Intellectual Property Rights Adoption in Developing Countries

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IPR debates

- With the integration of the world economy IPR debates have become global.
- Amongst policy makers, a consensus emerged that "Western style" IPR legislation should be extended to every other country in the world.
- TRIPS hence imposes a common framework for IPR.

Arguments in favor of universal IPR

- The proponents of global IPR argue that without them innovations would stop in certain industries.
- The industries that spend heavily on R&D (i.e., more than 5% of their sales revenue) are pharmaceutical, computers, and communication equipments.

Arguments against universal IPR

- The main critic against IPR is that they increase the cost of patented commodities which reduces welfare.
- This problem is exacerbated in developing countries because they are net importers of technology.
- Innovative activities are indeed concentrated in a handful of developed countries with top ten countries accounting for 84% of global R&D activity.
- The detractors of universal IPR argue that they do not stimulate research to benefit the poor because they are not able to afford the high priced products if they are developed.

The paper goal

We aim to explore analytically the relevance of pursuing universal IPR.

Literature

- Grossman and Lai (2004), Lai and Qiu (2003) $\Rightarrow$ Nord-Sud models, equilibrium patent protection too low in the South, theoretical foundation of TRIPS.
- Grossman and Edwin (2008), Rey (2003), Malueg and Schwartz (1994), Valletti (2006), Li and Maskus (2006) $\Rightarrow$ parallel trade.
- Aghion, Harris, Howitt, and Vickers (2001) $\Rightarrow$ imitation may also stimulate innovation increasing neck-and-neck competition.
- Anton and Yao (2004), Encaoua and Lefouili (Forthcoming) $\Rightarrow$ incentive to patent small vs large innovations.

The paper framework

- The paper studies the impact of different IPR regimes on the investment decisions make by private firms in a two (heterogeneous) countries model.
- Countries differ in population size *and* per-capita income, which are both relevant demand characteristics.
- There is a firm producing a vertically differentiated commodity in each country.
- Innovation increases the quality of the commodity (e.g., a new generation of mobile phone, a new drug).

- The innovation cost depends on the efficiency of the *R&D* process, which by convention is higher in country 1 (i.e., the advanced economy).
- Imitation is costless but yields a potential indirect cost: a firm that violates IPR cannot export in a country that enforces them.
- There are thus benefits for a country which enforces IPR to compete with a country that does not enforce them: it can freely copy its competitor innovation, if any, while IPR act like a barrier to entry of its market.

- In a closed economy, each firm is in a monopoly position. Let p_i be the price in country i. Demand is given by:

$$p_i = a_i(v_i - b_i q_i)$$

where v_i is the quality and q_i the quantity of good i, a_i increases with the per-capita income and b_i is the *inverse* of the population size of country i.

- The intensity of the demand in country i:

$$\alpha_i = \frac{a_i}{b_i}.$$

- There is no clear relationship between α_i and development.

- When the market is integrated, there is a duopoly in each country. Demand for good i in country j then writes:

$$p_{ij} = a_j(v_i - b_j(q_{1j} + q_{2j})) \qquad i, j \in \{1, 2\}$$

  where q_{ij} is the quantity of good i sold in country j.
- We focus on the cost of R&D. The marginal cost of productions are normalized to zero for both firms.
- The common level of quality before investment is normalized to 1.

- Innovation increases the quality of the commodity by ϕ_i: $v_i^I = 1 + \phi_i$. The cost of the R&D investment is

$$C_i(\phi_i) = k_i \frac{\phi_i^2}{2}$$

where k_i is an inverse measure of the efficiency of the $R\&D$ process in country $i = 1, 2$.

Assumption

$$k_2 > k_1 > \frac{16}{9}\left(\alpha_2 + \alpha_1\right)$$

Open economy

- In the common market the timing is as follows:
  1. In the first stage, firms invest in $R\&D$ and the quality of the goods is determined.
  2. In the second stage, they compete in quantities.
- We assume that imitation is costless.

The level of protection of the innovation activity influences investment. We distinguish among three possible regimes:

1. Full patent protection (F): both countries protect patents and the quality after investment of the good produced by firm i is $v_i^F = 1 + \phi_i$.
2. No protection (N): countries do not protect patents and the quality after investment of the good produced by firm i is $v_i^N = 1 + \phi_i + \phi_j$.
3. Partial protection (P): only country 1 protects innovation. Firm 2 free-rides on the innovation of firm 1 so that it cannot export in 1. Moreover it cannot prevents firm 1 to use its own innovation if any. We have $v_i^P = 1 + \phi_i + \phi_j$.

