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FDI in a Two-Tier Oligopoly: Coordination, Vertical Integration, and Welfare

Ping LIN Kamal SAGGI*

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Abstract

In a two-tier oligopoly model, we examine the foreign direct investment (FDI) entry decisions of an upstream intermediate good supplier and a downstream final good producer. We find that the FDI decisions of the two firms may be subject to a coordination problem that can be solved by an appropriately designed host country subsidy to FDI. Indeed, an FDI subsidy at one level of the industry may be sufficient to induce FDI at both levels. However, whether FDI at both levels is more desirable for the host country relative to FDI at only one level (or neither level) depends upon underlying market structure of the host industry. While vertical integration can also solve the coordination problem, the integrated firm finds it optimal to not supply the intermediate good to its downstream competitors in the host country. As a result, FDI by a vertically integrated unit fails to generate additional backward or forward linkages and can yield lower welfare than FDI by two independent firms even though vertical integration avoids the double marginalization problem.

JEL Classifications: F21, F23

Keywords: FDI, oligopoly, linkages, vertical integration, welfare, technology spillovers.

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1 Introduction

The economics literature has paid significant attention to the determinants of foreign direct investment (FDI). Two distinct questions have been addressed. The first question is locational: when and why firms opt for FDI over exporting? The second question pertains to the organizational form of foreign entry: given that production is to be shifted abroad, what is the optimal entry mode of FDI? The typical menu of organizational choices considered includes technology licensing, the formation of a joint venture, or the establishment of a wholly owned subsidiary.¹ These two strands of the literature on FDI have enriched our understanding of real-world patterns of FDI and its effects on host countries. However, most of this literature has focused almost exclusively on FDI in a single-tier industry; relatively few attempts have been made to study the entry decisions of multinationals into different levels of a vertically-related industry. In this paper, we build a two-tier oligopoly model that studies firm incentives for FDI and the effects of such FDI on the host country.

Given the *complementarity* of production in vertically related industries, it stands to reason that decisions regarding FDI into such industries are likely to be *interdependent*. For example, a foreign firm may not enter the host country if it foresees difficulties in sourcing key intermediate goods locally. But such goods could be supplied by another foreign investor. If so, FDI by an intermediate good supplier can enhance the FDI incentive of a final good producer by helping lower the local price of the intermediate good and/or improving its quality. Similarly, an upstream/intermediate good producer may not find it attractive to undertake FDI into a country unless FDI into the downstream sector occurs to generate sufficient demand for the intermediate good. Thus, an important insight underlying our model is that FDI into one type of production activity may induce additional FDI into related upstream and/or downstream activities. Casual observation suggests that the aspects of FDI we attempt to model are highly relevant in the real world. For example, the investment of Japanese auto-makers in Southeast Asian countries in the 1970s and 1980s was accompanied by investment by the producers of auto parts and subsystems.² More generally, global FDI flows occur in virtually all inter-related sectors of the world economy, including resource sectors, manufacturing, distribution,

¹ See, for example, Saggi (1996), Buckley and Casson (1998), Makusen and Venables (1999), Helpman, Melitz and Yeaple (2004), and Nocke and Yeaple (2007).

² Moran (1998) provides a comprehensive survey of the effects of FDI on the economic development of host countries.

and services.

In our two-tiered model, two foreign investors – one that produces an intermediate good and another that produces a final good – decide independently whether or not to enter a host country. FDI entry by either firm incurs a fixed cost and potentially generates technological spillovers for local firms in that sector, which reduce their marginal cost of production.³ The interdependence of the decision making of the two investors manifests itself in the form of multiple Nash equilibria. More specifically, if fixed entry costs are large, there exist two Nash equilibria – one in which both firms enter and the other in which neither does. The no-entry equilibrium can exist even when entry at both levels is profitable if both firms choose to invest. Under such circumstances, a *coordination problem* characterizes the decision making of firms.⁴

The existence of the coordination problem implies that an appropriately designed government subsidy to FDI at one level of the two-tiered industry may yield multiple benefits for the host country by inducing FDI at both levels. For example, an FDI subsidy in the upstream sector can make entry a dominant strategy for the foreign firm producing the intermediate good. Observing this, the foreign firm producing the final good, that otherwise would not have entered the local market, will choose to enter as well.⁵ Our model fits well with Rodrik's (1996) argument that in the absence of scale economies in production, for coordination failures to exist between upstream and downstream industries there must be some type of imperfect tradability for some of the goods, services, or technologies associated with manufacturing. In our stylized model, such imperfect tradability arises because both goods need to be produced locally in the host country.

Unlike much of the existing literature on coordination failures, we also consider vertical integration as a solution to the coordination problem. If vertically integrated, the two foreign investors no longer face a coordination problem since the integrated unit can always choose to enter at both levels of the industry. However, the vertically integrated firm is subject

³Recent literature on the spillover effects of FDI includes Aitken and Harrison (1999), Blomstrom and Kokko (1998), and Javorcik (2004).

⁴See Pack and Westphal (1986) and Okuno-Fujiwara (1988) for early and influential analyses of how coordination failures can arise during industrialization and the types of policies government can use to address such failures.

⁵Coordination problems arising from production and investment complementarities are not the only reason why FDI sometimes fail to occur. For example, Gordon and Bovenberg (1996) have shown that the informational disadvantage faced by foreign investors relative to domestic ones can also make capital internationally immobile. They also show that subsidies to capital inflows by capital importing countries can sometimes be optimal in order to address the "lemons" problem created by the presence of such type of asymmetric information.

to an important incentive constraint since it takes into account the fact that supplying the intermediate good to rival downstream producers hurts the profitability of its downstream business. To internalize this negative externality, one would expect the vertically integrated firm to typically produce a smaller quantity of the intermediate good relative to an independent intermediate good supplier. This intuition is borne out rather sharply in our model: the negative effect of supplying rival firms the intermediate good turns out to be so strong that the vertically integrated firm chooses to not supply its downstream competitors at all. This naturally implies that the vertically integrated firm foregoes profits that could be earned by supplying the intermediate to local final good producers. As a result, there exist circumstances where a vertically integrated firm is *less likely* to undertake FDI than two independent firms. For example, we find that the joint profits of two independent firms are higher than that of a vertically integrated unit when the local final good market is highly competitive (i.e. the number of downstream competitors is large).

Furthermore, even though the vertical integrated unit avoids the double marginalization problem that characterizes oligopolistic market interaction between independent upstream and downstream firms, the incentive of such a firm to not supply the intermediate good to local final good producers can have adverse welfare consequences for the host country. Indeed, we find that the entry of a vertically integrated firm is preferable to that of two independent firms only if the downstream market is sufficiently competitive; otherwise, the host country is better off with independent entry at both stages. Interestingly, the decisions of foreign firms regarding vertical integration turn out to be in harmony with local welfare considerations only when market structure at both levels is moderately competitive.

Our two-tier model also shows that greater technological spillovers from FDI to local competitors can actually *encourage* FDI under certain conditions. This occurs because higher spillovers at one level of the industry intensify post-FDI competition at that stage, which makes FDI into the *other* stage more attractive and due to complementarity in production this indirectly enhances the incentive for FDI into the first stage. For instance, an increase in FDI spillovers in the final goods market increases derived demand for the intermediate good, making FDI into the intermediate stage more attractive. And FDI into the intermediate good makes FDI into the final good relatively more profitable. A similar logic implies that an increase in technological spillovers in the intermediate market can increase the incentives for FDI at both stages of production. To the best of our knowledge, this positive relationship

between incentives for FDI and the degree of technological spillovers has not been studied in the existing literature. Indeed, in models with only stage of production, greater spillovers from FDI at that stage will generally make FDI less likely.

Existing studies of FDI entry decisions have focused almost exclusively on entry into one level of the host industry – i.e. the final product market. For example, in a recent paper Helpman, Melitz and Yeaple (2004) investigate how firm heterogeneity (e.g., in cost) affects the choice between exporting and FDI. Nocke and Yeaple (2007) construct a model in which multinationals can enter the host country either by greenfield investment or cross-border merger and acquisition while Eicher and Kang (2005) incorporate exports as an alternative way of serving the foreign market. To the best of our knowledge, our paper is among a handful of papers that study FDI at multiple levels of a vertically related industry. Like us, Markusen and Venables (1999) study the effects of FDI on the host economy in a two-tier industry, but they consider FDI only into the downstream market. In addition, their monopolistic model abstracts from strategic interaction among foreign investors that are central to our oligopoly model. Lin and Saggi (2007) consider the effects of downstream FDI in a two-tier model but they focus on the effects of an exclusivity condition that a multinational might impose on local suppliers in return from transferring technology to them.

