovation Surveys conducted in EU member states since the early 1990s. In these surveys, pharmaceutical companies show a very high propensity to patent, and research managers typically report that patents are very important to securing competitive advantage, or would reduce R&D by a very large fraction (>50 per cent) if patent protection for pharmaceutical products were removed. Some surveys connecting R&D incentives to patent protection outside the high-income countries have been conducted, but these are difficult to access, have not been published in international peer-reviewed journals and are not widely discussed. Lanjouw and Cockburn (2001) and Lanjouw and MacLeod (2005) reported results from surveying relatively small samples of managers of Indian pharmaceutical companies which suggest some sensitivity of R&D spending and project choices to the prospect of patent protection. However is it difficult to generalize from the case of India (which has a relatively large and well-established domestic pharmaceutical manufacturing industry) to other countries. There are also obvious difficulties inherent in trying to determine the impact of IPRs on R&D incentives through such surveys in circumstances where domestic R&D capabilities have yet to develop -perhaps because of historically weak or absent IPRs or other factors.

Broad-based statistical studies of the impact of changes in patent protection on R&D have found mixed effects. In an exemplary study, Qian (2007) found little evidence of a correlation between the strength of patent protection and a number of indicators of domestic innovation in pharmaceuticals in 92 countries, using a careful econometric methodology to control for other differences in country characteristics. Case studies of the impact of changing IPRs on pharmaceutical R&D expenditure in specific countries have found a range of effects. Scherer and Weisburst (1995) found no clear effect of introducing pharmaceutical product patents in Italy in 1982. However, introduction of a compulsory licensing regime in Canada in the 1970s resulted in a dramatic reduction in the amount of pharmaceutical R&D conducted in Canada, and its removal in the 1990s had an equally substantial positive effect (Padzerka (1997)). Indirect measures of the impact of changing IPRs on the profitability of R&D, such as estimates of the differential effect on stock market valuation of R&D-based pharmaceuticals firms vs. manufacturing-oriented firms, suggest quite substantial effects in some countries (La Croix and Kawaura (1996), Kawaura and La Croix (1995)).

However, it is difficult to generalize from these episodes, particularly to countries with very different income levels or countries with very little existing R&D capacity. Furthermore, the innovation process in this industry is increasingly complex, organized on a global scale, and involves a wider range of actors from both the for-profit and non-profit sectors, and the impact of changes in IPRs in a specific country on R&D incentives perceived by a pharmaceutical company is, therefore, increasingly difficult to assess. Beyond the most obvious – R&D expenditure – several distinct areas of potential impact of IPRs on the innovation process can be distinguished.

2.4.1 Level of R&D Expenditures

In some circumstances, it is reasonable to expect that changes in a country's IPRs affecting pharmaceuticals will result in changes in R&D spending, and efforts to track R&D expenditures by domestic firms, receipt of payments for contract R&D, venture capital investments and other sources can be a useful indicator. It may also be useful to look at complementary forms of R&D investment, particularly by government or other non-profit actors in the form of direct expenditure, subsidies, grants, or investments in public-private partnerships (PPPs.) Even in countries with highly developed national statistical systems, consistently tracking the full range of such expenditures over time can be very difficult due to changing definitions of R&D or changing sampling methodology. Identification of any impact of changes in IPRs on R&D spending may

therefore require the development of original datasets from primary sources such as company financial reports (see, for example, Arora *et al* (2008)).

However, even with comprehensive, high-quality data, the linkage between domestic IPRs and R&D expenditure may be difficult to observe in aggregate data, or for companies operating globally, or making the bulk of their sales outside the domestic market. The marginal impact of changing IPRs in a specific country on a global company's R&D incentives may be so small as to have no distinguishable impact on the overall R&D budget, or it may be significant, but "swamped" by other considerations, or its effect may be felt only gradually over time.

2.4.2 Location and Composition of R&D

Rather than looking to changes in the overall level of R&D spending, the impact of changes in IPRs may be most visible in their influence on the location and composition of the global R&D effort. Though pharmaceutical companies have always been able to operate R&D facilities largely independently from other activities, increased vertical dis-integration in R&D activities since the mid 1980s has further relaxed organizational constraints on the location of research activity, permitting extensive geographic reorganization of R&D across countries and regions, as well as vertical reorganization within firms. In the US, for example, "upstream" firms specializing in new technologies for drug discovery are now often located in different locations (such as Boston and the San Francisco Bay area) from those historically used by the "big pharma" firms concentrated in Philadelphia, New Jersey, Connecticut and the mid West.

Many factors drive these R&D location decisions, and the observed geographical distribution of research reflects complex tradeoffs among them. One the one hand, economies of scale and scope in performing R&D, the presence of internal knowledge spillovers, and costs of coordinating activity across dispersed units suggest that, all else equal, firms should limit geographic dispersion of R&D. Furthermore, some locations may be more intrinsically economically attractive because of lower costs, access to government subsidies or favorable tax treatment of R&D. Proximity to centers of academic excellence and other forms of non-commercial research also appears to convey benefits such as raised research productivity, see Furman *et al* (2006). On the other hand, these economic forces tending to concentrate R&D can be offset by the impact of public policy choices that give pharmaceutical companies strong incentives to maintain domestic R&D spending. For example, some countries, such as the UK, have explicitly linked the stringency of price regulation to local R&D spending levels (Bloom and Van Reenen (1998)). In other cases, such as Canada, local R&D spending has reflected an explicit political bargain to avoid compulsory licensing.

Historically, the US has been perceived by the industry as a very attractive location for pharmaceutical R&D because of its very limited use of price regulation and government purchasing, and strong patent rights. In contrast, in the late 1990s, EU governments became very concerned (see Gambardella *et al* (2000)) that overly aggressive price controls and hard bargaining by state purchasers were driving away investment in pharmaceutical R&D and adversely affecting the competitiveness of EU based companies, though there is little evidence of any major shift in R&D spending away from Europe. Episodes such as Canada's experience with compulsory licensing of pharmaceuticals in the 1970s and 1980s, or more recent examples such as the periodic heated disputes between OECD based companies and governments of developing countries over pricing of anti-retroviral drugs suggest that R&D location decisions may be quite sensitive to government policies directed at lowering the cost of acquiring pharmaceuticals. On the other hand, studies such as Chien (2003) of specific compulsory licenses suggest a muted response, if any, and critics of the industry argue that gains from lower prices more than offset any negative domestic impact from compulsory licensing.

Countries such as Australia, which have relatively stringent drug price controls, continue to face major challenges in attracting significant R&D investment by multinational drug companies, in spite of strong academic research capabilities, an attractive business environment and substantial public support of commercial biomedical research (Rasmussen (2003)). There is, however, little statistical evidence establishing strong causal relationships between the stringency of price controls and R&D location decisions.

Beyond these "price" drivers, several other factors have been identified as influencing R&D location decisions. These often work through indirect or unpriced effects such as knowledge spillovers that are conveyed by "open" publications, geographic proximity, or communication through informal professional networks rather than through economic transactions. For example, drug discovery laboratory sites tend to specialize in therapeutic areas or scientific disciplines and since proximity to publicly funded science appears to be an important determinant of research productivity, these often reflect local academic centers of excellence in particular fields. Furman *et al* (2006) showed that patenting by pharmaceutical companies is positively correlated with the volume of academic publications by "local" public sector scientists. The very substantial levels of publicly funded biomedical research in the UK, the US, and some other countries has, therefore, played an important role in sustaining similarly high levels of commercial investment in drug discovery in these countries.

More generally, like other knowledge-intensive activities, discovery research appears to display substantial agglomeration externalities. Drug discovery activity tends to "cluster" in a small number of locations around the world: many major discovery laboratories are located in New York/New Jersey/Connecticut SMSA, Boston, the San Francisco Bay area, the suburbs of Philadelphia, the Research Triangle in North Carolina, the Rhine Valley, the suburbs of London, Stockholm and Tokyo/Kansei.

These are conspicuously not low-cost locations, so this clustering suggests substantial offsetting economic benefits derived from being co located with other firms. Beyond the role of localized knowledge spillovers, benefits from co location with other pharmaceutical firms include access to skilled labor and "infrastructure" in the form of specialized services and suppliers, and efficient interaction with collaboration partners.

The final factor that may affect R&D location decisions is the strength of IP protection. Though there is no obvious connection between the degree of patent protection in the local product market and the productivity of R&D conducted in any given country, the nature of a country's IPR regime appears to affect multinationals' willingness to conduct R&D activities there. (See Arora, this publication, Branstetter, Fisman and Foley (2006), Smarzynska Javorcik (2004)). This may be because weak patent protection for products often correlates with weak legal protection of other forms of intellectual property such as trade secrets and associated contractual agreements with employees and suppliers, and limited avenues to enforce these rights. Both patent and non patent protection of intellectual property play an important role in maintaining exclusive access to, and control over, proprietary knowledge, and in countries with weak intellectual property, companies may have well-founded concerns about "leakage" of valuable information to local competitors. Unfortunately, summary indexes of IP protection such as the Ginarte Park indexes give only a partial view of appropriability conditions, and, therefore, cross-country regression analyses based on such measures cannot easily address these issues.

Zhao (2005) argues that weak IP regimes need not deter R&D investment by multinationals: in the absence of strong IPRs, companies can nonetheless develop alternative mechanisms for realizing returns on innovation and intellectual property. These mechanisms include rapid "internalization" of knowledge through efficient internal organizational processes and control of

complementary assets, and may make it possible to profitably exploit low prices of R&D inputs and under-utilized domestic innovation capabilities. However, this argument is most appealing for technologies that have a substantial tacit component, are strongly complementary to other protected assets held by the firm and have rapid development cycles. This is not the case for pharmaceutical R&D, where results from R&D are often easy to "externalize" and imitate, and product lifecycles are measured in decades.

Not surprisingly, therefore, R&D activity in pharmaceuticals has historically been concentrated in countries with strong and enforceable intellectual property and has only just begun to grow in countries that have recently adopted OECD-style patent systems under the provisions of the TRIPS agreement. It is, of course, difficult to assign causality from such observations: it may be that IPRs have been implemented or strengthened most quickly and extensively in those countries where the domestic pharmaceutical industry has greater influence on political processes. Nonetheless, political choices to subsequently weaken or limit patent protection on pharmaceutical products may have serious consequences for the development of nascent research sectors in some countries.

In India, for example, Arora, Branstetter and Chatterjee (2008) show a surge in R&D investment and in stock market valuation of research intensive companies, but it remains to be seen whether this trend is sustainable.

Proxy data on R&D activity, such as the location of inventors listed on US patent applications or PCT filings (see Cockburn (2008)), or location of clinical trial sites (see Thiers, Sinskey and Berndt (2007) and Berndt, Cockburn and Thiers (2008)) point to increasing geographic dispersion of R&D. This is at least correlated with the presence of IPRs, with the greatest growth in these measures occurring in countries which adopted stronger IPRs for biomedical inventions, even after controlling for other country attributes, such as costs of conducting clinical trials, GDP, medical infrastructure, human capital, and "e readiness." However, it is difficult to find a strong causal relationship in econometric tests of these relationships, and difficult to distinguish "pull" factors, such as lower costs or higher anticipated profits, from "push" factors, such as saturation of clinical research capacity in traditional locations.

Development of better data on R&D activity in this sector at the country level, particularly on contract and collaborative research arrangements, would be very helpful as would further detailed country studies such as Arora, Branstetter and Chatterjee (2008). Very little is known, for example, about the nature and extent of pharmaceutical R&D activity in China (which is widely believed to be likely to become a significant player in biomedical R&D) or in many other developing countries.

A final area where IPRs may have an impact on R&D is on the composition of expenditures. Incentives to develop drugs for specific diseases are clearly affected by the prospective profitability of these markets, which is a function of anticipated market size and margins to be realized from serving them. It has often been observed that the bulk of innovation in pharmaceuticals has been targeted at the "large" markets created by the combination of patent protection with population size, income and disease incidence in OECD countries. In contrast, a very small fraction of the global R&D effort has been directed at diseases which are "small" markets in the sense of being relatively rare, or prevalent in low-income populations or in countries with limited profit potential. Patent protection can, therefore, play a significant role in driving the composition of R&D if it effectively increases market size for neglected diseases. Lanjouw and Cockburn (2001) found some evidence that the prospect of IPRs in developing countries was stimulating R&D expenditure in the mid-1990s on tropical diseases prevalent in countries which had previously lacked patent protection. In a more recent study using IMS R&D Focus, a com-

mercial database of R&D projects, Kyle and McGahan (2008) found similar results, though the effect is smaller than the association that they found between strengthening of patent rights in countries where neglected diseases are most prevalent and the number of R&D projects conducted on "global" diseases, for which the largest markets are in the developed countries. This is an issue which surely merits further study. More generally, looking beyond neglected tropical diseases it may also be the case that changes in the IPR regime in countries with patterns of disease incidence that are different from those of the historically patent-protected markets may have substantial effects on the composition of the global R&D budget.

Alternative models for providing incentives to conduct R&D on neglected diseases such as Advance Market Commitments have overshadowed IPRs in recent policy debates. This is a complex and interesting topic, see Kremer (2001) and Berndt *et al* (2006), and careful studies of how alternative incentive schemes such as AMCs work in practice would be useful. Interactions between AMCs and IPRs are poorly understood: while AMCs or other alternative mechanisms may be necessary to support investments in R&D directed at economically unattractive markets, patents may nonetheless play an important complementary role, or may be completely unnecessary (see Maurer *et al* (2004)).

2.4.3 IPRs and the Market for Technology

IPRs clearly play a critical role in facilitating transactions in a "market for technology" that has come to play a central role in innovation in pharmaceuticals.

While this sector continues to be dominated by large integrated firms that conduct much of their innovative activity in house, recent decades have seen significant vertical restructuring of the industry and these firms increasingly rely on externally sourced R&D in both the discovery and development phases of research. In drug discovery, an active entrepreneurial sector that bridges academic and publicly funded research and industrial science has become a very important supplier of drug candidates and tools for performing R&D. In the development phase, specialist firms (contract research organizations (CROs)) now play a significant role in conducting clinical trials on behalf of the sponsor of a drug. The causes of this restructuring of R&D activity are complex, ranging from changes in patent law and practice that have extended exclusionary IPRs into "upstream" science, financial market innovations that have eased access to capital for early stage companies, and the development of institutions that have encouraged universities and public laboratories to actively promote commercialization.

One consequence of these changes is that pharmaceutical innovation now relies heavily on a complex web of contractual agreements linking a variety of actors at various stages of the drug development process. Danzon *et al* (2005) found that over one-third of new drugs approved between 1963 and 1999 originated in alliances between industry participants. Data on strategic technology alliances also shows an explosion of collaborative activity in the biomedical sector since the early 1990s, with many of these alliances spanning national boundaries.

While IPRs are often thought to support markets for technology, a counter-argument is often made that proliferation of patents may "choke" biomedical innovation by raising transaction costs (see Heller and Eisenberg (1998)). However, evidence on these issues is mixed: Walsh *et al* (2004) surveyed life scientists and found few adverse effects of patents. On the other hand, in one interesting study (Murray and Stern (2006)) patents were shown to negatively affect researchers' access to knowledge, as measured by citations. It would certainly be interesting to conduct similar studies of researchers located in emerging or transition economies, where the institutions of "open science" may receive different levels of funding from non-commercial sources, or operate within a different innovation system and cultural milieu.

A related issue, and another comparatively neglected area of research, is the contribution of the natural genetic and biological resources and associated traditional knowledge of developing countries to biomedical research. Anecdotal evidence suggests that the origin of many important pharmaceutical products can be traced back to such resources. However, there is very little systematic empirical work on this topic, and beyond the reporting of opportunistic attempts to obtain patents in the US on various traditional medicines, little analysis of the role of IPRs in promoting (or hindering) access to an important component of the "research commons".

