

IPR and Outsourcing: The Case of Indian Pharmaceutical Industry

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Abstract:

This paper presents a dynamic North-South trade model with outsourcing, innovation and imitation. In 1995, the TRIP's negotiations ended with the agreement in which India was required to strengthen protection of intellectual property. The effects of this requirement are modeled as a decrease in both the rate of imitation and the risk (cost of protecting the product) associated with outsourcing. The steady state comparative analysis yields opposite results regarding outsourcing, for these two effects. Empirical evidence suggests that the decrease in the rate of imitation (outsourcing increases) offsets the decrease in the cost associated with outsourcing (outsourcing decreases).

1. Introduction

Outsourcing is an important world trade issue in recent years. Loss of jobs, wage changes and lower prices are issues that concern not only the economists but also the general public.

Outsourcing can have many definitions. Firms can choose to import components for the final good, they can ship the components outside to be assembled or they can choose to shift the entire production (and some times services as well) outside.

Feenstra (1996 & 1998) is one of the first economists to analyze the extent of this phenomenon. He also looks for reasons that would generate higher integration/disintegration of trade.

More recent studies employ the model first presented by Grossman and Helpman (1991) in order to analyze outsourcing along with innovation, imitation and intellectual property rights (IPR). These models are closely related to the one presented in this paper.

Glass and Saggi (2001) constructed a North–South product cycle model to help identify causes leading to increased outsourcing and a lower Northern relative wage. It was a response to the claims that international outsourcing of production must be detrimental to the welfare of workers in industrialized countries. The Glass and Saggi model showed that faster innovation could create gains sufficient to offset the decline in Northern wages. Imitation was not included in the model.

Glass (2004) extended the previous model by introducing costless imitation that is exogenously given. She finds that an expansion in outsourcing, together with a decline in the Northern relative wage and faster innovation, could come from a decline in imitation (like implementing the TRIPs agreement).

This paper explicitly models the costs associated with outsourcing. Firms from developed countries are reluctant in outsourcing production in countries with weak IPR. They fear that technological transfer will help firms from developing countries copy their products.

In 1995, the TRIPs (Trade Related aspects of Intellectual Property Rights) ended with an agreement in which the developing countries were required to grant product patents (by 2005) for pharmaceutical innovations as a condition of membership in World Trade Organization (WTO). India was one of the countries who agreed with this requirement. Before that India was granting patents based on the production process. This allowed imitation from the domestic Indian firms of the products introduced to the market by multinational corporations (MNC). Imitation does not depend only on the strength of a country's IPR. It also depends on the imitative capacity of the developing countries/firms.

India proved to be one of the most prolific imitators, building a strong pharmaceutical industry.

When we talk about the pharmaceutical market we can distinguish between two products (given the nature of the production technology): active ingredients (bulk drugs - high capital investment) and formulations (final drug/ formulation – which is more skill intensive). The skills and equipment necessary for these 2 products are different. Firms from developing countries, in general, attempt to make generic formulations (minimal R&D expenditure) or imitate products developed by Northern firms. Only a few firms from China and India have changed the active ingredients (they also export the active ingredients to Northern countries) and innovated new products.

Indian firms used to follow three directions for R&D:

- reverse engineering of the products that will go off-patent;
- developed the existing formulations (similar but not identical);
- innovate new active drugs (a few big companies, some in cooperation with foreign companies)

The first two require less R&D effort and avoid the risk of uncertainty.

TRIPs will force local firms to restrict their generic formulations to off-patent drugs only.

What government policies were implemented in the past in order to support The Indian Pharmaceutical Industry?

- weak patent system (cannot use it after 2005);
- public sector firms (at the beginning);
- import tariffs (significantly reduced after 1990; be reduced – not so big effect on Indian firms that are already cost-competitive);
- price controls; Although it can have negative effects on quality it will encourage Indian exports with spillovers on the R&D activity.

What government policies are still available?

- price controls;
- R&D subsidies;
- Drug regulations;

So, what are the options for the Indian firms?

