International Innovation & Intellectual Property Rights:

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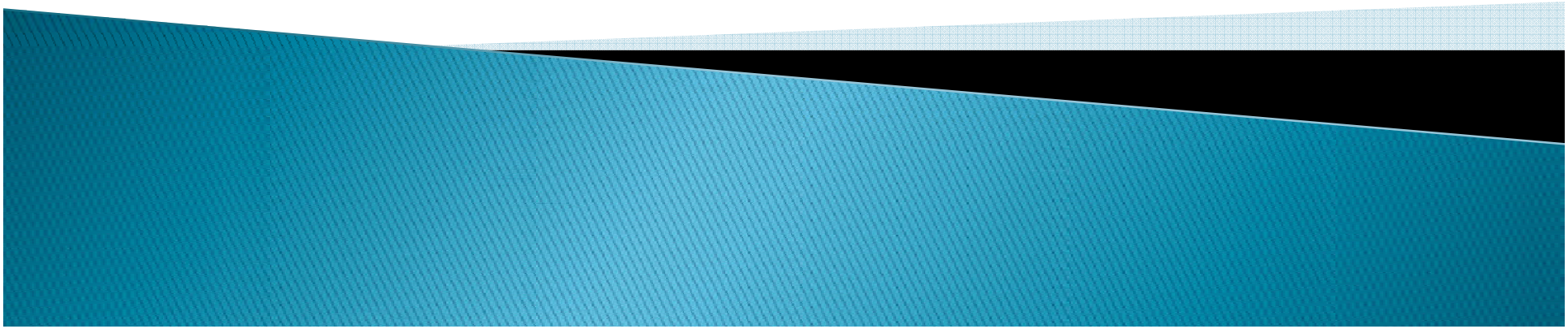
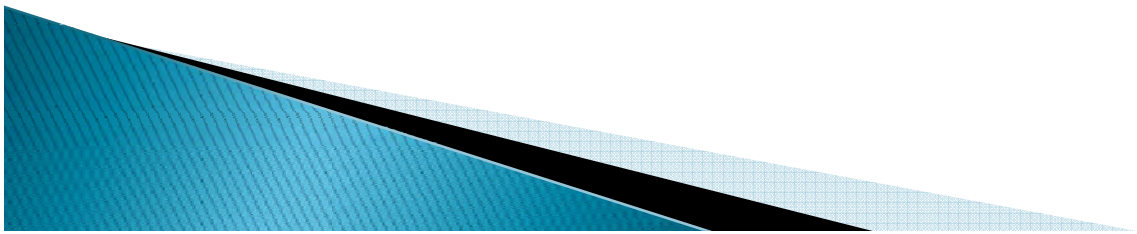


Overview

- Theoretical North-South Literature
  - Effect of IPRs in South on Innovation in North

- This study finds weak empirical feedback from South to North

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



A. Global Intellectual Property Rights (IPR): Background

- Uruguay Round 1986 – 1994
- GATT ⟶ WTO
- Trade-Related IPR Agreement (TRIPS)

- North vs. South: Guidelines
  - Transitional periods
  - Minimum Standards
  - Trade Preferences and Technology Transfer (Article 66)

B. Issues

- Gains to South?

A. Do IPRs Stimulate Local Innovation?

   Schneider (2005)

   Allred and Park (2007)

B. Do IPRs Facilitate Technology Transfer?

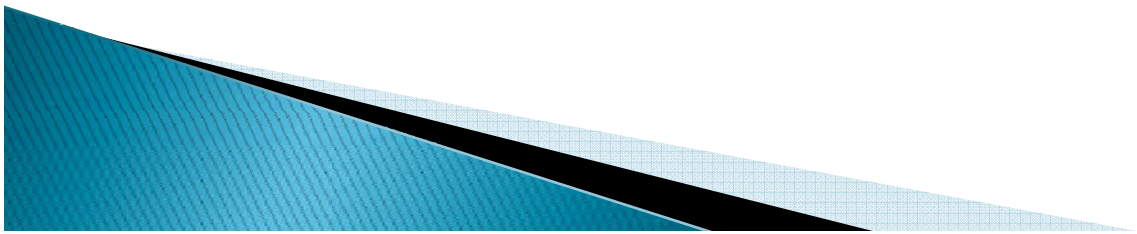
   Branstetter, Fisman, and Foley (2006)

