Intellectual Property Rights and Entry into a Foreign Market: FDI versus Joint Ventures

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Abstract

We study the effect of the intellectual property rights (IPR) regime of a host country (South) on a multinational's decision between serving a market via greenfield foreign direct investment to avoid the exposure of its technology or a North–South joint venture (JV) with a local firm, which allows R&D spillovers under imperfect IPRs. JV is the equilibrium market structure when R&D intensity is moderate and IPRs strong. The South can gain from increased IPR protection because it encourages a JV, whereas policies to limit foreign ownership in a JV gain importance in technology-intensive industries as complementary policies to strong IPRs.

1. Introduction

There is one aspect of globalization over which its advocates and critics agree: the increasingly important role of multinational enterprises (MNEs) in the global economy. The latter group criticizes the expanding market and political power of MNEs, while the former is convinced of their contribution to growth and development. The organizational structure of MNEs can be a significant factor in determining whether they simply exploit their market power or truly contribute to the development of the host country. Foreign investment by MNEs can take several forms: one option is to directly set up a wholly owned subsidiary in order to have more control over and closer monitoring of its operations abroad; another is to enter an agreement such as licensing, acquisition, or a North–South joint venture (JV) with an already existing foreign firm to serve a foreign market. We ask which form of investment MNEs prefer under different circumstances and whether their preferred market structure can be an equilibrium outcome.

Firm-specific assets may be knowledge based and can be protected by a patent. The patent grants the MNE technological superiority, creating incentives for it to move to a foreign market (Dunning, 1981). When an enforcement mechanism to protect patents is absent in the target country, the firm's desire to protect its knowledge assets can influence how (if at all) it chooses to enter that foreign market. Thus, the IPR regime in the host country is likely to affect this decision. If knowledge is valuable but can be copied, an MNE may not wish to reveal its technology to an unrelated Southern firm as it would lose absolute control over its know-how. This leads it to seek a safer alternative and engage in greenfield foreign direct investment (FDI) in countries with weaker IPRs and contract enforcement mechanisms (Maskus, 1998). Subsequently, as IPR

protection in a nation becomes stronger, i.e. trade-related aspects of intellectual property (TRIPS) is enforced, firms would not need to rely as much on the direct form of FDI and may choose more licensing and JV agreements.

The R&D intensity of an industry also plays an important role in the decision of firms on how to enter a foreign market. For instance, in low-tech goods such as textile and apparel, distribution, hotel, etc. FDI depends relatively little on IPRs. Firms with technologies that are too costly to imitate likewise pay little attention to local IPR levels.[1] It is particularly so in industries with valuable but easily copied technologies such as the pharmaceutical, chemical, or software industry where concern over the ability of local IPRs to deter imitation arises when making foreign investment decisions. A survey of intellectual property executives in 100 major US firms in six industries that had international operations found that JVs or licensing to unrelated firms is seen as riskier than FDI with a wholly owned subsidiary when IPRs are weak (Mansfield, 1994). This concern was higher for more R&D-intensive sectors.[2] This is because the risk at stake is much higher when technologies require larger R&D investments, making it more efficient to avoid potential losses by keeping tighter control of technology. As the IPR regime in a developing country improves we expect to see licensing and JVs displace FDI.

Since technology transfer has proved necessary for growth, it also has important welfare implications for developing countries that attempt to attract foreign capital. The illegitimate means of technology transfer can be achieved through imitation when MNEs choose the form of entry that is relatively more vulnerable to spillovers. However, it is less likely that an MNE makes such a choice when the IPR regime in the target country is loose. The legitimate (voluntary) form of technology transfer, on the other hand, can work through licensing or JV agreements, but this only occurs when firms see enough commitment to IPRs in the host country so that excessive leakage of its know-how outside the JV can be prevented. It will be seen that this form of technology transfer can be accelerated by an improvement in the level of IPR protection in the South. In fact, the TRIPS agreement includes provision such as Article 66.2 that requires Northern governments to provide incentives for their firms to transfer technology to the South in return for the protection of their IPRs (http://www.wto.org/english/tratop_e/trips_e/techtransfer_e.htm.). As there have been few signs of such a move by the North, governments in the South have sought a mechanism for ensuring this requirement in the Doha Round.[3]

Policies that limit FDI in the South have been used as an indirect way to encourage inward technology transfer. Indeed, foreign investment policies that place limits on the direct form of FDI, or on the degree of foreign ownership in a JV, are often observed in developing countries. Limitations on foreign investment still persist to a great extent in non-WTO members such as Iran. They can even be observed in several member countries such as China, which after joining the WTO has only raised its limits on foreign ownership of JVs in the telecommunications industry to 49% and in insurance and automobile industries to 50% (Lin and Saggi, 2004). This motivates an investigation to see whether such policies are optimal for the South and if so how they could benefit the latter when technology transfer is taken into account.

Although the literature on IPR protection is extensive, the role of JVs have been surprisingly little explored. Al-Saadon and Das (1996) model JVs in which ownership shares are endogenously determined through bargaining between an MNE and a single host firm. Only a handful of papers such as Das (1999) and Lin and Saggi (2004) dealt with aspects of a JV such as moral hazard problems and Southern policies on foreign ownership. Yet, IPR protection as a determinant of knowledge spillover and a firm's

decision on the mode of entry have been absent from the discussion. Mattoo et al. (2004) develop a model that differentiates between FDI and acquisition of existing domestic firms. They show circumstances where the preferences of the MNE and the host country government can be in conflict, justifying policy interventions through restrictions on FDI or JVs to induce the foreign firm to choose the socially optimal mode of entry. While this paper is the closest work to ours that deals with technology transfer and the decision of firms about the mode of entry, it leaves out matters concerning IPRs and technological spillovers.[4]

Our paper is the first theoretical paper to our knowledge that looks at IPR issues surrounding JVs. First, we focus on JVs and show how they are more likely to occur when the R&D intensity of an industry is at an intermediate range. We then show in line with empirical findings of Mansfield (1994) that an improved IPR regime can encourage JVs. We also analyze investment policies in the South and demonstrate that they are often ineffective from the perspective of the recipient country. From the point of view of Southern welfare, strengthening the IPR regime instead serves as a priority to induce a JV and with it technology transfer. It will be seen that Southern policies on the extent of foreign ownership in a JV only become important as a complementary policy to full IPR protection for sectors with high R&D intensity.