IPRs play a critical role in facilitating and governing transactions in the market for technology (Arora, Fosfuri and Gambardella (2001)). Technology licensing, collaborative R&D, and contract research are very difficult to sustain on a commercial basis without well-defined and enforceable rights over research results. It is widely believed, therefore, that strengthening IPRs will not just promote domestic R&D activity, but will also stimulate trade in technology. However, direct evidence on these types of international technology flows is very difficult to measure in many contexts. License agreements and similar contracts provide one indicator, but licensing of technology is notoriously opaque, since firms rarely publicly disclose licensing transactions. Some licensing payments are tracked in trade statistics: Branstetter, Fisman and Foley (2006) use trade data to show how licensing payments received by US multinationals from their foreign affiliates changed following patent reforms. However, non-priced licensing transactions (such as cross-licenses) are largely invisible.

Further, royalties paid under license agreements are only one indicator of technology transfer. Patent citations have been widely used to track knowledge flows (Jaffe and Trajtenberg (2002), Peri (2005), Keller (2002)) but there are obvious endogeneity problems in using patents to track the impact of changes in IPRs, and such studies typically are restricted to citations made within the USPTO or EPO systems. One important mechanism may be strategic partnerships, joint ventures and collaborative agreements. Some, but not all, of such agreements are tracked in databases, but their purpose and the amount of resources involved are often difficult to determine. The picture is further complicated by parent-subsidiary relationships, and the possibility that economic flows are driven by tax and transfer pricing concerns.

2.5 Trade and Production

IPRs may also play a role in driving patterns of trade and the national and international structure of production. Zuniga and Combe (2002) found dramatic changes in the industrial structure of pharmaceutical manufacturing in Mexico following the strengthening of IPRs on pharmaceuticals in the early 1990s. Similar "shake out" processes of consolidation among domestic manufacturers, and acquisition of domestic producers and "greenfield" FDI by foreign producers are apparently occurring in India and other countries, but are poorly documented.

Changes in the IPR regime may also be associated with a country's greater involvement in manufacturing and trade of pharmaceuticals and other knowledge-intensive goods. Delgado, Kyle and McGahan (2008) found that global trade in pharmaceuticals and related products has increased since the passage of the TRIPS agreement, relative to sectors identified as being less affected by its provisions. Koenig and MacGarvie (2008) found evidence that differences among European countries in the regulatory environment for pharmaceuticals influence foreign investment in manufacturing and marketing facilities, suggesting that variation in IPRs might have a similar impact in a wider sample of countries. Ahlering (2004) found little relationship between IPRs in a given country and the share of a pharmaceutical company's employment in that country, after controlling for "regulatory stringency", though in a relatively small sample of countries.

3. A RESEARCH AGENDA

Our understanding of the influence of IPRs on the world pharmaceutical industry would be advanced by research in all of the areas discussed above. There are numerous opportunities to inform policy using a variety of methods and approaches, conducted at a variety of levels. Informative methodologies include case studies, surveys and interviews, compilation and publication of high quality data sets and econometric modeling. Levels of analysis range from individual suppliers, distributors and purchasers, to country studies, to regional and international comparisons.

3.1 Characterizing Pharmaceutical IPRs

- It should be a priority to develop a comprehensive and multidimensional measure of the formal structure of IPRs in pharmaceuticals for a broad cross-section of countries, as described above.
- Country-based or cross-country surveys of a broad set of stakeholders (e.g. government and academic medical researchers, health care providers, branded and generic pharmaceutical company executives in R&D/marketing/public affairs/legal, import/export companies, wholesalers and retailers of pharmaceutical products, leading law firms) as to their perceptions of the strength and impact of IPRs would provide valuable context for discussion of policy issues, and a basis for measuring the *de facto* rather than *de jure* IPR environment.

3.2 Pricing and Demand

- Efforts should be undertaken to develop and disseminate comprehensive, accurate and well-documented data on pricing and consumption of pharmaceuticals in a large number of high-, middle- and low-income countries. Notwithstanding the importance of diseases or conditions such as HIV/AIDS, malaria and tuberculosis for global public health, and their prominence in public debates, it is important to cover as widely as possible the range of drugs. This type of data should feature:
  - Pricing of large "baskets" of directly comparable pharmaceutical products (appropriately weighted to reflect actual consumption patterns or "public health weights").
  - Tracking of consumption volumes.
  - Tracking of price levels and trends for off-patent (or multisource) vs. patented (or single source) products.
  - Tracking of dispersion in pricing within countries (e.g. by region, by urban vs. rural etc.) and by distribution channel (retail pharmacy, hospital, public/voluntary sector).
  - Tracking of components of prices faced by consumers or other end-user purchasers, such as manufacturer selling price FOB and CIF, local wholesaler acquisition price after tariffs or customs duties paid on imported products, distributor margin, retailer margin, dispensing fees, retail sales taxes, etc.
  - Tracking of the extent to which manufacturers or other participants in the distribution chain engage in intra-country price discrimination, and among which classes of purchasers (e.g. by income, insurance status, etc.).
  - Evaluation of the extent and quality of information about prices available to institutional or individual purchasers of drugs.
  - Careful characterization of the regulatory and institutional factors influencing pricing of pharmaceuticals:

  * Price controls and other forms of price regulation, including direct price controls, regulation of margins at various points in the distribution chain, rate of return of profit regulation of manufacturers, benchmarking of manufacturer prices against comparator countries ("international reference pricing") and therapeutic reference-based pricing.
  * Constraints on access or utilization of drugs through use of formularies or other limits placed on prescribing under government health plans or private insurance, such as quantitative limits placed on the volume of utilization of specific drugs, or reimbursement limits (or financial penalties) based on the volume of drugs prescribed.
  * Legal or regulatory frameworks that permit or encourage therapeutic substitution by dispensing pharmacists.
  * Legal or regulatory frameworks that permit or oblige substitution of generics for brands. What are the financial incentives to do so?

- Based on this type of data, analytical investigations of the following pricing issues would be very helpful:
  - Economics of the distribution channel: how do the manufacturer and non-manufacturer components of pricing vary with market structure and competitiveness at different points in the distribution chain?
  - Demand modeling: estimation of demand parameters (price elasticities, substitution, and income elasticities) for a variety of drug classes, using a variety of functional forms and estimation methods.
  - Economics of intra-country price discrimination.
  - Institutional and economic factors promoting or delaying access to newly developed drugs, such as IPRs, price regulation, health and safety approval processes, dissemination of information to prescribers, etc.

3.3 R&D

Studies of R&D and IPRs are generally frustrated by the paucity of consistently gathered and sufficiently detailed data on the full range of R&D activities. Outside the OECD countries, the consistency and quality of data on R&D expenditure is difficult to evaluate, and even within the OECD countries, data published by national statistical agencies is rarely broken down at the level of detail necessary to fully understand the economic and policy issues. Researchers may therefore be able to make major contributions by creating and analyzing data sets that cover the full range of R&D activities, gathered from sources such as surveys, analysis of company financial statements, review of international or local trade publications, or use of indirect indicators of innovative activity such as patent filings in various jurisdictions, publications in scientific journals or listings of clinical trial sites in published study protocols. Important aspects of innovative activity to track include:

- Measures of the volume of R&D activity and transactions in the market for technology as captured by:
  - R&D expenditure by commercial and non-commercial entities.
  - In-licensing and out-licensing agreements and payments.
  - Joint ventures and partnerships.
  - Grants or other forms of support provided to non-commercial entities.
  - Contract research services.
  - Formation of PPPs.
  - Acquisition or spin-out of research-based companies.
  - Investments in and sponsorship of training and skills development.

- Nature and composition of R&D:
  - Pre-clinical vs. clinical research.
  - Disease areas targeted.
  - Scientific disciplines (e.g. molecular biology, medicinal chemistry, process engineering, computer modeling).
  - Medical/scientific specialties (e.g. toxicology, oncology, virology, immunology, cardiology, etc.).

- Beyond the essential task of documenting R&D activity in different countries, and correlating this with the IPR regime, there are many important open research questions in this area:
  - What are the forces driving agglomeration and clustering of R&D activity? What types of government policies spark and sustain development of clusters in this sector?
  - How integrated are world markets for critical research inputs such as highly trained individuals?
  - What are the time horizons over which investments in R&D are planned?
  - What is the relative importance of IPR regimes compared to other factors influencing the location and composition of R&D investments (tax treatment, expected local demand, general business environment, legal system, language, infrastructure and transportation, telecommunications, etc.)?
  - How important is the scale and quality of complementary public sector research and clinical capabilities?
  - Is there evidence that changes in IPRs are affecting access to basic research in emerging and transition economies?

3.4 Trade and Production

Open questions in this area include:

- The influence of IPRs on origin, volume and destination of trade in pharmaceutical products at various stages of the supply chain (finished products, active pharmaceutical ingredients (APIs), intermediates and raw materials.
- The influence of IPRs on intra- or inter-country transfer of process and manufacturing technology, particularly for biotechnology products.

4. CONCLUSION

The pharmaceutical industry is unusually knowledge-intensive, and the economics of this sector are widely recognized to be unusually sensitive to IPRs. Some progress has been made in documenting and understanding the interactions between IPRs, complementary regulatory and policy provisions, the international expansion of the industry, and the implications of these for pricing and access to drugs, R&D, trade and production. However, opportunities abound for developing and analyzing more comprehensive data on this complex and critical sector, particularly in developing countries and countries with economies in transition.

Note

1 Valuation studies based on renewal data suggest that patents are unusually valuable in the pharmaceutical sector (Schankerman (1998).

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COMMENTS ON
INTELLECTUAL PROPERTY RIGHTS IN THE PHARMACEUTICAL INDUSTRY: CHALLENGES AND OPPORTUNITIES FOR ECONOMIC RESEARCH

CARSTEN FINK*

Iain Cockburn's contribution provides an excellent introduction to the topic, summarizing the key findings of the available literature, outlining important knowledge gaps and offering sensible recommendations on how these gaps might be filled. I find myself largely in agreement with the views and priorities put forward in Professor Cockburn's paper and will, therefore, use these comments to elaborate on one specific theme discussed in the paper: the incentives for and effects of differential pricing of pharmaceutical products.

Differential pricing structures are sometimes regarded as a way of promoting access to medicines in developing countries without compromising research and development (R&D) incentives. Indeed, such a view is grounded in economic theory. Efficient recovery of fixed R&D outlays calls for discriminatory pricing structures, whereby low-demand elasticity consumers pay more for drugs than high-demand elasticity consumers. Admittedly, free-market discriminatory pricing in segmented markets is unlikely to approximate what economists refer to as Ramsey pricing – which are, after all, regulated prices.[1] Nonetheless, pricing-to-market holds the promise of poor patients being able to afford patented medicines, while encouraging an efficient sharing of global R&D costs.

Questions surrounding differential pricing will arguably become more important in the future. In the mid-1990s, developing countries signed up to the WTO's TRIPS Agreement which requires WTO member governments to protect product patents for pharmaceuticals. However, due to the transition periods in the TRIPS Agreement, developing countries had to (fully) implement the relevant pharmaceutical obligations only by January 1, 2005. In light of the substantial delays between patenting a promising pharmaceutical compound and obtaining marketing approval for the resulting product, the full impact of the TRIPS Agreement will only materialize in the next five to 15 years, as patented products take on a larger share of the pharmaceutical markets in the developing world.

Controversies about pharmaceutical pricing are therefore bound to increase. In principle, countries can resort to compulsory licensing to override the market exclusivity conferred by patents. Indeed, a number of developing countries have done so, mainly for anti-retroviral drugs used in government-run HIV/AIDS treatment programs. In 2007, Thailand broadened the use of this instrument by issuing a compulsory license for a drug to fight heart disease. Such a move appears entirely legal under the rules of TRIPS: contrary to what is sometimes stated in the popular press, the TRIPS Agreement does not confine compulsory licenses to emergency situations.[2] Selected use of compulsory licensing by individual developing countries is unlikely to alter global R&D incentives.

However, systemic use of such a policy by all developing countries raises a collective action problem. Middle-income countries as a group already account for more than 10 per cent of global pharmaceutical sales and given their faster rates of economic growth relative to developed

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countries, this share is rising continuously (see Fink (2008)). It seems only fair and, indeed, economically efficient for these countries to contribute to the global R&D 'burden'.[3] Within the global patent system, such burden sharing can be implemented precisely through differential pricing schemes.[4]

Against this background, what is the evidence on differential pricing? Notwithstanding the substantial methodological challenges in appropriately comparing prices across countries described in Iain Cockburn's paper, some empirical evidence is available. Scherer and Watal (2003) found marked variations in the wholesale prices of 15 anti-retroviral drugs over the 1995-99 period. However, they could not discern any positive correlation between price levels and countries' *per capita* GDP. Wong (2003) confirmed this result using a larger sample of drugs covering seven therapeutical categories between 1994 and 1998. Interestingly, this study found that income-inequality, as measured by countries' Gini-coefficient, has a positive and statistically significant effect on drug prices. At face value, this latter result suggests that pharmaceutical companies take into account local demand conditions in their pricing strategies, but the resulting international pricing structure may not promote broader access to medicine objectives.

At a more anecdotal level, differential pricing according to countries' *per capita* incomes seems more widespread in the case of vaccines and condoms (Scherer and Watal (2003)) – though the characteristics of markets for the latter differ substantially from those of pharmaceutical markets. In the case of drugs fighting HIV/AIDS, tuberculosis, and malaria, several research-based pharmaceutical companies have over the past eight years established *per capita* income-based pricing structures for sales to developing country governments, not-for-profit organizations, and international aid agencies.[5] Similar pricing policies also exist for other diseases – such as Novartis' International Patient Assistance Program for the cancer drug *imatinib* (brand name: Glivec), which relies on an assessment of patients' means to determine the drug's price.

In summary, available evidence suggests that incentives for differential pricing differ across pharmaceutical products and purchasers. More studies are needed to refine this picture and, in particular, to identify policy measures that may affect differential pricing strategies. The latter include parallel import and price control policies, which may lead to a *de facto* unification of national pharmaceutical markets. From a normative perspective, economists could make a contribution in developing methodologies for calculating globally efficient Ramsey prices in the pharmaceutical sector. Such methodologies could help policymakers in national compulsory licensing and price control policies. By proposing a more objective benchmark of what constitutes 'justified' price levels in poorer countries, they may also serve to reduce conflicts between research-based pharmaceutical companies and pharmaceutical purchasers, which the new IP regime in the developing world will invariably bring about.

Notes

1 See Fink (2008) for a discussion of free-market discriminatory pricing vs. Ramsey pricing.

2 Emergency situations merely trigger the additional flexibility in the TRIPS Agreement not to seek first a voluntary license from the patent holder before granting a compulsory license. See Article 31(b) of TRIPS.

3 LDCs constitute a negligible share of global pharmaceutical sales and, in any case, are still exempted from the TRIPS pharmaceutical patent obligations.

4 Even when countries resort to compulsory licensing (or direct price controls), burden sharing is still possible through differential royalties that patent holders receive from generic producers (or differential price controls).

5 The relevant price discounts are documented in various editions of the publication Untangling the Web of Price Reductions by Médicins sans Frontières, available at http://www.accessmed-msf.org. It should be noted, however, that price reductions may have been, at least in part, brought about by competition from generic producers, as most first-line anti-retroviral drugs were still not patent-protected in major developing countries.