- export new products and soon to go off-patent products (big firms);
- some acquired manufacturing facilities in USA and become MNC themselves (big firms);
- contracting manufacturing for MNC that do not have subsidiaries in India (medium size firm);
- subcontracting from the existing subsidiaries of MNC (small firms);

2. The Model

There are two countries, North and South (India). Each has a representative consumer (identical in both countries) and many firms. The Northern firms supply n^N goods, while the Southern firms supply n^S goods ($n^N + n^S = 1$).

Consumers

They have preferences as described in the model of Grossman and Helpman (1991). Higher quality level of products gives more utility. A consumer has additively separable intertemporal preferences given by lifetime utility

$$U_t = \int_t^{\infty} e^{-\rho(\tau-t)} \log u_{\tau} d\tau, \quad (1)$$

The instantaneous utility is given by the formula:

$$\log u_{\tau} d = \int_0^1 \log \left[\sum_m q_m(i) x_{m\tau}(i) \right] di, \quad (2)$$

where $x_{m\tau}(i)$ is the consumption of quality level m in industry $I \in [0,1]$, and $q_m(i) = \lambda^m$. Consumers spread their consumption expenditure evenly across goods. The demand of each good is:

$$x^j = E/p^j \quad (3)$$

where E represents total expenditure and p^j is the lowest quality adjusted price.

Consumers maximize their utility given the budget constraint. The solution is the standard differential equation:

$$\dot{E} / E = r - \rho \quad (4)$$

where r is the market interest rate and ρ is the common subjective discount rate.

At the steady state, $r = \rho$.

If we normalize the world expenditure at each point in time to be one, the demand for each good is:

$$x^j = 1/p^j, \quad j = N, S \quad (5)$$

Producers

For simplicity, it is going to be assumed that the production process can be divided in two: the production of an intermediate good (bulk) and the production of the final good (formulation). The production of the final good will be performed in India (export imitated products and the price of original northern products is prohibitive for Indian consumers). A final product that was made by using an imitated intermediate good is an imitated final good. This will be more of a shift in production (except for R&D) than outsourcing a part of production. Glass (2004) models this partial outsourcing as a fraction of the total product that must take place in the North.

Only Northern firms can innovate. Southern firms imitate (a different type of R&D). A Northern firm can sell a newly designed good until a Southern firm imitates it.

Northern firms allocate their resources between R&D and protection of outsourced products. Southern firms use their resources for R&D, imitation and the production of outsourced goods.

The profits for a Northern firm are:

$$\pi^N = (p^N - W^S a_F) x^N - W^N C_F = (1 - a_F/\lambda) - W^N C_F \quad (6)$$

where, a_F is the labor requirement for producing in the South, C_F is the fixed cost of protecting the outsourced good.

A Southern imitator sets a price $p^N = \lambda W^S$, where $\lambda > 1$ is the quality difference between the new good and the old good.

The profits for an imitative Southern firm are:

$$\pi^S = (p^S - W^S) x^S = 1 - 1/a_F \quad (7)$$

Firms engaging in limit pricing, set $p^S = W^S a_F$. In order to have both imitative and outsourcing firms, we impose $\lambda > a_F$ (makes the innovation profitable).

The labor requirement for one unit of R&D is one unit of labor (in both countries). The probability of success in inventing a new quality equals the intensity (ι) of R&D. For the imitators (also R&D), the probability of success is μ .

The expected reward for a successful innovation should equal the expected reward for imitation:

$$v^j = w^j, \text{ for } j = N, S \quad (8)$$

The no arbitrage conditions are:

$$\pi^N / v^N + \dot{v}^N / v^N = \rho + \mu \quad (9)$$

$$\pi^S / v^S + \dot{v}^S / v^S = \rho + \iota$$

Using the fact that in steady state the following must hold true

$$\dot{v}^j / v^j = 0, j = N, S$$

we can re-write the arbitrage conditions:

$$(1 - a_F/\lambda) / W^N - C_F = \rho + \mu \quad (10)$$

$$(1 - 1/a_F) / W^S - C_F = \rho + \iota$$

The resource market

Northern firms allocate their resources between R&D and protection of outsourced products.

$$n^S + n^N C_F = L^N \quad (11)$$

Southern firms use their resources for R&D, imitation and the production of outsourced goods.

$$\mu n^N + n^S / W^S a_F + n^N a_F / \lambda W^S = L^S \quad (12)$$

Industry flows

$$u^S = \mu n^N \equiv f, \quad (13)$$

The inflows should equal outflows.