2. The Model

There are two countries: the North and the South. We assume one MNE that belongs to the North and two local firms operating in the South. Firms produce a homogeneous good intended for the South and compete in a Cournot manner and thus choose their outputs taking the output (and sales) of their rival as given. For instance, these could be thought of as drugs aimed at combating tropical diseases only prevalent in the South. We use an oligopoly model as MNEs are usually found in concentrated industries. In addition, markets in which technology transfer plays an important role are usually not perfectly competitive. For simplicity and because we wish to focus on one industry we adopt a partial-equilibrium approach.[5] Firms face an aggregate demand in the South

$$p = A - Q, \tag{1}$$

where A represents the size of the market and Q is the total quantity produced.

Assume the Northern MNE has already decided to establish production in the South due to significantly lower production costs there.[6] It must decide whether to enter the South through FDI or a JV agreement. It could establish a wholly owned subsidiary to protect its technology from exposure to Southern firms. In this case the MNE remains the only firm that has access to the superior technology generated by its R&D. Alternatively, it could form a JV with an existing Southern firm in order to carry out its production activities.[7] In this case, a loose IPR policy in the South makes it possible for local firms outside the JV to imitate the Northern technology.

When forming a JV, the firms bargain over their profit share. The outcome of the negotiations depends on the relative bargaining power and the outside option of the firms. Following Lin and Saggi (2004) we focus on the two extreme cases: when either the Northern or Southern partner has all the bargaining power.[8] The firm with full bargaining power leaves itself the maximum rent it can achieve from a JV, while giving its partner just the equivalent of its outside option. A JV contract only goes through if it creates extra rents. Whether or not a JV is formed and thus the equilibrium market structure depends on the level of IPR protection and the R&D intensity of the industry.

R&D investment takes place in the next stage. The level of this investment determines the potential quality of technology transfer to the South. R&D in this model is aimed at inventing more efficient production technologies and hence takes a cost-reducing form. The Northern MNE is assumed to be the sole firm that can invest in R&D as the South is considered less developed. The mode of entry along with other factors such as the level of IPR protection in the South determine the level of R&D investment. The model captures a range of industries with different R&D intensities, but not extremely high-technology-intensive industries discussed in a somewhat similar framework in Chin and Grossman (1990) and Zigic (1998).[9] Such industries are not of interest in our discussion on JVs as they lie beyond the region where sharing ownership is a profitable option for the MNE.[10] The cost functions for the Northern and the Southern firms, respectively, are

$$C = \alpha - \sqrt{gx}, \quad c = \alpha - \beta\sqrt{gx}, \tag{2}$$

where x is the R&D investment, g is the effectiveness of R&D, α is the pre-innovative production cost, and $x \leq \alpha^2/g$.[11] The level of technological spillovers are captured by $\beta = b\iota$. Parameter β is a product of the absorptive capacity $0 \leq b \leq 1$ and $0 \leq \iota \leq 1$, a measure of the weakness of IPRs in the host country with $\iota = 0$ indicating full IPR protection and $\iota = 1$ the complete lack thereof.

Absorptive capacity b is the ease with which the outsider Southern firm can absorb the knowledge generated by the Northern firm. This will depend on such factors as the complexity of the knowledge generated and the level of development of the Southern firm and country. The larger is b, the greater is the absorptive capacity. Thus when $b = 0$ it is impossible for the outsider Southern firm to learn anything from the JV while when $b = 1$ the firm is fully capable of making use of the available technology. When IPR protection is completely missing in the host country, spillovers amount to the natural level determined by how easy it is to copy the technology ($\beta = b$). In the rest of the paper, we focus the discussion on changes in the level of IPR protection and take b as given. Note that the former is a policy instrument whereas b is exogenous.[12] Finally, $\beta = 0$ always holds under FDI as it is assumed that this form of subsidiary prevents any leakage/spillover of knowledge to competing firms operating in the South.[13]

We also compare the welfare implications of each mode of entry to find the socially optimal form of foreign investment for the host country. This allows us to see whether it is optimal for the South to upgrade its IPR protection regime and/or put restrictions on foreign ownership in a JV.

The timing of the game for firms is as follows. Firms bargain in the first stage over their share in a potential JV and decide the market structure. If both firms are at least as well off with a JV than competing on their own, the agreement goes through. Otherwise the MNE enters the South through FDI. The MNE then engages in R&D and firms compete in output in the final stage of the game. At the end of the analysis, we examine the IPR and FDI policy set at stage zero by the Southern government to maximize welfare and manipulate the preferred mode of entry as a Stackelberg leader. We now turn to the two modes of entry and look at production and R&D investment for each case before analyzing the preceding stages on the bargaining game and government policies.

Foreign Direct Investment

When the MNE chooses to enter the South through FDI, it competes with local firms in the host country. It is usually assumed that FDI incurs fixed costs that can be avoided

by forming JVs to utilize already existing facilities of a foreign firm. Fixed costs of FDI are, however, left out of the model for simplicity. Adding them would naturally increase the relative attractiveness of JVs.[14]