Extensions:

1. Partial enforcement in Country 1 (allowing for illegal imports) $\longrightarrow$ all results are in between regime (P) and (N), i.e. for given level of parameters, innovation, welfare and profits with partial enforcement are convex combinations of the ones under (P) and (N).
2. Partial imitation, i.e. $v_i = 1 + \phi_i + g\phi_j$, $0 \leq g \leq 1$. Does not change the qualitative results.
3. Non cumulative innovation, i.e. $v_i^P = v_i^N = 1 + \max\{\phi_i, \phi_j\}$.

The duopoly

- If there is a duopoly, at the second stage, the quantity produced by firm i in country j is the Cournot quantity:

$$q_{ij}^D = \frac{2v_i^I - v_{-i}^I}{3b_j}, \qquad i, -i, j \in \{1, 2\}, i \neq -i$$

Where the index $-i$ represents the competitor and the value of v_i^I depends on the IPR regime, i.e. $v_i^I \in \{v_i^F, v_i^N, v_i^P\}$.

The socially optimal level of investment

- Welfare of country j:

$$W_j^D = S_j^D + \Pi_j^D$$

where:

$$S_j^D = a_j(v_1 q_{1j} + v_2 q_{2j}) - a_j b_j \frac{(q_{1j} + q_{2j})^2}{2} - p_{1j} q_{1j} - p_{2j} q_{2j}$$

and

$$\Pi_j^D = p_{j1} q_{j1} + p_{j2} q_{j2} - k_j \frac{\phi_j^2}{2}$$

- The optimal investment chosen by a centralized authority maximizes total welfare taking into account the firms market power (i.e., property right).
- The supranational social planner always chooses full disclosure of innovation (i.e. the no protection regime N).
- The socially optimal level of innovation in country i is thus obtained maximizing total welfare, $W = W_1^D + W_2^D$, with respect to ϕ_1 and ϕ_2 so that

$$\phi^* = \frac{\alpha_1 + \alpha_2}{\frac{9}{8}\frac{k_1 k_2}{k_1 + k_2} - (\alpha_1 + \alpha_2)}.$$

Full IPR protection (F regime)

- With full IPR protection $\phi_i^F = \phi_i$.
- At the second stage quantities are given by the Cournot levels. Profit maximization gives the reaction functions:

$$\phi_i(\phi_j) = \frac{(\alpha_1 + \alpha_2)(1 - \phi_j)}{2.25k_i - 2(\alpha_1 + \alpha_2)}$$

- Quality levels and thus investment levels are strategic substitutes.
- The firm $i = 1, 2$ investment level under F:

$$\phi_i^F = \frac{1}{2} \frac{(\alpha_1 + \alpha_2)(1 - \frac{\alpha_1 + \alpha_2}{3k_j})}{\frac{9}{8}\frac{k_1 k_2}{k_1 + k_2} - (\alpha_1 + \alpha_2)(1 - \frac{\alpha_1 + \alpha_2}{3\frac{k_1 + k_2}{2}})} \frac{k_j}{k_1 + k_2}$$

No IPR protection (N regime)

- When IPR are not protected $\phi^N = \phi_1^N + \phi_2^N$.
- The firm i reaction functions:

$$\phi_i(\phi_j) = \frac{(\alpha_1 + \alpha_2)(1 + \phi_j)}{4.5k_i - (\alpha_1 + \alpha_2)}$$

- Quality levels and thus investment are strategic complements.
- In equilibrium we have:

$$\phi^N = \phi_1^N + \phi_2^N = \frac{\alpha_1 + \alpha_2}{4.5\frac{k_1 k_2}{k_1 + k_2} - (\alpha_1 + \alpha_2)}.$$

IPR protection only in one country (P regime)

