IPR MEASUREMENT AND EFFECTS ON INNOVATION: IMPLICATIONS FOR CHINA

Walter G. Park, American University, Nov. 15, 2010
Outline

- Construction of Index of Intellectual Property Rights
- Case Study: South Korea
- Implications for China
Background

- GDP
- GPA
- IPR Index
Background

- **Email Requests for IPR Data (2008 – 2010):**
  - Fellow Academics: 12%
  - Business: < 1%
  - Government/Institutions: 7%
  - Undergraduate Students: 5%
  - Graduate Students: 17%
  - Students in China: 58%
I. Construction of Measures of IPR

☐ Survey Approach
  ☐ World Economic Forum (WEF) *Global Competitiveness Report*
  ☐ Institute for Management Development (IMD) *World Competitiveness Yearbook*

☐ Index Approach
  ☐ Rapp and Rozek (1990)
IA. Survey Approach

WEF:

“Intellectual Property Protection in your country
Is Weak and Not Enforced < 1 2 3 4 5 6 7 > Is Strong and Enforced

Circling 1 means you completely agree with the answer on the left-hand side
Circling 2 means you largely agree with the answer on the left-hand side
Circling 3 means you somewhat agree with the answer on the left-hand side
Circling 4 means your opinion is indifferent between the two answers
Circling 5 means you somewhat agree with the answer on the right-hand side
Circling 6 means you largely agree with the answer on the right-hand side
Circling 7 means you completely agree with the answer on the right-hand side”

- Moving Average Score
  - Per country:
    \[
    \text{Score (year } t \text{)} = \omega_t \text{ Rating (year } t \text{)} + \omega_{t-1} \text{ Rating (year } t-1 \text{)}
    \]
## Sample Estimates

<table>
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<tr>
<th>Country</th>
<th>2010 Score (Rank)</th>
<th>2001 Score (Rank)</th>
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<tbody>
<tr>
<td>USA</td>
<td>5.1 (24th)</td>
<td>6.5 (3rd)</td>
</tr>
<tr>
<td>Germany</td>
<td>5.7 (9th)</td>
<td>6.3 (6th)</td>
</tr>
<tr>
<td>S. Korea</td>
<td>4.1 (44th)</td>
<td>4.0 (37th)</td>
</tr>
<tr>
<td>China</td>
<td>4.0 (49th)</td>
<td>2.9 (60th)</td>
</tr>
<tr>
<td>India</td>
<td>3.6 (66th)</td>
<td>3.0 (58th)</td>
</tr>
</tbody>
</table>

139 countries  79 Countries
Survey Approach

Advantages

- Based on experience
- Provides information that is otherwise unobserved (e.g. actual practice)

Limitations

- Limited Time-Series
- Comparability Issues
- Lump all IPR together
- Subjective
- Expensive
IB. Index Approach

- Patent Rights Index (0 - 5)
  - Duration (0 - 1)
  - Coverage (0 - 1)
  - Restrictions, if any (0 - 1)
  - Enforcement Mechanisms (0 - 1)
  - Membership in International Treaties (0 - 1)
Duration

- Application-Based Systems: 20 Years
- Grant-Based Systems: 17 Years
Coverage

- Pharmaceuticals
- Chemicals
- Food
- Surgical Products
- Microorganisms
- Plant & Animal Varieties
- Software
- Utility models (Petty patents)
Restrictions, if any

- Working Requirements
- Compulsory Licensing
- Revocation
Enforcement Mechanisms

- Preliminary Injunctions
- Contributory Infringement
- Burden-of-Proof Reversal
Membership in International Treaties

- Paris Convention
- Patent Cooperation Treaty
- UPOV (New Varieties)
- Budapest Treaty (Microorganism Deposits)
- TRIPS
<table>
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<th>2005</th>
<th>Rank</th>
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<td>5</td>
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<tr>
<td>Japan</td>
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<td>6</td>
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<td>United Kingdom</td>
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<tr>
<td>Germany</td>
<td>3.97</td>
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<td>4.50</td>
<td>14</td>
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<td>12</td>
<td>4.33</td>
<td>18</td>
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<tr>
<td>China</td>
<td>1.33</td>
<td>93</td>
<td>4.08</td>
<td>34</td>
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<td>Mexico</td>
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<td>3.88</td>
<td>39</td>
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<td>India</td>
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<td>105</td>
<td>3.76</td>
<td>41</td>
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<tr>
<td>Brazil</td>
<td>1.28</td>
<td>94</td>
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<td>49</td>
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<td>Cameroon</td>
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<td>52</td>
<td>3.06</td>
<td>71</td>
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<tr>
<td>Thailand</td>
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<td>97</td>
<td>2.66</td>
<td>96</td>
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</table>
Figure 1. Strengthening of Patent Rights by Income Group