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COMMENTS ON
INTELLECTUAL PROPERTY RIGHTS IN THE PHARMACEUTICAL INDUSTRY: CHALLENGES AND OPPORTUNITIES FOR ECONOMIC RESEARCH

ROKIAH ALAVI*

Professor Cockburn's paper has touched upon all the key issues related to IPRs in the pharmaceutical industry. It is an interesting and very comprehensive paper. What I intend to do here is to add one additional point that I thought would be useful to be highlighted.

In almost all developing countries that have domestic pharmaceutical production facilities, such facilities are primarily for generic drug manufacturing. As such, these producers mainly benefit from the TRIPS-compliant exceptions and limitations to patents rather than patent protection itself.[1] These exceptions include the "Bolar" provision, permission to utilize clinical test data filed by the patent owner to obtain regulatory approval and compulsory licensing. The concern expressed by many observers is that many regional and bilateral free trade agreements (RTAs and FTAs) are imposing constraints on the use of these flexibilities. Erosion of such flexibilities may have implications on generic drug producers and consequently on prices, competition and access to drugs.

My comments here will focus only on the "Bolar" provision and data exclusivity requirement since issues related to compulsory licensing have been discussed in Professor Cockburn's paper. To obtain approval for a generic product, the manufacturer is required to conduct a study on the formulation of the product, perform stability experiments and undertake bioequivalence studies. The 'Bolar' provision allows generic producers to carry out all these tests, develop the product and submit an application for regulatory approval of a generic product before the expiry of the patent. Thus, it permits a generic producer to market its products soon after the patent expires. Elimination of this provision would mean delays in market entry by generic producers, as they will have to wait until the patent expires before conducting the necessary tests and obtaining regulatory approval.

Data exclusivity refers to the exclusive right granted to innovator companies to prevent the use of their safety and efficacy test data that were submitted to the competent regulatory authority for marketing approval. This exclusive right could be granted to patent owners for a period of time (usually five to 10 years) after obtaining marketing approval.[2] In most of the developing countries, national laws allow generic drug producers to refer and utilize clinical test data for product approval and registration. Data exclusivity provisions limit the ability of local generic manufacturers from entering the market because they are required to undertake their own clinical tests which are time consuming and costly. Grabowski (2002) estimated the cost of accumulation and compilation of these data to be 467 million US dollars accounting for 60 per cent of total costs of pharmaceutical R&D. Though the exact costs of clinical tests are not known, it is obvious that the amount is very substantial and often beyond the affordability of generic producers in developing countries. Therefore, any initiative to include data exclusivity provisions in patent law is likely to create significant barriers for generic entry. The proponents for data exclusivity claim that the benefits of this provision for developing countries are that it provides incentives for research in identifying new uses for existing unpatented products and encourages the

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innovator manufacturers to introduce and register new products in developing countries (Clift (2007)). In fact, some analysts are recommending a longer data exclusivity period of 12 to 16 years in order to promote investment in research and development in new medicines and new indications for existing medicines (Grabowski (2007)).

The economic literature on the impact of the erosion of TRIPS flexibilities as a result of free trade agreements on the pharmaceutical industry is quite extensive. Generally, most of these studies are qualitative in approach and therefore the findings are not backed by empirical data and analysis. Studies that provide useful and interesting insights into this issue, to list a few, are Pugatch (2004), Kuanpoth (2006) and Baker (2006). The most highly debated and analyzed issue is related to data exclusivity provisions. Almost all studies focusing on developing countries argue that the application of this provision would have a negative impact on them in terms of generic competition and consequently on affordable access to medicines (see, for example, Pugatch (2004). Kuanpoth (2006) and Baker (2006)). Furthermore, some argue that, in developing countries where there is negligible or no innovative pharmaceutical research capability, the prospect for data exclusivity provision to promote research is very limited (Clift (2007)).

Empirical studies are very limited, particularly in developing countries and countries with economies in transition. Nevertheless, there are two interesting empirical studies that have focused on the US-Australia FTA, which might provide some interesting insights for developing countries. Lokuge *et al* (2003) estimated the potential costs of changes in IP provisions under the US-Australia FTA on the pharmaceutical industry in Australia. Using five leading medicines nearing patent expiry as reference, they concluded that generic entry would be delayed by 24 months and, as a result, the additional costs incurred to the Pharmaceutical Benefits Scheme (PBS)[3] would be 1.12 billion Australian dollars (approximately 0.67 billion US dollars)[4] over a four-year period.

Another useful study in this area is a major research project conducted by Thomas Faunce and his team. This project was funded by the Australian Research Council (ARC) in 2005 and it aims to assess the impact of the Australia-US FTA on Australia and the global medicines policy.[5] Part of that study evaluates the effects of AUSFTA on the activity and returns of innovator and generic manufacturers. The research questions in relation to innovator manufacturers include (1) What are the changes to monopoly rent for patent holders? (2) What are the changes in the number of applications to the Therapeutic Goods Administration (TGA)[6] and PBS for listing of innovative patented products? (3) What is the impact on research and development investment? (4) What would be the effects on promotion and marketing expenditure? To assess the impact on generic manufacturers, the study planned to evaluate changes in the number of applications for marketing approval and changes to the timing of generic entry. In addition, the study also sought to examine the impact of the AUSFTA on the government's pharmaceutical expenditure; the opportunity costs to other areas of health services as a result of the increase in expenditure on pharmaceuticals; the direct and indirect effects on drug prices; changes in the availability of innovative drugs; changes in the mix of generic and brand name drugs in the Australian market; the impact on out-of pocket charges and changes in the use of newer innovative drugs compared to existing therapies on the PBS list. Unfortunately, the findings of the study are not available.[7]

The proliferation of FTAs involving developing countries, especially with the US, warrants study on the impact of the erosion of these TRIPS flexibilities on the pharmaceutical sector. There is a need for more concrete empirical research to assess costs and benefits of the changes in the IPR regime. The study undertaken by Faunce *et al* (2005) is an excellent research project that could be replicated for developing countries.

Notes

1 Except for when they enter into agreements (e.g. licensing agreements) with larger pharmaceutical companies.

2 Note that it also applies to products that have not been patented.

3 PBS is a medical subsidy scheme in Australia where from January 1, 2008, patients pay up to only A$31.30 for PBS medicines or A$5.00 for concession card holders. The Australian government pays the remaining costs. About 80 per cent of prescriptions dispensed in Australia are subsidised under the PBS. Taken from http://www.health.gov.au.

4 Based on the 2003 average nominal exchange rate.

5 The proposal of this project was published in Globalisation and Health (2005), 1:15. The research team included Thomas A. Faunce, Evan Dovan, David Henry, Peter Drahos, Andre Searles, Brita Pekarsky and Warwick Neville. Available at *http://www.globalisationandhealth.com/content/1/1/115*.

6 The TGA carries out a range of assessment and monitoring activities to ensure therapeutic goods available in Australia are of an acceptable standard, with the aim of ensuring that the Australian community has access, within a reasonable time, to therapeutic advances. More details are available at http://www.tga.gov.au/about/about.htm.

7 It is not known whether this project has been completed.

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INTELLECTUAL PROPERTY RIGHTS AND KNOWLEDGE TRANSFER FROM PUBLIC RESEARCH TO INDUSTRY IN THE US AND EUROPE: WHICH LESSONS FOR INNOVATION SYSTEMS IN DEVELOPING COUNTRIES?

FABIO MONTOBBIO*

1. INTRODUCTION

The issue of intellectual property and knowledge transfer from universities and public research organizations (PROs) stirs heated debate and is the object of strong policy interest in developed and developing countries alike. The question that many authors and policy makers try to tackle is how knowledge produced in universities and PROs can be transferred and used in industry, in order to contribute to economic growth, development and improvement in standards of living. The issue is complex because universities and PROs have a broad and changing role in national innovation systems that ranges from general education to basic research (Lissoni and Foray, (2008); Mowery and Sampat, (2004), Rosenberg and Nelson, (1994)). Moreover, intellectual property is only one of many channels through which knowledge flows between universities, PROs and industry and IP regulations cover many delicate issues (e.g. subject matter, type of licenses, research exemptions) which may affect scientists' choices about the number and type of research projects to undertake and, therefore, the trajectory of research and type of knowledge created. Moreover, the knowledge bases of different scientific disciplines differ substantially and this creates different research and disclosure methods on the university side, different appropriability strategies on the firm side, and different levels of efficiency of intellectual property for technology transfer.

Patenting and licensing from universities and public research centers are particularly important phenomena in biotechnology, drugs and medical science. In the US, licensing revenues reached 1.6 billion US dollars in 2005 and some recent success stories have attracted a lot of attention, e.g. the patent covering Emtrivia – an anti-retroviral drug that generated a revenue of 540 million US dollars for Emory University and 40 per cent of that amount for the three Emory inventors. Beyond these (very much hyped) success stories, the issue still causes heated controversies among scientists, managers and technology transfer practitioners. The conventional wisdom about patenting university research, and in particular, about the introduction of the Bayh Dole Act in the US, can be epitomized with the following words: "Overnight, universities across America became hotbeds of innovation, as entrepreneurial professors took their inventions (and graduate students) off campus to set up companies of their own (…). A goose that lays such golden eggs needs nurturing, protecting and even cloning, not plucking for the pot." (Innovation's golden goose – *The Economist*, December 14, 2002). At the same time, concerns are expressed by many authors, in particular in the field of biomedicine, that claim that the rules of open science are being jeopardized and the access to public knowledge could be restricted. This is expected to be particularly harmful for cumulative innovations and for developing countries. The statement in The Economist finds, therefore, its detractors: "Universities have evolved from public trusts into something closer to venture capital firms. What used to be a scientific community of free and open debate now often seems like a litigious scrum of data hoarding

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and suspicion. And what's more, Americans are paying for it through the nose." (The Law of Unintended Consequences – Clifton Leaf – *Fortune Magazine*, September 19, 2005). Many voices also in business and management point to possible problems in technology transfer arising from an aggressive approach of universities to intellectual property and some authors interpret the recent decline in university funding from industry as proof of the increased difficulties in the negotiations of sponsored research agreements, generated in particular by disagreements over the treatment of intellectual property[1] (Rapoport, (2006)).

This paper is aimed at providing a survey on the main empirical results in economics regarding the use of intellectual property in universities and PROs. In particular, it explores the effects of intellectual property on technology transfer and on the processes of knowledge creation and scientific development. In this paper, I focus on the relationship between intellectual property and technology transfer from an empirical perspective. Therefore, I do not discuss (with some necessary exceptions) the empirical evidence on channels of technology transfer not related to intellectual property (and the broader role of universities for local and regional economic development) and I do not discuss the theoretical models that address the issue of intellectual property and technology transfer from university and public research.[2]

Other surveys are available that cover many aspects of this literature that has been growing remarkably in recent years. In particular, Geuna and Nesta (2006) and Verspagen (2006) dealt with the economic literature on university patents and took a European perspective. Thursby and Thursby (2007) surveyed both models and empirical evidence on university patenting and licensing. Almost all the evidence they discussed comes from the US. Roathermel *et al* (2007) provided an extensive review on intellectual property and entrepreneurship. Foray and Lissoni (2008) and Mowery and Sampat (2004) discussed the broader role of universities in the national innovation system. Campos *et al* (2007) extended the analysis to developing countries.

This paper is organized as follows. In section 2, I discuss the main economic justifications for intellectual property in public research. In section 3, I summarize the debate on university patenting in the US and the EU, and discuss the different institutional environments and specific policy issues. In section 4, the concerns related to patenting science are taken into consideration. In section 5, the role of technology transfer offices (TTOs) and the determinants of their productivity is discussed. Section 6 concludes and discusses some lessons that can be learned for innovation systems in developing countries. In particular, I discuss some dilemmas that developing countries may have to face when designing their IP policies for universities and public research organizations. Finally, I discuss potential areas of additional research in developing countries.

2. THE ECONOMIC JUSTIFICATION FOR IP ON PUBLIC RESEARCH

The basic economic justification for university patenting is based on the idea that it facilitates the commercialization of the discoveries produced by scientific research (Arora et al, (2001), Kitch, (1977)). Thanks to well defined IPRs, firms or individuals have the incentives to invest additional R&D in product development because imitation is deterred and they can appropriate the related monopoly rents. Without a patent, the non rival and non excludable nature of knowledge would dissipate the expected profits and, therefore, the incentives to have extra R&D to bring such a product into the market.

This justification differs from the traditional economic justification for having a patent system. Typically, a patent is considered an incentive to innovate and a mechanism of knowledge diffusion through the disclosure of the technical details of the innovation. However, this is not the

case for scientific research performed in universities for at least two reasons. First, the mission of research universities and PROs is to solve the public good type of market failure through patronage, i.e. a publicly financed system of research (Arrow, (1962), Nelson (1959). David, (1993), (1998)). If only market based incentives are present, companies are expected to under invest in basic science and this requires public intervention to support basic scientific research and its diffusion. Second, incentives to disclose and to publish scientific discoveries are generated by the priority reward system in science. As a result, the main economic argument for patenting by universities and PROs is not the incentive to invent or disclose, but the incentive to transfer to private firms and to commercialize the generated knowledge. Patents are then considered the effective instrument to create markets for technologies.

This argument requires that licensing is exclusive, that there are substantial additional costs necessary to develop the invention and, finally, that there is no possibility to register patents on the results of the additional R&D effort. If there is no exclusivity, many companies can access the patented technology and this reduces the incentive to sustain the development costs. If the development can be done at no cost, companies will do that to improve the product and the issue of incentive is simply solved by competition forces and, finally, patenting downstream research could provide companies with the incentives for additional R&D (instead of intellectual property on upstream discoveries) (Mowery et al, (2001), Mazzoleni and Nelson, (1998), Verspagen, (2006)).

While this is the major logic behind policy recommendations and interventions in favor of university patenting in advanced countries, it is not the only one. In many developing countries,[3] the emphasis is not only on using intellectual property to promote cooperation and technology transfer between universities and industry, but also on preserving the public control on inventions generated by universities and PROs. These inventions should be patented to defend the public nature of all possible applications that may derive from them.[4] In many developing countries, IP policies may be designed together with specific health and food policies. In fact, the issue is perceived as particularly important in crucial sectors like agriculture, biomedicine and energy. Two issues are important in this respect: the alleged decrease in the quality of patents in the US and the increased number of patents in research tools. The first issue is linked to the non obviousness standard which is aimed at protecting the public pool of knowledge and, according to some authors (e.g. Merril *et al* (2004)), has declined in the US in particular in relation to software and DNA sequences. The second issue is addressed at some length in section 4 and raises concerns related to the generated barriers to entry in some research fields.

The use of intellectual property to protect public interest may result in an enhancement of the public good nature of the knowledge produced by preventing companies or individuals to patent innovations from university-generated inventions. At the same time, for example in military technologies, patenting (coupled with a secrecy clause) may help in keeping key technologies under control and to avoid knowledge spillovers. In this case, universities and public research organizations have to control that scientists and public servants do not appropriate and do not disclose independently the relevant knowledge.[5]

To sum up, the starting point of this survey is that the economic justification for intellectual property in universities and PROs has two facets: commercialization and public interest. The former keeps on being underlined in the political discourse in developed countries, while the latter may be particularly important for developing countries in key sectors like pharmaceuticals and agriculture. However, the specific design of IP policies may vary considerably according to the weight that policy makers want to assign to these two normative facets of intellectual property. Two dimensions may be particularly relevant in this respect: (1) the degree of exclusivity of licensing schemes; (2) the specific regulations on who is the owner of the university-generated

inventions. First, exclusive licenses are clearly needed for commercialization, but may conflict with the second justification as long as they limit the use and diffusion of the discovery. Second, in some European countries, universities are not entitled to retain IPRs over university based inventions. Intellectual property is assigned by law to professors who, therefore, differ from a normal employee. As I shall discuss in section 3.2, this could facilitate the transfer of technology from individual inventors to companies. In any case, if the public institution does not have the property right, this clashes with the idea of intellectual property being necessary to maintain control over the technology.

