Global INTANInvest: Innovation data for the global economy

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Intangible Assets in the Global Economy
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Global INTANInvest

- The Global INTANInvest project
  - Part of a longer workstream (INTANInvest, Data Assets, EUKLEMS & INTANProd)
  - Cross-country analysis of productivity with intangible capital using an expanded investment framework (Corrado, Hulten, and Sichel 2005, 2009)

- Pillars of the project
  - Development of timely (quarterly) estimates of intangible investment
  - Expanding coverage of intangible investment to middle- and lower-income countries
  - Expand the capability to conduct productivity analysis with intangible capital by including new countries (e.g., as we are doing with India)

- Use Global INTANInvest to analyze directions for innovation and growth-promoting policies
Plan of talk

- Intangible capital: What it is and why it’s important
  - Definition and scope
  - (Some) important “facts” in advanced economies

- Correlates of intangible intensity
  - (Some) takeaways for economic development

- Global INTANInvest: Redux
  - Expansion of estimates to middle and lower income countries
Intangible Capital: What it is and why it’s important.
How can we understand modern firms?

Need to broaden the concept of capital beyond tangibles

✓ More than R&D
✓ Economic criterion for investment: Outlays expected to yield a return in a future period.
✓ Implies investment includes spending to develop wide range of capabilities modern firms rely upon.

The World's Largest Companies by Market Capitalization, March 31, 2021
(billions of US dollars)

<table>
<thead>
<tr>
<th>Company name</th>
<th>Market capitalization</th>
<th>Tangible assets</th>
<th>R&amp;D assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>2,051</td>
<td>344</td>
<td>75</td>
</tr>
<tr>
<td>Saudi Aramco</td>
<td>1,920</td>
<td>322</td>
<td>5</td>
</tr>
<tr>
<td>Microsoft</td>
<td>1,778</td>
<td>245</td>
<td>92</td>
</tr>
<tr>
<td>Amazon</td>
<td>1,558</td>
<td>330</td>
<td>137</td>
</tr>
<tr>
<td>Alphabet</td>
<td>1,393</td>
<td>300</td>
<td>105</td>
</tr>
<tr>
<td>Facebook</td>
<td>839</td>
<td>141</td>
<td>51</td>
</tr>
</tbody>
</table>

Source: PWC and company reports (market capitalization and tangible assets for 2020). R&D assets are authors’ estimates of 2020 R&D stock based on time series of R&D spending from company reports.

This gap is ginormous!

... and adding R&D doesn’t help much
Intangible investment and intangible assets

- Three broad categories
- Populated by 10 asset types
- Includes R&D (and other means of developing new products)
- Includes spending on organizational change, new business processes and new business models
- Includes marketing assets, including those created by AI
- Includes employer-provided training (creation of firm-specific human capital)

**Digitized information**
- Software
- Databases

**Innovative property**
- R&D
- Mineral exploration
- Artistic, entertainment, and literary originals
  - Attributed designs (industrial)
  - Financial product development

**Economic competencies**
- Market research and branding
- Operating models, platforms, supply chains, and distribution networks
- Employer-provided training

*Source: Adaptation of Corrado, Hulten, Sichel (2005, 2009)*
Fact 1: In many advanced countries, the rate of intangible investment exceeds the rate for tangibles.

- UK and US (see chart)
- Regional variation in EU: Some EU North and EU Center countries display same pattern as UK and US (e.g., SE and FR)
- In these countries, intangible investment in national accounts averages about 40 percent of total intangible investment.
- Japan: divergent trend since 2009

Source: EU KLEMS & INTANProd; tangible refers to nonresidential assets. Covers all NACE activities.
Fact 2: In modern economies, innovation investments are widely distributed across industries

Source: Figure 3 in Corrado, Carol (2023). “Intangible Capital: What it is and why it’s important.” manuscript (Chapter 3) in forthcoming book edited by Louise Sheiner and Marshall Reinsdorf.
Pause and consider, What happens when you expand the coverage of intangibles?

