

WIPO - JPO - UNU Joint Research Project

Impact of the Intellectual Property System on Economic Growth

Fact-Finding Surveys and Analysis in the Asian Region

Country Report - China

Huaiwen He

PhD Candidate

Law School of Peking University

Ping Zhang

Professor

Law School of Peking University

Table of Contents

1. Introduction.....	1
1.1 Outline of China IPR System	1
1.2 Outline of China Economic Trend.....	1
2. Survey on Reforms in china IPR law and the Economic trend	2
2. 1 Summary History of china ipr Laws and Policies	2
2. 2 IPR Law Reforms and Economic Trend.....	3
2. 3 Results of Analysis	7
3. Case Studies on Selected Companies' Utilization of the IP System	8
3.1 Comparison of selected Companies' Data among Major Industry Fields.....	8
3.2 Results of Analysis	10
4. Model Analysis of Reforms' Impact on Economic Development.....	11
4.1 Establishing the Economic Models	11
4.2 Results of Analysis	14
5. Discussion and Proposal	15
Reference.....	17
Figures	17

1. Introduction

1.1 Outline of China IPR System

Intellectual property protection was and is playing an important role in China's on-going open-door policy and economic reform, which began since late 1970s. The past three decades have witnessed dramatic changes in China Intellectual Property Rights (hereafter referred as IPR) both in terms of national IPR law system and international treaties membership. Step by step, China has joined almost all important international IPR treaties. Just for a glance, China now is a member of the World Intellectual Property Organization Convention, Paris Convention for the Protection of Industry Property, Berne Convention for the Protection of Literary and Artistic Works. Notably, with its accession to the World Trade Organization in 2001, China IPR system was brought into line with the Agreement on Trade-related Aspects of Intellectual Property Rights (TRIPS). Most recently, on June 9, 2007, the WIPO Copyright Treaty (WCT) and the WIPO Performances and Phonograms Treaty (WPPT) both came into force within China.

With its entry into a variety of international IP treaties, China has been incorporating international IP rules and has formed its own IPR system. Though there is no Intellectual Property Code, Intellectual Property Rights are codified by laws and mainly complemented and supplemented by related regulations, judiciary interpretations, administrative measures, and local regulations or measures, which are of varying authority depending on the competent bodies that promulgate them. Among them, basic IPR laws, enacted and revised by the Standing Committee of the National People's Congress, are Patent Law, Trademark Law, Copyright Law and Anti-Unfair Competition Law. IPR regulations, promulgated by the State Council, could either supplement IPR, or implement relevant IPR laws. The important regulations include those on protection of Computer Software, New Varieties of plants, Layout-design of Integrated Circuit, and on Right of Communication through Information Network, etc. The Supreme Court, empowered to apply law, issue judicial interpretations, e.g., those on Application of the Law to the Trial of Patent Dispute, Trademark Dispute and Copyright. Administrative organs may also issues IPR measures dealing in detail with IPR prosecution, protection or enforcement. Apart from these, the Criminal Law and the Civil Law, like the General Principles of the Civil Law and the Contract Law, also provide for IPR protection. Taken together, they form China IPR system which is updated with time and typically, with China international trade policy.

1.2 Outline of China Economic Trend

With 30 years of gradual economic reforms, China has been opening the economy to international trade and investment, and seen fast economic growth. And there is a nearly

nine-fold increase in GDP per capita since 1978. Notably, from 1990s, Gross Domestic Product grew by average about 10% per year (See, Figure 1).

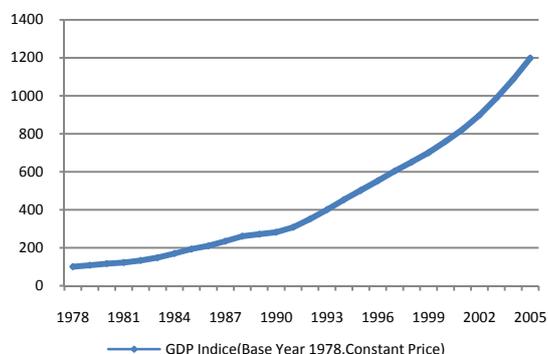


Fig.1 China GDP Indices By Year 1978-2005
Base Year 1978=100, Calculated By Constant Price

But challenges remain. Despite the huge GDP growth and dramatic IPR reforms, China’s economy is still mainly locked in traditional low-skilled, labor-intensive industries. China now is formulating its National IPR Strategy in an attempt both to confront IPR pressure coming from main trade partners and capture the possible benefit of TRIPS-level IPR protection as a developing country. Evidently, knowledge about the relationship between IPR reforms in China and its economic growth is invaluable for our confidence in IPR system and for future policy-making.

Thanks to this World Intellectual Property Organization’s progressive project, “Impact of Intellectual Property System on Economic Growth”, we are encouraged to explore such relationship in an evidence-based manner. In the following sections, considering limited space allowed, we firstly briefly review China IPR reforms, with focus on Patent Law; secondly, we survey industries and companies for data to evaluate IPR reforms’ impact on economy; thirdly, we analyze the data by using simple economic model given; and finally, we make some discussion and proposal.

2. Survey on Reforms in china IPR law and the Economic trend

2.1 summary History of china ipr Laws and Policies

China’s modern IPR law began from 1980s and the main IPR laws, such as Patent Law, Trademark Law, Copyright Law and Anti-Unfair Competition Law, were reformed over time. Those reforms are always an important component of China open-door policy and thus have their cause in China’s commitment to international trade system.

