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Intellectual property rights, technology transfer and exports in developing countries[☆]

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ABSTRACT

We develop a model to analyze one mechanism under which stronger intellectual property rights (IPR) protection may improve the ability of firms in developing countries to break into export markets. A Northern firm with a superior process technology chooses either exports or technology transfer through licensing as its mode of supplying the Southern market, based on local IPR policy. Given this decision, the North and South firms engage in Cournot competition in both markets. We find that stronger IPR would enhance technology transfer through licensing and reduce the South firm's marginal production cost, thereby increasing its exports. Welfare in the South would rise (fall) if that country has high (low) absorptive capacity. Excessively strong IPR diminish competition and welfare, however. Adding foreign direct investment as an additional channel of technology transfer sustains these basic messages.

1. Introduction

Since 1995 many developing countries have reformed their laws governing intellectual property rights (IPR). Reforms in IPR are commonly presumed by trade economists to raise imitation costs, reduce access to global information and place firms in developing countries at a competitive disadvantage in global markets (Helpman, 1993; Lai and Qiu, 2004). However, one essential purpose of IPR is to reduce the costs of technology transfer (Maskus, 2004). Indeed, empirical evidence supports the view that multinational firms expand technology flows through greater foreign direct investment (FDI) and licensing as local patent rights are improved (Smith, 2001; Branstetter et al., 2005).

By expanding access to international technologies, strengthened IPR could improve the export performance of recipient firms, a possibility that has been little studied to date. In this paper we provide a model of contracting and technology transfer that illuminates one such mechanism. Specifically, we analyze a model of two-country competition between a Northern firm and an unaffiliated Southern firm, where the former may choose to provide cost-reducing technical information to the latter through licensing or FDI. We find conditions under which greater transfers are made in equilibrium under stronger patents and the consequent effect on exports of the Southern firm. Welfare in the Southern country increases if its firm has high absorptive ability, but could fall if it has a weak capacity to implement new technology.

In contrast to our strategic approach, the theoretical literature generally has set out general-equilibrium, North–South product-cycle models among atomistic firms competing dynamically. Helpman (1993) and Glass and Saggi (1999) assumed stronger IPR would raise imitation costs, tending to diminish technology flows and global innovation. Lai (1998) noted that innovation could be enhanced if FDI is the form of technology transfer. Yang and Maskus (2001) found that patent reforms would both raise imitation costs and reduce the costs of technology licensing, with the latter encouraging greater information transfer and innovation in equilibrium.

These insights are valuable. However, to make these dynamic models tractable the authors forego analysis of strategic interactions among firms. The primary advantage of our approach is to permit detailed analysis of the microeconomic tradeoffs involved in contracting in response to IPR changes. Our bargaining framework explicitly considers strategic choices among imitation, licensing, and FDI at various ranges of patent strength, generating a rich menu of

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tradeoffs and welfare calculations that cannot readily be analyzed in the more general context. Of course, the partial-equilibrium Cournot context within which we operate also makes strong assumptions for tractability.[1] Thus, we comment later on how the results would vary with alternative assumptions.

Empirical evidence in several developing countries suggests that investing in technology is important for entering export markets (Hasan and Raturi, 2001). Key sources of such investment are imports of technology and linkages to multinational firms (Kumar and Siddharthan, 1993). However, this literature has paid little attention to the combination of IPR, technology transfer and trade in order to establish a linkage between IPR and exports. A recent exception is Branstetter et al. (2007), whose empirical analysis found an increase in export intensity of local affiliates of multinational firms after IPR policy changes. Again, none of these papers considered the detailed mechanisms under which IPR reforms could expand technology transfer and exports.

As empirical motivation for our framework, within which patent reforms may encourage more technology transfer through unaffiliated licensing, with a subsequent boost to exports, consider two recent histories from East Asia. South Korea engineered a major strengthening of its patent laws from 1988 to 1995 (La Croix and Kawaura, 1996), increasing its measured patent index by 47%, from 2.65 to 3.89, between 1985 and 1995.[2] Taiwan (Chinese Taipei) made substantial reforms in 1986 and 1994 (Diallo, 2003), raising its index by 152%, from 1.26 to 3.17, over the same period. South Korea's licensing payments to unaffiliated U.S. firms rose from \$38 million in 1987 to \$717 million in 1995, reaching \$1.686 billion in 2005. Taiwan's licensing payments to unaffiliated U.S. firms rose from \$17 million in 1986 to \$267 million in 1996, reaching \$1.165 billion in 2006. Finally, South Korea's merchandise exports rose from \$28.5 billion in 1985 to \$99.5 billion in 1995, reaching \$284.4 billion in 2005. Taiwan's exports similarly rose from \$33.4 billion in 1985 to \$128.4 billion in 1995, reaching \$223.7 billion in 2006.[3]

2. The model

We study the effects of IPR on export development in an oligopolistic setting. Consider a world economy of two regions, North and South. Assume that at most one firm in each country can profitably produce the good. We denote these firms by N and S. Both firms produce a single homogenous good and compete in Cournot fashion. Assume also that the two markets are segmented, in the sense that firms can charge a different price in each market.