The remainder of the paper is organized as follows. Section 2 presents our basic model of FDI in a two-tier industry and it highlights the coordination problem between entry decisions of an intermediate good supplier and a final good producer. Section 3 compares the welfare effects of various patterns of FDI. Section 4 examines how technology spillovers at both levels of the vertical industry affect incentives for FDI. Section 5 compares the FDI incentive a vertically integrated firm with that of two independent firms. Section 6 discusses the case of export-oriented FDI while section 7 concludes.

2 Model

We consider a host economy that produces two final goods (x and y) and an intermediate good (z). Good x serves as the numeraire and is produced by a perfectly competitive sector. Labor is the only factor of production. One unit of labor produces one unit of good x so that price of good x equals the wage rate in the economy that is normalized to 1.

Consumer preferences over the two goods are as follows: $U(x, y) = x + u(y)$. Since preferences are quasi-linear, the inverse demand function for good y can be written as $p(y)$. To

facilitate analytical derivations, we assume that $u(y)$ is quadratic so that $p(y) = a - y$.

One unit of good y requires one unit of good z . From hereon, we refer to good y as simply ‘the final good’ and good z as ‘the intermediate good’. There exist $n \geq 1$ downstream firms that produce the final good and $m \geq 1$ upstream firms (called local suppliers) that produce the intermediate. Each local supplier’s unit cost of production equals $c_I > 0$. The marginal cost of a final good producer equals the sum of the price of the intermediate, denoted by w , and the unit cost of transforming the intermediate into final good, denoted by $c > 0$.

A foreign producer of the intermediate good, called firm A , and a foreign producer of the final good, called firm B , are contemplating entry via greenfield FDI into the host country industry. The fixed cost of FDI entry at the intermediate stage equals $F \geq 0$ while that at the final good stage equals $G \geq 0$. Each foreign firms possesses a cost advantage over its local competitors. Specifically, the unit cost of production for firm A equals c_A , where $c_A \leq c_I$, while that of firm B is c_B , where $c_B \leq c$.⁶

We assume that incoming FDI has the potential to generate technology spillovers to local firms and we model such spillovers as follows. Upon FDI by firm A , the unit cost of each local supplier i becomes

$$c_i = c_I - s_A(c_I - c_A) = c_A + (1 - s_A)\Delta_A, \quad i = 1, 2, \dots, m,$$

where $s_A \in [0, 1]$ measures the degree of technological spillover at the intermediate stage, and $\Delta_A \equiv c_I - c_A$ represents the cost differential between local suppliers and firm A (in the absence of any spillovers). Similarly, FDI by firm B at the final good stage reduces the cost of production of each domestic producer j to

$$c_j = c - s_B(c - c_B) = c_B + (1 - s_B)\Delta_B, \quad j = 1, 2, \dots, n,$$

where $s_B \in [0, 1]$ is the spillover parameter in the downstream market and $\Delta_B \equiv c - c_B$ equals the cost advantage of the firm B over its local competitors (in the absence of any spillovers).

The timing of the game is as follows. First, the two foreign firms simultaneously decide whether or not to enter the host country. Then, as in Salinger (1988), interaction between suppliers of the intermediate good and producers of the final good occurs as follows. Taking the unit price of the intermediate as given, all final good producers compete in quantities

⁶In what follows, we assume that the cost advantages of the foreign firms are not so large that foreign entry leads to exit of local firms.

(i.e. Cournot fashion). And given the derived demand generated by downstream competition, intermediate good suppliers compete in quantities, which establishes the equilibrium price of the intermediate. It is straightforward to show that the equilibrium price of the intermediate good under autarky (or no FDI entry) denoted by $\langle N \rangle$ equals

$$w^N = \frac{a - c + mc_I}{m + 1} \quad (1)$$

2.1 FDI at the intermediate stage

Let $\pi_A^A(s_A, m, n)$ denote the equilibrium profit of firm A (gross of entry cost) if it enters the host country but firm B does not. Under this market structure, denoted by $\langle A \rangle$, derived demand for the intermediate good is as the same as that under autarky. If firm A enters the local market, the number of suppliers of the intermediate good increases relative to autarky, and the cost configurations of these suppliers may also change because of technological spillovers from firm A .

Increased competition upstream and the possible cost reduction implied by such spillovers lowers the equilibrium price of the intermediate good which in turn benefits downstream final goods producers – i.e. FDI upstream creates additional *forward linkages* in the local industry. Furthermore, it also lowers the price of the final good and increases consumer surplus relative to autarky. At the same time, however, FDI entry by firm A hurts local suppliers of the intermediate good by increasing competition in that market. The equilibrium price of the intermediate good under $\langle A \rangle$ is easily calculated:

$$w^A = \frac{a - c + m(c_I - s_A \Delta_A) + c_A}{m + 2} \quad (2)$$

where it is straightforward that $w^A < w^N$.

2.2 FDI into the final good

Let $\pi_B^B(s_B, m, n)$ denote the equilibrium profit of firm B under the market structure $\langle B \rangle$ where it enters but firm A does not. FDI entry by firm B intensifies competition in the final good market by increasing the number of firms and by generating FDI spillovers to local downstream firms. Increased competition downstream raises derived demand for the intermediate good and the sales of upstream suppliers increase – i.e. FDI downstream creates additional *backward*

linkages in the local industry. Increased competition in the downstream sector also enhances consumer welfare. The negative effect of firm B 's entry on the host country is that it increases competition in the final good market so that market shares and profits of local final good producers tend to decline due to firm B 's entry (unless the spillover effects are sufficiently strong). The equilibrium price of the intermediate good under the FDI entry pattern $\langle B \rangle$ equals

$$w^B = \frac{a - (c_B + n(c - s_B \Delta_B)/(n + 1)) + mc_I}{m + 1}. \quad (3)$$

where $w^B \geq w^N$ and $w^B > w^N$ if $c_B = c$.

2.3 FDI at both levels

Denote the FDI entry pattern where both firms A and B enter the local industry by $\langle AB \rangle$. As is clear, under $\langle AB \rangle$ the degree of competition in the local industry increases at both stages of production and this lowers prices of both the intermediate good and the final good. Furthermore, local firms at both levels of the industry may enjoy the benefits of spillovers from FDI.

Let $\pi_A^{AB}(s_A, s_B, m, n)$ and $\pi_B^{AB}(s_A, s_B, m, n)$ denote the equilibrium profits of firm A and firm B , respectively under the FDI entry pattern $\langle AB \rangle$. It is obvious that

- $\pi_A^{AB}(s_A, s_B, m, n) > \pi_A^A(s_A, m, n)$; and that
- $\pi_B^{AB}(s_A, s_B, m, n) > \pi_B^B(s_A, m, n)$.

In other words, each foreign firm earns greater profit from entering the host market if the other foreign firm also enters the other tier of the vertically related market than if it does not. For example, firm A 's profit is greater if both firms A and B enter the local market relative to when firm A enters alone. This is due to two reasons. First, firm B 's entry intensifies competition in the downstream sector and this increases demand for the intermediate good. Second, technological spillovers generated by firm B also benefit firm A : such spillovers in the final good market enable local firms to produce a larger quantity of the final good thereby creating more demand for the intermediate good.

It is straightforward to derive the equilibrium price of the intermediate good under $\langle AB \rangle$:

$$w^{AB} = \frac{1}{m + 2} \left[a - \frac{c_B + n(c - s_B \Delta_B)}{n + 1} + m(c_I - s_A \Delta_A) + c_A \right] \quad (4)$$

where $\alpha \equiv a - c_A - c_B$, $S_A \equiv (1 - s_A)\Delta_A$, and $S_B \equiv (1 - s_B)\Delta_B$.

2.4 The FDI entry game

Firms A and B simultaneously and independently decide whether or not to enter the host country. The payoff matrix of this FDI entry game is as follows.

		Firm B	
		Enter (E)	Not Enter (N)
Firm A	Enter (E)	$\pi_A^{AB} - F, \pi_B^{AB} - G$	$\pi_A^A - F, 0$
	Not Enter (N)	$0, \pi_B^B - G$	$0, 0$

Depending on parameter values, each of the four cells can arise as an equilibrium outcome: $\langle A \rangle$ obtains if $\pi_A^A > F$ but $\pi_B^B \leq G$; $\langle B \rangle$ obtains if $\pi_B^B > G$ but $\pi_A^A \leq F$; $\langle AB \rangle$ results if $\pi_A^{AB} > F$ and $\pi_B^{AB} > G$; and the autarkic market structure $\langle N \rangle$ persists if $\pi_A^A \leq F$ and $\pi_B^B \leq G$. The equilibrium pattern of the FDI entry game is depicted in Figure 1.

