Patent Protection and the Industrial Composition of Multinational Activity: Evidence from U.S. Multinational Firms

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The statistical analysis of firm level data on U.S. multinational companies and their foreign affiliates was conducted at the Bureau of Economic Analysis, U.S. Department of Commerce, under arrangements that maintain legal confidentiality requirements. Views expressed in this paper are those of the authors and do not necessarily reflect the official positions of the U.S. Department of Commerce

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Motivation

• Article 7 of the WTO TRIPS Agreement:

"Protection and enforcement of intellectual property rights should contribute...to the transfer and dissemination of technology."

- The actual impact of strengthened IPRs on technology transfer depends on a complex interrelation of factors
 - Mode of transfer
 - within firm boundaries
 - by contracting with independent entities
 - Interdependency between various channels
 - Imitation risk and product complexity

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 - Mode of transfer
 - within firm boundaries
 - by contracting with independent entities
 - Interdependency between various channels
 - Imitation risk and product complexity
- Questions:
 - How do stronger PRs in developing countries impact the choice of U.S. multinationals between internal and arms-length technology licensing?
 - Observe the impact vary across products according to their complexity?

Conceptual Framework

- The technological complexity of industry products
 - acts as a barrier to imitation
 - affects the risk of imitation faced by the U.S. firms operating in developing countries
 - influences the firms' preferred modes of technology transfer

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 - influences the firms' preferred modes of technology transfer
- Theoretical framework: "Intellectual Property Protection and the Industrial Composition of Multinational Activity," with Walter Park and Kamal Saggi
- Licensing in low-imitation-risk (complex) industries
- FDI in high-imitation-risk (simple) industries
- Strengthening PRs in developing countries
 - affects Northern rents and imitation risks
 - impacts the scale and composition of technology licensing according to industry complexity
- Multinational production rises predominantly in simple industries
- The composition of MNA
 - shifts towards arms-length licensing and away from FDI in complex industries
 - shifts towards FDI and away from Northern production in simple industries

Data

- Data from the U.S. BEA on affiliated and unaffiliated technology licensing by U.S. multinational companies
- 1,185 U.S. parent firms
- 5,309 unique firm-by-host country pairs
- High-tech manufacturing sector
 - 3000 < NAICS '02 < 4000 (excl. Food/Beverages/Tobacco, Textiles, Wood)
- 44 developing countries over the 1993-2009 period (annual)

| Algeria | Dominican Rep | Mexico | Singapore | |
|---------------|---------------|--------------|-------------------|----|
| Angola | Ecuador | Morocco | Slovakia | |
| Argentina | El Salvador | Nicaragua | South Africa | |
| Brazil | Ghana | Nigeria | South Korea | |
| Bulgaria | Guatemala | Panama | Sri Lanka | |
| Chad | Hong Kong | Peru | Taiwan | |
| Chile | Hungary | Philippines | Thailand | |
| China | India | Poland | Trinidad & Tobago | |
| Cote D'Ivoire | Jamaica | Romania | Venezuela | |
| Cyprus | Kenya | Russia | Vietnam | |
| Czech Rep | Malaysia | Saudi Arabia | Zimbabwe | Ξ. |

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Patent Protection

Ginarte and Park (1997) index of patent rights

- Available by country and time
- Based on statutes and case laws
- Measures strength of regime
- Score 0 5
 - Duration of protection
 - Coverage
 - Enforcement provisions
 - Membership in international agreements
 - Restrictions on exclusive use

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- The task-based measure from Naghavi et al. (2015)
- The product category level (2-digit NACE codes)
- The complexity level of the tasks involved in the product's manufacturing
- How is it constructed?
 - The complexity score for 809 (8-digit SOC) occupations
 - The level and importance of complex problem-solving skills
 - Participation Provide the second s
 - The employment of labour across occupations by industries (3-digit SIC)
 - O The share of industry in the production of each product
- We focus on 15 high-tech manufacturing product categories