In fact, China domestic IPR legislation often heralds joining international IPR treaties. On August 3, 1982, Trademark Law was enacted as China’s first modern IPR law. From March 1, 1983, it came into effect. One year later, China’s first Patent Law was enacted. And another year later, the Paris Convention for the Protection of Industry Property entered into force in

China. Similarly, China's first Copyright Law was effective about one year before China acceded to the Berne Convention for the Protection of Literary and Artistic Works. Recently, the Regulation on Right of Communication through Information Network, promulgated in July 2007, anticipated China's entry into WCT and WPPT.

IPR laws often are reformed in company with China foreign trade policy. Patent Law and Trademark Law were both revised at the beginning of 1990s in support of China's attempt to accede to GATT. They were revised once more at start of the 21st century, together with the first amendment of the Copyright Law, to back China's bid to enter WTO in 2001. Around the same time, the Supreme Court successively issued important judicial interpretations regarding law application in IPR trials as mentioned before.

These are just some examples which demonstrate that the motivation for China IPR reform was to serve its broader policy: opening national economy. IPR law reforms were not driven by internal pressure of IPR protection, but instead by external pressure that require strengthened IPR protection.

In China's case, if there are any reforms of IPR law or policy towards IP-based economic development, they could only be the National IPR Strategy, which was started in 2005 and is still in the making. But even this Strategy was mainly motivated by widespread concerns arising from China's increasing IPR conflict with its main trade players.

2. 2 IPR Law Reforms and Economic Trend

2.2.1 Patent Law Reforms

To evaluate the impact of IPR system on national economic growth entails measuring IPR protection. For this report, the Ginarte-Park Index of Patent (G&P Index) is required as indicator for IPR protection. Therefore, the following explanation focuses on those Patent Law reforms that matters for calculating G&P Index. Please note, unless otherwise indicated, "Patent" in this report refer only to "invention patent", and does not cover utility model and industry design, which are both classified as "patent" under China Patent Law.

A. Limits of Patentability

Patentability was expanded through the Patent Law revisions. Under the 1984 Patent Law, the following were excluded from patent protection: foods, beverages and condiments, pharmaceutical products and substance obtained by means of a chemical process. But processes used in producing chemical compounds might be granted with patent.

The 1992 law, however, limits on patentability were much relaxed, leaving only the following subjects outside patent protection: rules and methods for mental activities, methods for diagnoses and treatments of diseases, animal and plant varieties and substance obtained by means of nuclear transformation. Nevertheless, it should be noted that plant varieties are

protected by the *Regulations on the Protection of New Varieties of Plants* promulgated in 1997.

B. Scope of Protection

The scope of protection for patent was extended. Under the 1984 patent Law, “without authorization, no individual or entity may make, use, sell the patented product, or use the patented process, for production or business purposes”. By the 1992 amendment, patent holders are granted with the exclusive right to import, both with regard to patented product and the product directly obtained by the patented process. Further, the right of “offer for sell” was added by the 2000 revision.

C. Term of Protection

The term for patent protection was stretched by the reform. Under the 1984 Patent Law, the term for an invention patent was 15 years, counted from the application filing date; and utility model or industrial design 5 years, with a possible 3 years extension. Through 1992 revision, the term for an invention patent was extended to 20 years, utility model or industrial design to 10 years.

D. Preliminary Injunction

Preliminary injunction was absent in 1984 and 1992 Patent Law. And there are no relevant provisions like this under P. R. C Civil Procedure Law. This deficiency was cured by the Article 61 of the 2000 Patent Law, which provide that under certain circumstances, right holders may, before any legal proceeding is instituted, request the People's Court to order the suspension of relevant acts and the preservation of property.

E. Revocation and Invalidation Procedure

Under current Patent Law, invalidation procedure with Patent Reexamination Board is the only mechanism available to declare a patent invalid after its granting. But under the 1984 law, there was pre-grant opposition procedure, which was often used by competitors to prolong the examination, rendering the prosecution process inefficient. Therefore, the 1992 revision replaced this pre-grant opposition with post-grant opposition. Although this reform shortened the examination process by 6-10 months (depending on the type of patent in question), unfortunately, there was overlap between revocation and invalidation procedures. So, the 2000 Patent Law abolished the revocation procedure all together.

2.2.2 G&P Index, Patent Application and Grants Trend and R&D Trend

A. G&P Index

Although those reforms mentioned above are important to calculate G&P Index, we don't

confine our view within Patent Law. Rather, our examination scope, as required by the Categories and Scoring Method for calculating the Index, covers the Civil Law, Civil Procedure Law, and the Detailed Rule for Implementation of Patent Law, the Patent Examination Guideline, related Judiciary Interpretation and other related legal instruments. Our result is in Figure 2, which shows that China patent protection law was strengthened over the time. (See, figure 2)

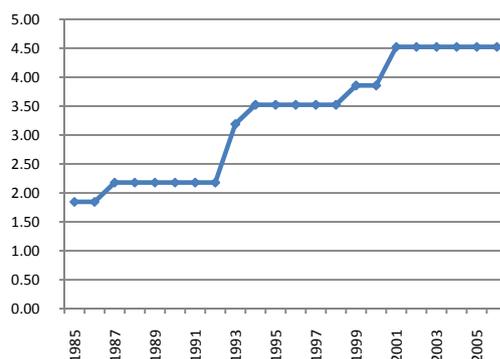


Fig. 2 China Ginarte-Park Index of Patent 1985-2006, Author's Calculation

B. Patent Application and Grants Trend

Over the past decades, especially after 2001, China has witnessed an explosion of

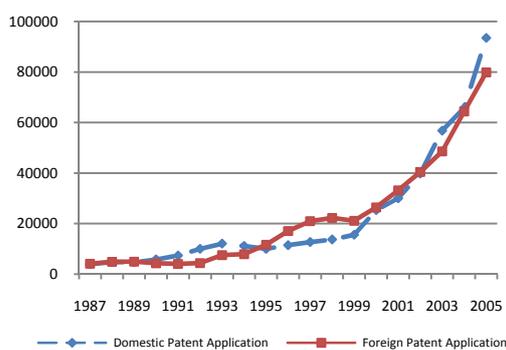


Fig. 3 China Invention Patent Application Filed with SIPO by Year 1987-2005, Source: China Science and Technology Statistics