- When only country 1 protects IPR $\phi^P = \phi_1^P + \phi_2^P$.
- Moreover firm 1 is a monopoly in country 1 and compete with 2 à la Cournot in country 2.
- The reaction functions:

$$\phi_1(\phi_2) = \frac{(1+\phi_j)(2.25\alpha_1+\alpha_2)}{4.5k_1-(2.25\alpha_1+\alpha_2)} \quad (1)$$

$$\phi_2(\phi_1) = \frac{(1+\phi_1)\alpha_2}{4.5k_2-\alpha_2} \quad (2)$$

- Investments are strategic complements.
- The total level of investment under the partial regime is :

$$\phi^P = \phi_1^P + \phi_2^P = \frac{(\alpha_1 \frac{2.25k_2}{k_1+k_2} + \alpha_2)}{4.5\frac{k_1k_2}{k_1+k_2} - (\alpha_1 \frac{2.25k_2}{k_1+k_2} + \alpha_2)}$$

Comparison of Investment levels

Under assumption 1 we have:

$$\phi^* > \phi^P > \phi^N$$

What about full protection (F) wrt partial (P)?

$\Rightarrow$ It depends

Only the Rich do R&D ($k_2 \to \infty$)

- In the limit case in which the less developed country does not contribute to innovation, firm 2 only free-rides under (P) and (N).
- Under Assumption 1 we have:

$$\phi^N \leq \phi^P \leq \phi^F \leq \phi^*$$

Emerging Countries with Efficient R&D ($k_2 \longrightarrow k_1$)

- Countries like China and India have developed a world class R&D capacity in many areas including space, nuclear energy, computing, biotechnology, pharmaceutical, software development and aviation.
- Assume k_2 is sufficiently close to k_1. Under assumption 1 we have:

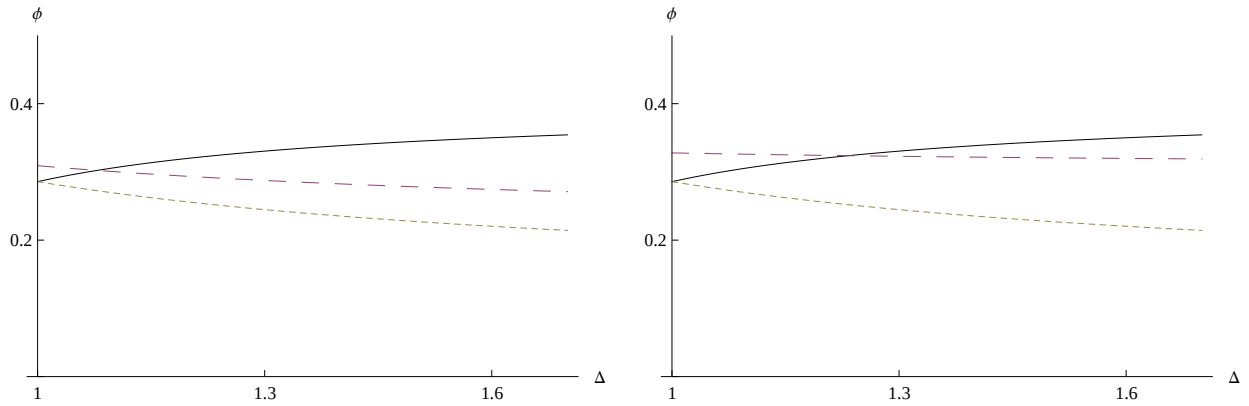
$$\phi^N < \phi^F < \phi^P < \phi^*$$

General case with k_1 fixed $(k_1 = 2(\alpha_2 + \alpha_1) < k_2)$

The results depend on :

- The relative size of demand $\gamma = \frac{\alpha_2}{\alpha_1}$
- The relative efficiency of R&D $\Delta = \frac{k_2}{k_1}$

General case



(a) $k_1 = 2(\alpha_1 + \alpha_2)$, $\alpha_1 = \alpha_2 = 1$ (b) $k_1 = 2(\alpha_1 + \alpha_2)$, $\alpha_1 = 1$, $\alpha_2 = 1/8$

Figure 1: Innovation levels, ϕ^F is in solid line, ϕ^N in dotted, ϕ^P in dashed.

Endogenous IPR regimes

- IPR regimes are chosen by governments based on domestic criteria.
- Assuming country 1 (the advanced economy) has a strong IPR regime, will country 2 have an incentive to adopt strong IPR regime?
- Country 2, which can choose between (F) or (P), targets the highest national welfare.

