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

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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
- Questions:
  1. How do stronger PRs in developing countries impact the choice of U.S. multinationals between internal and arms-length technology licensing?
  2. How does the impact vary across industries?

Literature review

- Internalization aspects of MNCs
  - Contractor (1984); Markusen (1995, 2001); Ethier & Markusen (1996); Yang & Maskus (2001); Glass & Saggi (2002); Antras (2005); Nicholson (2007)
- Empirical Studies of Global IPR (Selected)
  - Trade: Maskus & Penubarti (1995); Smith (1999); Co (2005); Ivus (2010, 2011)
  - FDI: Ferrantino (1993); Javorcik (2004); Nunnenkamp & Spatz (2004); Branstetter, Fisman, Foley, & Saggi (2011); Berry (2014); Bilir (2014)
  - Licensing: Yang & Maskus (2001); Park & Lippoldt (2005); Branstetter, Fisman & Foley (2006); Aulakh, Jiang, & Sali (2013)
  - Primarily focused on national characteristics that condition the impacts of IPRs, and on a specific mode of technology transfer

Our Contribution

1. Focus on the composition (affiliated vs. unaffiliated) of licensing
   - The importance of analyzing affiliated and unaffiliated licensing in an integrated framework
     - Yang and Maskus (2001)
2. Study the interaction between product complexity and the nature of licensing
   - The importance of product characteristics for the effects of IPRs on technology transfer:
     - Antràs (2005)
     - Bilir (2014)
     - Naghavi et al. (2015)
3. Use firm-level data in high-tech manufacturing

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
- 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 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

Empirical Framework

- 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} - affiliated and unaffiliated licensing; the 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
- Augmented version: $+\beta_6 Z_p + \beta_7 Z_p \times P_{jt}$
  - Z_p - the level of complexity of product category p
- Key Hypothesis: $\beta_1 > 0$ and $\beta_7 < 0$ when T_{ijt} = unaffiliated or affiliated licensing

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

Patent Protection

1. 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
2. Patent reform dummy
   - Based on year of major reform

Complexity

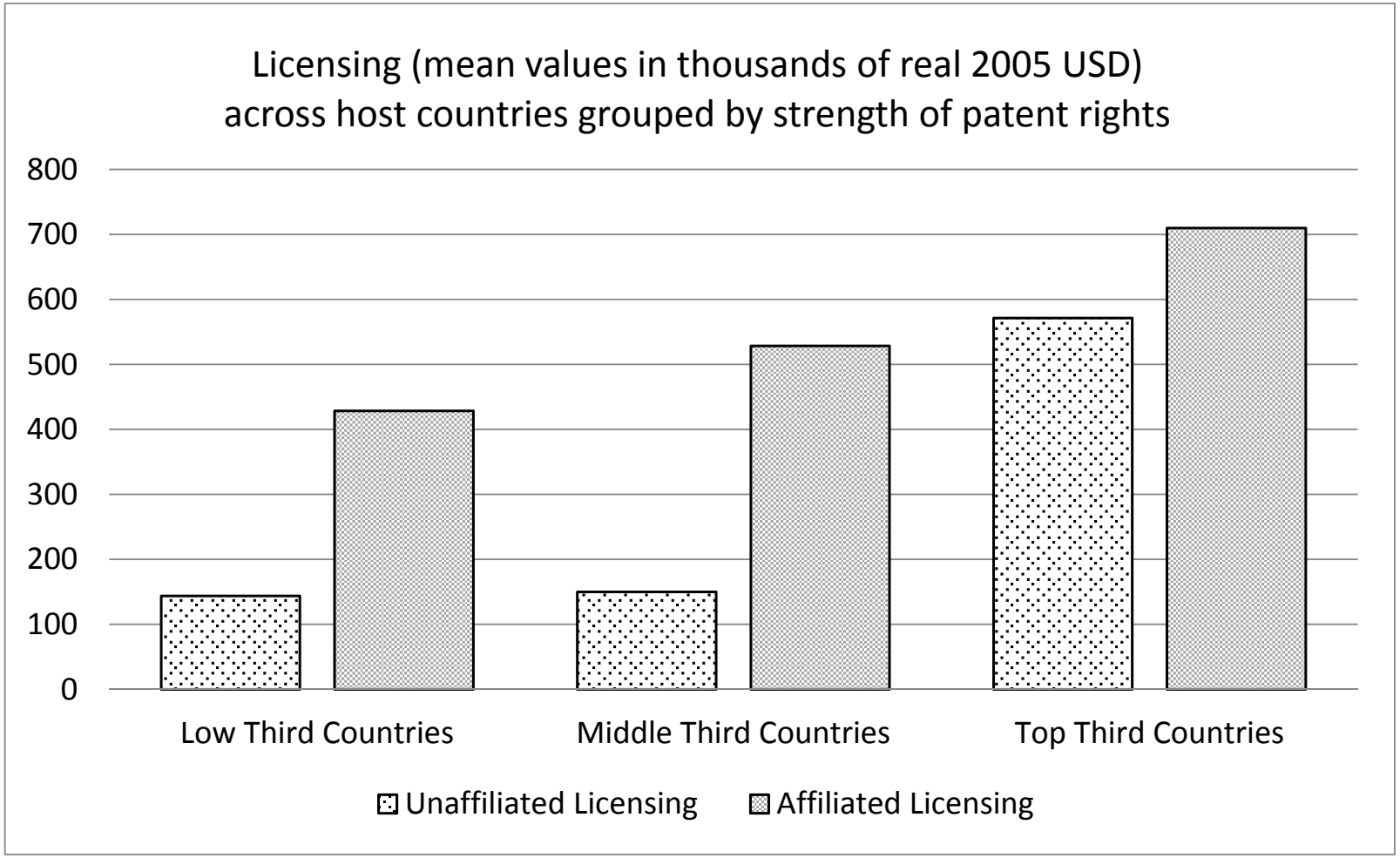
- The task-based measure from Naghavi et al. (2015)
- The product category level (2-digit NACE codes)
- The complexity level of the tasks involved in the product's manufacturing
- How is it constructed?
  1. The complexity score for 809 (8-digit SOC) occupations
     - The level and importance of complex problem-solving skills
  2. The industry occupational intensity
     - The employment of labour across occupations by industries (3-digit SIC)
  3. 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