This survey explores the empirical work in economics in which the two broad issues of knowledge transfer and public interest have been articulated in a set of empirical questions. In particular, the questions that the recent literature has tried to address are: is university intellectual property bringing into the market important inventions? Is intellectual property hindering the scientific development or shifting research toward a more applied nature? Is it efficient as a means for technology transfer? Are there institutional differences in the use of intellectual property for public research? What are the effects on technology transfer? What is the role of TTOs? What makes TTOs efficient? Which are the best licensing schemes?

3. AN OVERVIEW OF THE DEBATE ABOUT UNIVERSITY PATENTS IN THE US AND EU

The first way to look at the role of intellectual property in technology transfer is, on the one hand, to understand the historical evolution of the relation between IP institutions and public research and, on the other, the changing attitude towards intellectual property of universities and scientists over the past few decades. In fact, a great body of recent literature has tried to address the issue looking at the historical evolution of the practice of university patents in the US, where universities started to use patents in the 1920s. In Europe, only recently has empirical research tried to understand the attitude of universities and PROs towards intellectual property and to compare the institutional differences among European countries and between Europe and the US.

3.1 University Patenting in the US

In the last 25 years, there has been a remarkable increase of university patents and licensing activity in the US. Reliable data is provided by the National Science Foundation (e.g. NSB (2004)) and the Association of University Technology Managers (AUTM) which produces a detailed annual survey on university licensing and new products from university research.[6] Patenting by academic institutions at the USPTO has increased over time, rising from 436 issued patents in 1981 to more than 3,500 patents in 2001. New patent applications by the 191 respondents to the 2005 AUTM survey numbered 10,270. In parallel, the ratio of academic patents – relative to the US private and non-profit sectors – has also risen significantly from 1.48 per cent in 1981 to a peak of 4.81 per cent in 1999. During the same period, there has been a rapid increase in the number of academic institutions receiving patents, although the distribution of patenting activity remains highly concentrated among a few major research universities. Moreover, in the period 1990–2000, there has been a remarkable increase in the licensing of university patents and revenues from licensing and fees (NSB (2004)).

Conventional wisdom links the increase of university patents to the Bayh Dole Act (BDA). However, US universities (in particular land grant ones) started patenting back in the 1920s (Mowery, Sampat (2001a)). It is worthwhile noting how the issue of university patenting was addressed at the early stages of the US innovation system. In fact, the motivations for universi-

ty patenting reflect the two facets we have underlined in the previous section: commercialization and public interest. Mowery and Sampat (2001a) cite, among other documents, a paper from the American Association for the Advancement of Science (AAAS) published on Science in 1934, where it is clearly shown that university patents are needed in order to provide incentives for the development and commercialization of new products (AAAS (1934)). The AAAS expressed the concern that university patents should prevent unqualified companies or individuals from charging monopoly rents or withholding the scientists' invention from use. In other words, scientific advances patented by universities should warrant that the research results are widely used and correctly exploited by competent firms.

The AAAS report stresses that the public interest issue is particularly important in two circumstances: when innovation is cumulative (with broad and basic inventions) and in the field of public health. Importantly, the report shows some reluctance to support the direct involvement of universities in patent management and points to the necessity to find competences for technology management outside the university. In fact, many US universities in the following years used the Research Corporation, founded in 1912, to manage their patents (Mowery, Sampat, (2001b)). During the 1920s and the 1930s two issues were considered relevant by university administrators, particularly in public universities. The first issue, as a result of the need to justify taxpayers' money, was to consider patenting as a sign of the link between the research effort and knowledge that becomes economically valuable at the local level. Secondly, with the Great Depression, patenting and licensing were needed to generate extra funds for the university (Mowery and Sampat, (2001a)).

In the US, after World War II, there was a big shift in the attitude of universities toward intellectual property that was the result of three interconnected issues. The first was the increased amount of federal funds, in particular in biomedicine. More money for research resulted in increases also in the scale of research activity and its output in US universities. The second issue was the related expansion of molecular biology in which intellectual property is particularly effective. Actually, most of the growth in university patenting activity in the last decades comes from this scientific field. Finally, during the 1970s, the perception in the US of the risk of losing technological leadership was particularly strong and, accordingly, the necessity to protect domestic technology guided some policy intervention[7] (Mowery, Sampat, (2001b)). In this context, the Bayh Dole Patent and Trademark Amendment Act (BDA) was approved in 1980. This gives uniform treatment to university and PRO patents derived from research funded with federal funds (Mowery *et al* (2001), Eisenberg, (1996)). The BDA is part of a general reinforcement of IPRs (which include the Stevenson-Wydler Act and the creation of the Court of Appeals for the Federal Circuit (CAFC) and the inclusion of IP issues in international trade negotiations) and tried to solve some uncertainty about licensing of academic inventions in previous IP arrangements with federal funding agencies. The BDA had its economic justification in the attempt to create an institutional setting conducive to the commercialization of the discoveries made within university laboratories and, to this end, it intended to facilitate exclusive licensing to support the development phase of the innovation process.

It is important to note that the BDA affected the attitude of US universities towards intellectual property and licensing. However, the positive trend in university patenting after 1980 would have probably occurred even without the BDA. In parallel to the general expansion of the patentable subject matter (that includes software, financial services, life forms and biotechnology), there was a change in attitude toward university patenting by some large academic institutions, even before the BDA (e.g. Columbia University in biomedicine) (Mowery *et al* (2001), (2004), Mowery and Ziedonis (2002), Sampat (2006)).

The salient characteristics of the BDA are that it leaves universities free to use exclusive licensing, and royalties have to be shared with the inventors (40 per cent in the Emory case, even if uni-

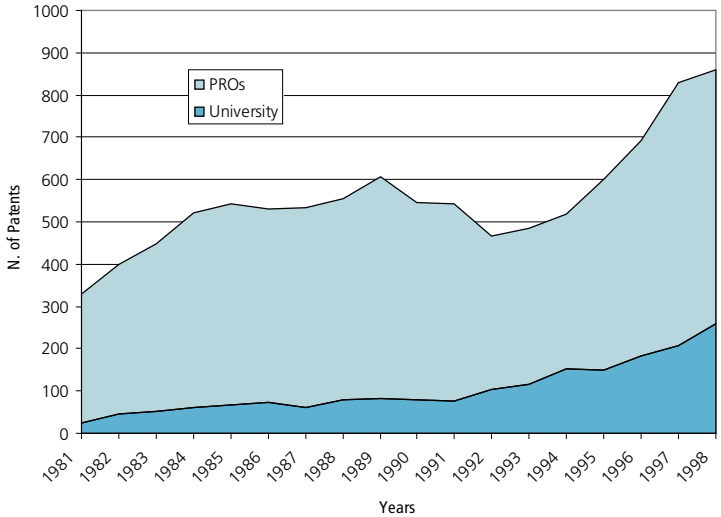
versities differ substantially in the way they share patent revenues and fees). The BDA includes a royalty-free government use and a "march-in" right, which, however, has never been used. Moreover, it is interesting to observe that the universities and TTOs have "right of first refusal" which means that the university has exclusive control rights over the scientists' inventions.

3.2 Europe

In Europe, there has also been an increase in university patenting even if its magnitude is inferior relative to the US. In addition, there are strong institutional and national specificities and the available evidence is still weak. First of all, issues related to federal sponsoring of research do not arise as often as in the US. There are different relationships between funding or "federal" funding agencies (e.g. *Centre National de la Recherche Scientifique* (CNRS) or the *Commissariat à l'Energie Atomique* in France (CEA), *Comitato Nazionale per la Ricerca e lo Sviluppo dell'Energia Nucleare* or *Consiglio Nazionale delle Ricerche* (CNR) in Italy, or, finally, *Max-Planck-Gesellschaft* or *Helmholtz Gemeinschaft – Forschungszentrum Julich* in Germany) and universities. As we have seen, the BDA in the US allows universities to retain the IPRs over research results funded from federal agencies. In contrast, in many European countries, national agencies administer and spend a large share of R&D funds directly within their own laboratories. For example, in Italy and France, the CNR and the CNRS (or the INSERM and the CEA) are very active patenters and keep control on IPRs. Figure 1 shows the number of patents at the EPO owned by universities and PROs in France, Germany, Italy and the UK and what is noticeable is the growing, but extremely limited, absolute number of university-owned patents and the relatively higher number of patents owned by PROs.

Accordingly, given the low number of patents owned by universities, Europe has its own policy issues. In some countries, the existence of the professor's privilege has played an important role. In Germany (as in Austria, Denmark and Sweden) the so-called professor's privilege allowed university professors to retain property rights over their research findings. It is worthwhile noting that in 2000 German law abolished the professor's privilege (the same occurred in Austria and Denmark) (see OECD (2003), Lissoni *et al* (2007)). For universities and research centers in France, Italy and the UK, the standard rule applied, according to which the employers retained the property rights (e.g. see Sections 39-43 of the UK Patent Act). In Italy, in 2001, the professor's privilege was introduced for the first time and amended in subsequent legislative interventions.

Figure 1. Number of Patents by PROs and Universities in France, Germany, Italy and the UK (1981-1998)

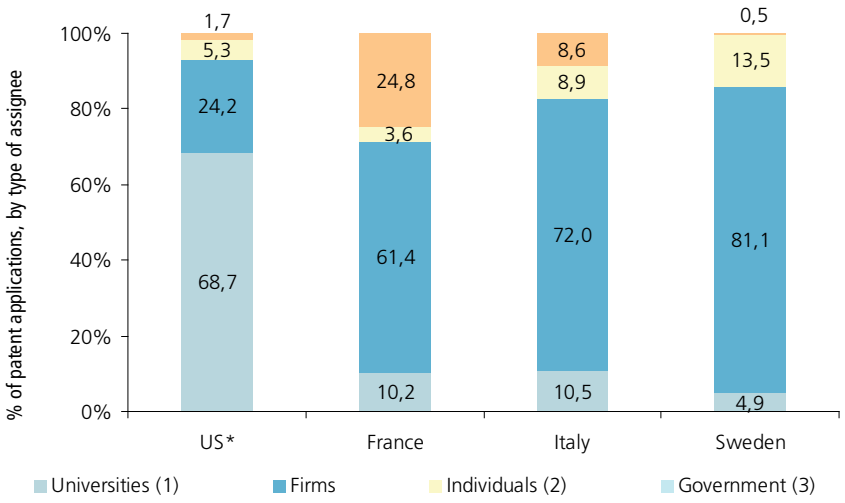


Source: EP-CESPRI Database (see also Bacchiocchi and Montobbio (2007))

Importantly, recent research shows that in many European countries IPRs on the output of university research activity are often owned by private companies (Lissoni *et al* (2007); Giuri *et al* (2007)). Consequently, the count of university patents (patents owned by universities) underestimates the technological activities of the European universities and the amount of technology transfer between universities and industry. Meyer *et al* (2003) and Balconi *et al* (2004) showed that 3 per cent of the patents in Italy (at the EPO) and 8 per cent of the patents in Finland (at the EPO) have at least one academic inventor. Moreover, in Italy, approximately 70 per cent of the patents with an academic inventor belong to private firms (Balconi *et al* (2004), Breschi *et al* (2007)). Similar evidence seems to emerge for Germany, France and Sweden (Schmiemann and Durvy (2003); Gering and Schmoch (2003); Lissoni *et al* (2006) and (2007)).

Lissoni *et al* (2007) undertook a considerable effort in matching the inventors' names from the EP-CESPRI database and the names of university professors from different sources in France, Italy and Sweden. They showed that the share of university-invented patents over the total number of patents in these countries was between 3 per cent and 6 per cent and this figure was comparable with that observed in the US. Moreover, Figure 2 displays the ownership of academic patents by assignees for France, Italy and Sweden and compares it with the US, as discussed in Thursby *et al* (2007). The difference between the various European countries and the US is striking. In the US, commercial companies own only 24 per cent of US academic patents. At the same time, in Europe these shares are respectively 60 per cent in France, 72 per cent in Italy and 81 per cent in Sweden. Universities, as already emphasized, own a very small share of university generated patents, around 10 per cent in France and Italy and 5 per cent in Sweden.

Figure 2. Ownership of academic patents by domestic inventors in France, Italy, Sweden, and the US*, 1994-2001



* US patent/inventor pair data from Thursby et al. (2006)
(1) US data include no-profit organizations (4,2% of tot obs); all data include co-assigned patents
(2) US data include "unassigned"
(3) European data include public laboratories

Source: Lissoni *et al* (2007) and Thursby *et al* (2007)

This is the result of the specific institutional characteristics of the various national research and innovation systems, in particular, the different role of the PROs on the one hand and, on the other, the lack of control over IP issues of many European universities. In Sweden, it may be because of the professor's privilege, whereas in France and Italy universities are not particularly autonomous from central government in fund raising and professors perceive themselves as civil

servants employed by the government rather than by the university. This created an incentive system such that universities did not create internal structures able to manage IPRs and professors felt free to dispose of the IPRs over their research results even in the absence of the professor's privilege (Lissoni *et al* (2007)). For example, Baldini *et al* (2006) showed that Italian universities created IPR regulations only in the second half of the 1990s. The important question that arises from this evidence is whether the fact that so many university-invented patents are owned by companies can be interpreted as a sign of an effective technology transfer.

A possible answer comes from the case of Denmark. Valentin and Jensen (2007) analyzed the impact of the Law on University Patenting (LUP) in 2000 that abolished the professor's privilege making a comparison with Sweden in the field of biotechnology. They observe a decline in collaboration between Danish firms and Danish scientists after the LUP approval and an increase in collaboration with non-Danish researchers. Moreover, they note that, when research is exploratory, the presence of a third actor (TTOs) brings delays in decisions over intellectual property and uncertainty.

It is remarkable that the institutional characteristics of the processes of interaction between universities, PROs and industry seem, to some extent, independent from the specific design of IP legislation. We observe similar patterns in the ownership structure of university-generated inventions in France, Germany, Italy and Sweden, countries that differ in terms of legislation. So it is possible to argue that technology transfer and cooperation between university and industry develops and adapts over the years according to established practices embedded in the variety of institutional actors. Changes in IP regulation may, therefore, be disruptive of the established practices.

3.3 The Importance of University and PROs Patents

Another (indirect) way to start answering the question about the impact of university and PRO patents on technology transfer is to take the approach of Henderson *et al* (1998) (HJT): "the extent to which this explosion [of university patents] should be taken as evidence of a large increase in the contribution of universities to commercial technology development depends on the extent to which it represents more commercially useful inventions vs. the extent to which it represents simply increased filing of patent applications on marginal inventions." (p.119)

Accordingly, they ask whether the relative growth in university patents changes the characteristics of these patents, in particular their importance and the way in which knowledge is transferred from universities. HJT compared the universe of university patents between 1965 and 1992 and a random control sample (equal to 1 per cent of USPTO patents). They measured the importance and "generality" of university patents using patent citations[8] and showed that over the whole period university patents were more general and important than their controls. Generality was measured using the number of technological classes the citing patents belong to and importance was measured counting the citations received by each patent. A high generality index indicates that the patent possibly had a widespread impact and affected subsequent innovations in different fields of technology. University patents are expected to be more general than corporate patents because universities should undertake research that is more basic and, therefore, the ensuing results should have a wider use across different disciplinary fields. HJT found that, after the introduction of the BDA, the relative importance and generality of these patents decreased. Two factors may explain this decline: (1) fewer original patents from smaller universities without a strong experience in patenting; (2) a general decline in the average quality of the patents with many patents receiving zero citations.