   Park and Lippoldt (2005)

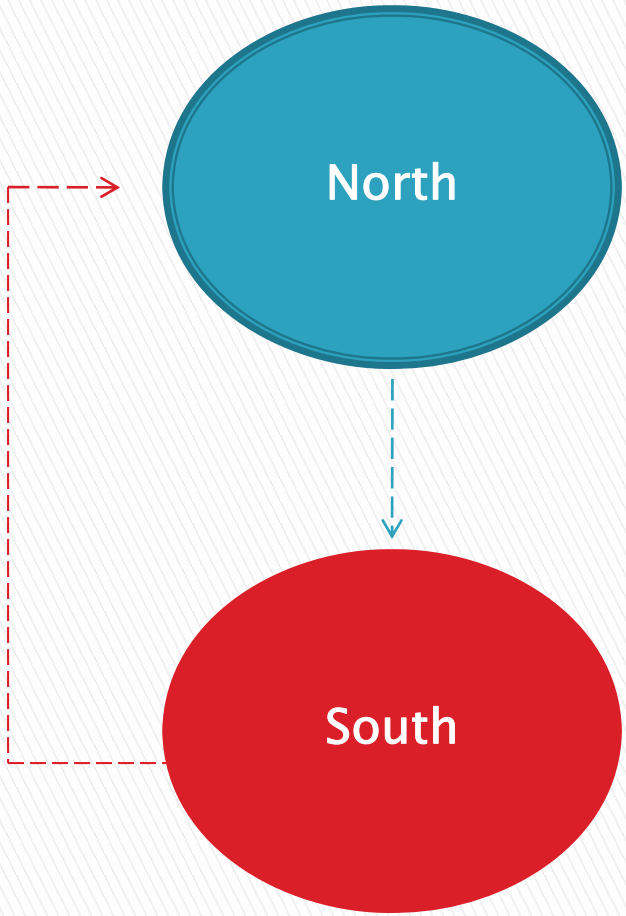
C. Do IPRs Induce Northern Innovation?

   Theory: Helpman (1993), Lai (1998), Glass & Saggi (2002), etc.

   No Empirics (so far)



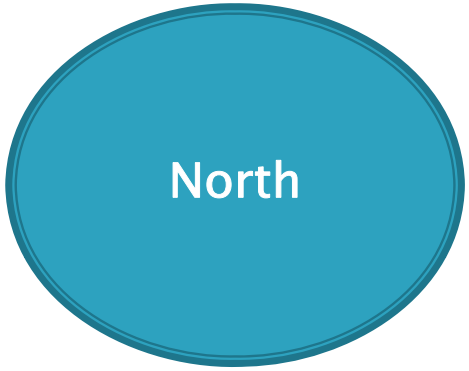
C. North–South Theoretical Work



- $w^N > w^S$
- $n = n^N + n^S$
- $n^S = n^S(IPR), \quad n^{S\prime}(.) < 0$
- $L = L^R + L^M$
- $g = \dot{n}/n$

Ambiguous Effect of IPR on g

Main Criticism: Asymmetric Market Sizes



Developing Countries

Least Developed Countries

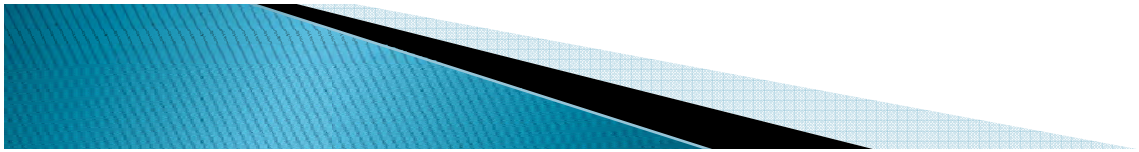
Table 3. Shares of International Market and Innovation

	World GDP	Exports	Priority Filings	Trilateral Filings	National R&D
Developed Countries					
1985	78.6%	77.9%	88.8%	99.2%	n/a
2005	75.1%	73.2%	60.5%	88.3%	87.1%
Upper-income Developing Countries					
1985	17.0%	15.9%	10.4%	0.6%	n/a
2005	15.8%	20.3%	22.1%	11.3%	9.4%
Lower-income Developing Countries					
1985	4.4%	6.2%	0.8%	0.2%	n/a
2005	9.1%	6.5%	17.4%	0.4%	3.5%