Quintiles (Real GDP per capita, 1990, in constant 2000 U.S. dollars)
Figure 2. Composition of Change in Patent Strength 1990-2005, Bottom Quintile

- %Chng Coverage: 6%
- %Chng Duration: 21%
- %Chng Loss of Rights: 19%
- %Chng Membership: 53%
- %Chng Coverage: 1%
Figure 3. Composition of Change in Patent Strength 1990 - 2005, Middle Quintile

- %Chng Coverage: 20%
- %Chng Duration: 13%
- %Chng Enforcement: 21%
- %Chng Membership: 34%
- %Chng Loss of Rights: 12%
Figure 4. Composition of Change in Patent Strength 1990 - 2005, Top Quintile

- %Chng Membership: 40%
- %Chng Coverage: 24%
- %Chng Enforcement: 19%
- %Chng Loss of Rights: 13%
- %Chng Duration: 4%
# Correlations with other Measures

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<th>Measure</th>
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<th>2000</th>
<th>2005</th>
</tr>
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<tbody>
<tr>
<td>World Economic Forum IPR</td>
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<td>0.74</td>
<td>0.67</td>
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<tr>
<td>Institute Mgt Development IPR</td>
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<td>0.56</td>
<td>0.48</td>
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<td>Econ Freedom Network: Property Rights</td>
<td>0.69</td>
<td>0.66</td>
<td>0.68</td>
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<tr>
<td>Business Software Alliance: Piracy Rate</td>
<td>-0.74</td>
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<tr>
<td>Governance Indicators: Rule of Law</td>
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<td>0.73</td>
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<tr>
<td>Governance Indicators: Regulatory Quality</td>
<td>0.58</td>
<td>0.76</td>
<td>0.79</td>
</tr>
<tr>
<td>Governance Indicators: Government Effectiveness</td>
<td>0.77</td>
<td>0.76</td>
<td>0.78</td>
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<tr>
<td>Doing Business: Legal Rights</td>
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<td></td>
<td>0.35</td>
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<tr>
<td>Doing Business: Investor Protection</td>
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<td></td>
<td>0.25</td>
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<tr>
<td>Doing Business: Cost of Contract Enforcement</td>
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<td>-0.51</td>
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More detail: China

<table>
<thead>
<tr>
<th>Components</th>
<th>1995</th>
<th>2000</th>
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<tbody>
<tr>
<td>Membership Intl Agreements</td>
<td>0.200</td>
<td>0.800</td>
<td>1.000</td>
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<tr>
<td>Coverage</td>
<td>0.250</td>
<td>0.625</td>
<td>0.750</td>
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<tr>
<td>Loss of Rights</td>
<td>0.333</td>
<td>0.333</td>
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<td>Enforcement</td>
<td>0.333</td>
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<tr>
<td>Duration</td>
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<tr>
<td>Total</td>
<td>2.117</td>
<td>3.092</td>
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</table>
China: Complementary Data

Software Piracy Rate
China: Complementary Data

Governance Indicators

Gov't Effectiveness
Rule of Law
Regulatory Quality
II. Case Study (S. Korea)

Patents vs. Utility Models

**Similarities**
- Exclusive Rights
- Disclosure
- Registration

**Differences**
- Duration
- Substantive Examination
- Inventive Step
- Scope
Theoretical Perspectives

  - Optimal IPR varies between North and South

- Eicher and Penalosa (2008)
  - Endogeneity between IPR and Development

- Suthersanen (2006)
  - Incremental Innovation and learning-by-doing
Theoretical Perspectives

- **Evenson and Westphal (1995)**
  - "Strong IPRs can be a powerful instrument for encouraging many forms of investment at all levels of technological development if they are sufficiently focused on promoting those forms of investment which are respectively important at each level. More imagination than has previously been given to their design is clearly in order. ... [U]tility models exemplify the gains in creativity in this area. Utility model protection, for example, is actively sought in the few countries, like Korea, that grant it. Moreover, the evidence suggests that it stimulates the kinds of minor, adaptive inventions that are important in the early to middle phases of technological development."