2.1. Consumption

Let the utility functions in both regions be quadratic in the good we study, with an additive term for a second composite good. If A and B represent the market size of North and South, respectively, the inverse-demand functions for our good are

$$p_N = A - q_N; \quad p_S = B - q_S. \tag{1}$$

We assume that market sizes are sufficiently greater than marginal costs to ensure positive production.

2.2. Decision on mode of supply

Only the N firm engages in prior R&D, which achieves proprietary technological knowledge embedded in the production process for its good. It can retain production at home and export the good to market S, risking loss of its knowledge through imitation, or transfer the technology through licensing.[4] The choice depends on the absorptive capacity of the licensee, market size, the threat of imitation, and the legal protection of technology.

We assume that codified knowledge (e.g., blueprints and formulas) can be imitated by S, but tacit knowledge (e.g., know-how and information gained from experience) cannot. Imitation of codified knowledge is costly and can be achieved under the export mode through product inspection, reverse engineering, or trial and error. Imitation permits S to avoid paying license fees but the reduction in its production costs is less than it would be with licensing because the firm cannot acquire know-how this way.

N may instead offer to license production rights to S. In this event the licensing contract specifies a lump-sum fee and S is able to produce the good at reduced marginal cost with partial access to know-how. If S accepts the licensing contract it would have no incentive to imitate. Thus, its problem is a tradeoff between the license fee and imitation costs, with different impacts on marginal production costs.

Our specification of a lump-sum license fee without per-unit royalties captures the empirical reality that a large portion of technology contracts in developing countries have this feature. For example, Vishwasrao (2007) assembled data on all foreign technology licensing agreements entered into by manufacturing firms, unaffiliated with the licensors, in India between 1989 and 1993. Over the period 1991–1993, there were 968 contracts with only lump-sum fees, amounting to 45% of all licensing deals.

2.3. Costs and production

We assume that labor is the only factor of production and that N's marginal production cost is c_N. Before any imitation or licensing, let S's marginal production cost be c_S, which is greater than c_N because the firm has no knowledge of N's improved technology. A key parameter, the absorptive ability of S, is denoted by $a \in [0, 1]$, where an increase in a indicates higher learning capacity. This capacity is exogenous and given by such characteristics of the South market as education level and infrastructure. Because a stronger learning capacity would permit more efficient production, we assume that imitation reduces marginal cost by more, the greater is a. The reduced cost is $c_S - m(a)$, $m' > 0$.

Let $k \in [0, 1]$ be the strength of IPR in the South. Parameter k is 1 when patent protection is highest and 0 if patents are absent. Denote by $I(k, a)$ the S firm's imitation cost. Stronger IPR make it harder for S to imitate N's product. Indeed, as IPR protection approaches its maximum the costs of legally imitating around a patent become quite high. Thus, we suppose that imitation will not occur beyond some less-than-full level of protection.[5] At the same time, a higher absorptive capacity makes it easier for S to imitate.

There are costs of transferring technology through licensing. Two components of these costs involve setting enforceable contract terms and shifting codified knowledge. These costs typically fall as Southern IPR are tightened because enforceable patents and trade secrets reduce contracting problems under asymmetric information and limit the need for N to masque its proprietary knowledge (Taylor, 1994; Yang and Maskus, 2001). The third component of transfer cost is ensuring that local partners gain the know-how needed to produce efficiently. We assume that these costs increase with the proportion of know-how transferred, which we capture by parameter $x \in [0, 1]$. Thus, let licensing incur a transfer cost $F(x, k) = \varphi + G(x, k)$, where φ is a fixed transfer cost and variable cost G decreases with the strength of IPR and increases with the proportion of know-how transferred.[6] This transfer cost F is borne by

[1] Vishwashrao (1994) is an early example of a strategic model of IPR and technology transfer.

[2] This measure is the well known Ginarte–Park index, explained in Ginarte and Park (1997).

[3] Sources for these data include the on-line WTO statistics database, World Bank *World Development Indicators* (CD-ROM), and U.S. Department of Commerce (2007).

[4] We extend the model to technology transfer through FDI in the next section.

[5] One proof below relies on a convexity assumption that $\frac{\partial^2 I}{\partial k^2} < 0$, though this cost can get high enough to deter imitation.

[6] We assume that $\frac{\partial^2 G(x,k)}{\partial x \partial k} < 0$.