3. Steady state analysis

At the steady state equilibrium v^j , w^j , ι , μ , the fraction of each type of firms and the wage in both regions is constant.

From (11) and (13):

$$f = L^N - C_F n^N \quad (14)$$

From (10), (12), (13) and $n^N + n^S = 1$:

$$f = \frac{1 - n^N}{1 - (1 - a_F/\lambda)n^N} [(1 - 1/a_F)L^S - \rho(\frac{1 - n^N}{a_F} + \frac{a_F n^N}{\lambda})] \quad (15)$$

In order to have a steady state, the following must hold:

$$(1 - 1/a_F)L^S > L^N + \rho/a_F$$

This conditions can be satisfied if the Indian labor supply (L^S) is big enough.

For this analysis, only the case of a unique steady state was considered.

An increased IPR protection decrease the rate of imitation and the risk (cost of protecting the product) associated with outsourcing.

A decrease in the rate of imitation can be considered a tax on imitation. Southern resources will be allocated towards outsourcing, reducing the Southern relative wage, and in the end increasing outsourcing.

The fall in the cost of protecting the product will increase the expected reward for innovation, which increases the amount of Northern labor engaged in R&D, increases innovation and imitation, and in the end reducing outsourcing.

The resource allocation equation for the South can be written as:

$$f + \frac{1}{w^S} (\frac{1 - n^N}{a_F} + \frac{a_F n^N}{\lambda}) = L^S \quad (16)$$

A decrease in f due to lower protection costs will reduce the production in South. From the no- arbitraj condition and flow equality we have the following condition:

$$\frac{1}{w^S} = \frac{\rho + \iota}{1 - a_F/\lambda} + \frac{a_F n^N}{\lambda} = \frac{1}{1 - 1/a_F} (\rho + \frac{f}{1 - n^N}) \quad (17)$$

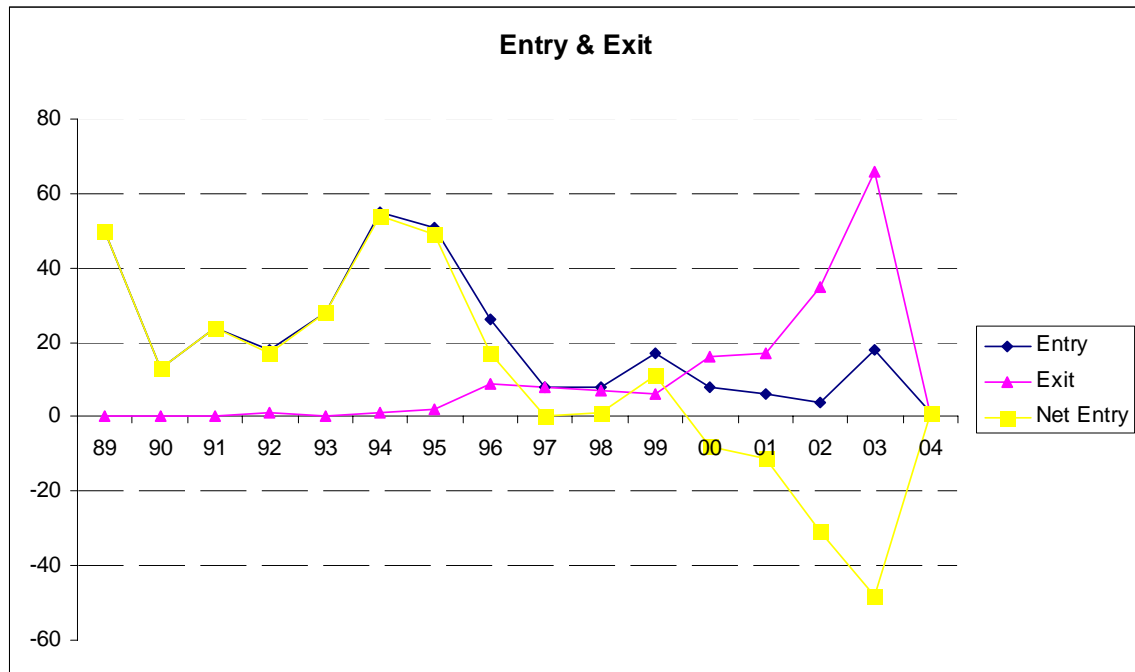
If the labor supply in south doesn't change, n^N must declines f grows.