To sum up, HJT claimed that after the BDA, there was an increase in the propensity to patent, but fewer general and important inventions were produced. The increased technology transfer effort thus brings less significant technologies into the market. However, Sampat *et al* (2003), using a longer time series of citations, showed that university patents take longer to be granted; on average they receive citations more slowly and the quality decline observed by HJT could depend upon the truncation of the citations data and this different intertemporal distribution of citations to university patents. Moreover, Mowery and Ziedonis (2002) found that the generality and importance of the patents of two large US universities (University of California and Stanford University) did not decline after the BDA. At the same time, more experienced universities have more general patents than their less experienced counterparts that entered into patenting after the BDA. However, Mowery *et al* (2002), (2004)) suggested that the importance of patents of entrant institutions increased in the 1980s and 1990s and, therefore, a learning process took place over time.

There are wide differences across technological disciplines in the relevance of university patenting. Patent growth is concentrated mainly in biotechnology and pharmaceuticals (Mowery and Ziedonis (2002), Mowery and Sampat (2005)). As already mentioned in the previous section, this expansion depends upon federal support to medical research in the US and the expansion of molecular biology at the end of the 1970s. Moreover, it is only in pharmaceuticals, communications, and electronics that the results of university research are conducive to R&D projects which require clearly identified intellectual property. The question, therefore, is also whether the importance and value of university patents vary across different technological fields. It may be that reinforcing patenting is beneficial only for some fields and crowds out other technology transfer systems such as publications, conferences, workshops and consulting. In this respect, Bacchiocchi and Montobbio (2007) estimate the process of diffusion and decay of university and corporate patents in six countries and, using EPO data, show that US university owned patents are more cited relative to company patents, in particular in the drug and medical sector.

Fabrizio (2007) suggested that increasing university patents were associated with slowing commercial exploitation. She used USPTO patents and patent citation data from NBER and citations to non patent literature from the MicroPatent Database and showed that the slowdown in the pace of knowledge exploitation (e.g. the mean value of the citation-lag distribution) depends upon the increase in university patents, in particular in those technological areas that rely more heavily on public science (i.e. a higher-than-average citation rate to non-patented prior art).

Sampat (2006) compared a sample of university patents and a random control sample from the USPTO and showed a remarkable increase in the citation to non-patent literature of university patents (relative to their control) between 1976 and 1996. This evidence might suggest that universities are increasingly patenting science.

In Europe, as policy-makers move steadily in the direction of stimulating patenting activity of universities and PROs, no evidence is yet available on the relative characteristics of university and PRO patents and on their relative value. One problem that arises is that the EPO does not register the institutional nature of the applicant in a separate field. Actually, there is no comprehensive evidence available yet, apart from specific case studies at the departmental or university level (OECD (2003), Geuna and Nesta (2006), Sapsalis *et al* (2006), Sargossi and Van Pottelsberghe (2003)). Bacchiocchi and Montobbio (2007) provided an attempt at filling this gap using an original database on patents from universities and PROs. Their paper estimated the process of diffusion and decay of university and corporate patents in six countries and tested the differences across countries and across technological fields using data from the EPO: in Europe they did not find evidence suggesting that university and PRO patents are of a higher quality. Their results showed that knowledge produced in universities and PROs appears to dif-

fuse more rapidly, in particular in Germany, the US and, to a lesser extent, France and Japan. However, strong national specificities emerge in this respect.

Finally, Crespi *et al* (2006) compared university-owned and university-invented patents resulting from university–firm research joint ventures. They used the Patval database and asked whether university-owned patents are more often applied, or are more valuable, than privately owned patents. They concluded that university owned patents do not differ significantly from privately owned patents. Crespi *et al* (2006) interpreted this result using the model by Aghion and Tirole (1994) that shows that a potential market failure (sub optimal social value of the innovation) exists when companies own the patent from a public private research joint venture if the university has low bargaining power and is cash constrained. The evidence of no statistical effect of ownership on the rate of commercial application of university patents may suggest that there is no evidence of potential market failure in the allocation of IP ownership from European research joint ventures (Verspagen (2006) discusses this point thoroughly).

3.4 Summing Up

This section has analyzed the historical evolution of university patenting in the US and the institutional differences between the US and Europe. The evidence shows that in the US importance and generality have not displayed a significant decline in recent years. Also universities are undergoing a learning process that increases the value of their patents. Moreover, there is no evidence of a shift in university research toward more applied science or of a clear decline in the basic nature or importance of university inventions. At the same time, in Europe, there is evidence of increased use of university patents, but there are strong specificities in the form of a relatively more important role of PROs and different ownership structure of university patents. While it is now clear that the contribution in terms of patents of European universities is not unlike the contribution of US universities, the impact of these institutional specificities on the process of knowledge transfer is still largely unexplored.

Overall this evidence does not rule out the possibility that restrictions on science may emerge, together with costs of access to science and negative effects on other forms of disclosures of scientific results. The next section is devoted to the analysis of these issues.

4. PATENTING SCIENCE

In recent years, empirical economists have shown that industrial activity relies substantially on basic research. In many cases, public research performed by universities and PROs provides companies not only with knowledge and understanding of basic phenomena, but also with tools and methodologies. However, the idea that publicly funded new ideas spill over without cost to the private sector is naïve. Many empirical works show that the relationship between university and industry is based upon many forms of reciprocal interaction, and the process is far from being without cost. Moreover, many authors have noted that publicly funded research also has an important role in training researchers and facilitating information flows across a scientific and technical community that transcends organizational boundaries (Cockburn and Henderson, (1998)). I mention here a few empirical papers among the multitude of contributions in the field. Cohen *et al* (2002) used data from the Carnegie Mellon Survey to show that public research both suggests R&D projects and contributes to the completion of existing R&D projects. University research affects industrial R&D through many channels other than patents: published papers and reports, public conferences and meetings, informal information exchanges and consulting. This influence is greater for larger companies.

Mansfield (1995) showed that a large number of industrial innovations in many high-tech industries are based directly on academic research. He also found that the quality of the university's faculty in the relevant department, the size of its R&D expenditures and industry geographic proximity are important factors that affect the university's impact on industrial innovations. Mansfield (1991) and (1998) confirmed that a substantial share of industrial innovations (over 10 per cent) would not have been possible without academic research. Industrial innovation benefits greatly from open science also in pharmaceuticals. In this sector, where intellectual property is typically considered the major instrument of appropriability, Cockburn and Henderson (1998) showed that companies, on the one hand, have to invest in substantial R&D to complement externally generated knowledge and, on the other, they have to be connected with public-sector institutions. They comment on their results as follows: "(…) the ability to 'do good science' in the private sector may not be supportable in the long run without a close partnership with the institutions of open science. Policies which weaken these institutions, make public sector researchers more market oriented, or redistribute rents through efforts to increase the appropriability of public research through restrictions in the ways in which public and private sectors work with each other may be, therefore, counterproductive in the long run". (p.180)

Many authors share this concern and suggest that university patents may restrict access to public knowledge and, in the long run, change the rules of open science. This may occur along the following lines: decreased informal interaction, incentives to increase secrecy in research and teaching, delayed publications, restricted access to patented research tools, costly negotiations and opposition procedures. First of all, concerns have been expressed in relation to patents for foundational upstream discoveries that could be used for downstream scientific research (Nelson and Merges (1990), Mazzoleni and Nelson, (1998), Cohen (2005)). This problem is particularly severe when universities are left free to license their discoveries exclusively.[9] Colyvas *et al* (2002) surveyed 11 case studies (inventions) from Stanford and Columbia universities in biomedicine, electronics, software and medical devices. They underlined that patents are particularly important for embryonic inventions. In these cases, the ability to issue exclusive licenses is particularly important, but at the same time, the danger of exclusivity is particularly severe. This is because there is great uncertainty around the possible technological trajectories that may depart from the invention and this makes it difficult to choose the right licensee ex ante.

Second, there may be a problem with secrecy and data withholding. In particular, it is worthwhile mentioning two articles – among others – in the *New England Journal of Medicine* and the *Journal of the American Medical Association* (Blumenthal *et al* (1996) and Campbell *et al* (2002)) that point to the negative effects of patenting in life sciences on scientific publications. Campbell *et al* (2002) reported on a survey of 1,897 geneticists showing that almost half of them had been denied requests or additional information, data or materials regarding published research. Moreover, 10 per cent of all post-publication requests for additional information were denied. In many cases, therefore, published research could not be confirmed.

Blumenthal *et al* (1996) surveyed 210 life-science companies and underlined that over 60 per cent of companies providing support for life-science research in universities (this support is small comparable to federal funding) had received patents as a result of the relation with public research. Moreover, the companies reported that researchers are often required to keep the results of research secret beyond the time needed to file a patent. Given this preliminary empirical evidence, I will focus on two aspects that have been the object of particular attention in the last few years. The first is the well-known anti-commons problem and the second asks whether patenting activity has an impact on other forms of scientific disclosures, such as publications.

4.1 The Problem of the Anti-Commons

The "anti-commons" problem, in its more general formulation, refers to the idea that the privatization of the scientific commons reduces the benefits from scientific progress. More specifically, the anti-commons problem was suggested for biomedical innovation in light of the proliferation of patents on genes and gene fragments. Given the increase in the number of patents and the number of patent holders over a given product innovation or research tool, the cost of acquiring and negotiating the rights may become prohibitive and the likelihood of breakdown in negotiations over IPRs is higher. In this case, a loss of collective surplus is expected and, in the biomedical field in particular, the fragmentation of property rights may impede the development and commercialization of promising therapeutics and diagnostics (Heller and Eisenberg (1998), Murray and Stern (2007a) and (2007b)).[10]

Walsh *et al* (2003) conducted 70 interviews with IP lawyers, managers and scientists from biotech and pharmaceutical firms and universities (10 interviews of university scientists) examining the impact of patenting and licensing of research tools on biomedical innovation. They showed that the "patent landscape" is becoming more complex, exclusive licensing is pervasive and the pre-conditions for anti-commons effects exist. At the same time, they found little evidence of breakdowns in negotiations, or on projects that are not undertaken. In any case, they found that licensing fees for research tools have risen and this may be a problem, in particular for smaller firms and universities. They emphasized that some working solutions have emerged to deal with patents on research tools such as licensing, inventing-around or off-shore R&D to avoid infringement liability. However, what seems to be particularly important for universities is a sort of "informal research exemption". Even if this possibility is now undercut by CAFC's 2002 Madey v. Duke decision abrogating the (narrow) research exemption, faculty members seem to feel free to use research tools for research. Companies in most cases do not bring universities to court because they fear a loss in reputation, because they perceive that university research adds value and possibly because of the high cost of enforcing rights through litigation. Some exceptions are however observed in the field of clinical diagnostic. Overall, the situation is perceived as manageable, and results are confirmed by a subsequent larger survey (Walsh *et al* (2005)). Walsh *et al* (2005) analyzed the results from 655 researchers (398 from academia) in the fields of biomedicine (in particular proteomics and three specific signaling proteins). They did not observe that patent thickets significantly limit research activity in the field. However, few respondents seem to be aware of the necessity to regularly conduct patent searches and of risks related to infringements. For this reason, we cannot exclude that litigation may more significantly affect the researchers' activities in the future.

Walsh *et al* (2005) showed that access to tangible research inputs (materials) is more problematic and this should be, in their opinion, the main object of policy interest. However, it is worthwhile noting that the reasons the researchers gave for not sharing are more connected to scientific competition and costs related to material transfers, than commercial factors.

Murray and Stern (2007a) used a different perspective and methodology to examine the anti commons problem. They focused on the research in Pasteur's Quadrant: that is research activity that focuses both on fundamental scientific understanding and on usefulness and applications (Stokes (1997)). In this case, researchers can disclose their inventions using both patents and publications. Accordingly, Murray and Stern (2007a) constructed a sample of 169 patents associated with papers published in Nature Biotechnology over the period 1977-99. They considered that the initial knowledge disclosed through the scientific publication and patents were granted with a time lag. Therefore, they could study citation patterns before and after a patent is granted. They found that the citation rate declines by between 10 and 20 per cent after a patent grant, and the decline is more pronounced for researchers with public-sector affiliations.

Therefore, they reject the null hypothesis that intellectual property does not affect the diffusion of scientific research, and the existence of IP-related restrictions on subsequent research cannot be excluded. Huang and Murray (2007) confirmed these results for 1,279 patents on human genes, particularly in the presence of patent thickets and ownership fragmentation.

Rosell and Agrawal (2006) asked whether knowledge from university research was disseminated to a narrower variety of users. They used the National Bureau of Economic Research patent database as described by Hall *et al* (2001) and a report of university patents (USPTO (2002)). They calculated a Herfindahl type measure of the concentration of patents across applicants and estimated whether patented university inventions were more widely disseminated than those of firms. They found that the 'university diffusion premium' – i.e. the degree to which knowledge flows from patented university inventions are more widely distributed than those of firms – declined by over half between the early and late 1980s.

4.2 Patents and Publications

This section explores the empirical work that analyzes the issue of university patenting and its impact on the scientific activity of academic researchers. Many authors have underlined that the relationship between patenting and publishing may be negative at the individual level mainly for two reasons: there may be a "publication delay" effect and/or a "basic-applied trade-off" (Breschi *et al* (2006)). First, publication delays may be necessary to meet the novelty step requirement in all patent legislations throughout the world: only new ideas can be patented, and ideas that entered the common pool of knowledge (no matter how recently and no matter by which means) through a published output are not new. Academic researchers who aim to take a patent, either in their own name, or in the name of their universities or business partners, should keep their inventions secret until the patent application has been filed. Second, the diversion of a researcher's attention from basic research to more applied targets may result in lower rates of publications in refereed journals, or in less ambitious publications with a lower impact on the scientific community. This can be expected to exert non-negligible effects only if patenting is non-occasional, especially if resulting from business-oriented research. Thus, we expect academic inventors with prolonged contacts with industry and more than one patent to be the most affected by the tradeoff (for a discussion, see Breschi *et al* (2007)).

There are at least three counter-arguments against the existence of a patenting-publishing tradeoff at the individual level. First, there may be a "resource effect". This argument suggests that the individual researcher who chooses to address her/his research to IPR relevant objectives does so in order to access additional resources. Scientists can access not just financial resources and expensive scientific instruments, but also "focused" research questions (cognitive resources). Answers to research questions raised by technological puzzles may at the same time be economically valuable and scientifically relevant, up to the point of opening up new research avenues and disciplines (Mansfield (1995) and (1998)). Possibly, the resource effect would show up much more clearly for patents applied for by business companies, with the scientists appearing just as designated inventors, rather than by the scientists themselves or their universities (or public funding agencies).

The other two counter-arguments against the publishing-patenting tradeoff derive from long-debated questions in the sociology of science. We may label them the "productivity fixed effect" and the "augmented Matthew effect". Both of them suggest that academic inventors may be among the most productive scientists, namely those with the highest publication rates. The "productivity fixed effect" argument simply suggests that both patents and publications are proxies of a scientist's productivity. The "augmented Matthew effect" builds upon the classic

remarks by Merton on the tendency of the priority reward system to benefit highly productive scientists, especially precocious ones, with a number of cumulative advantages, ranging from higher visibility and reputation to ever-increasing ease of access to research opportunities and resources (Merton, (1968)).

Due to increased data availability, in particular the use of EPO and USPTO patent databases and the Web of Science, there is an increasing number of papers that have studied the relationship between patents and publications.