A marginal cost asymmetry arises as firms in the South do not have access to the Northern firm's technology attained through its R&D efforts. Given that there are no spillovers with FDI ($c = \alpha$), the profits of the Northern firm and the two Southern firms are, respectively,

$$\pi_F = (p - C)q_F - x, \quad \pi_{Sj} = (p - \alpha)q_{Sj}, \tag{3}$$

where subscript F represents the Northern firm when it engages in FDI, and S_j denotes rival Southern firms with $j = 1, 2$.[15] In the final stage of the game, firms compete in quantity and find their optimal output using the first-order conditions of (3) with respect to q:

$$q_F = \frac{a + 3\sqrt{gx}}{4}, \quad q_{Sj} = \frac{a - \sqrt{gx}}{4}, \tag{4}$$

for $j = 1, 2$. As $A - \alpha$ appears in all the upcoming equations, it is replaced by a to simplify the notation. Replacing the optimal quantities back into the Northern firm's profit function and differentiating the latter with respect to x, we can derive the optimal level of R&D investment:

$$x_F^* = \frac{9a^2 g}{(16 - 9g)^2}. \tag{5}$$

It can be seen that R&D effort is higher the more technology-intensive is an industry (i.e. the higher is g). Finally, replacing the optimal output and R&D investment back into (3), the optimal profits for each firm can be found:

$$\pi_F^* = \frac{a^2}{16 - 9g}, \tag{6}$$

$$\pi_{Sj}^* = \frac{a^2(4 - 3g)^2}{(16 - 9g)^2}. \tag{7}$$

We assume that $g \leq 4/3$ to assure that all firms produce nonnegative output and earn nonnegative profits. A higher level of g would lead to the Southern firms being driven out of the market. In that case, neither Southern firm finds it profitable to enter the market and compete in technology-intensive industries. We rule out this case.

North–South Joint Venture

Now we look at a situation where the MNE forms a JV with a local firm to produce output in the host country.[16] We assume a JV maximizes joint profits with a fixed share of profits going to each partner. The joint profits of the Northern firm and the Southern firm in a JV are

$$\pi_J = (p - C)q_J - x, \tag{8}$$

with subscript J representing a JV. An agreed share of profits ϕ goes to the Northern partner where $0 \leq \phi \leq 1$; the remaining share goes to the Southern partner is thus

$(1 - \phi)$. While the Northern firm continues to perform its own R&D activities, all production by the JV is assumed to take place in the South at marginal cost C. This makes it more likely for the technology to leak out to the outsider Southern firm, which can then gain partial access to the technology developed by the Northern firm. How great a spillover it enjoys depends on the absorptive capacity and the weakness of IPR protection in the South, β. The profit of the outsider Southern firm is therefore

$$\pi_{SO} = (p - c)q_{S2}, \tag{9}$$

where the second subscript O stands for outsider. Solving for the optimal output by each firm yields

$$q_J = \frac{a + (2 - \beta)\sqrt{gx}}{3}, \quad q_{SO} = \frac{a - (1 - 2\beta)\sqrt{gx}}{3}, \tag{10}$$

for the JV and the outsider Southern firm, respectively. Optimal R&D investment under a JV is

$$x_J^* = \frac{a^2 g (2 - \beta)^2}{\left[9 - g(2 - \beta)^2\right]^2}. \tag{11}$$

Comparing (5) and (11), it can be seen that the equilibrium R&D is higher under FDI than with a JV as long as R&D effectiveness is above the threshold level:

$$\tilde{g} = \frac{5 - 16\beta}{3(2 - \beta)(1 + \beta)}. \tag{12}$$

This value starts at 5/6 for full protection ($\beta = 0$) and is falling in β until it reaches 0 when $\beta = 5/16$.[17] Looser IPR protection reduces R&D incentives of a JV due to higher spillovers, while not affecting that in the case of FDI. Note that the R&D decision is independent of how profits are divided between the two partners in a JV as joint profits are maximized when solving for the optimal R&D investment.[18]

Substituting the optimal levels of output and R&D investment back into the profit function of each firm, optimal profits turn out to be

$$\pi_J^* = \frac{a^2}{9 - g(2 - \beta)^2}, \tag{13}$$

$$\pi_{SO}^* = \frac{a^2 [3 - g(1 - \beta)(2 - \beta)]^2}{\left[9 - g(2 - \beta)^2\right]^2}, \tag{14}$$

for the JV and the outsider Southern firm, respectively. The profit of the JV is always decreasing in spillovers, whereas that of the outsider Southern firm is always increasing with it. The advantage of the JV over a third firm decreases with a weaker IPR regime as the cost asymmetry that exists between the JV and the outsider firm is reduced.

3. The Equilibrium Mode of Entry

In the first stage, the Northern firm decides how to enter the Southern market. A JV is the equilibrium market structure when it generates additional rents for the insiders, i.e. $\pi_J \geq \pi_F + \pi_{Sj}$. A JV is not an equilibrium for a low g because total JV profits here are
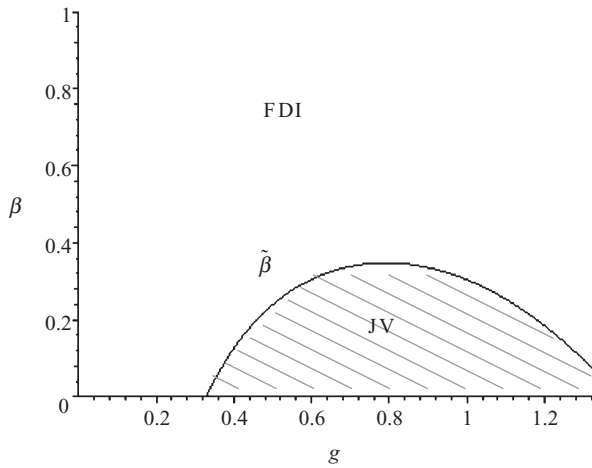
Figure 1. Equilibrium Market Structure

smaller than the sum of profits of the two participants in the absence of a JV, i.e. $\pi_J < \pi_F + \pi_{Sj}$. Looser IPR protection in the South reduces the relative profitability of the JV inducing the MNE to instead choose FDI to protect itself from spillovers. As β increases, the range of g over which a JV occurs is reduced. There is a threshold level of above which a JV is no longer profitable and hence is not an equilibrium. A JV will be formed below this threshold regardless of who holds the bargaining power. This critical level of spillovers can be derived by solving for the β at which $\pi_J^* = \pi_F^* + \pi_{Sj}^*$:

$$\tilde{\beta} = 2 - \sqrt{\frac{32 - 9g}{g(9g^2 - 33g + 32)}}. \tag{15}$$

At $\tilde{\beta}$ there are just zero gains from a JV. A JV can therefore only take place when the IPR regime in the South is strong enough so that $\beta \leq \tilde{\beta}$. When a technology is more complex and harder to copy (low b), the role of IPRs in the decision of the MNE about the mode of entry diminishes. The equilibrium market structure can be seen in Figure 1, which depicts $\tilde{\beta}$ for different levels of R&D intensity.