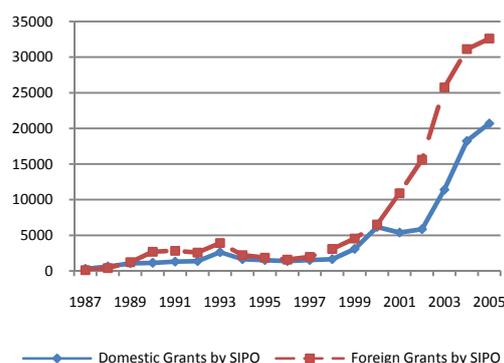


Fig. 4 Invention Patent Granted by SIPO 1987-2005, Data Source: China Science and Technology Statistics

invention patent application and grants. Domestic filings overcame foreign ones in 2001, but difference between domestic and foreign grants grew ever since wider. (See, Figure 3 - 4)

Our study on major industry fields serves to put into context our case studies on selected companies in the following section. We choose specific industries for survey and analysis: Pharmaceutical, Telecommunication Equipment, Manufacturing and Automotive Industry.

The industries surveyed typically followed the same trend, with varying impetus. In 1995, there were few domestic patent filing in Pharmaceutical and Telecommunication Equipment. In 2005, however, filing was near 6,700 and grants about 3,000 in Telecommunication Equipment and in Pharmaceutical filing about 1100, grants near 500. (See, Figure 5 - 6) Manufacturing saw about twelve-fold application and approximately eight times grants when compare 2005 annual filing and grants with those of 1995. In contrast, China automotive

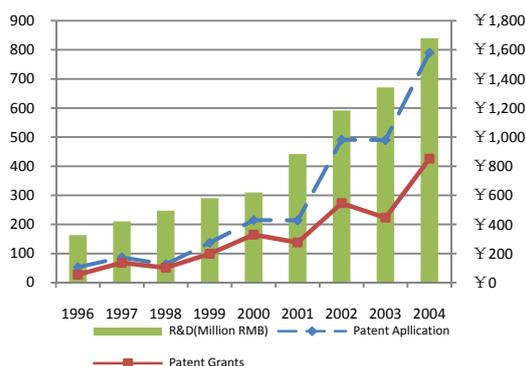


Fig.5 China Chemical Pharmaceutical Product Industry: R&D, Patent Application with and Grants 1996-2005
Data Source: China Statistics Yearbook on High Technology Industry

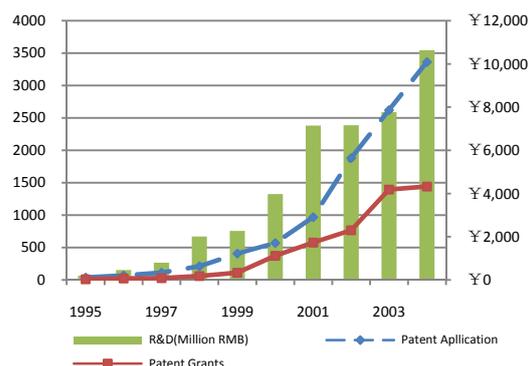


Fig.6 China Telecommunication Equipment Manufacturing: R&D, Patent Application and Grants 1995-2005
Data Source: China Statistics Yearbook on High Technology Industry

industry files very few invention patent applications. Instead, domestic automotive companies are rich in Utility Model, a kind of patent with weaker requirement for inventiveness according to China law.

C. R&D Trend

Over the same period, Gross Domestic Expenditure on R&D (GERD) grew steadily. Despite strengthening of patent protection at the beginning of 1990s, the rate of GERD to GDP once slid to a historical low 0.57 per cent in 1995 and 1996. But since 1996, the rate climbed roughly 0.1 per cent yearly and reached 1.34 per cent in 2005. (See, Figure 7)

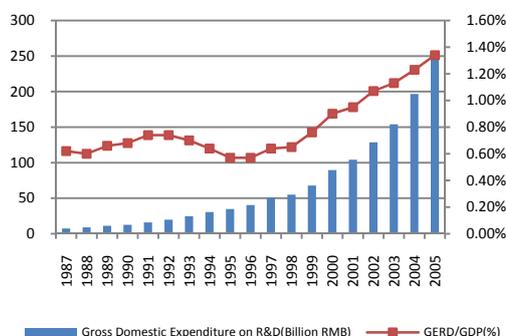


Fig. 7 Gross Domestic Expenditure on R&D and the percentage of GERD/GDP 1987-2005
Data Source: China Science and Technology Statistics

At the industry level, annual Research and Development (R&D) expenditure in 2004 were about 54 times 1995 for Telecommunication Equipment, 5 times more for Pharmaceutical, 10 times more for Manufacturing. (See, Figure 5-6) For Automotive Industry, 2005 annual R&D was about 4.5 times 1998. This kind of intensified R&D mainly gains impetus after 2000, which could partly explain the expanding patent filing since 2001.