– Insert Figure 1 –

For parameter values in Region I of Figure 1, entry costs are so low that it is a dominant strategy for both firms A and B to enter. In Region II, entry is the dominant strategy for B but not for firm A ; it is worthwhile for firm A to enter only if firm B enters as well. Similarly, in Region IV, entry is the dominant strategy for firm A but not for firm B , and firm B enters only if firm A does so as well. In Region III, two Nash equilibria coexist. In one equilibrium both firms enter while in the other neither firm does. Obviously, the two firms are better off under the first Nash equilibrium. The coexistence of $\{N, N\}$ in Region III highlights the coordination problem faced by the two firms while making independent decisions regarding entry at the two stages of the vertically linked industry in the host country.

Proposition 1 (Coordination problem of FDI): *If $\pi_A^A(s_A, m, n) < F < \pi_A^{AB}(s_A, s_B, m, n)$ and $\pi_B^B(s_B, m, n) < G < \pi_B^{AB}(s_A, s_B, m, n)$, then both $\{E, E\}$ and $\{N, N\}$ are Nash equilibria of the FDI entry game.*

Perhaps the purest illustration of the coordination problem characterizing FDI into the vertically related industry can be provided by the case where $m = n = 0$. When local industry is non-existent at both levels, the absence of FDI implies that the final good is not supplied to the local economy at all. Under such a scenario, the coordination problem manifests itself

in two starkly different Nash equilibria: one in which domestic welfare is zero and another in which it is strictly positive. In general, it is easy to show that the degree of the coordination problem declines with the degree of local industrial development: i.e. an increase in industry scale either upstream (as measured by m) or downstream (as measured by n) reduces the parameter space over which $\{N, N\}$ obtains as a Nash equilibria. We can show that:

$$\frac{\partial(\pi_B^{AB} - \pi_B^B)}{\partial m} < 0 \text{ and } \frac{\partial(\pi_A^{AB} - \pi_A^A)}{\partial n} < 0$$

i.e. an increase in the number of domestic suppliers reduces the dependence of firm B on firm A 's entry decision while an increase in the number of domestic final good producers reduces the dependence of firm A 's entry decision on that of firm B .

The coordination problem facing the two firms can be overcome in at least two separate ways. First, the host country could subsidize FDI thereby making entry a dominant strategy for one of them; which in turn induces the other firm to enter even if it is not subsidized.⁷ The other way to solve the coordination problem is for firms A and B to enter as a *vertically integrated* entity – a strategy we consider in section 5. In order to examine the desirability of a FDI subsidy policy, in the following section, we first study the welfare effects of FDI on the host industry. An interesting insight of this analysis is that it is not always the case that the host country is better off with FDI at both levels of the industry.

3 Patterns of FDI and domestic welfare

In this section we examine two important questions from the viewpoint of the host country. First, how are different patterns of FDI patterns related in terms of domestic welfare? Second, do the various patterns of FDI necessarily increase domestic welfare compared to autarky?

The existing literature on FDI has emphasized two types of benefits of FDI to the host country: technological spillovers to domestic firms at the level of the industry at which FDI occurs (see Saggi, 2002 for an in-depth discussion) and the vertical linkages (both backward and forward) generated within the domestic industry – see Rodriguez-Clare (1996), Markusen and Venables (1999), and Lin and Saggi (2007).

As was already noted, when market structure is oligopolistic FDI also generates a competition effect since multinationals gain market share at the expense of competing local firms.

⁷It is worth noting that fiscal and financial incentives designed to attract FDI are widespread in the global economy (UNCTAD, 2003).

However, besides this usual horizontal competition effect of FDI, in our model, FDI has an additional negative effect on local firms that arises due to the two-tier production structure we consider. For example consider the FDI entry pattern $\langle B \rangle$ relative to autarky. The entry of firm B increases derived demand for the intermediate good which in turn raises its price – an outcome that is detrimental to local final good producers. This indirect price effect of firm B 's entry, together with increased competition in the downstream market, makes such entry doubly problematic for local competitors of firm B . It is easy to see that the same argument applies with respect to a comparison of FDI entry patterns $\langle AB \rangle$ and $\langle A \rangle$. In fact, using (1),(2) and (3) we can show the following lemma:

Lemma 1: *If $c_B < c$, then $w^B > w^N$ and $w^{AB} > w^A$, for all s_A and s_B . That is, FDI entry by firm B raises costs of its local competitors by increasing the price of the intermediate good.⁸*

Let $\pi_z^k(s_A, s_B, m, n)$ denote the equilibrium profit of a typical local supplier in the intermediate sector and $\pi_y^k(s_A, s_B, m, n)$ that of a local final good producer under FDI entry pattern k , where $k = \langle N \rangle, \langle A \rangle, \langle B \rangle$, or $\langle AB \rangle$. Aggregate domestic welfare is then given by

$$W^k \equiv m\pi_z^k(s_A, s_B, m, n) + n\pi_y^k(s_A, s_B, m, n) + CS^k(s_A, s_B, m, n)$$

where CS^k denotes the domestic consumer welfare under FDI entry pattern k .

We are now ready to study the welfare properties of different FDI entry patterns. We initially ignore technology spillovers and concentrate on the welfare effects of FDI that result from its impact on market structure and vertical linkages in the domestic industry. Once these effects are clearly understood, we then discuss the impact of technology spillovers.

3.1 Is more FDI necessarily better?

To concentrate on the trade-off between the beneficial linkage effects of FDI and its negative competition effects, in this section we abstract from technology spillovers from FDI and set $s_A = 0$ and $s_B = 0$. For simplicity, we assume that firms A and B do not have any cost advantages over their counterparts in the host country. In fact, as we shall see in the next section, the competition effects of FDI almost dominate the linkage effects even when foreign firms do not possess any cost-advantages over their local competitors.

⁸If $c_B = c$, then firm B 's entry changes the slope but not the vertical intercept of the derived demand for the intermediate good. In this case, we have $w^B = w^N$ and $w^{AB} = w^A$.

Our first result below is rather surprising in that it shows that in an economy that has production capabilities at both stages, opening up to FDI at only level of the local industry can sometimes be *more* desirable than opening up at both levels:

Proposition 2: *Suppose $c_A = c_I$ and $c_B = c$ so that technological spillovers from FDI are irrelevant. Then,*

- (i) $W^A \geq W^{AB}$ for all m and n and $W^A = W^{AB}$ holds only if $m = n = 1$;
- (ii) $W^B > W^{AB}$ for all m and n .

In other words, given that there are no spillovers from FDI, the host country is better off with FDI at just one level of the market as opposed to both, except for the case where the domestic market is a successive monopoly. This result places an important qualification on the intuitive notion that the complementarity of FDI into two stages of production of a vertically related industry necessarily implies that FDI at both stages is necessarily more beneficial to the host country than FDI at a single stage. The logic for this surprising result is as follows. Relative to FDI into just one level, FDI at both levels *partially offsets* the vertical linkages created while at the same time creating additional competition for local firms. For example, consider entry by firm B , which increases backward linkages by increasing demand for the intermediate good and thereby benefits local suppliers. Now imagine that firm B 's entry into the final good market is accompanied by firm A 's entry into the intermediate market. As a result, the backward linkage effect of firm B 's entry is now partially captured by firm A , whose profits are not a component of domestic welfare.

Similarly, compare entry patterns $\langle AB \rangle$ and $\langle A \rangle$. As firm A enters, it creates a forward linkage effect that benefits local final good producers. However, a part of this forward linkage effect accrues to firm B if it too enters the host country. In sum, while complementary to one another, FDI at both stages of production partially offsets the linkage benefits conferred on the host industry by FDI at only one stage of production. Finally, note that when the domestic market is heavily lacking in competition, as is the case under successive local monopoly, the benefits of increased competition implied by FDI at both stages of production outweigh the offsetting of linkages caused by such FDI relative to FDI at only one stage of the local industry.⁹

⁹It can be shown that whether or not entry pattern $\langle A \rangle$ leads to higher domestic welfare than entry pattern $\langle B \rangle$ depends on values of m and n . Loosely speaking, $\langle B \rangle$ is better than $\langle A \rangle$ if n is sufficiently large relative to m . It is worth noting that if market structure at the two stages of production is symmetric (i.e. $m = n$) then FDI entry in the final good market is preferable: $W^B > W^A$.

Our results above regarding the offsetting effects of FDI on vertical linkages are reminiscent of an insightful point made by Rodriguez-Clare (1996) who observed that incoming FDI does not just create new linkages, it also *displaces* existing linkages between local firms at different stages of the production chain. Such displacement also occurs in our model since FDI reduces the output levels of firms that compete with the multinational(s). By considering the impact of FDI at two vertically related stages of production, our model further extends this insight of Rodriguez-Clare (1996): given that a multinational has entered the local industry, the entry of a multinational at another, vertically linked stage of production ends up severing some vertical links between the first multinational entrant and the local industry, something that can be detrimental for local welfare.

3.2 Comparison with autarky

Given the relative welfare ranking of various FDI entry patterns, it is natural to ask: under what conditions does each FDI entry pattern make the host country better off relative to autarky? The result here is analogous to Proposition 2: in the absence of FDI spillovers, FDI into one or both levels of the domestic industry increases domestic welfare if and only if the domestic industry is (almost) a successive monopoly under autarky.