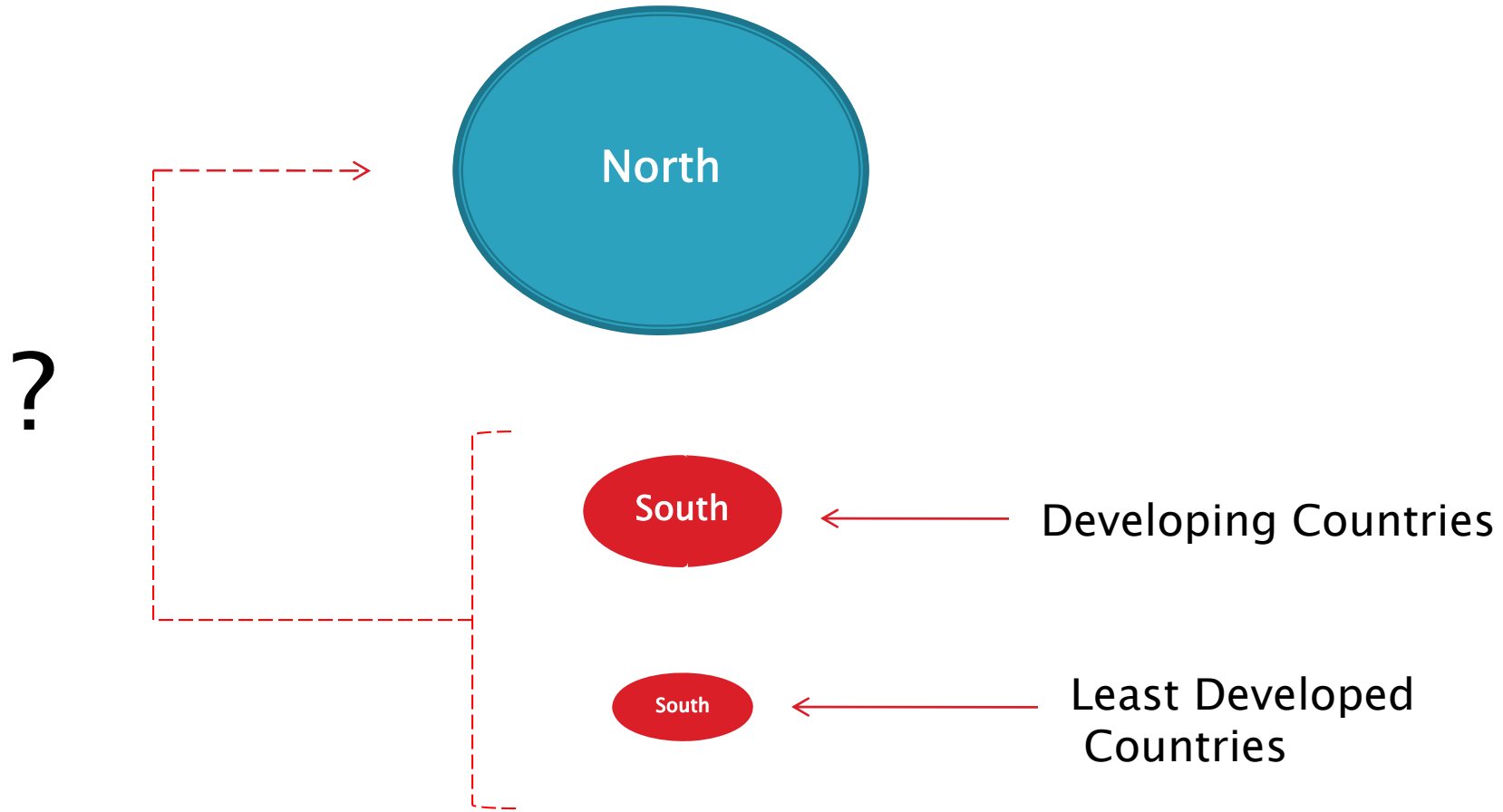
Notes:

Developed countries refer to the group of 23 countries listed in Table 1. Upper-income developing countries refer to the high-income and medium-income countries, and lower-income developing countries to the low-income and least developed countries, as classified by the U.N. (see UNCTAD (2006)).