U.S. Parent Firm Sample Statistics

| | Unaffiliated Licensing | Affiliated Licensing | Ratio Unaff./Aff. |
|-------------------------|---------------------------|-------------------------|----------------------|
| Above Median Complexity | 531.2 | 487.3 | 1.090 |
| Below Median Complexity | 173.2 | 648.2 | 0.267 |
| Difference in means | 358.0*** | -160.9*** | 0.823*** |

The licensing figures are in thousands of real 2005 U.S. dollars. Computed over 44 developing countries, from 1993 – 2009

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U.S. Licensing by Destination



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The basic model of the technology transfer via the licensing of intangible assets:

 $T_{ijt} = \alpha + \beta_1 P_{jt} + \beta_2 X_{jt} + \beta_3 R_{it} + \beta_4 A_{it} + \beta_5 A_{it} \times P_{jt} + \alpha_j + \alpha_t + \tau_{jt} + \varepsilon_{ijt}$

- *i* the U.S. parent firm; *j* host country; *t* year
- T_{ijt} unaffiliated and affiliated licensing, and their ratio
- P_{jt} the strength of patent protection
- X_{jt} GDP, wages, corporate income tax rates, inward capital restrictions
- R_{it} parent R&D/sales
- A_{it} firm ranking in its use of patents
- α_j and α_t country and year fixed effects
- τ_{jt} country-specific linear time trends

Results. The Basic Model (without complexity effects)

| | Unaff. Licen. | Affil. Licen. | U/A Ratio |
|-------------------------------------|---------------|---------------|-----------|
| log (host's PRs) | 0.124** | 0.200** | -0.070 |
| | (0.054) | (0.090) | (0.094) |
| log (Parent R&D/Sales) | 0.010*** | 0.038*** | -0.030*** |
| | (0.002) | (0.007) | (0.007) |
| log (Host GDP) | 0.501*** | 1.452*** | -0.947*** |
| | (0.163) | (0.292) | (0.341) |
| log (Host/U.S. Wages) | -0.083 | 0.021 | -0.106 |
| | (0.201) | (0.351) | (0.361) |
| Capital Restrictions Dummy | 0.064** | -0.007 | 0.070 |
| | (0.030) | (0.057) | (0.061) |
| Host Corporate Income Tax | -0.013 | -0.043 | 0.030 |
| | (0.047) | (0.066) | (0.070) |
| Parent Patent Rank | 0.043* | 0.110*** | -0.063 |
| | (0.022) | (0.039) | (0.045) |
| log (host's PRs)×Parent Patent Rank | -0.041* | -0.034 | -0.011 |
| | (0.021) | (0.037) | (0.042) |
| Constant | -8.440*** | -22.752*** | 14.216** |
| | (2.703) | (4.834) | (5.629) |

Notes: 29,940 obs. *** p < 0.01, ** p < 0.05, * p < 0.1.

All regressions include year FEs, country FEs, and host-country specific time trends.

Empirical Framework. The augmented model

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- α_i and α_t country and year fixed effects
- τ_{it} country-specific linear time trends
- The augmented model: $+\beta_6 Z_p + \beta_7 Z_p \times P_{jt}$
 - Z_p the level of complexity of product category p

Results. The Augmented Model (with complexity effects)