Agrawal and Henderson (2002) analyzed the patenting and publication behavior at the Mechanical and Electrical Engineering Department of the MIT (68 interviews) and showed that patenting is not a major activity in these fields and there is no evidence of a tradeoff at the individual level between patents and publications. Azoulay *et al* (2006) used a panel of 3,862 scientists in life sciences and did not find evidence of a negative effect of patents on the quantity and quality of publications. They controlled for the inherent "patentability" of the scientists' research and did not exclude the possibility that patenting also changes the content of these publications by binding them more tightly to commercialization. Markiewicz and DiMinin (2005) again found complementarity between patenting and publishing using a panel of 150 randomly chosen academic inventors at the USPTO and a control of 150 scientists who were not inventors. Breschi *et al* (2006) and (2007)) investigated the scientific productivity of Italian academic inventors on patent applications to the EPO. They used a longitudinal data set comprising 299 academic inventors and matched them with an equal number of non patenting researchers. They inquired whether a tradeoff between publishing and patenting, or between basic and applied research exists on the basis of the number and quality of publications, but found no trace of such a tradeoff, finding instead a strong and positive relationship between patenting and publishing, even in basic science. Moreover, Breschi *et al* (2006) found this result particularly relevant in pharmaceuticals and electronics and telecommunications.[11]

Stephan *et al* (2007) used approximately 10,000 scientists from the Survey of Doctorate Recipients in various disciplines. They found that work context and field were important predictors of the number of patent applications. They also found patents to be positively and significantly related to the number of publications even if the cross-sectional nature of their data precluded an examination of whether a tradeoff exists between publishing and patenting.

Other papers have also explored what are the determinants of patenting activity for the scientists at the individual level. Azoulay *et al* (2007), Breschi *et al* (2006) and Calderini *et al* (2007) found that individual scientific productivity is a major factor that exposes scientists to the risk of patenting. In particular, Azoulay *et al* (2007) used their panel of 3,862 academic life scientists and implemented discrete time hazard rate models and fixed effect logistic models to find that patenting events are preceded by a flurry of publications, controlling for individual heterogeneity and latent patentability of a scientist's research. They, therefore, emphasized not only that academic inventors are among the most active scientists, but also that patenting behavior is also a function of scientific opportunity. Breschi *et al* (2005) showed for the sample of Italian academic inventors, that more productive scientists are more likely to become academic inventors, not to the detriment of their orientation towards basic research. Research cooperation with industry is a useful predictor of patenting, when IPRs are owned by commercial companies. Finally, Calderini *et al* (2007), using a sample of 1,276 Italian scientists and 131 inventors in material sciences, found that the probability to patent depends upon the basic nature of the invention, the impact factor of the journal in which it was published and on individual productivity of the inventors. However, they suggested that the relationship is not linear and that for individuals who publish very basic or very high-impact research, every increase in productivity results in a reduced probability to patent, although this effect is very small.

4.3 Summary and Discussion

The studies surveyed did not find strong evidence of anti-commons effects or significant foreclosure of public science in the research fields where university patenting is a particularly significant activity. Taken together, these papers also convey the idea that academic inventors are among the most prolific scientists in term of scientific publications and there is no evidence of a strong tradeoff between patenting and publishing at the individual level. However, some words of caution are needed. First of all, there is much sectoral heterogeneity. On the one hand, it is reassuring that most of the 'complementarity' results between patents and publications are related to pharmaceutical or life sciences where the issue of university patenting is particularly important and the anti-commons problem felt to be more severe. On the other hand, the scant evidence that we have for other fields suggests that there is no (or a very weak) relationship between publishing and patenting. More importantly, this literature still struggles with counterfactuals and endogeneity issues. We are not really sure what would have happened had the academic inventors not patented their research results.

Second, we do not know which institutional processes may be conducive to both patenting and publishing and, indeed, if there are several. As suggested by Stephan *et al* (2007), context variables are important and the underlying model probably depends on whether the inventor is involved in consultancy with a private company or the research is purely publicly funded; whether the scientists are employed in a small or large university; in universities with competent staff skilled on IPR issues, or whether scientists are occasional or persistent innovators.

We have evidence that high-quality research and high-quality researchers tend to go together with patenting. Murray and Stern (2007a) showed that patented research is on average more often cited and continues to be cited even if at a lower rate. However, we still cannot exclude, for the afore-mentioned reasons, that patents may have a wider negative impact on scientific behavior. In particular, we do not know whether scientists are shifting their resources toward other unpatented research activities and we do not know whether the very productive scientists who patent and publish are, because of the patents, publishing at a sub-optimal rate. Finally, case study evidence suggests that patenting is becoming important for its bargaining power to exchange and share protected tools and materials. This may considerably change the rules of the game and penalize institutions and individuals with weak bargaining power. Since this is a relevant argument for developing countries, I will come back to the issue in the final section.

5. TECHNOLOGY TRANSFER OFFICES AND LICENSING

In the previous section, I noted that there was substantial empirical evidence on the benefits deriving from knowledge flows between academia and the rest of the economy. In this section I focus on the licensing of university owned inventions to private firms and the role of technology transfer offices (TTOs). Such technology licensing activity has grown dramatically in the past two decades. In particular, I explore the institutional context in which TTOs operate and its effect on the propensity to commercialize research and, especially, the relevance of the presence of prominent faculty members who themselves are engaged in this activity.

5.1 University Licensing and TTOs Profits

In the US, there has been a substantial increase in patenting and licensing and in the number of TTOs. The sheer numbers tell a story of continuous growth of university patenting, licensing and invention disclosures. According to the 2005 AUTM survey, there were 28,349 currently

active licenses in the US between companies and universities and 4,932 new licenses were signed in 2005. The total university licensing income reached 1.6 billion US dollars in 2005 (1.4 billion US dollars in 2004) (Thursby and Thursby (2007), AUTM (2005) and (2004)). At the same time, it is important to note the highly skewed distribution of licensing revenues across universities. In 2005, Emory accounted for approximately 585.5 million US dollars and New York University for 133.8 million US dollars. It is difficult to say whether many TTOs cover their costs and generate profits for their universities (Thursby and Thursby (2007), NSB (2004)).

Thursby and Thursby (2007) wondered why so many universities set up a TTO if for many TTOs the licensing income is low. They gave three possible explanations. The first could be that universities hope to "hit the jackpot" as in the Emory case. The second explanation is that TTOs may serve other university goals different from licensing, such as sponsored research. Finally, they suggested that there could be emulative behavior. They noted that there are a number of TTOs in universities with a very low research budget. For these institutions it is probably not necessary to have a TTO.

Moreover, Thursby *et al* (2001) and Thursby and Thursby (2002) analyzed the nature and determinants of this increased licensing activity. Thursby and Thursby (2002) developed a model to examine the extent to which the growth in licensing is due to the observable inputs (patenting, licensing and disclosures) or driven by a change in the propensity of faculty and administrators to engage in commercializing university research. They used survey data from 65 universities and observed that patent applications grow much faster than innovation disclosures which depend more closely on faculty choices. As a result, they suggested that increased licensing is due primarily to an increased willingness of faculty and administrators to license, rather than a shift in faculty research. In this connection, Thursby *et al* (2001), in a survey of 62 US universities, underlined the fact that additional disclosures generate smaller percentage increases in licenses, and those increases in licenses generate smaller percentage increases in royalties. Overall, these results confirm the findings of Henderson *et al* (1998) that universities are trying to extract as much as they can from a given set of discoveries and this decreases the value and the generality of the marginal patents.

One final possible concern is related to the cost of oppositions and lawsuits for universities. What is the effect of increased patenting by universities on enforcement costs? Shane and Somaya (2007) studied the effects of patent litigation on university efforts to license technology. They used secondary data on licensing and interviews with TTO directors for research universities and discovered that patent litigation impacts negatively on university licensing activity. They emphasized that litigation changes the nature of TTOs' activities and shifts resources from marketing and licensing toward lawsuits and opposition activities.

5.2 Putting TTOs in Context: The Performance of Different TTOs and the Role of Faculty

A second group of papers refers not only to the type, growth and profitability of TTO activity, but also to the determinants of TTO efficiency. Thursby and Kemp (2002) considered that the TTO inputs are: number of staff, federal funds for research, faculty size and research quality. Output is measured in terms of patents, disclosures, licenses executed, royalties and research funds from industry. They showed that universities are more commercially productive than they were in the recent past and at the same time there is a wide heterogeneity of efficiency across the 111 universities they studied. They found that the increase in overall university resources is not a determinant of the increased licensing activity and higher levels of commercialization.

Lach and Shankerman (2004) and (2008)) developed a model and performed an econometric exercise on the role of economic incentives in university research and licensing outcomes. In particular, they examined how the share of license royalties received by academic inventors affects the number and licensing value of inventions in universities. They used data from the Association of University Technology Managers and collected information on the distribution of royalty shares from university websites for 102 US universities between 1991 and 1999. In the US, the inventors share with the university a portion of the fees and royalties from licensing IPRs and universities differ substantially in these royalty sharing arrangements. There are two type of agreements: linear and non-linear royalty schedules. In the case of the former, inventors receive a constant share of the license income generated by an invention. The average figure in this case is 41 per cent (maximum 65 per cent, minimum 25 per cent). In the latter case, inventors' royalty shares vary (in the majority of cases regressively) with the level of licensing income. In this case, variation across universities is even wider because the inventor's share ranges between 20 per cent and 97 per cent with an average value of 51 per cent. Lach and Shankerman showed that both academic research and inventive activity in universities respond to variations in inventors' royalty shares. In particular, they found that universities, particularly private universities with higher royalty shares for inventors, generate higher levels of licensing income. The papers of Lach and Shankerman are particularly important because they show that the specific design of intellectual property and the incentives in the form of royalty shares can have real effects on the direction of research. Royalty incentives work through two mechanisms: raising faculty effort and sorting scientists across universities. These incentives mainly increase the quality rather than the quantity of inventions.[12]

Di Gregorio and Shane (2003) studied TTOs from the point of view of IP-related start up formation and inquired why some universities generate more new companies to exploit their intellectual property than others. They analyzed a panel of 102 universities over the 1994–98 period for which they collected data on start-ups, patents, intellectual eminence, venture capital and policy-related information with a survey of TTO directors. Therefore, they asked which factors affect the creation of new companies: the availability of venture capital in the university area; the commercial orientation of university research and development; intellectual eminence; university policies.

Their results showed that only the last two factors affected the creation of start-up firms. In particular the relevant policies are: (1) making equity investments in TTO start-ups; (2) maintaining a low inventor's share of royalties. This result can be compared with Lach and Schankerman (2004). Many universities leave a high proportion of royalties to inventors in order to encourage the reporting and exploitation of inventions. Di Gregorio and Shane (2003) suggested, however, that significant royalty sharing may create disincentives to the creation of start-up companies. They also showed that more eminent universities have greater TTO start-up activity. Their results confirm previous evidence that star scientists found companies to earn rents on their intellectual capital and that the growth of biotech companies in the US regions is strictly linked to the high scientific standard of the researchers (Zucker *et al* (1998)).

Stuart and Ding (2006) underlined, for a sample of approximately 6,000 life scientists and 600 start ups (or participation in the scientific advisory board of a new biotechnology firm), that the institutional context is crucial to explain the heterogeneity of behaviors of transition to commercial activities. In particular Stuart and Ding found that the orientation of colleagues and co-authors towards commercial science, as well as a number of other workplace attributes, significantly influenced scientists' hazards of transitioning to for-profit science. The quality of faculty members affects not only start-up formation, but also licensing activity. Elfenbein (2007) used approximately 1,700 inventions considered patentable from the Harvard University's Office of Technology and Trademark Licensing and the Office of Technology Licensing and Industry

Sponsored Research at Harvard Medical School. He showed that inventors' prior academic output is positively correlated with the likelihood that their new technologies will be licensed.

Faculty behavior, however, is also important because faculty-specialized knowledge is needed to develop licensed technologies (Agrawal and Henderson (2002), Colyvas *et al* (2002), Jensen and Thursby (2001), Thursby *et al* (2001), Thursby and Thursby (2002) and (2007)). Jensen and Thursby (2001) and Thursby *et al* (2001) found that 71 per cent of licensed inventions used faculty in further development after the license was signed. Thursby and Thursby (2004) showed that faculty used 55 per cent of the time for the development of licensed technologies that were only a proof of concept (54 per cent for prototypes). Therefore, when the technology is at an early stage of development, the involvement of the scientists is crucial, even if companies typically do not perceive this involvement to be cheaper than in house development. Finally, Agrawal (2006) showed that the likelihood and degree of commercial success are related positively to the extent in which the firm engages the inventor and his graduate students in technology development after a license is signed. He claimed that the inventor's tacit knowledge is a crucial asset in the process of commercialization.

5.3 Preliminary Evidence from Europe

In Europe, the role of TTOs has been much less studied. First, because there is a very high diversity across countries and because there is no coherent data and systematic data collection as in the US with the AUTM surveys. An exception is provided by Arundel and Bordoy (2006) who conducted a survey for the Association of Science and Technology Professionals (ASTP) on the technology transfer activities of ASTP members (universities and other PROs). The ASTP has 209 members, and represents 20 per cent of the approximately 1,000 TTOs in Europe. The survey collected data for 2004 and 2005 and analyzed 74 responses from universities and 27 responses from other public institutes in 22 European countries. Arundel and Bordoy (2006) showed that the average TTO has 8.7 staff members. University TTOs have lower staffing levels (5.43) than PROs (12.3). However, there is wide variation across institutions and the staff distribution is extremely skewed (Conti *et al* (2007)). University TTOs are relatively recent, with an average age of eight years since establishment. These results were confirmed by the 2005 annual survey of the other important network of TTOs, companies affiliated to universities and PROs, known as ProTon Europe.[13]

In fact, in many European countries, universities and PROs have created TTOs in the last decade (OECD (2003)). Germany has established patent exploitation agencies at a regional level. In Italy, Baldini *et al* (2006) showed that universities started to adopt patent policies and regulation over the last ten years. Also, in Belgium, Denmark and France, TTOs are small with a very limited number of staff members (Bach *et al* (2007), Conti *et al* (2007)). It is not surprising, therefore, that licensing activity is not as developed as in the US. ProTon (2007) showed that the number of licenses grew between 2004 and 2005. However, the absolute number is still very low (731 licenses for 392 respondents in 2005) and the license revenues are only equal to 0.17 per cent of the R&D investment. Conti *et al* (2007) showed that the distribution of licenses is skewed with many institutions having very few licenses (the median number of licenses across TTOs is only 4.5). This confirms the evidence provided by the OECD (2003) that the majority of PROs negotiate a very small number of licenses each year. The OECD (2003) also underlined that a major share of license agreements in Italy, the Netherlands and Switzerland were concluded for patent pending inventions or non patented inventions (e.g. biological materials or know-how), as well as for copyrighted materials.

Only in the UK are TTOs more developed. Chappel *et al* (2005) found that there TTOs have low levels of absolute efficiency. Universities located in regions with higher levels of R&D and GDP appear to be more efficient in technology transfer. The authors underlined the necessity to enhance the skills and capabilities of TTO managers and licensing professionals in the UK. Similarly, Conti *et al* (2007) estimated the determinants of the number of licenses for the respondents to the ASTP and found that the skill composition of a TTO plays an important role in determining its productivity. In particular, they claimed that employing PhDs appears to reduce the coordination costs arising from interactions between the TTO and academic researchers.

5.4 Summary and Discussion

This section has shown that significant differences exist across universities and TTOs in their generation of new firms, patenting and licensing activities. University policies that provide economic incentives for TTO staff and faculty, and the scientific status of researchers and departments, greatly affect this variation. Faculty involvement in the development phase also clearly emerges as an important determinant of success. This produces a better understanding of the context in which technology transfer is particularly successful and has some important implications for specific institutional schemes in terms, for example, of royalty sharing and equity participation.