In fact, the R&D investment growth followed the expansion of sale revenue. Overall, it seems that industries are more willing to spend money in innovation when revenue grows. As for the rate of R&D in sale, Telecommunication Equipment saw considerable increase between 1995 and 2001, reaching its high about 2.5% in 2002. These years, it is sliding. For Pharmaceutical, over the same period, the rate climbed from 0.64% to 1.18%; and for Manufacturing, grew rather steadily from 0.17% to 0.56% in 2002 and fell slightly back to 0.52% in 2005. For the Automotive Industry, however, the rate plunged down from 1.9% in 2000 to about 1.3% in 2001 and edged up slowly to near 1.7% in 2005. On average, the rate of R&D to overall sale never exceeded 0.9%, even though enterprises of large and medium scale saw considerable increase in the amount of R&D from 1991 to 2005. (See, Figure 8)

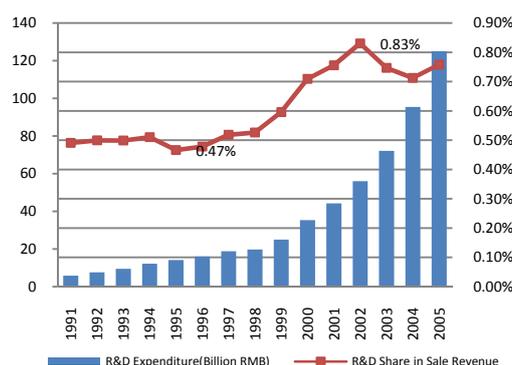


Fig.8 R&D Expenditure of Large Scale and Medium Enterprises in Relation to Sale 1991-2005
Data Source: National Bureau of Statistics of China

2.3 Results of Analysis

While the patent application, grants and R&D trend tend to show that patent creation follows economic growth, the situation is not so optimistic as it seems. Take China High-tech industry for example, from 1992 through 2003, China import of high-tech products was ever in excess of the export. True, 2004 and 2005 saw export exceeding import, but export of high-tech products mainly came from foreign funded enterprises. They are also the major importers of high-tech product: local companies' importation was less than 1/4 that of the foreign-funded companies, and exportation less than 1/7, according to recent national Science and Technology Statistics. Therefore, the situation is far from been changed that local companies, in lack of essential patents, remain in the low value-added processing trade, i.e., processing with imported or supplied materials, Chinese dominant trade mode since 1980s.

This point is further supported by our case study on specific companies in these four field mentioned above.

3. Case Studies on Selected Companies' Utilization of the IP System

3.1 Comparison of selected Companies' Data among Major Industry Fields

The situation proves worse when we look at specific company cases. We have surveyed companies in Telecommunication, Pharmaceutical, Automotive and Manufacturing industries. For the survey, we rely heavily on information that are public available. We had exerted much effort to arrange interview with the relevant department of several companies selected, but most of our attempts meet no repose; and where interview was arranged, the interview conducted fail to provide information enough to make sensible analysis. Therefore, without unreasonably compromising our object, we choose the successful companies whose relevant information is open to public. Where patent information is needed, we made invention patent search from pubic available database. Where data about sale, net income and R&D input are needed, we rely on corporate annual reports and other available publications and reports.

For Telecommunication industry, we choose Huawei Technologies, a leader in providing next generation telecommunication networks, and ZTE Corporation, China's largest listed telecommunication manufacturer and wireless solutions provider, both of which are international players. They both stepped up their patent filing activity since 2000: Huawei's filing surged from 206 in 1995 to 3508 in 2005, ZTE 139 to 909. They also strengthened international patent-seeking effort through PCT over the years. Huawei and ZTE are committed to innovation. From 2000 to 2005, they are both among the top three in China Electronic Industry who input the most into R&D. However, despite their expansion of sale, over the same years, their profit margin diminished: Huawei suffered a decreased margin from about 18% in 2000 to about 6.0% in 2005, with violent up and down in between; and ZTE, a continued decline from about 8% to 3.5%.(See, Figure 9-10)

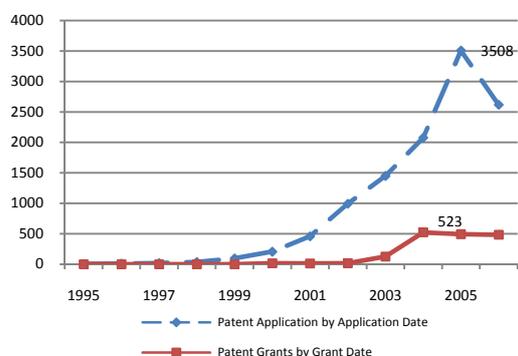


Fig. 9 Huawei Technology Patent Application and Grants in China 1995-2006, Author's Patent Search

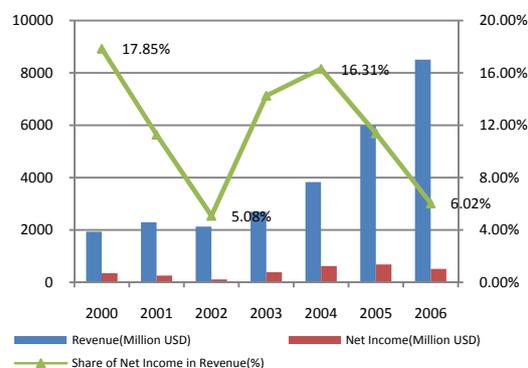


Fig.10 Huawei :Revenue and Net Income 2000-2006, Data Source: Annual Reports.

For Pharmaceutical, we select North China Pharmaceutical Group Corporation (NCPC), a leading pharmaceutical manufacturer within China Top 500 Enterprises and one of the named Best Profit-makers in China. Like Huawei and ZTE, NCPC filed more patent application with the State Intellectual Property Office (SIPO) after 2000, but even in the peak year 2005, its filing was less than 20. Though NCPC boasted to be China No.1 pharmaceutical exporter, so far there are only four PCT applications titled NCPC as an applicant. Despite NCPC revenue growth, the share of net income in revenue slid all along the way from 1998 to 2003 and simply plunged from 6.04 percent in 2003 to 4.65 percent below zero in 2005, the year when NCPC filed 17 patent applications. It is likely that NCPC is not strong enough to make innovation, considering a slightly intensified patent application leading to such a deep deficit. (See, Figure 11-12)