| | Unaff. Licen. | Affil. Licen. | U/A Ratio | | |
|---|---------------|----------------------|------------|--|--|
| log (host's PRs) | 0.314*** | 1.394*** | -1.069*** | | |
| | (0.102) | (0.216) | (0.232) | | |
| Product complexity | 0.891** | -1.558** | 2.509*** | | |
| | (0.383) | (0.762) | (0.782) | | |
| log (host's PRs)×Product complexity | -0.638* | -4.165*** | 3.512*** | | |
| | (0.353) | (0.679) | (0.755) | | |
| log (Parent R&D/Sales) | 0.010*** | 0.045*** | -0.038*** | | |
| | (0.002) | (0.007) | (0.007) | | |
| log (Host GDP) | 0.522*** | 1.554 ^{***} | -1.027 | | |
| | (0.164) | (0.294) | (0.343) | | |
| log (Host/U.S. wages) | -0.099 | -0.011 | -0.092 | | |
| | (0.202) | (0.347) | (0.361) | | |
| Capital restrictions dummy | 0.065** | -0.008 | 0.072 | | |
| | (0.030) | (0.057) | (0.060) | | |
| Host corporate income Tax | -0.015 | -0.041 | 0.026 | | |
| | (0.048) | (0.064) | (0.068) | | |
| Parent patent rank | 0.043** | 0.107*** | -0.060 | | |
| | (0.022) | (0.040) | (0.045) | | |
| log (host's PRs)×Parent patent rank | -0.042** | -0.025 | -0.021 | | |
| | (0.021) | (0.037) | (0.043) | | |
| Constant | -9.039*** | -23.997*** | 14.838*** | | |
| | (2.723) | (4.870) | (5.652) | | |
| Notes: 29,533 obs. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. | | | | | |
| | | A D > A B > A | 리에 세종에 가운. | | |

The Effects of Stronger Patent Protection

The elasticity of unaffiliated licensing:

$$rac{d \ln T^U}{d \ln PRs} = 0.314 - 0.042 ar{A} > 0 ~~ ext{for any}~~Z_{
ho}$$

- The mean patent rank $\bar{A} = 0.48$
- The coefficient on $Z_p \times P_{jt}$ is not stat. significant at 5% and so is not included
- The elasticity of affiliated licensing:

$$rac{d\ln T^A}{d\ln PRs}=1.394-4.165Z_p>0~~ ext{for any}~~Z_p<0.335$$

• In our data, Z_p ranges from 0.184 to 0.422

The elasticity of the licensing ratio:

$$rac{d \ln (T^U/T^A)}{d \ln PRs} = -1.069 + 3.512 Z_p < 0 \quad ext{for any} \ \ Z_p < 0.304$$

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Sensitivity Analysis

Results are not driven by:

- Cross-product differences in technology transfer independent of PRs
 - Included product fixed effects
- Cross-industry differences in technology transfer independent of PRs
 - Included industry fixed effects interacted with the strength of PRs
- Endogeneity due to omitted firm-by-country specific effects
 - The OLS estimator with firm-by-country fixed effects
- Endogenous selection of firms into licensing
 - Heckman's two-stage estimation procedure (Heckman, 1979)
- Endogenous strengthening of patent rights
 - The instrumental variable estimator (Ivus, 2010)
- Measure of patent protection:
 - Patent reform dummy, based on year of major reform

Findings

Product complexity has a significant influence on the licensing decisions of U.S. multinational firms

- The composition of licensing is relatively more skewed towards affiliated parties among simple-product firms, particularly so in countries with strong PRs
- Simple-product firms choose the more secure means of transfer via affiliates, and also rely on a host's PRs

Findings

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- Simple-product firms choose the more secure means of transfer via affiliates, and also rely on a host's PRs

Product complexity plays a key role in determining the technology transfer impact of PRs

- Strengthening PRs in developing countries increase the attractiveness of unaffiliated licensing across all firms
- Among simple-product firms, the attractiveness of affiliated licensing also rises, strongly enough that the composition of their licensing shifts towards affiliated parties
- For complex-product firms, the attractiveness of affiliated licensing falls and the composition of licensing shifts towards unaffiliated parties

Conclusions

- Studied the impact of patent protection on U.S. multinational firms' technology transfers to developing countries
- Focus on the composition of licensing (between affiliated and arms-length) and the cross-product differences in the impact
- The study is significant for recent work on the internalization theories of multinational firms
 - Imperfections in contracting due to weak IPRs can impede transfers of proprietary knowledge between independent entities
 - Firms producing simple products have a greater incentive for internalization and a stronger reliance on a host country's patent protection
- The study also has significant policy implications
 - Arms-length licensing in the developing world may better provide indigenous agents access to know-how and ability to adapt global innovations
 - Our results indicate that patent protection is an enabling factor for that purpose