Welfare in country 2

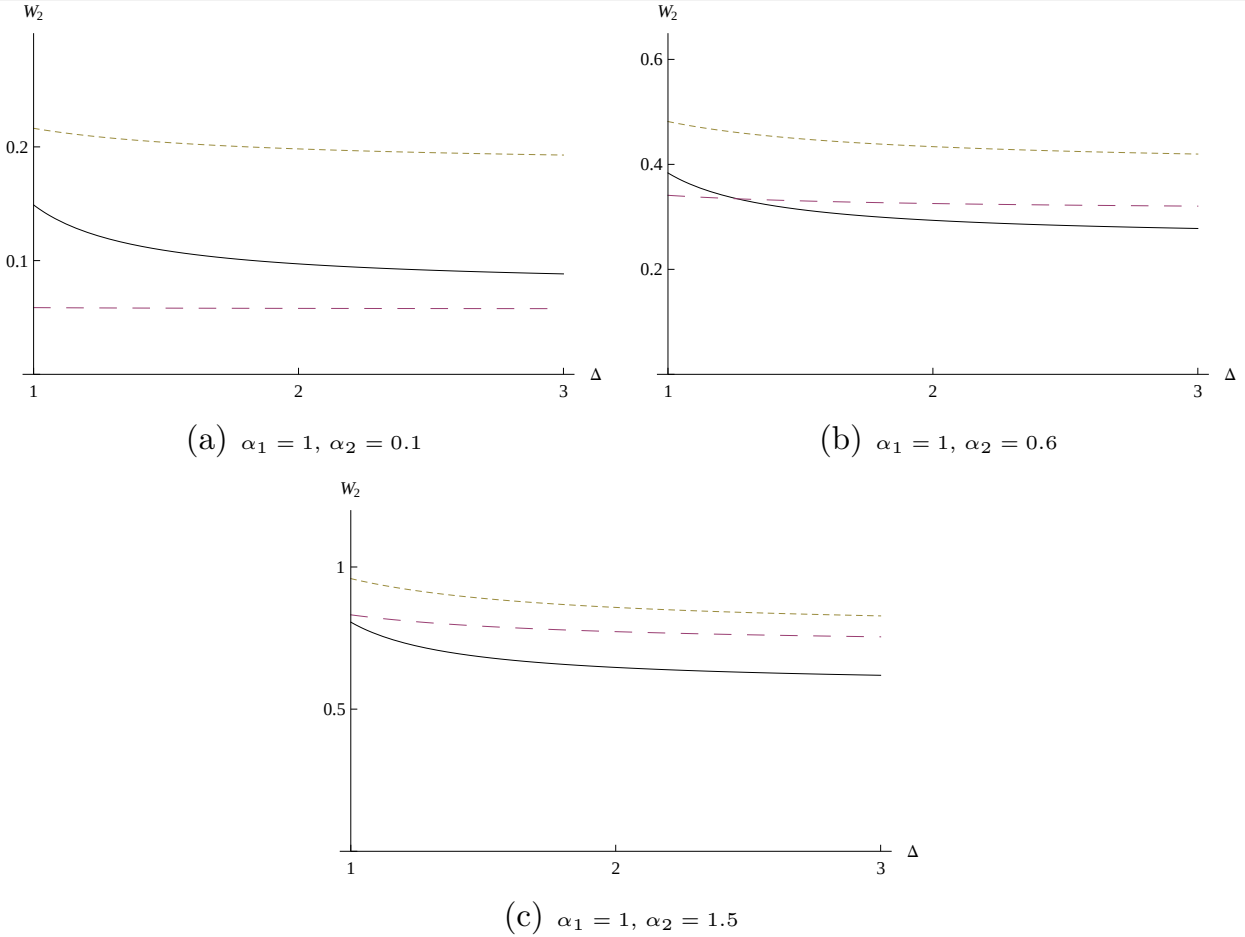
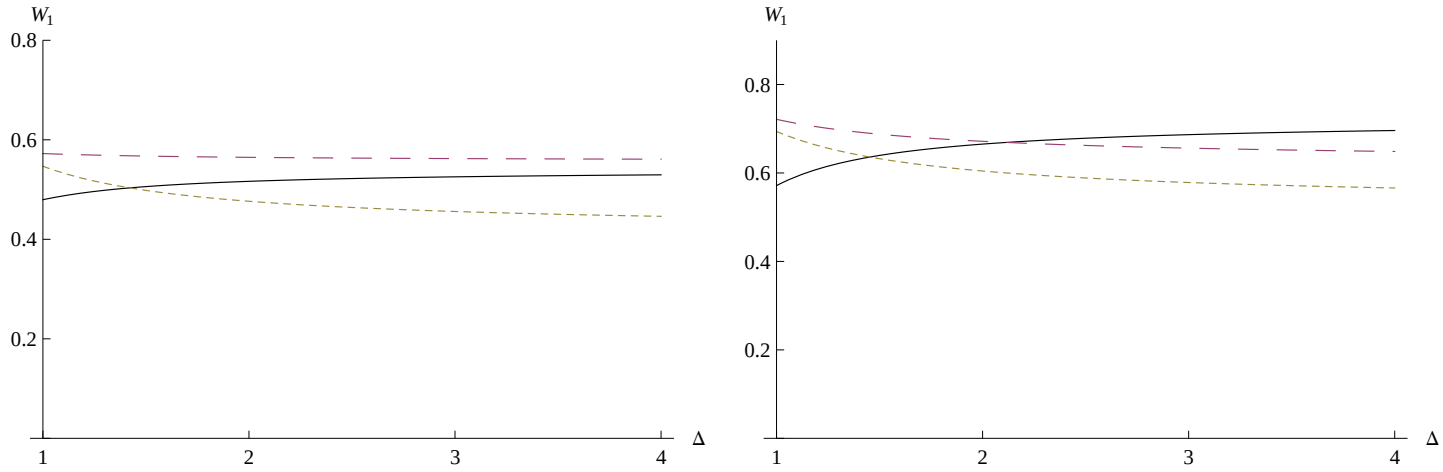