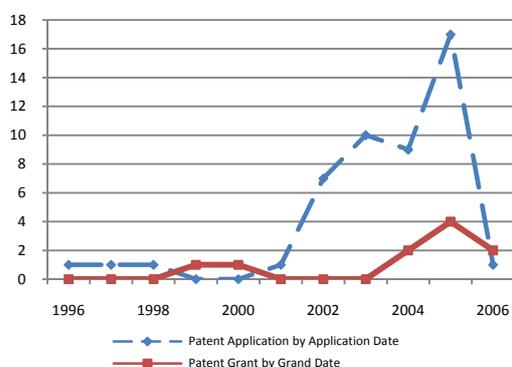


Fig.11 NCPC: Patent Application and Grants in China 1996-2006, Author's Patent Search

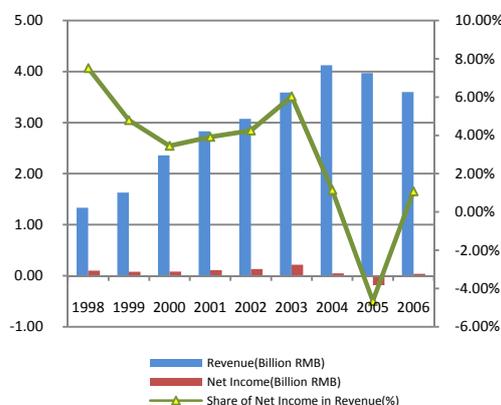


Fig.12 NCPC: Revenue and Net Income 1998-2006, Data Source: Annual Reports

For Manufacturing, we choose Xuzhou Construction Machinery Group (XCMG), the largest company of China in developing, manufacturing, and exporting construction machinery. Worse than NCPC, XCMG filed even fewer patent applications. These applications were mainly made after 2001, with its annual maximum of 6 items in 2005. Similar to NCPC, the expansion of XCMG revenue was dogged by continuously diminishing profit margin. The

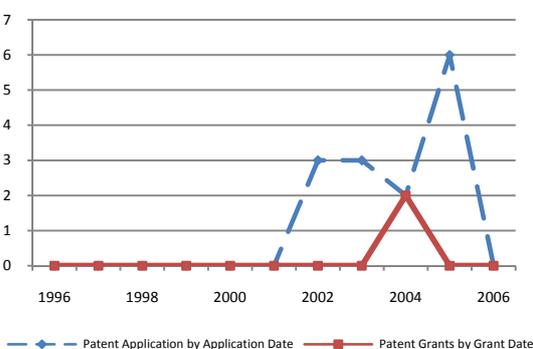


Fig. 13 XCMG: Patent Application and Grants in China 1996-2006, Author's Patent Search

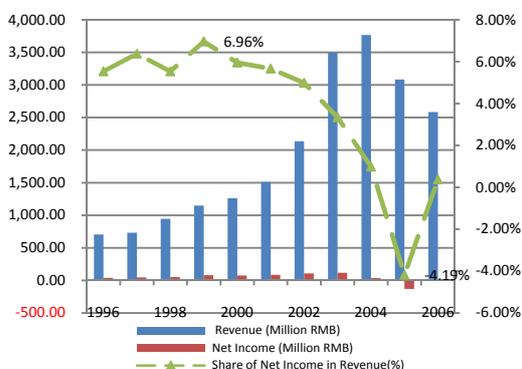


Fig. 14 XCMG: Revenue and Net Income 1996-2006, Data Source: Annual Reports

share of net income in revenue slopped downward from 6.97% of 1999 to 0.98% of 2004, and simply dived into 4.19 percent below zero in 2005, the year when XCMG filed the maximum patent application. It seems that XCMG is too weak to invest in R&D, as slightly increased R&D leading to a deep deficit. In fact, XCMG is subject to acquisition by the Carlyle Group, who agreed to acquire an 85% stake in XCMG for USD \$75 million in 2005. But so far, the transaction has not been approved yet. (See, Figure 13-14)

For automotive industry, we select China First Automobile Works Group Corporation (FAW), a pioneer of China's automotive industry in cooperation with several big international players, equipped with a total assets valued at 109.85 billion Yuan (US \$14.27 billion) and China's largest and most extensive automotive R&D facility. Similar to NCPC, FAW bolstered invention patent application after 2001, with its annual maximum filing of 17 items in 2005, the year when its profit margin fall deeply. Unlike the companies discussed before, FAW saw an expansion of sale with widening of profit margin from 1996 to 2003. But the share of net income in revenue dived from 6.12% in 2003 to 1.94% in 2005. No surprise, the FAW 2005 Annual Report, blaming increase in management cost, complained that it was heavy R&D that swallowed 12.78% of the profit. (See, Figure 15 -16)

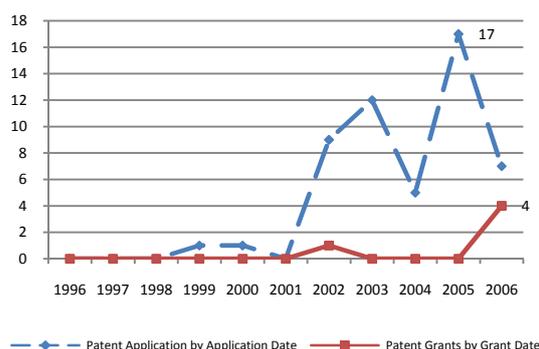


Fig.15 FAW: Patent Application and Grants in China 1996-2006, Author's Patent Search