It is important, however, to emphasize that most of the evidence we have surveyed comes from top universities in the most advanced country. The ability to generalize for other countries with different levels of development is limited. For example, we do not know the factors affecting the efficiency of TTOs in universities that are not research-oriented and do not systematically exploit their intellectual property. For example, in Europe, it seems particularly important that TTOs develop the hiring of technically competent staff. Moreover, in the evidence I have surveyed, some factors such as commercial orientation, the availability of venture capital funds or the presence of an incubator, do not seem to be major determinants of commercialization in terms of start up and licensing activities. The fact, however, that these practices may be important in different countries and fields cannot be ruled out.

6. INTELLECTUAL PROPERTY ON PUBLIC RESEARCH: CONCLUSIONS AND OPEN ISSUES FOR DEVELOPING COUNTRY INNOVATION SYSTEMS

This paper summarizes the recent empirical literature in economics that has analyzed the role of patents in universities and PROs in facilitating knowledge transfer. Assessing empirically whether intellectual property facilitates knowledge transfer from public research to industry is an extremely difficult task because there are many different and interdependent channels of interaction and spillovers between universities, PROs and companies and it is difficult to build counterfactuals. A large number of empirical papers on this topic have focused mainly on the US experience where patenting public research has increasingly been a vehicle for effective transfer of technology from universities and public research to industry.

The empirical work in economics has shown that knowledge transfer between university and industry is based on many different forms of interaction. Most of the research has focused on life sciences and biotechnology where basic research is very close to commercial applications. In these fields, there has been an impressive growth of university patents. However, technology transfer mechanisms vary considerably according to the particular scientific field, the stage of development of the invention and across regions because they are adapted to different institutional settings and research systems.

I think, however, that some lessons can be drawn from the literature surveyed and from the US experience. First of all, companies' absorption capacity is extremely important. Companies have to be "connected" with public research in order to be able to absorb new ideas and discoveries. Substantial R&D is often necessary within companies to develop complementary knowledge that can be used to develop and commercialize innovation from public science. Geographic proximity and co-location between an "anchor tenant" firm and the research institutions seem to be particularly conducive to vertical knowledge flows between downstream industrial R&D and upstream university research (Agrawal and Cockburn (2003), Cockburn and Henderson (1998)).

At the same time, much of the "transferred" knowledge is tacit (or the costs of transferring are high) and faculty members are considered to play an important role, in particular for early stage embryonic inventions. In fact, top researchers in science and engineering are particularly active in technology transfer through start up, licensing and publications.

In the innovation systems of developing countries we can expect to see companies specialized in more traditional, less science-intensive sectors and a research system less mature with fewer resources dedicated to research activity. Considering that evidence suggests that patenting and licensing (even in the US) are of secondary importance in most fields, and taking into account that in emerging innovation systems markets for technologies are less developed, intellectual property in public research probably plays a less relevant role. It is worthwhile reiterating the point made by Mowery and Sampat (2005) that the explosion in university patenting in the US is to a great extent related to the biotechnology revolution that in turn has its roots in the considerable amount of federal funds dedicated to medical research in the US after WWII in a country with a long-standing, close relationship between PROs, universities and industry.

A first issue is, therefore, the improvement of the scientific quality and productivity in universities and PROs and the absorptive capacity of companies. It is important that in the innovation systems of developing countries, universities reach high standards in education and training of personnel and expand the networks of scientific and technological capabilities (Campos *et al* (2007)). In this context, IP regulations should be designed to improve collaboration between industry and public institutions and ¬– since intellectual property is becoming a central aspect of cooperation with industry – avoiding unintended consequences, in particular when collaboration is exploratory. In this vein, Sampat (2003) and Mowery and Sampat (2005) criticized the movement to mimic the BDA to improve the "entrepreneurial" nature of the university system in developing countries. They suggested that broadly disseminating new knowledge is to the comparative advantage of universities and PROs in these countries and "policies like the Morrill Act of 1890 –which created incentives for US universities to create and diffuse knowledge targeted at local agricultural and industrial needs – would yield far greater social returns than Bayh-Dole type legislation" (Sampat (2003), p.64).

Secondly, evidence suggests that university income from royalties and fees is extremely skewed. Many TTOs in Europe (but also in the US) have a negligible number of executed licenses (Geuna and Nesta, (2006), OECD (2003), ProTon (2007)). To "win the jackpot" is an extremely rare event, particularly for small universities with limited economies of scale and few research projects. Also, in the US, it is difficult to say whether many TTOs generate profit for their universities since licensing revenues often do not outweigh the operating costs of the TTOs. Moreover, the TTOs appear to be particularly efficient when they are staffed with competent and well-paid people and in specific contexts where commercialization of public research is a common and pervasive activity. Considering, finally, that TTOs may help technology transfer in particular in science and engineering universities, administrators and policy makers facing tight budget constraints should always evaluate carefully the opportunity costs of creating new and expensive institutional entities.

In particular, this discussion suggests that the fixed cost of TTOs could be conveniently spread by building "central brokers" (e.g. at the regional level). Transfer activities and learning could take place over a relatively large number of inventions and exploit the benefits of portfolio diversification. A potential drawback of regional approaches could be that stimulating invention disclosures, writing patent applications and finding licensees may require geographic proximity to facilitate informal interaction and close working between faculty members and employees of individual PROs and universities.

Third, faculty involvement is extremely important for fruitful cooperation with industry, in particular when technology transfer offices lack the resources and expertise necessary to search for potentially valuable innovations. Our evidence suggests that researchers may perceive transfer activities as a dangerous diversion from their publication activity because there can be high costs in interacting with licensing professionals and technology transfer offices (Owen-Smith Powell (2001)) and because licensing may include some non-disclosure or publication delay agreements (Thursby *et al* (2001)). However, scientists respond to perceived economic incentives and substantial royalty sharing seems to be a convincing argument (Owen-Smith Powell (2001), Lach and Shankerman (2004)).

An extreme form of incentive for faculty members to participate in the commercialization process is the so-called professor's privilege that assigns to individual scientists the property right over an invention arising out of university research. In this respect, the European experience is that industry-university cooperation involves adapting to specific institutional settings and research systems. Changing the design of intellectual property may disrupt the established practices of cooperation. In Denmark, the abolition of professor's privilege in 2001 and the new attitude of universities towards intellectual property may have caused biotechnology companies to change research partners and move some research projects to Sweden (where the privilege is maintained). Conversely, in Italy the introduction of the professor's privilege in 2001 caused concern among universities and companies because of the difference in treatment of researchers from private and public sectors, in a context where the majority of university-invented patents are owned by commercial companies. This reinforces the feeling that a specific IP design must be aligned with the other components of the research and innovation systems. In this respect, the professor's privilege might not be appropriate when, in developing countries, public institutions want to keep control of intellectual property over strategic technologies (in agriculture or health) for public interest or policy reasons.

This survey also discusses the potentially harmful effects of patenting scientific commons. This problem may be particularly acute in developing countries in key sectors like agriculture, biotechnology and health. The costs of access to databases, materials and research tools may become prohibitive. Moreover, developing countries may suffer potential negative effects of university patenting on other technology transfer mechanisms: publications, conferences, informal interaction with researchers and consulting.

In this case, the survey and quantitative evidence provided in this paper suggest that academic patenting is not fatally undermining the scientific system (Murray and Stern (2007a) and (2007b), Cohen *et al* (2005)). US based evidence shows that patents impose some extra costs on scientific research and in some cases delay publications, but overall there is no strong evidence of systematic privatization of intellectual commons. At the same time, as strongly emphasized by Murray and Stern (2007b), the rules of the game are changing rapidly and the rise of academic patenting has increasingly stratified the power structure of academic science since patents are not only used to commercialize but also to provide bargaining power with other scientists. University patents may, therefore, become an important currency in the global scientific college. This currency may be particularly expensive for individuals and institutions that are traditionally in a weak bargaining position.

While many universities and research centers in developing countries may be interested (or may be forced) to play this game – exchanges of cell samples are crucial in certifying and replicating results, in particular in the case of viruses that may lead to vaccines and diagnostic tests, like the controversy about AIDS blood test patents (Murray and Stern, (2007b) – close attention must be paid in order to safeguard knowledge access and limit restrictions on the use of research tools and materials. This is particularly important because there are many (possibly biotech) products in agriculture and health that have only a developing country market and, therefore, the private sector in developed countries may have no incentive to undertake the necessary R&D investment. National legislation should, therefore, ensure adequate disclosure in the research system and protect scientists from the most aggressive types of IP licensing. In this respect, inventions from public science should probably be licensed non-exclusively in developing countries. Moreover, research exemptions should be adopted for public and "non commercial" research and a "grace period" should be introduced for university researchers according to which it is possible to have a one-year lag between the patent application and the publication of the research. Finally, ensuring that low-quality patents are not granted (e.g. raising the "non-obviousness bar") could help to alleviate the possible negative impact of patenting public research.

6.1. Potential Areas of Additional Research in Developing Countries

A lot of quantitative and qualitative evidence is needed to understand precisely how IP regulations affect technology transfer from universities and PROs in developing countries. The amount of knowledge and technology that is transferred from university to industry (and/or is the result of cooperation between these two types of institutions) depends on: (1) the amount of knowledge generated within universities and PROs (i.e. the scientific productivity of individual scientists and researchers); (2) the type of knowledge disclosure; (3) the nature and type of their research; (4) the absorptive capacity and demand for new knowledge by companies. All these aspects are affected by the specific IP design in different disciplinary fields.

The first question is, therefore, to measure the scientific and patenting activity in universities and PROs and subsequently to assess how the scientific productivity of individual researchers is affected by patents. Much work here has to be done to build reliable databases on patents invented by university professors. As is happening in Europe, I expect many university patents in developing countries to be owned by private companies or by individual inventors. This creates difficulties in quantifying the number of university-invented patents because the university name does not appear in the patent document. A possible solution is to apply the methodology explained in Lissoni *et al* (2007) and to match a database with the names of individual professors with a database showing the names of the domestic inventors of the patents. Moreover, individual scientists' publication profiles can be tracked thanks to the increased availability of bibliometric databases. It is important to underline once again that intellectual property is expected to play some role only in specific disciplinary fields. It could also be interesting to evaluate the effects of recruitment policies in universities and PROs that introduce intellectual property or other forms of technology transfer to evaluate researchers' activity (as happened, for example, in the Mexican *Sistema Nacional de Investigadores*)[14] and to inquire as to the effects of these policies on scientists' activity, their promotion and career paths.

In this vein, another interesting topic largely under-researched is the relationship between intellectual property and labor mobility. Mobility of scientists is extremely relevant for developing countries because, on the one hand, the brain drain affects the scientific productivity of local universities and, on the other, many highly prolific scientists in developing countries have taken their postgraduate degrees in top US and European universities. In this respect, case studies

could trace the movement of people from US and European universities to domestic universities, and study – together with the different scientific productivity of this sub-sample of researchers – whether they face restrictions on the use and diffusion of their discoveries (often from laboratories situated in foreign countries), and how, if at all, IP protection affects this process. Here again, important differences may emerge across different disciplinary fields. For instance, what is the effect of patents on research tools to the incentive to move from a foreign university to a domestic one, where the cost of access to patented research tools may be perceived as prohibitive? Is this stronger in a country with stronger IP protection? Is it more likely to share materials and data with the original university in such cases? Are more mobile scientists more productive and more likely to take patents on their research or to create start ups? If this is the case, do they play a special role in connecting universities and companies?

Secondly, since intellectual property and licensing are not independent from other means of technology transfer (such as scientific publications, consulting, workshops and collaborative agreements), there is room for a set of quantitative studies in different countries and disciplinary fields on how the increased involvement of individual researchers and universities in intellectual property and licensing is hindering or enhancing other forms of knowledge disclosure like scientific publications.

In particular, it would be interesting to study the effects of changes in legislation on scientists' choices. Scientists choose their research projects, the way they disclose their findings and, possibly, the way they transfer the knowledge produced; all these choices are increasingly affected by the specific IP setting. Institutional changes that can be taken into account may be related to the owner of the property right (the inventor – as in the professor's privilege case – or the institutions), to changes in regulations within universities or to the creation of TTOs.

At the institutional level, it is always difficult (even in Europe and the US) to have a quantitative account of the costs and benefits of the use of intellectual property in universities and PROs. Collecting data on TTO costs, application fees and opposition costs and on revenues from licensing or other forms of transfer, would greatly help to assess the impact of intellectual property on the knowledge transfer activity of these institutions.

Third, patenting in universities and PROs may affect the nature and the direction of scientific research. Again, individual scientists' publications can be used and the journal fields may inform about the nature of scientific research that is performed. It would also be interesting to observe the scientific activity at the laboratory level and the dynamic interaction between specific IP policies, fund raising and recruitment policies. An exogenous source of variation could be found in changes in legislation like, for example, the Law N. 10.973, December 2, 2004, in Brazil, or the restructuring of governmental research institutes in China.

Moreover, one could take the Henderson *et al* (1998) perspective and ask whether the contribution of universities to commercial technology development is the result of the creation of more useful inventions in developing countries or, alternatively, simply an increased propensity to patent in universities. Also, in this case, some characteristics of the university patents – like their technological value, their generality or basic nature – may be measured using patent citations.

It would also be interesting to have a detailed understanding, again through case studies in specific fields or surveys, on how patenting in research tools creates barriers to entry for research in developing countries or, at the opposite end, whether the absence of patent protection has attracted funds for research on something that is protected elsewhere. In addition, cross-country comparisons could help to disentangle the effects of different norms regarding research

exemptions, grace periods and non obviousness standards. The underlying research question is always to disentangle how different forms of knowledge spillovers are conditioned by the IP regime in the country, in specific industries.

Moreover, intellectual property on research results in many developing countries may be motivated by public interest. It is important for many governments in developing countries for research results to be widely used and correctly exploited, in particular in crucial sectors like food and health. In this respect, how intellectual property should be used for public interest in universities and PROs – in connection with health systems and food programs – is a very interesting field of research.

Finally, in developing countries, detailed case studies could be done to discover which arrangements are particularly effective in regions and industries where the number of high tech companies is small and innovation is incremental. Another stream of research could ask which type of company is more likely to engage in cooperative agreements with universities and how these relationships are affected by different IP regimes. Over the past 20 years, some countries have undertaken profound processes of liberalization and privatization. Does the changing competitive environment require different IP arrangements to promote technology transfer and cooperation? Do privatized companies invest less in university-based research? Is this related to IP issues?

Notes

1 The proceedings and the presentations at the Re-Engineering the Partnership: Summit of the University-Industry Congress at the National Academies in Washington D.C. (April 25, 2006) – available at *http://www7.nationalacademies.org/guirr/ Meetings.html* – offer a clear picture of the concerns related to the role of intellectual property in the current university-industry relations in the US. Moreover, Stanley Williams, HP Corporation, testimony to Senate, September 17, 2002 complained: "US-based corporations have become so disheartened and disgusted with the situation – i.e., negotiating IPRs with US universities – they are now working with foreign universities, especially the elite institutions in France, Russia and China, which are more than willing to offer extremely favourable intellectual property terms."

2 Providing an extremely detailed description of the different rules and norms that regulate technology transfer in different countries is also beyond the reach of this paper.

3 As in Brazil, in the debate related to the new IP Law N. 10.973, December 2, 2004.

4 Interestingly, this is the same logic that pushed US universities to have their first patents in the 1920s and 1930s: to obtain control of the technology from "patent pirates" and to preserve the reputation of universities and PROs from its use against the public interest (Mowery and Sampat (2001a)).