Proposition 3: *Suppose $c_A = c_I$ and $c_B = c$. Then, the following hold:*

- (i) $W^A > W^N$ if $m = n = 1$ and $W^A < W^N$ otherwise;
- (ii) $W^B > W^N$ if $(m, n) \in \{(1, 1), (2, 1), (1, 2), (2, 2)\}$ and $W^B < W^N$ otherwise; and
- (iii) $W^{AB} > W^N$ if $m = n = 1$ and $W^{AB} < W^N$ otherwise.

This result can be understood in terms of the competition effect of FDI on local firms. As the host country opens up to FDI either in the intermediate or the final good market, or both markets, the resulting intensification of competition lowers profits of those firms that compete with the foreign firms. When spillovers from FDI are absent, the competition effect is so strong that it dominates the vertical linkage effects of FDI as well as the beneficial effects on consumers so that domestic welfare declines, except for the cases where m and n are both close to 1. In other words, unless there is very little domestic competition at each level of the domestic industry, increasing competition in the local industry is not sufficient justification for further opening up to FDI since the increase in competition also transfers rents to foreign firms. In this context, it is worth noting that if the domestic industry comprised of a single stage of production with Cournot competition, under the assumptions of our model, foreign

entry into the industry would *necessarily* reduce domestic welfare if it is not accompanied by any technological spillovers to the local industry. By contrast, in our two-tiered oligopoly model, FDI has the potential to enhance welfare even when there are no technology spillovers provided that market concentration in the domestic industry is rather high (i.e. m and n are small). In other words, the presence of market power at both stages of production actually makes FDI more attractive since it implies that some of the profit destruction in the final good market that results from increased foreign competition is captured by domestic suppliers of the intermediate good.

Proposition 3 suggests that the usual backward linkage effects that economists have long recognized may not be significant enough to justify policies aimed at attracting FDI. This raises the question whether a case for pro-active FDI policies in oligopolistic markets could be made on the basis of technological spillovers to local firms. We examine this possibility next.

4 Effects of FDI spillovers

Proposition 3 informs us that in the absence of spillovers, FDI into the local industry increases domestic welfare only when the industry is either a successive monopoly (in case FDI occurs in the intermediate market) or a successive duopoly (in case FDI occurs in the final good market). We show below that the presence of FDI spillovers increases the parameter range for which FDI increases domestic welfare relative to autarky. We use the FDI pattern $\langle AB \rangle$ to illustrate this argument. The analysis below also provides a rationale for the FDI subsidization policies that are considered at the end of this section.

4.1 Spillovers and the desirability of FDI

Now consider the case where the FDI entry of firms A and B generates technological spillovers to the local economy – the spillover parameters s_A and s_B are strictly positive. We show that in the presence of spillovers, entry by A and B can enhance domestic welfare, even when the domestic market is not highly concentrated at both levels. For simplicity, consider the symmetric case where $c_A = c_B = 0$, $c_I = c = \Delta$ and $s_A = s_B = s$. The parameter Δ then represents the cost advantage each foreign firm enjoys over its local competitors. As might be expected, domestic welfare W^{AB} depends on the level of spillovers as well as on the cost differential parameter: $W^{AB} = W^{AB}(s, \Delta)$ where W^{AB} increases with the level of FDI spillovers s while it decreases with the cost advantage Δ of foreign firms.

An example: successive duopoly For the special case where $m = n = 2, c_A = c_B = 0, c_I = c = \Delta$ and $s_A = s_B = s$, we have

$$W^{AB}(s, \Delta) = \frac{1}{96} (3a - 8(1 - s)\Delta)^2 + \frac{1}{1152} (9a - 28(1 - s)\Delta)^2 + \frac{1}{2} \left(\frac{9}{16}a - \frac{3}{4}(1 - s)\Delta \right)^2.$$

It can be shown that the following holds:

Proposition 4: *Assume $c_A = c_B = 0, c_I = c = \Delta, m = n = 2$, and $\Delta \geq \Delta_{\min} > 0$, then there exists a threshold level of spillovers $s^*(\Delta)$ such that $W^{AB}(s, \Delta) > W^N$ if and only if $s > s^*(\Delta)$. Furthermore, $s^*(\Delta)$ decreases with Δ .*

This result is easy to understand. For the extreme case where spillovers are complete (i.e. $s = 1$) domestic welfare under $\langle AB \rangle$ exceeds that under autarky because FDI by both firms lowers the cost of all domestic firms by the amount Δ and this cost reduction dominates the negative effects of increased competition on the profitability of local firms. Given that domestic welfare is an increasing function of the spillover parameter s , there exists a threshold level $s^*(\Delta)$ that exhibits the above property. For example, for $a = 10$, it is easy to calculate that $\Delta_{\min} = 0.2, s^* = 0.36$ if $\Delta = 0.5$ and $s^* = 0.06$ if $\Delta = 2$.

4.2 How spillovers may encourage FDI

The conventional belief is that technology spillovers tend to discourage FDI since multinationals have an incentive to preserve their technological superiority over local firms. In this section, we show that this argument may be incomplete since it ignores vertical linkage effects that lie at the heart of our model. We argue below that an increase in the degree of spillover may actually *increase* the incentive for FDI on the part of foreign firms.

Suppose that the level of upstream spillover (s_A) rises. Following this, π_A^{AB} decreases but π_B^{AB} increases since the price of the intermediate good falls. The new equilibrium entry pattern as a function of the entry costs is depicted in Figure 2.

– Insert Figure 2 here –

For the parameter values in Region Vb, entry was profitable for neither firm before the rise in s_A . However, at a higher level of upstream spillover, it is a Nash equilibrium for both firms A and B to enter. A higher level of upstream spillover increases the incentive for

downstream entry by firm B , and anticipating this firm A chooses to enter as well. Therefore, an increase in the level of technological spillovers upstream (s_A) induces additional entry at *both* stages of production. Of course, a similar logic applies to changes in the level of downstream spillover s_B . A rise in s_B enhances downstream competition and raises the demand for the intermediate good, thereby encouraging upstream entry. Additional upstream entry in turn leads to additional downstream entry which would not otherwise have occurred. To emphasize this, we state the following result:¹⁰

Proposition 5: *An increase in the degree of technological spillovers in either the upstream or the downstream sector may encourage FDI into both tiers of the domestic industry.*

4.3 Attracting FDI via subsidies

The above discussion informs us that one justification for attracting FDI in our vertical oligopoly model is the technology spillovers that FDI might bestow upon local firms. However, in many situations, multinational companies may lack the incentive to enter a host country because of the entry costs involved or if technology spillovers benefit local competitors too much.¹¹ Because of such positive externalities, many countries often offer fiscal and financial incentives to multinational firms to induce them to invest locally (UNCTAD, 2003).

Suppose parameters are such that entry by both multinationals is indeed desirable from a welfare perspective but firms do not find it profitable. Then, the host country government faces a policy design problem: How should subsidies to FDI be structured? Should the local government subsidize FDI at both levels or just one level of the industry? If at one level, should it be upstream or downstream?

We argue below that properly designed FDI subsidization by the host country has the potential to yield "multiple benefits" by encouraging entry at both levels of the local industry. Suppose that the fixed costs of FDI (F and G) are sufficiently large that $\{E, E\}$ is not a Nash equilibrium in the foregoing model. For instance, this will be the case when $F > \pi_A^{AB}$ and $\pi_B^{AB} > G > \pi_B^B$, that is, when no-entry is firm A 's dominant strategy (it would not enter even if firm B enters: $F > \pi_A^{AB}$) and no-entry is firm B 's best response to firm A 's choice of

¹⁰Of course, an increase in spillovers also has the usual effect of discouraging entry. For example, an increase in s_A reduces π_A^{AB} so that the vertical boundary defining Region III in Figure 3 shifts leftward and the parameter space over which $\{E, E\}$ is an equilibrium shrinks.

¹¹Furthermore, multinational firms will typically not take into account the beneficial effects of their entry on domestic consumers.

no-entry but it prefers to enter if firm A chooses to enter. In this case, in the absence of an FDI subsidy, no entry occurs and the host country remains in autarky.

There are at least three alternative FDI subsidization policies that the host country can adopt:

- (i) Subsidize only firm A by the amount just over $F - \pi_A^A$;
- (ii) Subsidize only firm B by the amount just over $G - \pi_B^B$; and
- (iii) Subsidize both firms A and B .

It is easy to see that policy (i) can make *Enter* a dominant strategy for firm A , which in turn induces firm B 's entry even though it does not receive any subsidy: firm A 's entry increases the supply of the intermediate good which in turn makes it profitable for firm B to enter as well. The net benefit of to the host country in this case is the increase in domestic welfare minus the costs of FDI subsidy: $W^{AB} - W^N - (F - \pi_A^A)$.