Share of exports here refer to the share of developed country exports (i.e. total exports of the 23 countries in the sample). National R&D refers to the sum of public, private, higher education, and non-profit research and development expenditures. Source of National R&D data: United Nations Educational, Scientific and Cultural Organization, Institute for Statistics, Data Center, http://stats.uis.unesco.org/unesco. n/a denotes not available.

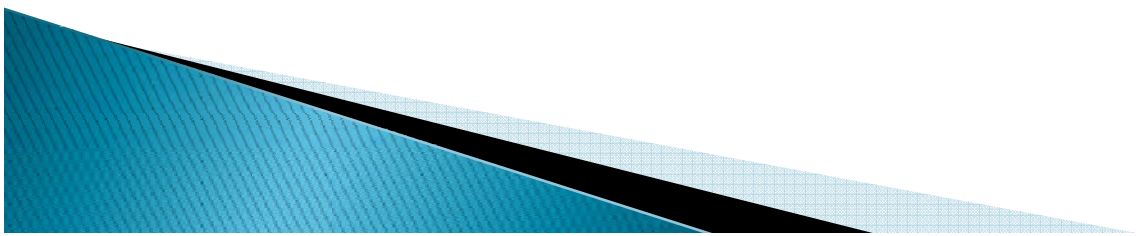


Main Criticism: Asymmetric Market Sizes



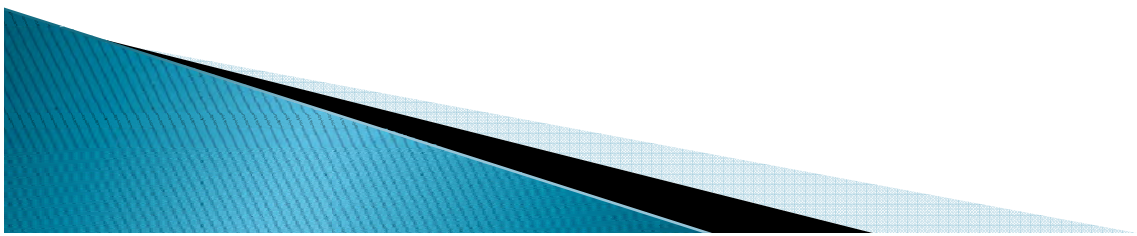
D. Empirical Analysis

- Setup
  - North: 23 Developed countries (OECD plus Israel)
  - South: Developing & Least Developed countries
- Measures of Innovation
  - Patent (Family) Filings, European Patent Office
  - R&D (Firm Level), U.S. BEA Micro-data
- Measure of IPR
  - Index of Patent Rights
  - Ginarte and Park (1997) and Park (2008)



Measure of Patent Rights Index

- P_{it}
- Ranges from 0 – 5 for each country per year
- Components
  - Duration
  - Coverage
  - Enforcement Provisions
  - Membership in International Treaties
  - Limitations



Measure of Foreign Patent Rights

$$P_{it}^{*\,I} = \sum_{j=1,\, j\neq i}^{J_I} s_{ijt-1}\, P_{jt}$$ ← Other Developed Group

$$P_{it}^{*\,II} = \sum_{j=1}^{J_{II}} s_{ijt-1}\, P_{jt}$$ ← Developing Countries (Upper-Income)

$$P_{it}^{*\,III} = \sum_{j=1}^{J_{III}} s_{ijt-1}\, P_{jt}$$ ← Developing Countries (Lower-Income)