   The figure illustrates that JVs are only offered and accepted and hence an outcome when R&D intensity is in an intermediate range. They are not likely to occur when R&D effectiveness is low as the Southern firm has little to gain from forming a JV to get access to knowledge. Here, we are nearer to the simple merger case, in which a two-firm merger with identical firms will not be profitable. Similarly, it is not in the interest of the Northern firm to share ownership and its technology when R&D effectiveness is high, IPR protection low and the technology easy to copy. Under these circumstances it will dominate the market on its own. Also the equilibrium JV share of the Southern firm is tiny in this region, causing little change in its market share and hence aggregate profits compared to the FDI case. R&D investment and profits are more convex in g under FDI than in the JV scenario. This means that, on the one hand, JVs are more profitable in intermediate levels of g. Therefore, they can also endure higher spillovers and still be profitable in this range (higher $\tilde{\beta}$). On the other hand, at high g, R&D investment x is increasing at a much faster rate for FDI than JV with the relative difference increasing in β. This increases the relative profitability of FDI at high g's causing $\tilde{\beta}$ to eventually fall in g after reaching a maximum. We can conclude that a

JV only takes place when the level of IPR protection in the South is sufficiently high so that the insiders can exploit the advantages of merging. The absolute maximum β consistent with a JV is $\bar{\beta} = 0.348$. When the level of IPR protection is not sufficiently stringent, no JV can occur and the Southern firm remains an independent competitor that uses the old technology.

PROPOSITION 1. *Increasing the IPR protection level in the South (lowering β) reduces the losses due to imitation of the JV technology by the outsider firm and consequently increases the range of g over which a JV occurs.*

4. Bargaining in a Joint Venture

Turning now to the bargaining between the two firms, a deal has to be reached in order to divide the joint profits π_J^* between the two sides. Let the portion of profits that goes to the Northern and the Southern partner be $\phi\pi_J^*$ and $(1-\phi)\pi_J^*$, respectively. We will look at the two extreme cases where either the Northern or the Southern firm holds full bargaining power. When a firm has all the bargaining power, it captures all rents from the JV and leaves its partner the minimum share that is just sufficient to convince the latter to participate.

When it is the Southern firm that has all the bargaining power, the MNE's profits are equal in the JV and FDI cases. Formally, the critical share is the ϕ which solves $\pi_F^* = \phi\pi_J^*$:

$$\phi^S = \frac{9 - g(2-\beta)^2}{16 - 9g}. \tag{16}$$

The superscript indicates which side of the deal enjoys the bargaining power. The share of the MNE is an increasing function of g.[19] Meanwhile, the Southern firm would only enter a JV if the share $(1 - \phi^S)$ matches its profits in the FDI case, where it uses its old technology to compete with the MNE.

We turn now to the case in which the Northern firm has all the bargaining power. It offers a share to the Southern firm that would make the latter indifferent between the JV and FDI. This share is denoted by $(1 - \phi^N)$ and is the $(1 - \phi)$ that solves $\pi_{Sj}^* = (1-\phi)\pi_J^*$:

$$1 - \phi^N = \frac{(4-3g)^2 \left[9 - g(2-\beta)^2\right]}{(16-9g)^2}. \tag{17}$$

The profits of the Northern firm when it has full bargaining power in a JV is $\phi^N\pi_J^*$. Similar to the previous case, the Northern firm would clearly only make the offer if $\phi^N\pi_J^* \geq \pi_F^*$. The share of the Northern firm when it has all the bargaining power is also increasing in g until it no longer finds it profitable to form a JV.[20] A JV not being possible when g is above a critical threshold complies with empirical findings of Javorcik and Saggi (2004) and Javorcik (2006), which show that JVs in highly R&D-intensive sectors present a lower potential for transfer of technology as Northern firms would be more likely to engage in wholly owned projects than to share ownership.

Figure 2 illustrates the share of profits that remains for the MNE in each case, namely ϕ^S and ϕ^N, for a situation when IPRs are fully protected. It can be seen that the share ϕ^N is concave and always higher than ϕ^S in the relevant range.
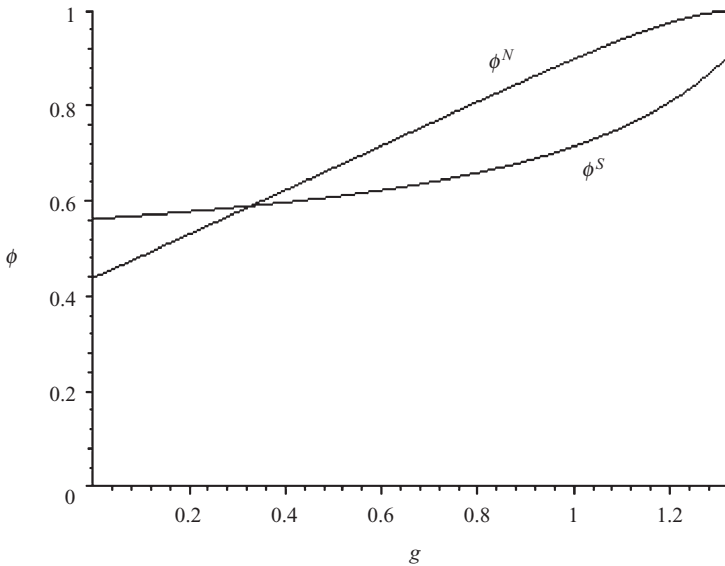
Figure 2. North–South Joint-Venture Profit Shares