Policy (ii), if implemented, would attract firm B to enter but firm B 's entry would not be accompanied by firm A 's entry because $F > \pi_A^{AB}$. Unlike policy (i), policy (ii) attracts FDI into just one level of the vertical industry. The net benefit of this policy to the host country is $W^B - W^N - (G - \pi_B^B)$. Therefore, policy (i) is more desirable than policy (ii) if and only if $W^{AB} - (F - \pi_A^A) > W^B - (G - \pi_B^B)$.

From Proposition 3, we know that in the absence of FDI spillovers, simultaneously entry by both firms lowers domestic welfare relative to FDI at just one level of the industry, because the entry by one firm partially cancels out the vertical linkage effects generated by the entry of the other firm. However, if FDI spillovers are present and substantial, the host country can enjoy spillover effects at both stages of production if both firms choose to enter. In this case, policy (i) can become the optimal FDI subsidization policy. For example, consider the case where $c_A = c_B = 0, c_I = c = \Delta, s_A = s_B = s, m = n = 2$ and $\Delta \geq \Delta_{\min} > 0$. To make the point in the clearest way and without loss of generality, assume that $s = 1$ (complete spillovers). Then, we have $W^{AB} = 0.32a^2, W^B = 0.35(a - \Delta)^2, W^N = 0.35(a - 2\Delta)^2, \pi_A^A = (a - \Delta)^2/24$, and $\pi_B^B = (a - \Delta)^2/36$. Hence, simultaneous entry by firms A and B enhances domestic welfare and indeed domestic welfare is the highest under this entry pattern if Δ is not too small. Therefore, policy (i) is more desirable than policy (ii) if $W^{AB} - W^B > (F - \pi_A^A) - (G - \pi_B^B)$, i.e., if $0.32a^2 - 0.28(a - \Delta)^2 > F - G$.

Similarly, for the case that $G > \pi_B^{AB}$ and $\pi_A^{AB} > F > \pi_A^A$, in the absence of an FDI subsidy it is the dominant strategy for firm B to not enter, and firm A enters only if firm B does.

This implies that an FDI subsidy granted to firm B can induce both firms to enter, whereas an FDI subsidy to firm A does not induce entry by firm B .

A general point can be made here. Due to the presence of complementarities in production, FDI subsidization at certain stages of an industry (in particular those with high entry costs relative to post-entry profits) may generate multiple benefits to the host country by encouraging FDI inflows into other related production stages of the same industry or into other vertically linked industries.

It was shown earlier in this paper that FDI into different levels of a vertically industry of the host industry may suffer from a coordination problem, namely it may be a Nash equilibrium for both firms A and B to not enter the host country, even when each firm responds by entering if the other firm chooses to enter (Proposition 1). It can easily be seen that for parameter region where two Nash equilibria co-exist: $\{E, E\}$ and $\{N, N\}$, the host country can subsidize one of the firms and make *Enter* a dominant strategy for that firm. If so, the other firm will choose to enter as well.

Of course, FDI subsidies by the host country are only an indirect solution to the coordination problem faced by firms A and B . In the next section, we consider vertical integration between the two firms as a possible solution to the coordination problem and examine its desirability relative to the entry of two independent firms. This analysis also allows us to shed light on the welfare implications of the different *organizational forms* of FDI.

5 Vertical integration and coordination

Suppose that firms A and B enter the host country as a vertically integrated firm, denoted as firm VI , which makes the intermediate good in-house and then transforms it into the final good. Upon entry, the integrated firm competes in the final good market with local firms and has the option to supply the intermediate good to them. If it chooses to supply the intermediate to local final good competitors, it also ends up competing with local intermediate good suppliers.

Vertical integration offers two main advantages to firms A and B . First, since the intermediate good can be secured at marginal cost by the vertically integrated firm, the integrated firm does not suffer from the standard double marginalization problem faced by independent firms. Second, the vertically integrated firm can coordinate its upstream and downstream entry decisions, thereby overcoming the no-entry equilibrium that can arise in the case of entry

by independent firms.

However, there is a subtle trade-off that the vertically integrated firm must also consider. Post entry, such a firm needs to choose the extent to which it will supply the intermediate good to its downstream competitors. On the one hand, demand for the intermediate good from such local competitors represents a lucrative business opportunity for the integrated firm. On the other hand, supplying the intermediate good to its competitors hurts the integrated firm's downstream business since increased competition in the intermediate market lowers the price of the intermediate good. Therefore, it is not obvious whether, post entry, it is optimal for the integrated firm to supply the intermediate good to its rival producers or not.

We next consider this incentive constraint in more detail and show that under the assumptions of our model, the vertically integrated firm chooses *not* to supply the intermediate good to its competitors in order to protect its downstream business.

5.1 The VI firm's incentive constraint

Let q_{VI} denote the quantity of intermediate good that firm VI produces for its own use and Q_{VI} the quantity it produces for sale to other downstream firms. In what follows, we show that it is optimal for the integrated firm to set $Q_{VI} = 0$.

Given the intermediate price w determined by the competition among suppliers of the intermediate good z , all downstream firms compete in Cournot fashion. The marginal cost of production for the VI firm equals $c_A + c_B$ while that for all other downstream firms equals $w + c - s_B(c - c_B)$ since they purchase the intermediate good from upstream suppliers. The derived demand for the intermediate good is $Q_d(w) \equiv q_1(w) + \dots + q_n(w)$, where $q_j(w)$ is the Cournot quantity of the other firms in the downstream sector, $1 \leq j \leq n$.

As an integrated unit, firm VI maximizes the sum of its upstream and downstream profits $\pi_z^{VI}(Q_{VI}, Q_{-VI}) + \pi_y^{VI}(w)$, where Q_{-VI} denotes the aggregate output level of other upstream firms. Obviously, $\pi_y^{VI}(w)$ increases in w . Given Q_{-VI} , the best response of firm VI in the upstream sector is determined by the following first order condition:

$$\frac{\partial \pi_z^{VI}(Q_{VI}, Q_{-VI})}{\partial Q_{VI}} + \frac{\partial \pi_y^{VI}(w)}{\partial w} \frac{\partial w}{\partial Q_{VI}} = 0. \quad (5)$$

If Q_{VI} increases, the equilibrium price w of the intermediate good z goes down, which lowers the costs of local downstream firms and thus hurts firm VI 's profit in the downstream market. Hence the second term on the left-hand-side of the equation captures the “*helping the*

rivals effect” created by the integrated firm’s decision to supply the intermediate to them: $\frac{\partial \pi_y^{VI}(w)}{\partial w} \frac{\partial w}{\partial Q_{VI}} < 0$. The following result, proved in the Appendix, informs us that for linear demand this negative effect is so strong that the vertically integrated multinational chooses to not sell the intermediate good it produces in-house to rival downstream producers:

Lemma 2: *It is optimal for the vertically integrated multinational to not supply the intermediate good to its downstream rivals: $\frac{\partial \pi_z^{VI}(Q_{VI}, Q_{-VI})}{\partial Q_{VI}} + \frac{\partial \pi_y^{VI}(w)}{\partial w} < 0$, for all Q_{-VI} .*

Thus, FDI by a vertically integrated multinational firm does not create *any* forward linkage effects for local final good producers.¹² Nor does it generate any backward linkage effects for local intermediate suppliers, since it produces the intermediate good by itself. Rather, the derived demand for the intermediate good declines after the entry of the vertically integrated firm by reducing the output of other downstream producers for any given w . However, relative to the case of FDI by two independent firms (A and B), entry under vertical integration avoids the double markup problem since the downstream unit of the integrated FDI firm buys the intermediate good from the upstream unit at marginal cost; this tends to lower the price of the final good and partly benefits the host country.

It is straightforward to derive the price of the intermediate good under vertical integration. We have

$$w^{VI} = \frac{\tilde{a} + m[c_I - s_A \Delta_A]}{m + 1} \quad (6)$$

where $\tilde{a} \equiv [a - 2(c - s_B \Delta_B) + c_A + c_B] / 2$. The equilibrium output and profit of firm VI are

$$q^{VI} = \frac{(2m + n + 2)(a - c_A - c_B) + 2mn((1 - s_A)\Delta_A + (1 - s_B)\Delta_B)}{2(m + 1)(n + 2)} \quad (7)$$

and

$$\pi^{VI}(s_A, s_B, m, n) = [q^{VI}]^2, \quad (8)$$

respectively.

Having described the behavior of the vertically integrated unit, we now turn to two central questions. First, under what circumstances do the two firms find it beneficial to vertically integrate? Second, how does domestic welfare under entry by the vertically integrated firm compare with entry by independent firm A and B ?

¹²Note that this result need not obtain when demand is non-linear.