- **Rosenberg (1979)**
  - Cumulative Impact of Small Improvements
Why Utility Models suited S. Korea

- Weak Patent System and Enforcement
- Lagging Technological Capability and Limited Technological Resources
- Relied on Imported Technologies, Reverse Engineering, and Imitation
- Adapted Foreign Technologies for Local Needs
- Innovation was Incremental in Nature
Korean Trends

Patent Right Index

Note: Revision of Choi and Lee (2005)
Korean Trends

R&D/GDP(%)
Korean Trends

Number of corporate R&D Centers in Korea

As of June 2000: 7,110
2001: 9,070
2002: 9,705
2003: 9,810
2004: 10,270
2005: 11,810
2006: 13,324
2007: 14,975
2008: 16,710
2009: 17,522

Corporate R&D Centers by Field

As of June 2009:
- Electronics/Electros: 8,327
- Machinery: 3,464
- Chemicals: 2,636
- Construction/Engineering: 1,059
- Food Processing: 361
- Textiles: 224
- Others: 1,481
## U.S. Patents Granted in 2009

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<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Count</th>
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<tr>
<td>1</td>
<td>JAPAN</td>
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<tr>
<td>2</td>
<td>GERMANY</td>
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<td>3</td>
<td>KOREA, SOUTH</td>
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<tr>
<td>4</td>
<td>TAIWAN</td>
<td>6642</td>
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<tr>
<td>5</td>
<td>CANADA</td>
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<td>6</td>
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<td>7</td>
<td>FRANCE</td>
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<td>8</td>
<td>CHINA, PEOPLE'S REPUBLIC OF</td>
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<td>9</td>
<td>ISRAEL</td>
<td>1404</td>
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<td>10</td>
<td>ITALY</td>
<td>1346</td>
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</table>
Resident Patenting in S. Korea

Grants

- Utility Models
- Inventions


- 2008: High patents
- 2000: Moderate patents
- Other years: Low patents
Ratio of Utility Models to Invention Patents (S. Korea)
Study in a Nutshell

- **Datasets 1970 - 2003**
  - International Panel Data Set (World Bank)
    - > 70 Countries
  - Korean Annual Firm Level Data Set (KIPRIS and KIS)
    - > 3000 Firms

- **Empirical Model (Dynamic)**
  - \( Y = f(Y_{-1}, P, UM, \text{ Control Variables}) \)
  - \( P = g(P_{-1}, IPR, \text{ Control Variables}) \)
  - \( Y \) denotes GDP (or Sales), \( P \) patents, \( UM \) utility models
### International Panel Data Results

#### Innovation Equation

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<th>Variables</th>
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<td>PRI * D</td>
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<td>UM * D</td>
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#### Growth Equation

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<td>PI * D</td>
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## Korean Firm Level Results

### Sales Growth Equation

<table>
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<th>(1) Full Period</th>
<th>(2) Pre 1987</th>
<th>(3) Post 1987</th>
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### Innovation Equation

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<td>N</td>
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Lessons of Study

- Effects of IPR varies by level of economic development
  - Patents raise cost of innovation; onerous in LDCs
  - Patents most effective where innovative capacity exists
  - Endogeneity between IPR and technological development

- Utility Models
  - Incentives for incremental innovation
  - Helps build innovative capacity
  - Stepping stone for further technological progress
  - Best utilizes local capabilities

- Rapid development in S. Korea is connected to "incremental innovation" as a strategy for technological catch-up
III. Implications for China

- Relevance?
  - Transition from Imitation to Innovation
  - Transition from Weak IPR System to Strong
- Incentives for Stronger IP Enforcement in China
Resident Patenting in China

- **Applications**
- **Grants**
Ratio of Utility Models to Invention Patents (China)
Issues:

I. Innovation in China (Domestic and Foreign Offshore)

II. Technological Development in China

III. IPR Enforcement in China

IV. U.S. Production, Employment, Wages
Issues:

- Innovation in China (Domestic and Foreign Offshore)
- IPR Enforcement in China
- Technological Development in China
- U.S Production, Employment, Wages