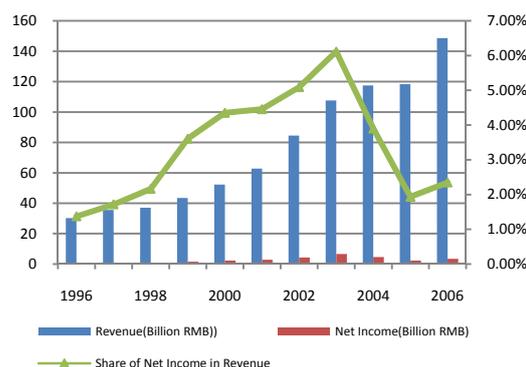


Fig.16 FAW: Revenue and Net Income 1996-2006, Data Source: Annual Reports

3.2 Results of Analysis

As shown, we have selected big China companies in four industries which are successful in one way or another. They all increased patent application filing after the 2000 patent law reform, which came before China's accession to WTO in 2001. But infact, except those in IT, other companies' annual filing never exceeded 20 items. Anyway, we believe that it is the accession—greater openness of national economy-- plays more important role in driving up domestic patenting activity than the 2000 law reform strengthening patent protection. Notably, in company with their more intensive patent application activity, most of the selected companies, in varied degree, were afflicted with decreased profit margin in spite of their expanded sale revenue. Some of them even suffer deficit. Our survey shows that typically, Chinese

companies are users of IP and seek patent protection for defensive purpose; and that even successful companies selected have not yet grown strong enough to bear the cost and risk inherent in R&D, let alone SMEs in China.

Although expanded sale can induce R&D investment to defend earned market share, diminished profit margin may cripple intensified R&D effort in the end. Intensified R&D entails intensified risk and augmented cost. With already limited net income and limited experience in managing R&D activity, concern is raised as to whether domestic companies could successfully make and commercialize innovation before being thrown out of the market or simply being absorbed by foreign companies. Challenges remain for Chinese companies, most of which are still struggling to walk out of the mire of low value-added business.

4. Model Analysis of Reforms' Impact on Economic Development

4.1 Establishing the Economic Models

4.1.1 Establishing Model: Impact on IP Creation

1. Model Given

The following model is given for model analysis of the impact on IP Creation:

$$\ln(X_n) = [c_1] \cdot \ln A + [c_2] \cdot \ln B + [c_3] \cdot \ln (\text{IP index}) + e$$

Note: A: R&D, B: Benefit; X1: Patent Application; X2: Patent Registration

As national R&D expenditure contributes to national innovation measured by domestic patent application and registration, we take domestic patent application or registration as the dependent variable to be explained. For the variable "Benefit", we chose GDP as the proxy.

2. Data

Our data mainly covers the period from 1987 to 2005. Our domestic patent application data come from SIPO. As patent registration data calculated by reference to grant date is largely represents the patent office's administrative capacity, we thought of collecting data of domestic patent grants counted by the corresponding application date. But unfortunately, we can not get that data. We could only use the total grants by SIPO counted by application date as the second best for this report, which comes from our own patent search. Caution should be taken that, considering that only about one third patent registrations were granted to domestic entities, when we make analysis on the basis of this data, we are in fact mainly evaluating the patent law reforms' impact on China's capability to attract valid patent filing from abroad. Further, it normally takes three to four year for being granted with a patent in China, and thus patent registration data before 2002 can be stable. In addition, our data about the national R&D expenditure comes from China Science and Technology Statistics and GDP from the National Bureau of Statistics of China. The IP index derives from our calculation following the G&P

Index methodology. All the data that will be used in this section is listed here:

Table 1 Data for Economic Model Analysis

Year	Domestic Patent Application	Patent Registration by Application Date	GDP (billion RMB)	Gross R&D Expenditure (billion RMB)	G&P Index	National Investment in Fixed Asset (billion RMB)	Labor Force (million)
1984	-	-	-	-	-	183.29	-
1985	-	-	901.60	-	-	254.32	-
1986	-	-	1027.52	-	-	301.96	-
1987	3975	4493	1205.86	7.40	2.18	301.96	498.73
1988	4780	4874	1504.28	8.95	2.18	364.09	512.82
1989	4749	4468	1699.23	11.23	2.18	449.65	527.83
1990	5832	4354	1866.78	12.54	2.18	413.77	543.34
1991	7372	4434	2178.15	15.95	2.18	451.70	553.29
1992	10022	5354	2692.35	19.80	2.18	559.45	567.40
1993	12084	7880	3533.39	24.80	3.19	808.01	583.60
1994	11191	11728	4819.79	30.63	3.52	1307.23	594.32
1995	10018	14597	6079.37	34.87	3.52	1704.29	602.20
1996	11471	17946	7117.66	40.45	3.52	2001.93	614.70
1997	12713	23081	7897.30	50.92	3.52	2297.40	623.88
1998	13726	24977	8440.23	55.11	3.52	2531.80	688.50
1999	15596	30284	8967.71	67.89	3.86	2840.62	696.00
2000	25346	36234	9921.46	89.57	3.86	2985.47	706.37
2001	30038	41116	10965.52	104.25	4.52	3291.77	713.94
2002	39806	36713(-)	12033.27	128.76	4.52	3721.35	720.85
2003	56769	21067(-)	13582.28	153.96	4.52	4349.99	730.25
2004	65786	6573(-)	15987.83	196.63	4.52	5556.66	737.40
2005	93485	113(-)	18308.48	245.00	4.52	7047.74	744.32

3. Model Establishing

When establishing the model, we find that the Pearson's Correlation between the variables GDP and R&D is 0.964, significant at the 0.01 level (two-tailed), suggesting inclusion of both variables unwise. We thus exclude R&D variable from the equation. We also find that the Variance Inflation Factors (VIF) are greater than 10 when we matching data of patent application with GDP of the same year and the preceding year. Hence, adjustment is required, for it may take some years for GDP to influence domestic IP creation and then patent filing activity. We adjust GDP data with a second order lag.