5.2 Vertical integration versus uncoordinated FDI

While vertical integration overcomes the coordination problem faced by independent firms A and B and also helps avoid double marginalization, it is not always more profitable for them to vertically integrate since the vertically integrated firm VI foregoes profit that can be earned by supplying the intermediate good to other downstream firms. This trade-off delivers the following result:¹³

Proposition 6: *Suppose $c_A = c_I$ and $c_B = c$. Then, for any given m , there exists an $n^{VI}(m)$ such that (i) $\pi^{VI} > \pi^{AB} \equiv \pi_A^{AB} + \pi_B^{AB}$ if and only if $n < n^{VI}(m)$ and (ii) $\frac{dn^{VI}(m)}{dm} > 0$.*

The proof of this proposition involves a straightforward comparison of the relevant profit functions that can be solved for n^{VI} – the analytical expression for which is somewhat tedious and therefore not reported (we plot $n^{VI}(m)$ below in Figure 3). The intuition for part (i) Proposition 6 is easy to grasp. Part (i) basically says that the incentive for a vertically integrated firm to enter the host industry is stronger than that of two independent firms if and only if the number of local final good producers is sufficiently small – i.e. $n < n^{VI}(m)$. This is because a reduction in the degree of downstream competition (i.e. a fall in n) lowers the opportunity cost of not supplying the intermediate good to rival downstream firms whereas it increases the degree of double marginalization problem. Both of these effects reinforce each other so that a decrease in n makes vertical integration relatively more attractive to firms.

Consider part (ii) of Proposition 6 which says that $n^{VI}(m)$ increases in m . The intuition for this result is as follows: as the intermediate market becomes relatively more competitive, the price of the intermediate good approaches marginal cost and profits earned from selling the intermediate to local final good producers decline which in turn increases the incentive to vertically integrate.

Taken together, the two parts of Proposition 6 point out that the incentive for vertical integration depends upon the degree of market competition at both stages of production. Holding n constant, an increase in m makes vertical integration more attractive by reducing the profitability of selling the intermediate to local producers. On the other hand, holding m constant, an increase in n makes vertical integration less desirable by increasing the opportunity cost of not selling the intermediate to local final good producers.

Consider now the choice between the entry of a vertically integrated firm and that of two

¹³For simplicity, we focus on the case without spillovers.

independent firms from the viewpoint of the host country. We can show the following:

Proposition 7: *Suppose $c_A = c_I$ and $c_B = c$. Then, there exists a threshold degree of downstream competition $n_w^{VI}(m)$ such that*

$$W^{VI} > W^{AB} \text{ if and only if } n > n_w^{VI}(m) \text{ where } \frac{dn_w^{VI}(m)}{dm} > 0.$$

While the analytical expression for $n_w^{VI}(m)$ is tedious, we can plot it using Maple (see Figure 3) from where we observe that $n_w^{VI}(m) > n^{VI}(m)$. To understand the intuition behind Proposition 7 it is useful to first consider a comparison of $\langle VI \rangle$ and the FDI entry pattern $\langle B \rangle$. Note that since the vertically integrated firm does not supply local downstream competitors, under both $\langle VI \rangle$ and $\langle B \rangle$ competition increases (only) in the final good market. However, there is a crucial difference between the two entry patterns: while the entry pattern $\langle B \rangle$ creates additional backward linkages in the local industry by raising the derived demand for the intermediate good, no such effect arises under $\langle VI \rangle$ since the vertically integrated firm does not buy the intermediate locally but rather produces it in-house. But this beneficial backward linkage effect of entry pattern $\langle B \rangle$ relative to $\langle VI \rangle$ has to be weighed against the fact that the degree of double marginalization problem in the local industry is worse under $\langle B \rangle$ relative to $\langle VI \rangle$ – under $\langle B \rangle$ all downstream firms purchase the intermediate at a mark-up whereas under $\langle VI \rangle$ only local firms do so. Intuition suggests that when the number of downstream firms (n) is large relative to the number of upstream firms (m), the increase in the derived demand or the backward linkage effect of entry pattern $\langle B \rangle$ would be minor whereas the degree of double marginalization problem in the local industry would be significant due to the relative lack of competition in the intermediate market. As a result, under such circumstances we would expect domestic welfare to be higher under the entry pattern $\langle VI \rangle$ relative to that under $\langle B \rangle$. Indeed, it is straightforward to show that $W^{VI} > W^B$ if and only if $n > 4m - 2$.

Once the welfare comparison of $\langle VI \rangle$ and $\langle B \rangle$ is understood, it is relatively easy to contrast $\langle VI \rangle$ and $\langle AB \rangle$. As we noted earlier in Proposition 2, the FDI entry pattern $\langle AB \rangle$ yields lower domestic welfare than the FDI entry pattern $\langle B \rangle$ for all m and n , due to the linkage-offsetting effect inherent to $\langle AB \rangle$. Furthermore, it is straightforward to show that that $n_w^{VI}(m) < 4m - 2$. Proposition 7 and the preceding inequality together imply that a weaker parameter restriction needs to be satisfied for domestic welfare under $\langle VI \rangle$ to be higher than that under $\langle AB \rangle$.

Note the *contrast* between what foreign firms prefer and the welfare ranking of the host country implied by Propositions 6 and 7. In particular, note that while vertical integration

obtains whenever $n < n^{VI}(m)$, the domestic economy is better off under such integration whenever $n > n_w^{VI}(m)$. This implies the following corollary:

Corollary 1: *If $n > n^{VI}(m)$, firms A and B choose not to vertically integrate whereas domestic welfare is higher under vertical integration. If $n_w^{VI}(m) \leq n \leq n^{VI}(m)$, vertical integration is preferred both by firms as well as the host country. Finally, if $n < n_w^{VI}(m)$, firms A and B prefer to enter as an vertically integrated firm whereas host country welfare is strictly higher under independent entry.*

– Insert Figure 3 here –

Figure 3 shows that there is harmony between choices of foreign firms and domestic welfare only when both stages of production are relatively competitive. When the final good market is relatively competitive and the intermediate good market less so, the firms choose not to vertically integrate whereas the host country would be better off if they were to do so. By contrast, when the intermediate market is quite competitive whereas the final good market is not, the two firms prefer to vertically integrate whereas the domestic economy is better off under separate entry.

6 Export-oriented FDI

Thus far, our analysis assumes that FDI firms sell all their output in the domestic market, where they compete with local firms. In this section, we briefly discuss how our model is modified if FDI is export-oriented rather than geared towards serving the domestic market. We consider exporting of the final product only, i.e. either firm VI or B export only their final products and their respective entries into the host country are motivated by the lower cost of production and/or a cheaper supply of the intermediate good. Furthermore, for simplicity, we assume that the domestic firms do not export, perhaps due to product quality considerations and/or lack of overseas distribution channels etc.

If firm B exports all of its output to a foreign market, the competition effect of its entry on local final good producers is no longer present. However, the indirect effect on local competitors still exists: firm B 's local sourcing of the intermediate good raises its price and this hurts local final good producers. This indirect effect would be especially strong if the magnitude of its

exports is large.¹⁴ Thus, even in this case of export-oriented FDI, firm B 's entry may still lower domestic welfare relative to autarky (unless it generates significant spillovers to local firms).

Note also that this indirect effect of firm B 's entry on the intermediate good market exists regardless of whether firm A enters or not. If firm A also enters, the degree of competition in the intermediate market increases and the indirect effect of firm B 's entry is weakened. However, under the entry pattern $\langle AB \rangle$, the linkage-offsetting effect identified in Proposition 2 come into existence. Hence, the result that domestic welfare may be lower if both firms A and B enter relative to when only one of them enters would still hold.

A key question of interest in the context of export oriented FDI is whether the vertically integrated firm would still find it optimal to not sell its intermediate good to competing local firms. Let q_{Ex}^{VI} denote that optimal quantity of the final product that the vertically integrated firm VI chooses to export, given its marginal cost of production $c_A + c_B$, the demand conditions in the foreign market and any per unit transportation cost t incurred from exporting.

It is useful to consider two separate scenarios: one where the vertically integrated firm exports all of its output and another where it serves both markets. In the first case, FDI in the local economy is *purely export-oriented* and such FDI indeed occurs in many countries in especially designated areas called export processing zones. When FDI is intended only for exports, the vertically integrated firm does not compete with local final good producers (given that they do not export). If so, there is no reason for the vertically integrated firm to not supply the intermediate good to local producers (so that Lemma 2 no longer holds).¹⁵ The profit of the vertically integrated firm then equals its profit from selling the intermediate good in the local market, which is essentially the same as π_A^A , plus its profit from exporting the final product to the foreign market, π_{Ex}^{VI} . Interestingly, in this case a "must export" policy of the host country not only shields local producers from competition with the vertically integrated firm, it also ensures that they have access to the intermediate good produced by that firm. Of course, the local suppliers of the intermediate good are likely to lose from competition from

¹⁴For example, if the demand for the final product in the foreign market is given by $p_{EX} = \beta - y_{EX}$ and firm B is the monopoly supplier in that market, then the quantity of the intermediate good it buys from the host country is $y_{EX}^B = (\beta - c_B - t)/2$, where t is the transportation cost associated with exporting. If β is large, then B 's entry will cause a large increase in the price of the intermediate good in the host country. It can be shown that a result similar to Lemma 1 holds: i.e. the equilibrium price of the intermediate good rises following firm B 's entry.