Looking at Figures 1 and 2 simultaneously gives interesting new insights regarding the division of JV shares and the market equilibrium outcome. It is easy to see that a JV is only formed if condition $\phi^N \geq \phi^S$ is satisfied. Note that the intersections of ϕ^N and ϕ^S in Figure 2 for different values of β sketches the $\tilde{\beta}$ curve in Figure 1. As β increases, the range of g for which $\phi^N \geq \phi^S$ holds shrinks until it is never satisfied when the ϕ^S curve moves completely above ϕ^N in Figure 2 and β surpasses $\tilde{\beta}$ in Figure 1. Note that at $\tilde{\beta}$, the Southern firm is just indifferent between staying out of a JV and getting the maximum possible JV share consistent with the Northern firm taking part, $(1 - \phi^S)$. Likewise, the Northern firm is just as well off without a JV as forming one and getting the maximum share ϕ^N. This implies that the equilibrium form of foreign investment is the same regardless of which side holds the bargaining power as $\tilde{\beta}$ is identical for both cases.[21]

LEMMA 1. *The critical level of spillovers $\tilde{\beta}$ under which a JV is the equilibrium market structure is the same regardless of which side of the JV holds the bargaining power as $\phi^N = \phi^S$ always holds at $\tilde{\beta}$.*

JV stability problems do not occur as long as profits of the outsider Southern firm are higher than those of the one in the JV. This is always the case unless g is very high ($g \geq 0.8$), and $\beta \approx 0$. Here, the outsider suffers a disadvantage due to high R&D effectiveness of the JV and very low spillovers. In this case, the Southern firm has to offer the Northern firm a slightly higher share to prevent the outsider from intervening to sway the MNE to switch partners. On the other hand, when profits of the outsider are higher than the insider's, a coordination problem may arise in that the potential Southern partner may be tempted to reject the offer and wait for the third firm to join the JV instead. In other words, no firm may opt to engage in a JV if it believes that another firm will do so. It remains the case that the JV would make Southern firms at least as well off as under FDI, which would be the outcome upon unsuccessful negotiations. Neary (2007) refers to this as the "after-you" problem and shows how it could be resolved by creating an *n*-stage bargaining game. Neither the stability nor the coordination

problems would arise if we assume that the MNE is randomly matched with one of the Southern firms and that there is only one round of negotiations.

5. Southern Welfare

In this section we examine policies that the Southern government could implement to raise welfare. To study this we extend the game we have been considering by introducing a prior stage in which the government can set policies. We refer to this as stage 0. In stage 0 the government acts as a Stackelberg leader to maximize welfare.

We adopt a two-step process to study this as follows: (i) find an optimal IPR policy in the case of JV as no spillovers are assumed to take place under FDI; (ii) given the optimal IPR policy, we assess the welfare gains from each type of inward foreign investment. The government, using their first-mover advantage, induces the entry mode of choice. To simplify the exposition, we consider an optimal IPR policy, t, which results in the amount of spillovers that maximizes Southern welfare.[22]

Before we look at optimal policy let us start by looking at each component of welfare separately to understand their individual characteristics and relationship with the level of IPR protection in the South. Southern welfare consists of consumer surplus and the profits of the two Southern firms. The welfare function can be written as

$$W^i = CS^i + \pi_{S1} + \pi_{S2} \quad \text{for } i = F, J, \tag{18}$$

where superscripts F and J denote FDI and JV, respectively. Recall that under FDI the two Southern firms are symmetric, whereas in the event of a JV one firm is inside the JV and the other is an outsider. Initially, we assume that all output is sold on the Southern market and Southern consumer surplus is:

$$CS^i = \frac{Q^{i2}}{2} \quad \text{for } i = F, J. \tag{19}$$

Solving for consumer surplus under each mode of entry, we obtain

$$CS^F = \frac{(q_F + q_{S1} + q_{S2})^2}{2} = \frac{a^2 18(2-g)^2}{(16-9g)^2}, \tag{20}$$

$$CS^J = \frac{(q_{JV} + q_{SO})^2}{2} = \frac{a^2[6 - g(1-\beta)(2-\beta)]^2}{2[9 - g(2-\beta)^2]^2}, \tag{21}$$

for FDI and JV, respectively. From (21) we can obtain the optimal level of spillovers from the consumers' perspective:

$$\hat{\beta} = 2 - \frac{3(1 - \sqrt{1-g})}{g}. \tag{22}$$

The β that maximizes consumer surplus approaches 1/2 as g tends to zero and falls in g until it reaches zero at $g = 3/4$. For higher g's where R&D takes a meaningful role in the industry, consumers prefer full IPR protection ($\beta = 0$) to enjoy higher levels of innovation.

The other constituent of welfare is producer surplus which consists of the profits of the outsider and the insider Southern firms. The profits of the outsider firm not

considered for the JV can be seen in equations (7) and (14) for FDI and JV, respectively. Equation (14) shows that the effect of technological spillovers β on the profits of this firm is always positive.

The profit of the Southern firm potentially involved in the JV is given in (7) if the MNE chooses FDI, and is $(1-\phi^S)\pi_J^*$ or $(1-\phi^N)\pi_J^*$ in a JV depending on which side holds the bargaining power. Notice that if it is the Northern firm who has the bargaining power, the insider firm's profit can be dropped from the welfare comparison as it is equal to its profits under FDI by the definition of ϕ^N.[23] When the Southern firm holds the bargaining power on the other hand, its profits are

$$(1-\phi^S)\pi_J^* = \frac{a^2[g(\beta^2-4\beta-5)+7]}{(16-9g)\left[9-g(2-\beta)^2\right]}. \tag{23}$$

Equation (23) shows that the profit of the insider Southern firm is always decreasing in β when it has the bargaining power in the JV.

We now turn to the IPR and the foreign investment policies in the South and discuss how they can be optimally set in stage 0 to maximize Southern welfare.