5 The extreme example is provided by the IP strategy of the Manhattan project that ultimately produced a large and aggressive patenting program on the processes to build the atomic bomb (Wellerstein (2008)).

6 http://www.autm.net/surveys.

7 For example it is important to mention the expansion of programs to support Public-Private Partnerships (e.g. RandE Tax Credit, NSF-ERC, IUCRC, Advanced Technology Program-ATP) and the relaxation of antitrust enforcement to promote collaborative research (e.g. National Cooperative Research Act (NCRA) of 1984 followed by the National Cooperative Research and Production Act (NCRPA) of 1993).

8 Patent citations delimit the scope of the property right and, at the EPO, are included in the patent document by the patent examiners who draft their reports, trying to include all the technically relevant information within a minimum number of citations (EPO, 2005). Recent evidence strongly supports their use to measure the value of innovations and to track knowledge flows from the cited to the citing inventors or applicants (Trajtenberg (1990), Trajtenberg *et al* (1997), Jaffe and Trajtenberg (1996), Jaffe *et al* (2000), Jaffe *et al* (1993), Harhoff *et al* (1999), Hall *et al* (2005)).

9 Nelson and Merges (1990) and Murray and Stern (2007b) provide an interesting set of examples.

10 Shapiro's (2000) analysis of the patent thickets raises a similar issue.

11 There are many papers that explore the relationship between patenting and publishing in different sectors and countries. Czarnitzki *et al* (2006) discovered a positive relationship between publishing output and patenting for more than 3,000 German professors active in a range of science fields. Goldfarb *et al* (2006) studied the behavior of 57 scientists in electrical engineering and 15 in biochemistry at Stanford and found complementarity. The effects of the inventive activity on publications is stronger in biochemistry. Van Looy *et al* (2006) found that 32 inventors of EPO patents at Louvain University were more productive than a sample of non-inventors in the same field and they did not observe substitution between patenting and publishing over time.

12 Belenzon and Shankerman (2007) and Siegel *et al* (2003) also suggested that the most critical organizational factors for success in licensing are the reward systems and compensation practices for faculty and TTO staff.

13 ProTon Europe has been supported as a thematic network under the 5th Framework Program of the European Commission. At the end of July 2006, ProTon Europe had more than 230 direct members employing about 2,000 knowledge-transfer professionals. ProTon Europe and its partner national associations cover more than 500 transfer offices in Europe.

14 *http://www.conacyt.mx/SNI/Index_SNI.html*

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COMMENTS ON
INTELLECTUAL PROPERTY RIGHTS AND KNOWLEDGE TRANSFER FROM PUBLIC RESEARCH TO INDUSTRY IN THE US AND EUROPE: WHICH LESSONS FOR INNOVATION SYSTEMS IN DEVELOPING COUNTRIES?

ALBERT G. HU

Professor Montobbio has produced a very exhaustive survey of the literature on the role that IPRs play in the process of knowledge transfer from public research institutions to industry in the US and Europe. Public research institutions, private industry, and the institutions that connect the two to channel knowledge transfer from the former to the latter, are critical components of the national innovation systems in developed countries. The dynamic interaction between these institutions has been instrumental in the success of industries such as biotechnology.

To help focus my comments, I will first summarize what we have learnt from Professor Montobbio's comprehensive survey. First, the fundamental incentive structure of university researchers in the OECD countries does not seem to have changed. The best minds of science and technology are still primarily occupied with conducting research, the results of which end up in the public domain. This is perhaps heartening to those of us who may worry that the heightened economic incentives promised by IPR may lure researchers away from the cutting edge of science. Second, universities in the US are clearly trying to appropriate a larger share of the social returns to their research discoveries: the propensity to patent has gone up in US universities. Lastly, despite the wealth of data and information available and processed, we know very little about the impact of this higher appropriability on basic and applied research.

Cumulative Research: an Organizing a Conceptual Framework

The literature is quite diverse and somewhat fragmented. As an organizational and presentational suggestion, it is useful to have a conceptual framework to tie together the discussion of the economic issues involved in various parts of this literature. The model of cumulative research (Green and Scotchmer (1995), Scotchmer (1996)) is useful in analyzing the implications of the design of IPR regimes when research takes place sequentially and inter-temporal knowledge spillovers complicate the division of profits between the innovators. For example, it would seem to be most productive to situate the issue of whether and how IPRs should be granted to university and public research discoveries within the cumulative research framework. Having such a framework –I am not suggesting the inclusion of a theoretical model but just couching the discussion of the economic issues in such terms – would help to clarify what the underlying fundamental tradeoffs are.

Public Interest Justification of IPRs in Public Research

The survey highlighted a public interest justification of IPRs in public research. The basic argument is that granting IPRs to public research discoveries is necessary as a way to prevent them from being appropriated and monopolized by private agents. I find this argument rather tenuous. It is basically suggesting that the way to overcome the evil of a monopoly is to create

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another, albeit perhaps a benign one. But if society's concern is the misappropriation of research discoveries in the public domain by private parties, a more cost-effective solution may be to shore up the patent office, since such a patent should not have been granted in the first place.

Robustness of the Findings of this Literature

The survey could benefit from a more critical assessment of the robustness of the findings reported in the literature. For example, in assessing the impact of IPRs on university research, most of the studies have focused on biotechnology and other life sciences. To what extent can the results be generalized to other sectors? Concurrent to the passing of Bayh-Dole Act, there have been changes in patent laws that expanded the scope of patent protection, e.g. genes; new technology opportunities have also emerged in life sciences; government support of scientific research has also demonstrated a bias in favor of life sciences. Have these confounding factors been properly accounted for?

Professor Montobbio has given some very interesting comparisons of the mode of commercialization of university research between the US and Europe. For example, many university patents in Europe are owned by private companies rather than the universities themselves. To what extent should we expect this different IPR arrangement to affect commercialization of university research and the incentive structure of university researchers? Are there other institutions involved in the process of commercializing university research in Europe?

Implications for Developing Countries

Developed countries' experience in using IPRs to promote commercialization of public research generates useful lessons for developing countries. The increasing propensity to grant IPRs to public research in developed countries is likely to lead to a higher cost of conducting research for public and university researchers in developing countries. There could be a higher cost of research materials or limited access to information and data. Another implication is that, given the nature of technological change in developing countries, the social cost of a close relationship between public research institutions and the private sector could be lower than that in developed countries. The primary function of universities in developing countries is education and training, whereas the dominant mode of technological change for most developing country firms is learning and adopting existing technology. As a result, policy-makers in developing countries would face a somewhat different tradeoff in welfare calculations in designing policies to encourage collaboration between public research institutions and private enterprises. Lastly, the experience of the newly industrialized Asian economies shows that public-private collaboration does not necessarily involve IPR as an incentivizing mechanism. For example, in one country, the Industrial Technology Research Institute, a public research institution, has largely played the role of identifying technology that is appropriate for adoption by domestic firms and providing the technical support to ensure its successful adoption. Many of the domestic technology giants today have been spin-offs from the Industrial Technology Research Institutes. Future research that examines how such institutional arrangement has promoted public-private collaboration without IPRs would be useful.

Restructuring China's Government Research Institutions

To provide a developing country perspective on this issue, I offer a brief account of the Chinese government's effort to restructure its large number of public research institutions (Hu and Jefferson (2008)). China's public research institutions were largely built in the central plan era

following the public research model of the former Soviet Union. Most of these institutes had over time become insulated from the increasingly market-driven economy. In the mid-1990s, the Chinese government started a gradual process of restructuring these research institutes with the aim of achieving an allocation of science and technology resources that could better serve the goal of economic development.

By 1999, there were 5,500 government research institutes. Between then and 2004, over 1,400 of them had been restructured with the objective of reorienting their research towards applied and commercializable research. Some of these were turned into for-profit consultancies and some acquired by or merged into enterprises. For most of the remaining institutes, the government started substantially reducing direct funding. It became necessary for the institutes to find their own resources to maintain their research programs and for expansion. High-powered incentive schemes have been implemented in these institutes. For example, based on information collected from an interview with a research institute under the Chinese Academy of Agricultural Sciences, as much as one-third of licensing revenues of an innovation can go to the individual inventors. However, to maintain and enhance the rigor of basic research, the central government has increased funding to the 98 research institutes under the Chinese Academy of Sciences, which are China's elite research institutions. The incentive structure in these research institutes has remained largely publication-driven.

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How best can public research contribute to industry's performance in innovation? An important point of departure is that research and invention are not innovation (David and Metcalfe (2008)). There is much more to the process of innovation than R&D. Achievement of innovation requires accessing and combining many more kinds of knowledge and capabilities than that summed up by the phrase "science and technology"; knowledge of markets and organizations and of the availability of factor inputs are key aspects of innovation, and this type of knowledge is not where a public research organization specializes. In the innovation business, a public research organization will never be better than a second-rank institution at best. This observation underscores the significance of the division of labor between public research and private firms that specialize in different tasks.

However, specialization, which is a good thing, is likely to create boundary problems that can impede interactions and connections between public research and the industry and service sectors. It is to these barriers, and the incentives to build connections that the paper by Professor Montobbio is devoted.

Better Connections and Interactions: a European Quest?

As stated by David and Metcalfe (2008), it is hard to find an innovation policy document from government, business or university sources that does not call for greater, wider or deeper interaction between private firms and universities. However, what is meant by interaction? The modes of connection are many and are used in different ways at different times. It seems that two very different and sometimes conflicting notions of connection or interaction are at stake:

- One – somewhat traditional – involves networks of people, collaborative funding of research programs and informal contacts. The recruitment of graduates in the business sector is part of this concept.
- The other sense of connection is about having universities better exploit the ideas developed there – through professional management of intellectual property, opening technology transfer offices and launching their own spin-offs and start ups.

While the first of these concepts of connection respects the division of labor between public research and business, the second seeks to transform it by bringing public research more fully into the market.

The movement to promote technology transfer from public research to industry via patent licensing in Europe was fueled by a widespread supposition that public research was dangerously disconnected from the processes of private sector innovation. The obvious contrast for

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Europe was with the US research universities patenting and licensing frenetically. Professor Montobbio is right to claim that evidence of this kind has to be carefully scrutinized: the appearance of a lack of university patents in Europe must be understood to be a lack of university-owned patents – not indicative of any dearth of university invention and connection. This means that in Europe private firms, rather than universities, apply for patents at the end of collaborative projects. At the system level, it does not matter whether the patent applicant is the private firm or the university.

Overcoming Dilemmas

As summed up in Professor Montobbio's paper, a recurrent result from various surveys shows the critical role of faculty in successful technology transfer. This role is unquestionably important at the invention disclosure stage but obviously extends beyond it.

Successful relations with industry therefore require faculty efforts in the management of those relations (invention disclosure, identification of partners, contribution to the development of the technology) but that effort potentially diverts faculty from its role in academic research. However, Professor Montobbio rightly recalls that according to several case studies and surveys, the potential risk entailed by this dilemma seems to be smaller than expected: many studies have shown that a combination of scientific and commercialization activities appears at least feasible. A large base of evidence shows that entrepreneurial scientists are highly productive and that technology transfer activity does not divert from basic research.

The next logical question then is how they can manage to be both strong academic publishers and active entrepreneurs. Recent case studies (Callaert *et al* (2006)) highlight the importance of two mechanisms for multi-tasking in an efficient way:

- a high degree of topic overlap will make application and commercial development a joint product of basic research and create a potential for economies of scope;
- the size and composition of the team need to be aligned with the multi-task agenda.

However, it is always useful to point out that one cannot, from the evidence that is reviewed by Professor Montobbio, assume an answer to the fundamental question of system-level effects. The question is whether the split between those researchers who seek active involvement in commercial exploitation of their research findings and those who do not, is stable or unstable. This is a "system balance" problem, both for the institution, and for the collectivity of institutions. It is here that the central administration's attitude can be critical. Does it encourage the movement towards technological commercialization as a legitimate, indeed, institutionally rewarded activity for researchers? Is the administration simply permitting a drift in that direction, accommodating the requirements of industry in the licensing agreement that permit suppression of research findings from research publications? Or does it seek to create a reward structure that is "neutral" insofar as it does not allow the relative earnings from research of those who are equally productive but choose not to involve themselves directly with commercialization to increasingly lag behind those of their entrepreneurial colleagues?

Manipulating Incentives: from a "By-Product Economy" to a "Joint Product Economy"

As in any other economic activities, people respond to incentives. The decision by a faculty member regarding a potential involvement in activities dealing with knowledge transfer and development in industries is obviously based on considering the various costs and benefits of this activity as compared with the costs and benefits of other more traditional academic tasks.

A decade ago the dominant incentive structures for faculty created a strong imbalance in favor of traditional academic missions, fundamental research and education. This was satisfactory as these two missions are those that potentially generate the two fundamental kinds of spillovers that benefit industry. On the other hand, all activities related to development, industrial problem-solving and commercialization had the status of some sort of by-product. In such a context, the sense of priorities and hierarchies between different objectives (for faculty) was not lost: it was crucial to allocate the greater part of resources to basic research, thus producing new ideas to fuel technology transfer and to be published in important journals to attract good students who would then help the faculty to manage their multitask agenda. If this is not done, not only is basic research at risk but also, in the long term, faculty and their research teams will be unable to deliver anything useful to industry. In this by-product regime, compromises and tradeoffs are easier to achieve since there is a clear mission priority and academic missions are maintained.

In such a by-product economy, however, one can expect a lot of lost opportunities,: some of the best inventions may not be disclosed; the most productive researchers are less likely to want to take the time to disclose inventions, and there is much less work on further development.

Another argument against keeping this by-product economy is that open science is inefficient in product development (muted response to signals of market demand, excessive resources devoted to communication, sub-optimal scale, weak incentives to work on "boring" projects) and a re-organized science could do a better job. Along these lines, inducing faculty to disclose inventions and get involved in further development is therefore a critical issue that must be addressed.

In a sense, the challenge should be to shift university research from a situation in which technology transfer and commercialization are seen as by-products to a situation in which these functions acquire a new higher status, that of a joint product. We refer to the definition of these concepts in accounting: joint products are two products that are simultaneously yielded from one shared cost and they have comparably high (sales) value. By-products for their part are produced along with a main product. The latter constitutes the major portion of the total (sales) value. By-products have a considerably lower (sales) value than these main products. We can apply these terms to apply to basic research and technological applications, substituting "perceived value to the academic professor" for sales value.

Such a shift, therefore, involves increasing the "perceived value to the academic professor" of development and commercialization, and this requires creating a new balance in the incentive structure. Lach and Schankerman (2004) showed that the design of incentives can have a real effect on disclosure and commercialization in universities. They exploited cross-university variations in the share of licensing royalties received by academic scientists to estimate the role of monetary incentives. They showed that academic research and inventive activity in universities do respond to variations in inventors' royalty shares: the incentive effect induces greater effort by scientists toward invention disclosure, or it works through sorting of scientists across universities. Incentives do matter.

Increasing monetary incentives to encourage faculty toward more disclosure (and more involvement in further development) may have an effect on faculty's motivations to be involved in technology transfer. However, this strategy also entails risk. As already mentioned, we know from multi-task problems in principal-agent theory that when output is generated by workers exerting effort on two or more different tasks, there is a need to optimally balance incentives across these tasks. Otherwise, people will devote too much effort to those tasks that provide them with the highest marginal return.

Since the long-term level of research productivity depends on the level of effort devoted to basic research, it is important to avoid any incentive bias. An important issue is, for example, that any change in incentive structures (to increase effort toward disclosure and commercialization) has to be designed in an integrative and concerted way with the bodies in charge of academic incentives.

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