where $$s_{ijt-1} = \frac{E_{ijt-1}}{E_{it-1}}$$

E, exports

Table 1. Selected Innovation Indicators in Developed Countries

	Priority Filings Average 1980-2005	Priority Filings per Billion Dollars of Private R&D Average 1980-2005	Trilateral Filings per Priority Filings Average 1980-2005	Firm R&D per Firm Sales Average 1982-2004
Australia	2467	906	10.9%	1.44%
Austria	1712	1149	10.0%	2.76%
Belgium	1529	606	17.7%	2.84%
Canada	6324	1196	8.1%	1.48%
Denmark	1517	1204	16.9%	3.99%
Finland	2397	1346	12.2%	2.63%
France	9451	685	17.0%	3.11%
Germany	42751	1613	11.5%	3.33%
Greece	352	321	4.8%	1.02%
Ireland	431	882	13.7%	1.28%
Israel	2036	887	22.2%	7.67%
Italy	6060	1063	10.3%	1.51%
Japan	56846	971	20.6%	3.10%
Luxembourg	172	761	14.5%	2.54%
Netherlands	5005	1491	26.4%	1.19%
New Zealand	411	1177	9.7%	0.53%
Norway	708	768	9.8%	0.87%
Portugal	305	334	3.9%	0.62%
Spain	2923	1090	3.5%	0.73%
Sweden	3134	726	21.2%	6.07%
Switzerland	3808	1044	19.3%	2.27%
UK	10538	901	12.0%	3.34%
USA	108363	887	13.3%	4.32%

Notes:

Priority filings are the number of first filings of a patent application for an invention, by country of the inventor. Trilateral filings are those priority filings that are subsequently filed in at least the U.S., Japan, and European Patent Office. Firm R&D refers to the research and development performed by a firm. See the Appendix for sources of data.

Table 4. Effective Patent Protection Levels, 1980 - 2005

	Patent Protection Levels that Developed Country faces in:									
	Own Country		Other Developed Countries			Upper Income Developing Countries			Lower Income Developing Countries		
	Mean	*Std Dev*	*Mean*	*Std Dev*	*Exp Share*	*Mean*	*Std Dev*	*Exp Share*	*Mean*	*Std Dev*	*Exp Share*
Australia	3.46	*0.83*	2.00	*0.18*	60.5%	0.55	*0.25*	24.8%	0.25	*0.23*	14.8%
Austria	3.83	*0.55*	3.05	*0.32*	81.2%	0.41	*0.26*	16.2%	0.05	*0.02*	2.6%
Belgium	4.26	*0.55*	3.51	*0.30*	88.9%	0.19	*0.11*	7.4%	0.07	*0.04*	3.7%
Canada	3.84	*0.81*	4.19	*0.41*	92.4%	0.12	*0.03*	5.4%	0.04	*0.02*	2.2%
Denmark	4.10	*0.62*	3.22	*0.23*	88.3%	0.21	*0.13*	9.1%	0.06	*0.02*	2.7%
Finland	3.87	*0.75*	2.82	*0.33*	74.3%	0.39	*0.33*	22.0%	0.09	*0.07*	3.7%
France	4.19	*0.48*	3.11	*0.44*	80.7%	0.34	*0.17*	14.1%	0.11	*0.03*	5.2%
Germany	4.10	*0.35*	3.11	*0.33*	80.9%	0.39	*0.28*	15.4%	0.08	*0.04*	3.7%
Greece	3.21	*0.84*	2.73	*0.37*	76.9%	0.50	*0.36*	20.3%	0.06	*0.02*	2.8%
Ireland	3.37	*1.25*	3.76	*0.36*	92.2%	0.16	*0.10*	6.1%	0.04	*0.02*	1.6%
Israel	3.37	*0.59*	3.18	*0.26*	81.9%	0.40	*0.23*	14.8%	0.08	*0.08*	3.3%
Italy	4.12	*0.53*	3.01	*0.34*	79.3%	0.40	*0.25*	17.0%	0.07	*0.03*	3.7%
Japan	4.08	*0.58*	2.22	*0.30*	57.4%	0.76	*0.34*	29.9%	0.28	*0.23*	12.7%
Luxembourg	3.33	*0.80*	3.77	*0.31*	92.4%	0.15	*0.07*	5.9%	0.04	*0.02*	1.7%
Netherlands	4.27	*0.42*	3.32	*0.36*	89.8%	0.20	*0.17*	7.7%	0.05	*0.03*	2.5%
New Zealand	3.35	*0.72*	2.62	*0.27*	70.8%	0.48	*0.19*	20.6%	0.17	*0.14*	8.7%
Norway	3.62	*0.45*	3.73	*0.48*	92.7%	0.13	*0.07*	5.1%	0.04	*0.02*	2.1%
Portugal	2.79	*1.27*	3.56	*0.46*	91.2%	0.13	*0.09*	5.0%	0.03	*0.02*	3.8%
Spain	3.64	*0.78*	3.10	*0.54*	81.3%	0.35	*0.15*	15.3%	0.06	*0.02*	3.4%
Sweden	4.03	*0.56*	3.35	*0.35*	85.3%	0.29	*0.18*	11.1%	0.08	*0.04*	3.6%
Switzerland	3.98	*0.37*	3.22	*0.39*	81.5%	0.36	*0.17*	14.9%	0.07	*0.04*	3.5%
United Kingdom	4.27	*0.36*	3.16	*0.51*	83.4%	0.27	*0.15*	11.7%	0.10	*0.03*	4.9%
United States	4.72	*0.21*	2.32	*0.29*	62.5%	0.76	*0.42*	31.5%	0.13	*0.09*	6.0%
Overall	3.82	*0.45*	3.13	*0.52*		0.34	*0.18*		0.09	*0.06*	