¹⁵We thank an anonymous referee for pointing out this difference between market-oriented FDI and export-oriented FDI.

the vertically integrated firm when it chooses to serve local final goods producers.

Now consider the second scenario where the vertically integrated firm exports as well as sells the final good in the domestic market. In this case, whether the firm chooses to supply the intermediate to local final good producers depends on cost conditions. If, as is assumed in the model here, the marginal cost of producing the final good is constant, then regardless of the level of its exports, the vertically integrated always sells the final good in the domestic market. In this case, it competes with local firms in the final good market and will therefore choose not to supply the intermediate good to them because of the "helping the rivals" effect such supply creates. However, if the vertically integrated firm's marginal cost of producing the final good is not constant but increasing, and the foreign market is sufficiently large, then a rather large volume of exports can make it profitable for the firm to not sell its final good in the domestic market. If this is the case, local competition in the final goods market is no longer a concern and the vertically integrated firm will choose to sell the intermediate good to domestic final good producers.

How does the possibility of exporting affect the vertical integration decision? We argue below that this choice can be affected in either direction. To see this, consider the entry pattern $\langle AB \rangle$ where firms A and B enter the host country as separate firms. It suffices to consider the case where firm B exports all its output. In this case, unlike the vertically integrated firm, the entry of firm B generates backward linkage effects for the host country, as its exports add to the derived demand for the intermediate good. These linkages benefit local suppliers as well as firm A . Relative to the case of VI , firm A 's profit is higher than π_A^A because of the increase in derived demand, whereas firm B 's profit, denoted as $\pi_{Ex}^B(w)$, is lower than that of firm VI because firm B must buy the needed intermediate good in the domestic intermediate market whereas firm VI makes the intermediate good in-house and secures it marginal cost. As a result, the aggregate profits of firms A and B may be higher or lower than that of the vertically integrated firm, depending on such factors as the demand condition in the foreign market, the size of the transportation cost, as well as the nature of market structure (i.e. m and n) at both stages of production.

7 Conclusion

In this paper, we construct a two-tier oligopoly model to analyze the incentives for greenfield FDI and its effects on different stages of the local industry. The model is motivated by the

simple observation that while real world FDI flows occur at various production stages of almost all manufacturing and services industries, quite a few of which tend to be oligopolistic in nature, existing literature has tended to focus mostly on FDI in final goods markets. Our two-tier oligopoly model is built on the insight that the complementarity underlying various stages of the production chain creates an interdependence in the FDI entry decisions of multinationals. Such interdependence can in turn lead to a coordination problem: in our two-tier model, FDI at both stages can fail to occur even when it is profitable for both foreign entrants. We argue that a local subsidy to FDI at one level of the domestic industry can sometimes be sufficient to induce FDI at both stages.

The two-tier structure of our model allows us to address some novel welfare questions. For example, is FDI at both stages necessarily better than FDI at a single stage? We provide conditions under which more FDI is better for the local economy as well as when it is not. An important insight underlying this analysis is that if FDI occurs at both stages, part of the vertical linkages created by FDI at any one stage are captured by FDI at the *other* stage. As a result, the local benefits of FDI at one stage of the local industry can be muted by FDI at the other stage. We show that only when the local industry is highly concentrated (or simply non-existent) is FDI at both stages of production is necessarily preferable for the host country.

We also consider firm incentives for vertical integration and the impact such integration has on local welfare. This analysis provides fresh insights regarding the impact various organizational modes of FDI have on firms as well as welfare. We show that from the viewpoint of foreign entrants, vertical integration is not necessarily the optimal arrangement. This is due to the following reasons. On the one hand, vertical integration helps coordinate entry decisions and eliminates the double marginalization problem that arises when firms have market power at both stages of production. On the other hand, the vertically integrated firm foregoes profit that can be earned by supplying the intermediate good to other downstream firms – something the vertically integrated firm does not find optimal to do. As a result, if the final good market is sufficiently competitive, the two foreign firms are better off entering as independent firms as opposed to a vertically integrated one. For related reasons, from the viewpoint of the local economy as well, vertical integration does not necessarily dominate entry by two independent foreign firms.

While our model is rather stylized, it captures some novel and potentially important considerations that arise under a two-tiered production structure with market power at each stage.

For example, we find that technology spillovers from FDI to a foreign firm's local rivals can actually encourage it to enter the local market. The intuition is central to the working of our model: if technology diffuses in the final goods market, it increases derived demand for the intermediate good making entry into that market more attractive which in turn makes FDI into the final good market more attractive as well. Nevertheless, our model is only a first step in the analysis of FDI at multiple stages of production of an oligopolistic industry since it focuses largely on the host country. Future research could shed light on the incentives for and effects of such FDI in models in a multi-country environment.

8 Appendix

Here we collect proofs and calculations omitted from the main text.

Proof of Proposition 2

(i) It can be shown that $W^A \geq W^{AB}$ is equivalent to $(2n^2 + 2n - 1)m^2 + 2mn^2 + 2n^2 + 2n - 2mn - 6m - 1 \geq 0$, which holds if and only if $m = n = 1$.

(ii) It is straightforward to show that $W^B > W^{AB}$ is equivalent to $(2m^2 + 2m - 1)n^2 + (4m^2 + 2m - 4)n + (6m^2 + 8m - 1) > 0$ which holds for all $m \geq 1$ and $n \geq 1$.

Proof of Proposition 3

It is straightforward to show that

$$W^A - W^N = \frac{n(2 + n + 2m - 2mn - m^2n)(a - c_I - c)^2}{(n + 2)^2(n + 1)^2(m + 1)^2}$$

which is positive if $m = n = 1$ and negative otherwise. This proves part (i). Similarly,

$$W^B - W^N = \frac{m(n^2 + 3n + 2 - mn^2 - mn + 5m)(a - c_I - c)^2}{(n + 2)^2(n + 1)^2(m + 1)^2}$$

which implies that (ii) holds.

If $m = n = 1$, $W^{AB} - W^N = \left(\frac{6}{27} - \frac{7}{32}\right)(a - c_I - c)^2 > 0$. For all other $(m, n) \neq (1, 1)$, since $W^A < W^N$ by part (i) of this proposition and $W^{AB} < W^A$ by Proposition 2, we have $W^{AB} < W^N$.

Proof of Lemma 2

Given the price of the intermediate good, w , all downstream downstream firms compete in quantities, yielding the the following equilibrium quantities

$$q_{VI}(w) = \frac{a - (n + 1)(c_A + c_B) + n(w + c - s_B \Delta_B)}{n + 2}, \quad (9)$$

for firm VI and

$$q_1(w) = \dots = q_n(w) = \frac{a - 2(w + c - s_B \Delta_B) + c_A + c_B}{n + 2},$$

for local downstream producers. The derived demand for the intermediate good is thus

$$Q_d(w) = q_1(w) + \dots + q_n(w) = n \frac{a - 2(w + c - s_B \Delta_B) + c_A + c_B}{n + 2},$$

or equivalently

$$w = \tilde{a} - \frac{n + 2}{2n} Q_d = \tilde{a} - \frac{n + 2}{2n} [Q_{VI} + Q_{-VI}], \quad (10)$$

where $\tilde{a} \equiv [a - 2(c - s_B \Delta_B) + c_A + c_B] / 2$.

The total profit of VI is

$$\begin{aligned} \pi_z^{VI} + \pi_y^{VI} &= (w - c_A)Q_{VI} + (p - c_A - c_B)q_{VI} \\ &= \left[\tilde{a} - c_A - \frac{n + 2}{2n} (Q_{VI} + Q_{-VI}) \right] Q_{VI} \\ &\quad + [a - c_A - c_B - (Q_{VI} + Q_{-VI} + q_{VI})] q_{VI}. \end{aligned}$$

Straightforward algebraic simplifications yield

$$\frac{\partial(\pi_x^{VI} + \pi_z^{VI})}{\partial Q_{VI}} = \frac{-2n(c - c_B)(1 - s_B) - (n + 4)Q_{VI} - 2Q_{-VI}}{2n} < 0.$$

This completes the proof.