When domestic patent application is to be explained, the result of our regression analysis is as follows:

Model Summary (b)

R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
				R Square Change	F Change	df1	df2	Sig. F Change	
.917(a)	.842	.822	.39020	.842	42.474	2	16	.000	.285

a Predictors: (Constant), LN_PINX, LN_GDP b Dependent Variable: LN_DPA

N.B.: PINX stands for G&P Index; ,GDP for Gross Domestic Product; DPA for Domestic Patent Application; LN for Natural Logarithm

Coefficients (a)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	2.502	1.534		1.631	.122	-.749	5.754		
LN_GDP	.798	.305	.790	2.614	.019	.151	1.445	.108	9.231
LN_PINX	.413	.938	.133	.441	.665	-1.575	2.401	.108	9.231

a Dependent Variable: LN_DPA

Therefore, domestic patent application is positively related to GDP. But the coefficient for variable G&P Index is *not* significant at the 0.05 level. And the Durbin-Watson test shows a rather strong autocorrelation. Thus, the equation, with defects, is like this:

$$\ln(\text{Domestic Patent Application}) = 0.789 \cdot \ln(\text{GDP}) + 0.413 \cdot \ln(\text{G\&P index}) + 2.502$$

Likewise, when patent grants counted by application date are to be explained, the result is:

Model Summary (b)

R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
				R Square Change	F Change	df1	df2	Sig. F Change	
				.986(a)	.973	.968	.15252	.973	

a Predictors: (Constant), LN_PINX, LN_GDP b Dependent Variable: LN_PGAD

N.B.: PINX stands for G&P Index; GDP for Gross Domestic Product; PGAD for Patent g calculated grants counted by application date; LN for Natural Logarithm

Coefficients (a)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	2.645	.649		4.075	.002	1.231	4.060		
LN_PINX	1.133	.372	.360	3.044	.010	.322	1.943	.161	6.197
LN_GDP	.682	.125	.646	5.464	.000	.410	.953	.161	6.197

a Dependent Variable: LN_PGAD

Thus, with the Durbin-Watson test showing rather strong autocorrelation, patent grants (counted by the reference to corresponding application date) are positively related to GDP; and the variable G&P Index and the coefficients are significant at the 0.05 level. The equation, with defects, is like this:

$$\ln(\text{Patent Grants}) = 0.682 \cdot \ln(\text{GDP}) + 1.133 \cdot \ln(\text{G\&P index}) + 2.645$$

4.1.2 Establishing Model: Impact on Economic Effects

1. Model Given

The following model is given for model analysis of Impact on Economic Effects:

$$\ln(\text{domestic production}) = \beta_1 \cdot \ln K + \beta_2 \cdot \ln L + \beta_3 \cdot \ln(\text{IP index}) + \varepsilon$$

Note: K: Private capital, L: Labor force

Here, we use GDP data for the dependent variable “domestic production” and “National

Investment in Fixed Assets” (hereafter referred as NIFA) for the variable “Private Capital”.

2. Data

Here again, data covers the period from 1987 to 2005. Our data on GDP, NIFA and labor force are from the National Bureau of Statistics of China. For data used in this model, please refer to Table 1.

3. Model Establishing

When establishing model, we find that the Pearson’s Correlation between the variables NIFA and labor force is 0.970, significant at the 0.01 level (two-tailed), suggesting inclusion of both variables problematic. The variable “labor force” is thus excluded from the equation. We also find that the VIF are bigger than 10 when we matching data of GDP with NIFA of the same year. Hence, adjustment is required, for it may take years for NIFA to be translated into GDP. We adjust NIFA data with a third order lag. The result is:

Model Summary (b)

R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
				R Square Change	F Change	df1	df2	Sig. F Change	
.992(a)	.984	.982	.11591	.984	497.083	2	16	.000	.926

a Predictors: (Constant), LN_NIFA, LN_PINX, b Dependent Variable: LN_GD
 N.B.: PINX stands for G&P Index; GDP for Gross Domestic Product; NIFA for National Investment in Fixed Assets; LN for Natural Logarithm.

Coefficients (a)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	3.698	.243		15.196	.000	3.182	4.214		
LN_PINX	1.180	.242	.405	4.883	.000	.668	1.692	.144	6.946
LN_NIFA	.504	.069	.605	7.301	.000	.358	.650	.144	6.946

a Dependent Variable: LN_GDP

Thus, GDP is positively linked with NIFA and G&P Index, and the coefficients are significant at the 0.05 level. But the Durbin-Watson test indicates a rather strong autocorrelation. And the equation, with defects, is like this:

$$\ln(\text{GDP}) = 0.504 \cdot \ln(\text{NIFA}) + 1.180 \cdot \ln(\text{G\&P index}) + 3.698$$

4.2 Results of Analysis

In view of the rather strong autocorrelation, here we only offer tentative analysis, which is subject to limitations. By the first model, we find that domestic patent application activity follows GDP growth, with no significant link with G&P index, which represents patent protection strength. However, the G&P index could explain yearly valid patent application,

measured by patent grants counted by application date. In view that only one third patent registrations went to domestic entities, it is certain that China reform impact mainly on China's capability to attract intensive patent filing from abroad. To what extent such reforms impact on China domestic valid patent application is yet unknown. Though the third model indicates that GDP is positively correlated with NIFA and G&P Index, with rather strong autocorrelation, we could not assume that this is a safe conclusion.

5. Discussion and Proposal

In this report, we have endeavored to understand how strengthening of IPR protection is related with national economy in an evidence-based manner. Intellectual property protection was and is playing an important role in China's on-going open-door policy and economic reform. Over the years, China national economy has witnessed decades of fast growth and China IPR law have been reformed and brought into line with its international obligations. While the trend of patent application, grants and R&D tends to show that patent creation follows economic growth, data shows that China's economy is still mainly locked in traditional low-skilled, labor-intensive industries.