Notes:
The index of patent rights varies from 0 - 5, with higher values indicating stronger levels of protection. The foreign patent rights index values are weighted by lagged export shares (see text). Exp Share refers to the share of the (row) developed country's exports that go to the specified group of countries. The grouping of countries by level of economic development is based on U.N. classifications (see UNCTAD (2006)).

Table 6. Estimates of the Patent Priority Equation: First Filings

	Dependent Variable: ln (Priority Filings)				
	Full Sample (1)	Full Sample (2)	Full Sample (3)	Non-U.S. (4)	Non-U.S (5)
Constant	1.241	-0.064	-5.168	0.824	-5.822
	(1.379)	(1.122)	(4.733)	(1.232)	(4.829)
ln (Priority Filings) $_{-1}$		0.365***	0.383***	0.255**	0.278**
		(0.132)	(0.136)	(0.129)	(0.135)
ln (Private R&D)	0.349**	0.218**	0.179*	0.183	0.145
	(0.140)	(0.090)	(0.093)	(0.115)	(0.116)
ln (Public R&D)	0.027	0.171**	0.152**	0.175**	0.145*
	(0.084)	(0.069)	(0.072)	(0.071)	(0.075)
ln (Domestic Patent Rights)	0.459**	0.351	0.351	0.364	0.353
	(0.214)	(0.248)	(0.254)	(0.309)	(0.313)
ln (Foreign Patent Rights in Group I)	1.612***	1.092**	0.932**	1.206***	0.985**
	(0.352)	(0.450)	(0.463)	(0.448)	(0.462)
ln (Foreign Patent Rights in Group II)	-0.079	-0.358***	-0.338**	-0.374**	-0.333**
	(0.109)	(0.138)	(0.139)	(0.152)	(0.151)
ln (Foreign Patent Rights in Group III)	0.107	0.145*	0.156*	0.130*	0.148*
	(0.089)	(0.081)	(0.084)	(0.080)	(0.083)
ln (Patenting Costs)	-0.072*	-0.072	-0.082	-0.104	-0.118
	(0.044)	(0.064)	(0.069)	(0.073)	(0.081)
ln (Real GDP per worker)			0.533		0.693
			(0.484)		(0.511)
Year Effects	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.683				
AB-test (p-value)		0.676	0.582	0.882	0.965
SH-test (p-value)		0.137	0.131	0.094	0.092
No. of Observations	1087	898	898	858	858

Notes:
In column 1, estimation is by panel fixed effects regression; in columns 2 – 5, estimation is by two-step system generalized method of moments (GMM). ***, **, and * denote significance levels of 1%, 5%, and 10% respectively. Robust standard errors are in parentheses. The sample consists of the first filings of 23 developed countries in all International Patent Classes (IPC) over the period 1980 – 2005 (every five years). Group I refers to other developed countries, Group II to upper-income developing countries, and Group III to lower-income developing countries. AB-test refers to the Arellano-Bond Test of 2nd order autocorrelation in the first-differenced residuals and SH-test the Sargan-Hansen test of over-identification.