U.S. Licensing by Destination



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 observations. $***\ p < 0.01$, $**\ p < 0.05$, $*\ p < 0.1$.

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 observations. $***\ p < 0.01$, $**\ p < 0.05$, $*\ p < 0.1$.

The effects of stronger patent protection

1. The elasticity of unaffiliated licensing:

$$\frac{d \ln T^U}{d \ln PRs} = 0.314 - 0.042\bar{A} > 0 \qquad \text{for any} \qquad Z_p$$

   - *The mean patent rank $\bar{A} = 0.48$*
   - *The coefficient on the interaction of Z_p and patent rights is not stat. significant at the 5% level and so is not included in the elasticity estimate*

2. The elasticity of affiliated licensing:

$$\frac{d \ln T^A}{d \ln PRs} = 1.394 - 4.165 Z_p > 0 \qquad \text{for any} \qquad Z_p < 0.335$$

   - *In our data, Z_p ranges from 0.184 to 0.422*

3. The elasticity of the licensing ratio:

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

Sensitivity Analysis

Our results are robust to different model specifications:

- Additional controls:
  - Product FEs
  - Industry FE interacted with PRs
  - Quality of institutional environment
  - Industry measure of product life-cycle lengths
- Intangible assets:
  - Stocks of licensing
  - Alternative definition of the composition of licensing
- Measures of patent protection:
  - Episodes of patent reform
- Estimators:
  - OLS with firm-by-country FEs
  - The two-stage selection model
  - The instrumental variable estimator

Findings

Product complexity has a significant influence on:

1. The licensing decisions of U.S. multinational firms
   - Firms producing complex products engage in unaffiliated licensing relatively more
   - Firms license complex products to unaffiliated parties in countries with weak PRs
   - Affiliated licensing is predominant for simple products in countries with strong PRs
2. The technology transfer impact of PRs

   Strengthening PRs in developing countries:
   - increases the attractiveness of unaffiliated licensing, particularly among simple products
   - shifts the composition of licensing towards affiliated parties among simple products
   - shifts the composition of licensing towards unaffiliated parties among complex products

Conclusions

- Studied the impact of patent protection on U.S. multinational firms' technology transfers to developing countries
- Focusing on the composition of licensing (between affiliated and arms-length) and the cross-product differences in the impact
- Imperfections in contracting due to weak IPRs can impede transfers of proprietary knowledge between independent entities
- Firms producing high-risk products
  - have a greater incentive for internalization when IPRs are weak
  - have a stronger incentive to transact with independent entities when IPRs protection rises
- Arms-length licensing in the developing world may better provide indigenous agents access to know-how and ability to adapt global innovations