Our case studies show that patent application activity grew but net income dropped. The studies do indicate that with expansion of sale revenue, corporate patent application filing grew. Possible reason for this may be that expanded sale induces R&D investment to defend earned market share: In fact, domestic companies typically seeking patent for defensive purpose. But characteristically, domestic companies' intensified R&D was often dogged by a diminished profit margin. Some of the selected successful companies even reported deficit and attributed this to increased innovation activity, even though they typically file very few patent applications and their main purpose for filing is to defend. Concern is raised whether domestic companies could sustain their innovation effort with diminished profit margin and crude experience in R&D management and whether they could make use of patent system to defend their market before being banished from market or absorbed by foreign companies.

By the given models, our model analysis brings out equations with some defect, which could not lead us to safe conclusion. One of the model suggests that, comparable to the case studies, domestic patent application activity follows GDP growth, but with no significant link with G&P index. Another model suggests that G&P index, together with GDP, might explain yearly valid patent applications, most of which come from abroad. The underlying logic may be that vibrant national economic growth coupled with strengthened IPR protection can attract foreign players to seek patent protection in the hope of controlling and profiting from the local market.

We must admit that the model analysis is subject to significant limitations. Unlike corporate case study where cost could be measured by profit margin, the models given took no account of the cost flowing from strengthened patent protection and intensified R&D. Due to the limitations of GDP as an indicator for domestic output, the given model runs the risk of

ignoring the trade-off of strong IPR protection. Indicators should be created to measure both the benefit and cost of strengthened IPR protection. Otherwise, our view is liable to be skewed.

Secondly, to evaluate IPR reforms' impact on national economic development, the sheer number of patent application and grants is rather a crude indicator. In fact, large portion of granted patents are either remote from market or simply abandoned. Data on commercialization of patented technology and licensing royalties will be valuable for understanding IPR reforms' direct impact on economic activity. But unfortunately, these data are out of our reach for the time being.

Thirdly, using of G&P Index may be problematic. Possible reasons are: First, it just a measure of legal provisions on paper, and thus may not be a good proxy for IPR protection in practice over the years. Secondly, Trademark and Copyright, which were also strengthen over the years in China, are left outside its view. Thirdly, it is not specific to field of technology, and thus could contribute little to evaluating IPR protection impact on a specific industry. Fourthly, our literature review shows that it was constructed mainly to conduct cross-section research across dozens of nations and often serve as the variable to be explained. But our task is to use it as a variable to explain historical national economic growth. Considering China's relative short history in Patent Law, our sample might well be too small to draw *statistically meaningful* inference when we employ G&P index.

The last, but not the least, for the purpose of this report, G&P index fails to consider measures adopted for IP-based economic development, for example, the measures fostering collaboration between university and industry are important for IP-based economic development. Bayh-Dole Act is widely deemed to have stimulated U.S IP creation and utilization. The Act grants patent rights to inventions coming from government-sponsored research and development to certain types of entities, and thus serve the important role to encourage commercialization of new technologies through cooperative ventures between and among the research community, small business, and industry. China is working on strengthening such cooperation by adopting similar measures. But again, the G&P Index, used in the given economic models, does not represent this kind of policy changes towards IP-based economic development.

In short, with the above survey and model analysis, we can't arrive at any safe conclusion as to the impact of IPR reforms on China national economy. As shown, we do not look for answer beyond methodology given and data collected. What was presented here must be a part of the real whole story. In fact, we have not yet analyzed IPR reforms' impact on foreign direct investment and technology transfer, let alone the possible conflicting roles of IPR protection in technology transfer and innovation promotion. We believe that future study, equipped with more advanced methodology and accessible data, will shed more light on our understanding of the relationship between IPR system and national economic growth by evaluating both the benefit and cost of strengthening of IPR protection. And we hope such study forward China's strive to be an innovative country.

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Figures

FIGURE 1 CHINA GDP INDICES BY YEAR 1978-2005	2
FIGURE 2 CHINA GINARTE-PARK INDEX OF PATENT 1985-2006	5
FIGURE 3 CHINA INVENTION PATENT APPLICATION FILED WITH SIPO BY YEAR 1987- 2005	5
FIGURE 4 INVENTION PATENT GRANTED BY SIPO 1987-2005	5
FIGURE 5 CHINA CHEMICAL PHARMACEUTICAL PRODUCT INDUSTRY: R&D, PATENT APPLICATION WITH AND GRANTS 1996-2005	6
FIGURE 6 GROSS DOMESTIC EXPENDITURE ON R&D AND THE PERCENTAGE OF GERD/GDP 1987-2005	6
FIGURE 7 CHINA TELECOMMUNICATION EQUIPMENT MANUFACTURING: R&D, PATENT APPLICATION AND GRANTS 1995-2005.....	6
FIGURE 8 R&D EXPENDITURE OF LARGE SCALE AND MEDIUM ENTERPRISES 1991-2005.....	7
FIGURE 9 HUAWEI TECHNOLOGY PATENT APPLICATION AND GRANTS IN CHINA 1995-2006.....	8
FIGURE 10 HUAWEI TECHNOLOGY: REVENUE AND NET INCOME 2000-2006	8
FIGURE 11 NCPC: PATENT APPLICATION AND GRANTS IN CHINA 1996-2006	9
FIGURE 12 NCPC: REVENUE AND NET INCOME 1998-2006	9
FIGURE 13 XCMG: PATENT APPLICATION AND GRANTS IN CHINA 1996-2006	9
FIGURE 14 XCMG: REVENUE AND NET INCOME 1996-2006.....	9
FIGURE 15 FAW: PATENT APPLICATION AND GRANTS IN CHINA 1996-2006.....	10
FIGURE 16 FAW: REVENUE AND NET INCOME 1996-2006.....	10