- As the chart (two slides ago) showed, the level of GDP and output per hour is raised.
- Impact on labor productivity growth depends on the relative growth of real intangible investment.
Including all intangibles in productivity analysis sometimes boosts labor productivity growth.
Fact 3: The efficiency of innovation-producing activities is improving

- Manifests as declines in the relative price of intangible assets
- Growth of labor productivity is boosted by intangibles as long as
  - cost shares rise (or, as volumes rise more rapidly than relative prices fall)
- Two technologies driving the disinflationary trend in US intangible asset prices
  - Reorg of IT depts as computing moves to the cloud
  - Increased use of data/AI in modern production processes, including processes that produce intangibles

Fact 4: The intangibles framework changes the interpretation of innovation (and importance of capital deepening) in sources-of-growth analysis

- For many advanced economies, once intangible capital is accounted for in analyzing factors affecting economic growth, capital deepening becomes the dominant proximate source of growth in labor productivity in modern economies (and TFP somewhat less).

- Though TFP still reflect the fruits of innovation via diffusion, and the old “perspiration vs inspiration” (or duplication vs innovation) distinction among factors affecting growth is not wrong….

- In the intangible capital framework, intangible investment reflects investments in innovation and TFP growth reflects their “costless” diffusion, i.e.,

  Contribution of innovation to economic growth =
  contribution of intangible capital + TFP growth
A recent productivity analysis by the EU KLEMS & INTANProd team focuses on TFP growth in advanced economies

- Paper title “A Resumption of TFP Growth in Advanced Economies: Intangible capital and Green Shoots” in Recent Productivity Data”
  - Would love to review but leave to another time….
- It demonstrates, we believe, the utility of
  - The intangible capital framework and
  - The EU KLEMS & INTANProd effort that Global INTANInvest builds upon
Final Fact: Intangibles seem to be more resilient over business cycles

*Intellectual Property Products Investment in the United States, 1985Q1 - 2023Q4*

Share of Gross Private Nonresidential Investment

- Pattern in official data for the United States
- Businesses may view investing in intangibles (e.g., software and data) as moves that dampen the impact of workforce layoffs and cutbacks in customer demand

Source: Elaboration of quarterly data from NIPA table 5.3.5. Notes: Intellectual property products include software, R&D, and entertainment originals. Shaded areas are periods of business recession as defined by the NBER.
Correlates of intangibles
(using some results from Global INTANInvest)
Intangible investment intensity and GDP per capita

Intangible investment intensity and the level of PPP-adjusted labor productivity are similarly correlated.

Note. Intangible investment and GVA cover all NACE activities. Data for India are through 2021. Sources. Intangible investment and GVA, EU KLEMS & INTANProd (2023) and Global INTANInvest (2024). Real GDP per capita in 2022 international dollars, Total Economy Database (The Conference Board, 2023).
Intangible investment intensity and digital competitiveness

India’s strong showing possibly due to its software industry. (Also, the informal sector is ignored.)

Note. Intangible investment and GVA cover all NACE activities. Data for India are through 2021.
Sources. Intangible investment and GVA, EU KLEMS & INTANProd (2023) and Global INTANInvest (2024). IMD index, IMD 2023 World Competitive Rankings at www.imd.org (accessed March 14, 2024).
Conditions affecting FDI in R&D: Software dynamism and IP rights

Correlation between a Country’s Software/IT Intensity and US MNC Foreign R&D Investment conditioning on country fixed effects

\[
\text{ln(Foreign Affiliate R&D expenditure), conditioning on country FE\~s)}
\]

\[
\text{Country Software/IT Intensity, conditioning on country FE\~s}
\]

\[
\text{coef = 7.3746914, (robust) se = .24079405, t = 30.63}
\]

Note. A country’s software/IT intensity is measured using patent data. Source: Branstetter, Glennon, and Jensen (2018). “The IT Revolution and Globalization of R&D.” NBER working paper #24707

Association between Index of Life Sciences-related Indicator of IP rights and Number of Clinical Trials per million population.