Figure 2: Welfare of country 2 under regime (F) (in solid line), (P) (in dashed line) and (N) (in dotted line).

Welfare in country 1



(a) $\alpha_1 = 1, \alpha_2 = 0.1$ (b) $\alpha_1 = 1, \alpha_2 = 1$

Figure 3: Welfare of Country 1, W_1. Regime (F) in solid line, (P) in dashed line and (N) in dotted line.

Global welfare

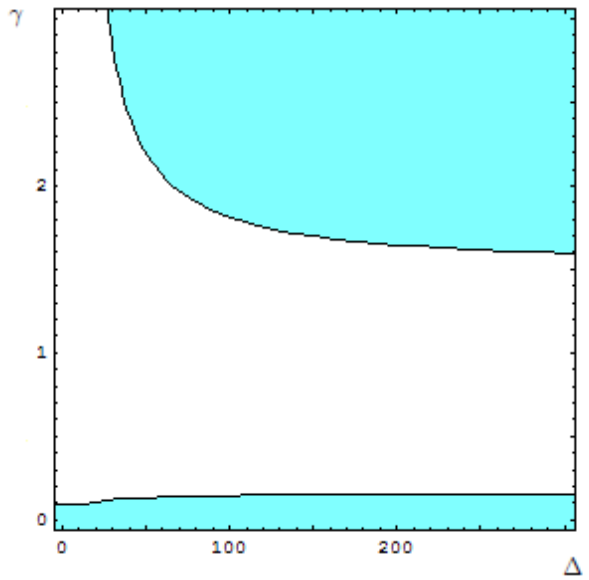


Figure 6: Welfare difference: $(W_1^F + W_2^F) - (W_1^P + W_2^P)$. In the colored region $(W_1^F + W_2^F) - (W_1^P + W_2^P) > 0$.

Conclusion

- When large developing countries do not have a R&D system, the global level of investment in R&D and of welfare tend to be higher under universal IPR regime.
- However with the emergence of new players in the R&D world system, such as China and India, the results are reversed: investment levels in R&D and welfare tend to be higher under a partial IPR.
- Looking at consumer surplus, regime (P) favors consumers in country 2, increasing competition. However, it harms consumers in country 1. Regime (N) harms all consumers (too low innovation).

Conclusion

- This paper has studied in a two countries model the incentives developing countries might have to enforce IPR.
- It also studied the impact of their adoption choice on global innovation and welfare.
- The analysis illuminates that one size does not fit all.
- The results depend both on the maturity of the R&D system and on the size of the developing country internal market.

Empirical analysis

- The testable implications of the model are consistent with the existing empirical literature. But our model is richer than the ones usually tested...
- We reveal the role of the size of demand (related to development and size) and the one of technological progress (R&D efficiency).
- For testing these predictions, we are developing our analysis to bring the model to the data $\rightarrow$ work in progress with Rodrigo Paillacar, Université de Cergy-Pontoise.