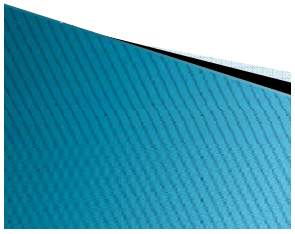


Table 7. Estimates of the Patent Priority Equation: Trilateral Filings

	Dependent Variable: ln (Trilateral Filings)				
	Full Sample (1)	Full Sample (2)	Full Sample (3)	Non-U.S. (4)	Non-U.S (5)
Constant	-1.830	-6.947*	-6.893	-7.389*	-3.547
	(1.861)	(3.885)	(15.38)	(4.431)	(14.72)
ln (Priority Filings) $_{-1}$		0.603***	0.599***	0.556***	0.539***
		(0.180)	(0.187)	(0.181)	(0.187)
ln (Priority Filings) $_{-2}$		0.233*	0.232*	0.210*	0.207*
		(0.127)	(0.128)	(0.128)	(0.128)
ln (Private R&D)	0.336*	-0.242	-0.218	-0.099	-0.024
	(0.187)	(0.405)	(0.496)	(0.400)	(0.487)
ln (Public R&D)	0.255*	0.504	0.499	0.495	0.495
	(0.131)	(0.335)	(0.326)	(0.351)	(0.345)
ln (Domestic Patent Rights)	-0.200	1.124	1.097	1.249	1.183
	(0.480)	(1.028)	(1.066)	(1.076)	(1.101)
ln (Foreign Patent Rights in Group I)	1.068*	2.657***	2.655***	2.843***	2.823***
	(0.643)	(1.049)	(1.046)	(1.088)	(1.076)
ln (Foreign Patent Rights in Group II)	-0.030	-0.200	-0.203	-0.314	-0.310
	(0.182)	(0.296)	(0.294)	(0.316)	(0.312)
ln (Foreign Patent Rights in Group III)	0.230	-0.005	-0.009	-0.015	-0.022
	(0.120)	(0.297)	(0.286)	(0.268)	(0.258)
ln (Patenting Costs)	-0.022	0.206	0.205	0.071	0.050
	(0.091)	(0.205)	(0.223)	(0.253)	(0.261)
ln (Real GDP per worker)			-0.016		-0.383
			(1.475)		(1.416)
Year Effects	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.248				
AB-test (p-value)		0.083	0.083	0.077	0.075
SH-test (p-value)		0.086	0.090	0.149	0.166
No. of Observations	759	433	433	401	401

Notes:
In column 1, estimation is by panel fixed effects regression; in columns 2 – 5, estimation is by two-step system generalized method of moments (GMM). ***, **, and * denote significance levels of 1%, 5%, and 10% respectively. Robust standard errors are in parentheses. The sample consists of the trilateral filings of 23 developed countries in all International Patent Classes (IPC) over the period 1980 – 2005 (every five years). Group I refers to other developed countries, Group II to upper-income developing countries, and Group III to lower-income developing countries. AB-test refers to the Arellano-Bond Test of 2nd order autocorrelation in the first-differenced residuals and SH-test the Sargan-Hansen test of over-identification.

Table 8. Estimates of the Research and Development (R&D) Equation – Full Sample

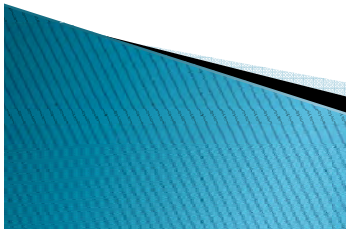
	Dependent Variable: ln (Firm R&D)		
	(1)	(2)	(3)
Constant	-8.588	-10.16	-24.65*
	(5.877)	(8.296)	(13.06)
ln (Firm R&D)$_{-1}$		0.056***	0.054***
		(0.014)	(0.013)
ln (Firm Sales)	0.367***	0.444***	0.444***
	(0.079)	(0.057)	(0.057)
ln (Firm R&D Employees)	0.513***	0.418***	0.418***
	(0.033)	(0.036)	(0.036)
ln (1 + Firm Income Tax Rate)	-0.030*	-0.013	-0.013
	(0.019)	(0.008)	(0.008)
ln (Domestic Patent Rights)	0.626*	-0.493	-0.319
	(0.368)	(0.562)	(0.570)
ln (Foreign Patent Rights in Group I)	0.794*	1.467***	1.542***
	(0.447)	(0.561)	(0.552)
ln (Foreign Patent Rights in Group II)	-0.059	0.071	0.017
	(0.127)	(0.200)	(0.197)
ln (Foreign Patent Rights in Group III)	-0.007	0.370*	0.377*
	(0.118)	(0.199)	(0.199)
ln (Public R&D)	0.262	0.332	0.212
	(0.191)	(0.265)	(0.266)
ln (Real GDP per worker)			1.649
			(1.063)
Year Effects	Yes	Yes	Yes
Within R-squared	0.400		
AB-test (p-value)		0.991	0.974
SH-test (p-value)		0.077	0.063
Number of Observations	6253	4117	4117