Global INTANInvest: Redux
Let’s look at Global R&D

- Global INTANInvest has 8 of the world’s 16 top R&D performing countries (including India)
- The remaining 8 include 2 with R&D intensities way above average:
  - South Korea
  - Taiwan
- Others are a mix of high- and middle-income countries:
  - Russia
  - Brazil
  - Canada
  - Turkey
  - Australia

Source: National Science Board (2023), Science & Engineering Indicators, Figure 4-6.
Countries in the “fast lane” (or slow lane, etc.)

- China
- India
- Poland
- Romania
- Turkey
- Vietnam
- Ethiopia
- Rowanda
- Bangladesh

Emerging economies occupy the fast, middle, or slow lane to convergence with advanced economies.

Countries who include IPP investment in GDP

- A global scan* of national accounting practices found:
  - 51 countries have consistently reported, annual data on IPP investment
  - We have 28 in quarterly Global INTANInvest already
  - Of the remaining 23, 11 also report quarterly data:
    - Argentina
    - Australia
    - Canada
    - Columbia
    - Costa Rica
    - Korea
    - Mexico
    - Norway
    - New Zealand
    - Philippines
    - Singapore
    - Taiwan

- Measurement is possible: IPP + private data on marketing and AI investment, ILO data on managers, etc.

* Scan also covers SUTs and GFCF detail and is still preliminary.
Patterns of growth depend upon where you look, and the inclusion of intangibles affects how growth and innovation is perceived.

✓ To understand modern firms and the performance of dynamic, innovative economies, intangible capital needs to be included in the analysis.

✓ The CHS framework for measuring intangible assets and including them in productivity analysis has been adopted and widely used in many studies (not just our own).

Finally, as a reminder, case studies abound showing that there are two ways to deploy intangibles.

✓ One involves using them to develop completely new business offerings (e.g., digital platforms)

✓ The other is to make tangible factors and brands more productive (e.g., product quality, supply chains, industrial IoT systems aka “factories of the future”)
Thank you.

Back ups follow.
Conceptual Framework: Intangibles and Productivity

**Upstream: Production of intangible assets**

**Inputs:**
- Upstream worker hours
- Upstream tangible capital services

**Output:**
Output of new, commercially valuable knowledge

**Freely available basic knowledge**

**Downstream: Production of final products**

**Inputs:**
- Downstream worker hours
- Downstream tangible capital services
- Paid-for services of commercially valuable knowledge stock

**Output:**
Output of goods and services

**Freely available commercially valuable knowledge**
Formal and informal sectors

Infosys Headquarters, Bangalore

Textile workers
Intangible investment a factor behind growth in productivity dispersion at the firm level

Evolution of firm-level productivity dispersion by intangible intensity of industry in a regression framework, after controls*

* Classification of industries according to intangibles intensity based on INTAN-Invest data. Source: Preliminary results from Corrado, Criscuolo, Haskel, Himbert, and Jona-Lasino (2021)
Implications for market power

- Realized rate of return for US private industries not consistent with significant increase in market power after accounting for intangibles.
Optional Slide: Other recent works (and more “facts”)

- The intangible capital framework applies to AI (OxRep paper)
- **Data assets** are subsumed in, i.e., largely overlap with, intangible assets (NBER/CRIW paper and IPSOS survey conducted in the UK)
- Theory predicts that nonrival capital goods create increasing returns in the macroeconomy because they can be copied and replicated at low cost.
  - Though data is fundamentally nonrival, capabilities developed from proprietary data are difficult to replicate at low cost (and/or held as trade secrets)
  - This restrains the diffusion of data intelligence across firms and industries, reducing TFP growth
- **Outsized returns, price markup and productivity dispersion** are “explained” when intangibles are fully accounted for (JEP paper, OECD paper)
Data capital growth strongly correlated with components of intangibles hypothesized as the most data intensive

Data capital vs intangibles (components not included in GDP, left), and vs those included, right) growth of investment rates, 2010 to 2018