Intellectual Property Rights Policy

We can now add up the different components of welfare to derive the impact of β on total Southern welfare. When the MNE has the bargaining power, total Southern profits increase with β along with outsider profits in (14) as insider profits are independent of β. While a higher β always increases total producer surplus, it also improves consumer surplus (21) up to $\hat{\beta}$. Nevertheless, total welfare is always increasing for $\beta \leq \tilde{\beta}$, i.e. $\partial W^J(\phi^N)/\partial\beta > 0$ is always true in the range of g where the formation of a JV is viable. It is hence optimal for the Southern government to maximize spillovers, i.e. $\beta = \tilde{\beta}$.

PROPOSITION 2. *For $\beta \leq \tilde{\beta}$, where a JV is an outcome, $\partial W^J(\phi^N)/\partial\beta > 0$ always holds when the Northern firm possesses full bargaining power, implying that a loose IPR policy always enhances Southern welfare by facilitating a higher level of spillovers. The optimal IPR policy in this case is one that achieves $\tilde{\beta}$, i.e. maximum feasible level of spillovers.*

On the other hand, when the Southern firm holds the bargaining power, adding up (14) and (23) shows that total Southern profits increase with β at low levels of g, where the gains of the outsider from spillovers dominates the losses it brings to the insider. Total profits are decreasing in β at high g's where the reverse is true. With consumer surplus behaving in the same manner, the impact of β on welfare therefore depends on g, the R&D intensity of the industry. In particular, when g is low both consumer surplus and producer surplus are increasing in β, while the opposite holds at high levels of g, creating ambiguous results on the impact of IPR policy on total welfare ($\partial W^J(\phi^S)/\partial\beta \gtreqless 0$). We find the threshold level of R&D efficiency above which the South can benefit from a strict IPR policy:

$$\bar{g} = \frac{1}{6}\frac{49-67\beta+28\beta^2-\sqrt{784\beta^2-2672\beta^3+3129\beta^2-1814\beta+673}}{(1-\beta)(2-\beta)^2}. \tag{24}$$

Southern welfare is increasing in β for $g < \bar{g}$, and decreasing in β for $g > \bar{g}$. Therefore, we can conclude that maximum welfare is reached at the highest spillover rate in

concurrence with a JV $\beta = \tilde{\beta}$ when $g < \overline{g}$, and at $\beta = 0$ or at zero spillovers when $g > \overline{g}$ as losses from lower incentives to innovate accompanied by higher spillovers are substantial.[24]

PROPOSITION 3. *Assuming $\beta \leq \tilde{\beta}$, where a JV is an outcome, and the Southern firm possesses full bargaining power then: (i) for low and intermediate R&D-intensive industries of $g < \overline{g}$, $\partial W^J(\phi^S)/\partial\beta > 0$ implying that a loose IPR policy always enhances Southern welfare by facilitating the maximum level of spillovers under a JV, $\tilde{\beta}$; (ii) for high R&D-intensive industries of $g > \overline{g}$, $\partial W^J(\phi^S)/\partial\beta < 0$ implying a strict IPR policy to fully block spillovers, $\iota = \beta = 0$, is optimal.*

Foreign Investment Policy

After assessing the optimal policy in the presence of a JV, we turn to the comparison of welfare under the two market structures (with and without a JV). The South is able to manipulate the decision of the MNE on the mode of entry by choosing an IPR regime that assures the preferred form of inward investment. It can also set FDI policies that limit foreign share in a JV, or block JVs altogether. We will now compare Southern welfare under FDI with the best attainable welfare under a JV. As we saw earlier, the latter reaches a constrained maximum at $\beta = \tilde{\beta}$ when $\phi = \phi^N$, and at $\beta = 0$ or $\beta = \tilde{\beta}$ when $\phi = \phi^S$ depending on the level of g. Recall also that the parity $\phi^N = \phi^S$ holds when spillovers are at the threshold level $\tilde{\beta}$, making the profits of the insider Southern firm equal under both bargaining power situations. Furthermore, consumer surplus and profits of the outsider firm are independent of the internal division of profits in a JV. Thus, at $\beta = \tilde{\beta}$, total welfare under a JV is independent of bargaining power.

LEMMA 2. *Southern welfare under a JV at $\tilde{\beta}$ is equal regardless of whether the Northern or the Southern firm holds the bargaining power and is thus independent of JV shares. This makes foreign investment policies irrelevant at this level of β.*

Next, comparing (20) and (21) reveals that consumer surplus with FDI is higher than that under a JV. This is because the JV results in less competition and thus a higher price. Comparing the profits of the outsider firm under the two modes using (7) and (14), it is easy to see that it is always higher when a JV is formed. This gain comes from two sources: lower competition and spillovers. As for the insider firm, we have seen in the previous sections that its JV profits only differ from that under FDI when it holds the bargaining power. When IPRs are fully protected ($\beta = 0$), the firms prefer a JV except for when R&D intensity is low, but when IPRs are less well protected ($\beta > 0$), the relative attractiveness of FDI increases. Finally, adding up profits of the two Southern firms for each case reveals that total Southern profits are always higher with a JV than with FDI, i.e. $\pi^*_{SI} + \pi^*_{SO} \geq \pi^*_{S1} + \pi^*_{S2}$. It can therefore be concluded that a JV always favors Southern firms and hurts consumers as it increases total profits at the expense of consumer surplus.