Notes:
In column 1, estimation is by panel fixed effects regression; in columns 2 – 3, estimation is by two-step system generalized method of moments (GMM). ***, **, and * denote significance levels of 1%, 5%, and 10% respectively. Robust standard errors are in parentheses. The sample consists of U.S. parent firms and their foreign affiliates in 23 developed countries over the period 1982, 1989, 1994, 1999, and 2004 (i.e. BEA survey benchmark years). Group I refers to other developed countries, Group II to upper-income developing countries, and Group III to lower-income developing countries. AB-test refers to the Arellano-Bond Test of 2nd order autocorrelation in the first-differenced residuals and SH-test the Sargan-Hansen test of over-identification.

Table 9. Estimates of the Research and Development (R&D) Equation – Foreign Affiliates Sample

	Dependent Variable: ln (Firm R&D)				
	(1)	(2)	(3)	(4)	(5)
Constant	-11.33*	-12.11	-25.01**	-12.81	-27.97**
	(6.069)	(8.339)	(12.83)	(8.968)	(13.25)
ln (Firm R&D)$_{-1}$		0.042***	0.040***	0.042***	0.039***
		(0.012)	(0.012)	(0.013)	(0.013)
ln (Firm Sales)	0.319***	0.361***	0.364***	0.323***	0.323***
	(0.106)	(0.085)	(0.085)	(0.084)	(0.085)
ln (Firm R&D Employees)	0.566***	0.532***	0.531***	0.512***	0.510***
	(0.047)	(0.055)	(0.055)	(0.060)	(0.060)
ln (1 + Firm Income Tax Rate)	-0.017	-0.039***	-0.040***	-0.041***	-0.042***
	(0.012)	(0.015)	(0.015)	(0.015)	(0.015)
ln (Domestic Patent Rights)	0.377	-0.903	-0.891	-1.005	-0.998
	(0.416)	(0.701)	(0.697)	(0.719)	(0.739)
ln (Foreign Patent Rights in Group I)	1.012***	0.972*	1.088**	0.947*	1.085*
	(0.499)	(0.562)	(0.561)	(0.583)	(0.589)
ln (Foreign Patent Rights in Group II)	0.025	-0.069	-0.135	-0.151	-0.238
	(0.135)	(0.221)	(0.218)	(0.227)	(0.226)
ln (Foreign Patent Rights in Group III)	0.053	0.152	0.187	0.208	0.253
	(0.149)	(0.207)	(0.212)	(0.219)	(0.228)
ln (Public R&D)	0.374*	0.461*	0.339	0.461*	0.306
	(0.208)	(0.271)	(0.275)	(0.285)	(0.298)
ln (Parent R&D)				0.099*	0.102*
				(0.061)	(0.061)
ln (Real GDP per worker)			1.554		1.866*
			(1.058)		(1.091)
Year Effects	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.410				
AB-test (p-value)		0.840	0.880	0.984	0.939
SH-test (p-value)		0.711	0.627	0.640	0.534
No. of Observations	3843	2414	2414	2296	2296

Notes: In column 1, estimation is by panel fixed effects regression; in columns 2 – 5, estimation is by two-step GMM. ***, **, and * denote significance levels of 1%, 5%, and 10% respectively. Robust standard errors are in parentheses. The sample consists of foreign affiliates of U.S. multinational corporations in 22 developed countries over the period 1982, 1989, 1994, 1999, and 2004. Group I refers to other developed countries, Group II to upper-income developing countries, and Group III to lower-income developing countries. AB-test refers to the Arellano-Bond Test of 2nd order autocorrelation in the first-differenced residuals and SH-test the Sargan-Hansen test of over-identification.



E. Summary

- Southern IPR reforms affected Northern innovation insignificantly – quantitatively & qualitatively. Northern innovation largely influenced by Northern IPRs.

- Implications for theory: need to model asymmetric market sizes

- Implications for policy: Southern IPR hasn't adversely affected North R&D, but specific Southern needs (e.g. treatments for tropical diseases) not addressed by Southern IPR policy

- Extensions: By sector, Alternative IPRs, and Innovation Policies (e.g. subsidies, joint research ventures)