4. Data and empirical findings

The data set used in the paper is from the Center for monitoring Indian economy (CMIE) database. The firm level data constitute an unbalanced panel covering period 1989-2004. The sample consists of 340 firms.

The dataset provides information like: company information (name, products, ownership,...), income and expenditure statement, liabilities and assets.

The year 1995 (when India joined the WTO) had a big impact on the net entry in the pharmaceutical industry.



It is interesting to see how different are the new (after 1995) entering firms (relative to the existing firms), from the firms entering the industry at the beginning of the dataset. In this respect I employ a difference in difference estimator, as follows:

- construct two dummy variables:

Event = 1 if the observation is after 1995
0 otherwise

New_entry = 1 if the firm is a new entrant (1990, 91, 92 and 1996, 97,98)
0 otherwise

- and a third variable for the interaction between them:

En = Event*New_entry

Last step is to regress the variable of interest: $var = \omega + \alpha Event + \beta New_entry + \gamma En$

The t-statistic for γ will tell whether or not there is significant difference between the entering firms after 1995 and the entering firms after 1989 (relative to the existing firms).

	New entry	Existing firms
Before (1995)	X_0	Y_0
After (1995)	X_1	Y_1

The difference in difference estimator will be $(X_1 - X_0) - (Y_1 - Y_0)$.

42 firms are in the treatment group (enter the market after 1995)
55 firms are in the control group.

The results are:

variable	t	Std. err.
Royalty expenses	1.14	.0616
Advertising expenses	- 0.37	.804
Intangible assets	- 2.28	1.086**
# employees	-2.93	92.554**
Secured borrowings/ borrowings	2.57	.0658*
R&D/sale	-0.35	.00888
Assets/ # employees	1.32	.1354
Operating profit	0.47	.9616

* significant at 10% level

** significant at 5% level

It is possible to observe entrance of small and medium firms, that are working for multinationals (or big national firms), who don't spend money on advertising and they do not have their own innovations but they have more technology and more efficient.

5. Conclusions

The model presents outsourcing as a Southern export of cheap labor and Northern export of know-how. An increased IPR protection decrease the rate of imitation and the risk (cost of protecting the product) associated with outsourcing. The Indian data shows an increase in outsourcing, which may be caused by a decrease in the rate of imitation.

6. Current work directions

Model:

- explicitly model the decisions of entry and exit of firms in the market (in a relatively similar framework);
- check if the results of the model change, when an outsourcing specification similar with the one introduced by Glass (2004) is used;
- consider the possibility of innovating new products due to stronger IPR protection, like Glass and Wu (2003);
- making the difference between skilled labor and unskilled labor, in order to check the Heckscher-Ohlin model (although the dataset does not have the wages reported separately) ;

Data:

- a more rigorous check of the treatment group and control group (see how similar characteristics they have).
- Based on a theoretical model of entry and exit, form a probit regression to analyze entry/exit decisions.

References

- Feenstra, R.C., Hanson, G.H., (1996) "Globalization, outsourcing, and wage inequality", *American Economic Review* 86, 240 - 245.
- Feenstra, R.C. (1998) "Integration of trade and Disintegration of Production", *Journal of Economic Perspectives* 12/4, 31-50
- Grossman, G. and Helpman, E (1991) "Quality Ladders and Product Cycles", *Quarterly Journal of Economics*, 106, 557-586
- Glass, A. J and Saggi, K (2001) "Innovation and Wage Effects of International Outsourcing" *European Economic Review* 45, 67-86
- Glass, A J (2004) "Outsourcing under Imperfect Protection of Intellectual Property" *Review of International Economics* 12(5), 867-884
- Glass, A J and Wu, X. (2003) "Intellectual property rights and quality improvement"