Figure 3 illustrates Southern welfare under FDI, and with a JV for both cases of $\beta = \tilde{\beta}$, and $\beta = 0$ when $\phi = \phi^S$. The figure represents only the range of g, over which JVs are an equilibrium for sufficiently tight IPRs. Thus, they correspond to those levels of g in Figure 1, where $\tilde{\beta}$ is positive. The figure can be divided into four regions. In the first region on the left, which contains the lowest g's where a JV is feasible ($g < g'$), the South prefers FDI. Here, spillovers allowed are not large enough to overcome the benefits of FDI.
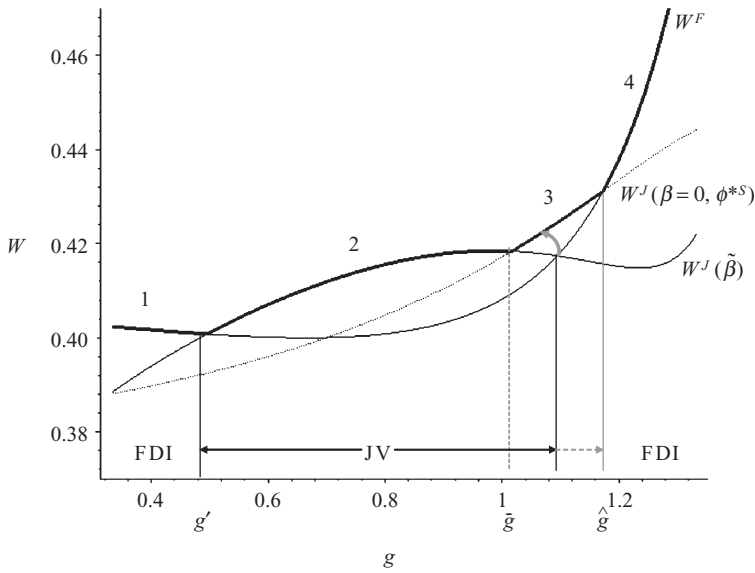
Figure 3. Southern Welfare

The second region lies within the range $g' \le g \le \overline{g}$. Here $\beta = \tilde{\beta}$ induces a JV, which is preferred to FDI regardless of who holds the bargaining power (see Lemma 2).[25] Thus in this region it is optimal to strengthen the IPR regime to $\tilde{\beta}$. If it is possible to set IPR at this level then policies aimed at increasing the Southern share in the JV do not affect welfare of recipient countries.[26]

PROPOSITION 4. *For a large mid-range of $g' \le g \le \overline{g}$, it is optimal for the South to set its IPR regime to the level that just induces a $\tilde{\beta}$ and with it a JV over FDI.*

For $g > \overline{g}$, provided the Southern government can use policy to ensure that the Southern firm receives the share $(1 - \phi^S)$ in the JV, the South can increase its welfare further by strengthening IPRs to the maximum level that eliminates spillovers altogether ($\beta = 0$). This also extends the desirability of a JV up to $\hat{g}$ when the Southern firm holds the bargaining power. Hence, in this third region of $\overline{g} < g \le \hat{g}$ a dual IPR/FDI policy results in higher welfare.[27] The small arrow on the right-hand side of Figure 3 shows the welfare gains brought about by a dual policy, which represents a jump from $W^J(\tilde{\beta})$ to $W^J(\phi^S; \beta = 0)$.

PROPOSITION 5. *At higher levels of R&D effectiveness ($\overline{g} < g \le \hat{g}$), the South can attain maximum welfare through a dual policy that limits foreign shares in a JV and fully protects IPRs ($\iota = \beta = 0$).*

In the fourth region, where R&D intensity is at its highest level ($g > \hat{g}$), the Southern government prefers FDI as the mode of inward investment because it brings more competition, the share of the JV offered to the Southern firm is negligible, and spillovers are not attractive. Similar to the first region with low g's, interests here are in conflict as the MNE prefers a JV, whereas the Southern government favors FDI. Therefore, at very low or very high levels of R&D effectiveness $g < g'$ and $g > \hat{g}$, it is

optimal for the government to prevent JVs from forming. This could be achieved by a ban or even by loosening IPR protection sufficiently, i.e. to push β beyond $\tilde{\beta}$.

PROPOSITION 6. *For $\tilde{\beta} \geq 0$ and $g < g'$ or $g > \hat{g}$, FDI is socially superior to a JV and the Southern government should use measures to deter JVs.*

6. Conclusion

We have developed a North–South model in which a Northern multinational firm that engages in R&D must decide how to serve a Southern market. We assumed that because production costs in the North are prohibitively high, the good is manufactured in the South. The MNE must choose whether or not to collaborate with a local firm. Initially there are two Southern firms in the host country and the MNE can choose whether or not to enter a JV with one of them. The basic ingredients that go into the model are fairly simple, but they nevertheless generate a rich set of results. The principal issue to which we have applied the model is to effects of the Southern IPR regime on an MNE's decision between serving a market via an independent venture-type FDI or by setting up a JV with a local firm. We assumed that entering a JV increases the exposure of the MNE's technology to imitation. To capture this effect we assumed that the outsider local firm that does not enter the JV could benefit from R&D spillovers from the JV when IPRs are imperfectly protected.

We demonstrated a precise set of conditions under which the JV will be established. When firms form a JV and coordinate their production they gain from reduced competition but tend to help their rivals gain market share. This, the well-known merger paradox, implies in our context that without R&D investment the JV is unprofitable. We showed that the level of R&D intensity must be sufficiently high to overcome the combined loss of market share that occurs as a result of the JV. Lower R&D spillovers also work towards JVs and we showed that the threshold spillover, below which it is an equilibrium, increases in the R&D intensity of the MNE up to a maximum and then declines. It eventually declines because if the MNE has very effective R&D it gains little from sharing its superior technology. Thus we found that JVs are most likely when R&D intensity is at an intermediate level. The strengthening of IPRs reduces losses that come from the imitation of the JV's technology by the outsider firm and consequently increases the range of R&D intensity over which a JV occurs. This makes it possible for the South to alter the way MNEs choose to serve its market by enforcing the TRIPS agreement of the WTO.

In addition to looking at the positive aspects of IPR protection we also employed our model to look at the effects on welfare in the Southern country and considered possible policy actions by the Southern government. We found that when a JV is viable, the sum of Southern firms' profits under a JV always exceed the corresponding levels under direct FDI. However, this gain to firms comes at the expense of the consumer who faces higher prices under the JV.