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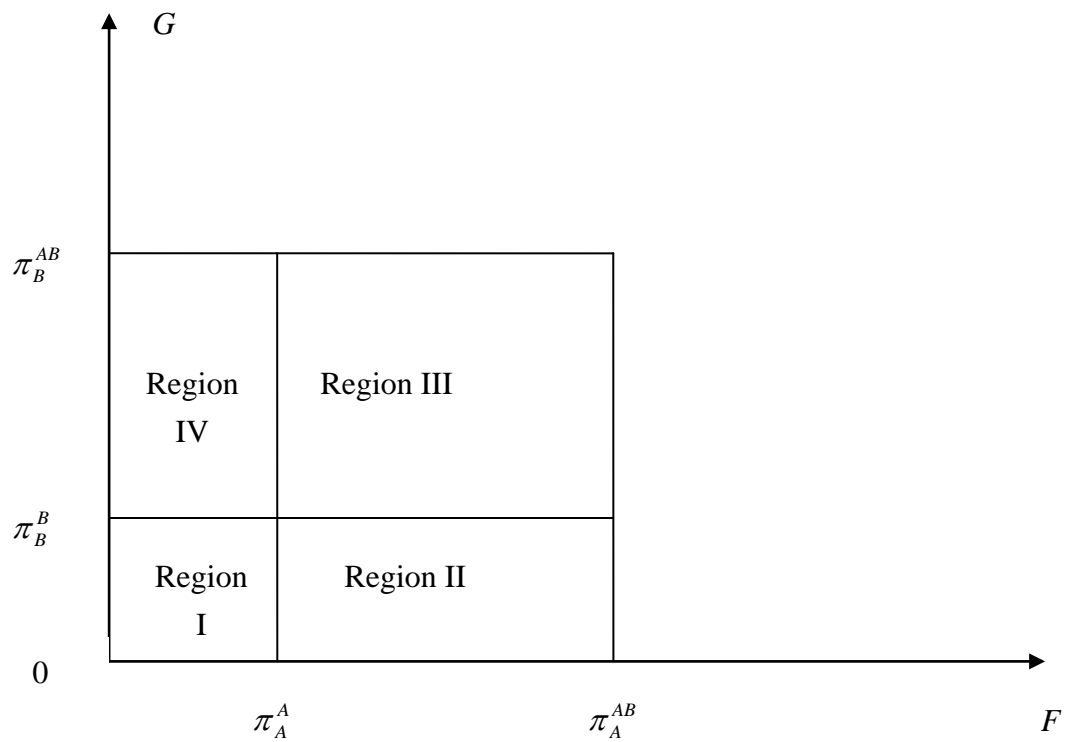


Figure 1: Equilibria of the FDI Entry game

Region I: Entry is the dominant strategy for both firms A and B .

Region II: Entry is the dominant strategy for firm B and the best response for firm A .

Region III: Two Nash equilibria exist: either both firms enter or neither does.

Region IV: Entry is the dominant strategy for firm A and the best response for firm B .

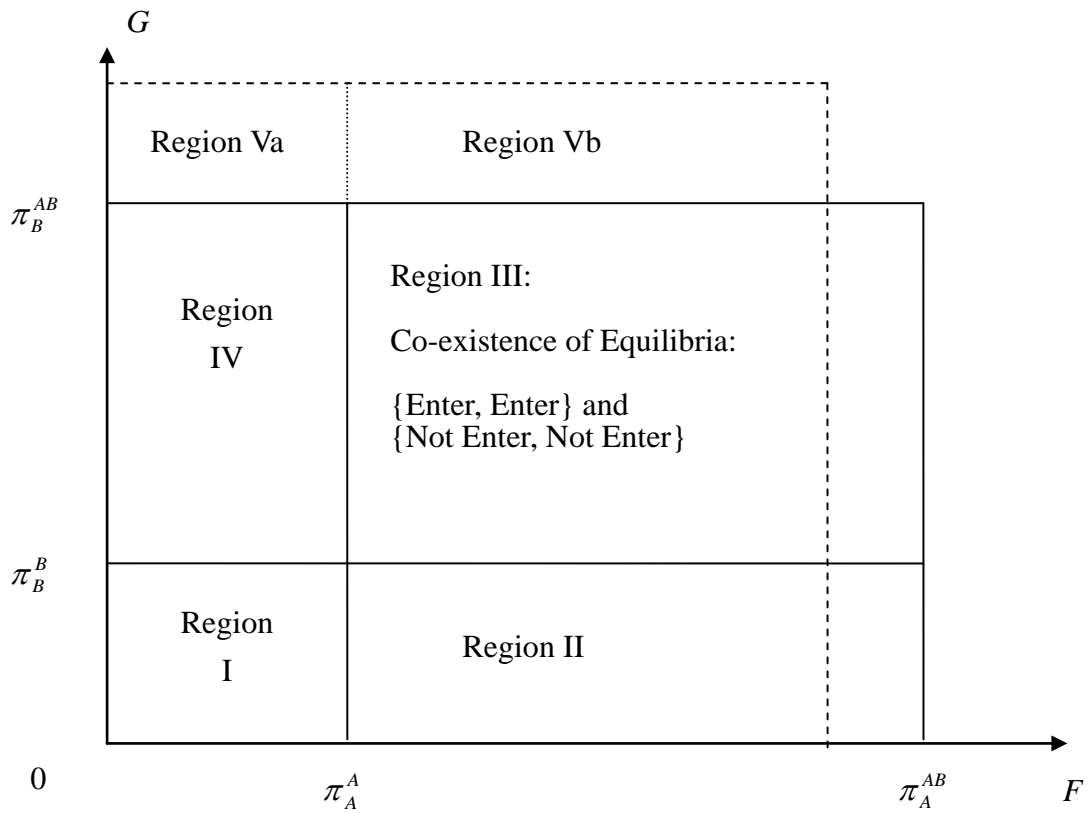


Figure 2: Effects of an increase in technology spillovers upstream (s_A)

An increase in s_A lowers both π_A^A and π_A^{AB} but raises π_B^{AB} . For parameter values of (F, G) in Region Vb, FDI by neither firm is profitable before the increase in s_A . At a higher level of s_A , however, it is a Nash equilibrium for both firms A and B to enter.

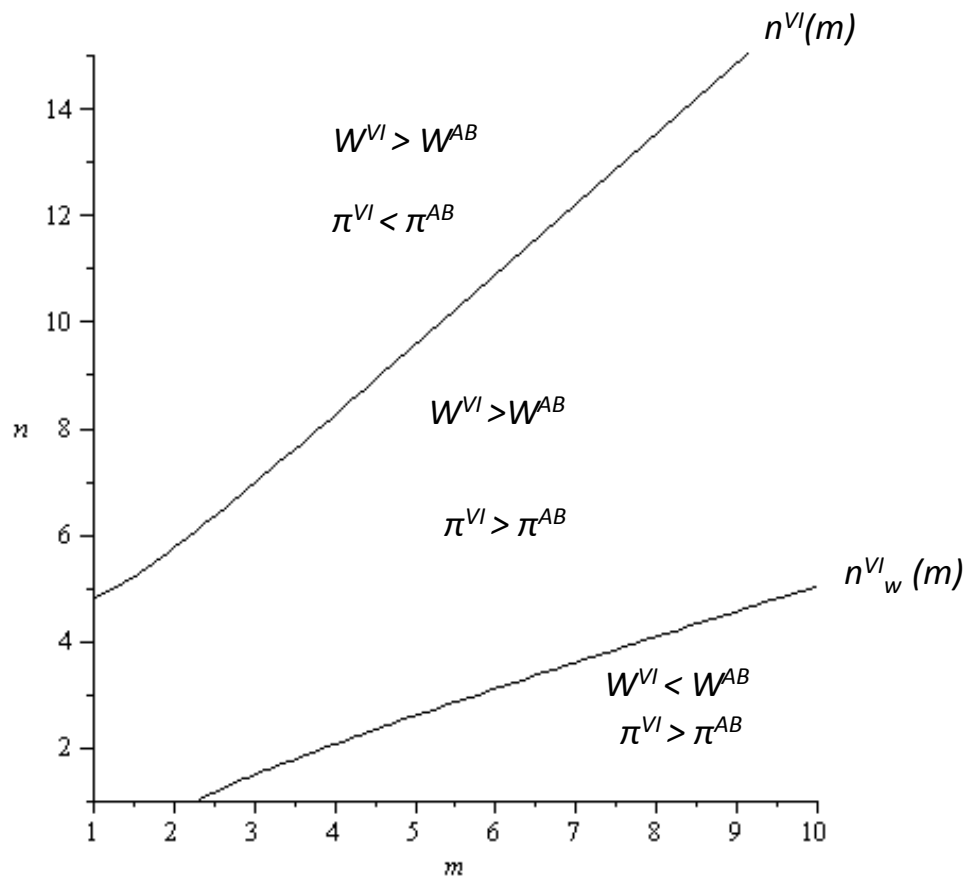


Figure 3: Vertical integration versus independent entry