We found that if the Northern firm has all the bargaining power and IPRs are fully protected then a JV will be inferior to direct FDI from the point of view of Southern welfare. For a JV to dominate from a Southern welfare perspective we need some Southern bargaining power and/or imperfect IPR protection. We showed that for moderately R&D-intensive industries the best possible policy is to set IPR protection at the level that will just induce a JV to occur. This result was shown to be independent of the bargaining power of the firms. For highly R&D-intensive industries Southern welfare under a JV can be higher with full IPR protection, but only if the Southern

bargaining power in the JV is positive. In particular, we demonstrated that this is the case when the Southern firm has all the bargaining power and the level of R&D effectiveness is above a threshold level. We also showed that there is also a higher threshold level of the effectiveness above which a JV always yields lower Southern welfare than direct FDI.

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Notes

1. Note that the fact that the imitation of complex technologies is getting easier with time gives rising importance to IPRs of the host country in FDI decisions.

2. The concern was also higher for all sectors when a higher stage of production was under question.

3. Scotchmer (2004a) studies how IPR policies are affected by international treaties with or without harmonization. Scotchmer (2004b) gives a textbook overview of economic and legal aspects of IPRs.

4. Saggi (1996, 1999) also examine the choice of an MNE between FDI and licensing when there are two firms in the host country with asymmetric costs.

5. The literature in oligopoly in general equilibrium is very small but growing. See, for instance, Neary (2003) for work on "general oligopolistic equilibrium." In this and in related papers Neary treats firms as large in their own sectors yet small in the economy as a whole.

6. The tradeoff between exporting and FDI in the context of IPRs has been explored in previous literature (see, for example, Naghavi, 2007) and is not the aim of this paper.

7. We rule out the possibility of the Northern firm entering a JV with more than one firm.

8. Lin and Saggi (2004) actually look at three cases with the third being the share that maximizes their joint profits. As in our models firms produce to maximize joint profits, the shares in the JV does not affect total profits.

9. These models do not look at the possibility of a JV, but extend the analysis to more technology-intensive sectors where the Northern firm can engage in strategic predation to deter entry or serve the market as an unconstrained monopoly.

10. Both theory (Mattoo et al., 2004) and empirics (Javorcik and Saggi, 2004; Javorcik, 2006) show that JVs do not occur for high-technology-intensive industries. Northern firms in such cases prefer to serve the foreign market through a wholly owned subsidiary.

11. We impose a simple linear–quadratic functional form in order to get explicit closed solutions. In doing this we follow a tradition that goes back to d'Aspremont and Jacquemin (1988) and Kamien et al. (1992), among others.

12. As is well known, the absorptive capacity depends on many factors—such as human capital, R&D effort, etc.—that are endogenously chosen by the economic agents. See, in particular, Cohen and Levinthal (1989), and for a recent application Leahy and Neary (2007). We simplify by ignoring this endogenous imitative behavior as in De Bondt and Henriques (1995).

13. Clearly, in practice, there can be some spillovers with FDI, although less than in a JV. For simplicity we just set spillovers under FDI equal to zero. Results remain qualitatively the same for positive, but lower spillovers under FDI.

14. It will be seen that although the model reflects a case with zero FDI fixed costs, a JV results in other advantages for the MNE such as sharing the fixed R&D investment cost.

15. One can also think of a set of all potential rival (outsider) Southern firms. Doing so will simply add another dimension to the analysis, namely the size of the set, or the number of competing Southern firms. More firms simply reduces the attractiveness of a JV due to higher competition and a bigger loss from spillovers.

16. Although there is a vast literature on research JVs and R&D spillovers (e.g. d'Aspremont and Jacquemin, 1988; Suzumara, 1992; Leahy and Neary, 2005), here we are concerned with a JV at the production stage.

17. Note that even with full IPR protection, the level of R&D is higher with FDI than a JV when $g \geq 5/6$. This is because the positive strategic effect of the cost asymmetry on output is stronger under FDI due to a higher number of competing rivals. When the cost difference is large enough, this effect outweighs the negative scale effect of FDI that arises from a smaller-sized MNE.

18. We can alternatively solve for the R&D investment that maximizes the Northern share of profits in a JV when it chooses to behave on pure self-interest. Our model is robust to such modifications as the nature of our results remain unchanged.

19. Northern share starts at $\phi^S = 9/16$ when $g = 0$ and is increasing in g until it reaches 1; that is, when the Northern firm no longer finds it optimal to create a JV and share its technology.

20. The Northern share in this case is $\phi^N = 7/16$ when $g = 0$ and rises with g until it reaches 1.

21. It will be seen that the division of the bargaining power does make a difference in welfare implications as the share of profits by the Southern firm is different under the two cases.

22. For instance, to achieve a target β, IPR protection needs to be stronger the easier it is to copy the technology of the MNE (the higher is the exogenous absorptive capacity parameter b). We assume $b \geq \tilde{\beta}$ so that $\tilde{\beta}$ is always feasible. Clearly, this requires that the absorptive capacity of the South is not too low. Note that $\tilde{\beta}$ never exceeds 0.35.

23. The profits of the insider Southern firm are equal to its profits under FDI when the MNE has full bargaining power and is hence independent of β. Keep in mind that these profits must, however, be added to both FDI and JV welfare when comparing either case to the JV scenario with the Southern firm holding the bargaining power.

24. The value of $\bar{g}$ starts from 0.96 at $\beta = 0$ and increases monotonically up to $\bar{g} = 1.06$ at the maximum allowable value of spillovers under a JV $\beta = \tilde{\beta}$. In addition, total welfare is locally U-shaped in β at this range of g (maximum welfare is a corner solution at $\beta = 0$ and $\beta = \tilde{\beta}$), assuring $\beta = 0$ and $\beta = \tilde{\beta}$ to be the only levels of spillover relevant for policy purposes.

25. Also these results are parallel to Javorcik and Saggi (2004) and Javorcik (2006), in which the South tends to favor JVs in order to facilitate absorption of new technologies.

26. These results are in accordance with Mattoo et al. (2004) regarding the interests of the MNE and the Southern government as long as their IPR protection is strong enough in this model. Both government and the firm would prefer JV over FDI for intermediate R&D effectiveness.

27. Welfare is maximized at $\beta = 0$ for $g > \bar{g}$ when the Southern firm has the bargaining power.