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Multinational Firms and Backward Linkages: A Critical Survey and a Simple Model

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There exist two opposing views in development economics regarding the effect of foreign direct investment (FDI) on a host country's industrial development. According to one view, multinationals are seen as agents that increase competition in the host economy, transfer modern technology, and help achieve a more efficient allocation of resources. Furthermore, this optimistic view argues that inward FDI pushes the process of industrial development forward by creating linkages with the rest of the economy.[1] This view is challenged by those that are concerned about the substantial market power enjoyed by multinationals and the negative effects that can arise from such market power.

In this chapter, we develop a simple model that explores FDI's effect on backward linkages and that accommodates both of these preceding views. The model considers the effects of a multinational's entry that enjoys market power and also transfers technology to the local economy. We also provide a detailed discussion of the existing analytical work on FDI and backward linkages in order to highlight the contribution made by our model and to indicate avenues for future research.

Basically, we argue that the degree to which FDI creates linkages with the rest of the economy should be a function of the technology transferred

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1. The concept of linkages is drawn from Hirschmann (1958). See Moran (1998, 2001) for recent comprehensive surveys of FDI's effects on the economic development of host countries.

by multinational firms. We explore the connection between technology transfer and linkages by focusing on a single industry with a two-tier production structure. In the model, production of the final good requires an intermediate input that is produced by m local suppliers ($m \geq 1$).[2] The final good is produced by n local firms ($n \geq 1$) and a single multinational firm. The model contrasts market equilibrium under autarky with that under entry by the multinational firm.

Relative to autarky, the multinational firm's entry has two conflicting effects on the degree of backward linkages in the domestic industry. On the one hand, such entry lowers the degree of backward linkage because the output level of a typical local firm shrinks relative to autarky due to competition from the multinational (competition effect). On the other hand, the multinational also sources the intermediate locally and thereby generates additional demand for the intermediate good (demand effect). The main result is that the net effect that the multinational has on the degree of backward linkages in the local economy (as well as on the profitability of local suppliers of the intermediate good) depends on the technological asymmetry between the multinational and its local competitors. When the multinational has only a moderate technological advantage over local firms, its entry increases both the degree of backward linkage and the profitability of local suppliers. However, when the multinational's advantage over local firms is large, its entry has exactly the opposite effect.

The above results depend upon two crucial underlying assumptions: the multinational (1) sources the intermediate in the local market, and (2) its technology is superior to that of its local competitors. The local sourcing assumption captures the idea that inward FDI in the production of the final good creates demand for local suppliers. The production of most manufactured goods requires multiple intermediate goods and services, all of which are tradable to different degrees. What is important for the logic underlying this model is that the multinational chooses to source some intermediates locally (due to policy measures or constraints imposed by the nature of production technologies such as just-in-time inventory). So long as tradable intermediates are complementary to those that must be sourced locally, the effects captured by the model will remain relevant.

The assumption that the multinational has more advanced technology than its local competitors hardly needs defense. In fact, the theory of the multinational firm is itself built on the premise that multinationals rely on intangible assets such as superior technology to successfully compete with local firms that are better acquainted with the host country environment (Markusen 1995). A wealth of evidence indicates that multinationals usu-

2. In a similar model, Roy and Viaene (1998) examine the incentives to undertake FDI in the intermediate goods market when downstream firms import the intermediate from abroad. By contrast, this chapter examines FDI's effects in the final goods market.

ally possess technologies that are superior to those of local firms in developing countries (see Markusen 1995; Moran 1998; and Saggi 2002). For example, in recent years, over 80 percent of global royalty payments for international transfer of technology were made from subsidiaries to their parent firms (UNCTAD 1997). Similarly, during 1985–97 between two-thirds and nine-tenths of technology flows were intrafirm in nature.

The view of backward linkages that is captured in the model is somewhat novel, since the model is one of oligopolistic competition. For example, the price response of the intermediate good to the multinational's entry implies that profits of local firms decline for two separate reasons. First, local firms lose because competition from a more efficient firm reduces their market share. Second, they suffer from the increased price of the intermediate good caused by the demand effect.[3] Thus, the model highlights another channel through which the entry of multinationals can affect their local rivals. It is worth noting that the intermediate good in our model can also be thought of as a specialized/skilled labor that has some market power (for example due to unionization) or is available in short supply because of which the multinational's entry leads to an increase in its price (as illustrated in Glass and Saggi 1999).

Empirical studies indicate that the positive impact of FDI on local suppliers may be even greater in the presence of vertical technology transfer (VTT) from multinationals (see Batra and Tan 2002 for evidence of such vertical transfers in Malaysia; Javorcik 2004 for the case of Lithuania; and Lall 1980 for India). Case study evidence also indicates that such transfers are pervasive. For example, Moran (1998) notes that the performance of the Mexican auto parts industry was improved (as per the admission of the suppliers themselves) due to the readiness of multinationals to invest in high quality vertical relationships. As per Peres Nuñez (1990), multinationals in the Mexican automotive sector conducted production audits, held weekly coordination meetings, and provided technical training in zero-defects and just-in-time procedures to their suppliers. Similarly, in the electronics sector, Moran (2001) notes that in Malaysia, foreign investors helped their local subcontractors keep pace with modern technologies by assigning technicians to the suppliers' plants to help set up and supervise large-volume automated production and testing procedures. Similar evidence exists for other sectors and countries, and such evidence is discussed in great detail in Moran (1998, 2001).

It is clear that local suppliers benefit from vertical technology transfer. However, it is worth noting that the local competitors of the multinational also stand to partially benefit from such technology transfer due to decline in the cost of production of the intermediate good. To fully evaluate the

3. In Markusen and Venables' (1999) monopolistic competition model, equilibrium prices of intermediate goods do not respond to the entry of multinationals—see their equation 7.6.

effects of vertical technology transfer, the model is extended to allow for the possibility of such transfer from the multinational for the case of two final good producers and one local supplier. We find that vertical technology transfer necessarily benefits the local firm whereas the multinational gains only when its technological advantage over the local firm is moderate. Furthermore, there exist levels of technology transfer that can make even the local firm better off relative to autarky.

Existing Analytical Work on Linkages

A voluminous informal as well as empirical body of literature exists on backward linkages. For example, the 1996 issue of the *UN World Investment Report* was devoted entirely to the effects of FDI on backward linkages in host countries. However, analytical models that explore the relationship between multinationals and backward linkages in the host country are scarce. To the best of our knowledge, only a few such studies exist: Markusen and Venables (1999) and Rodriguez-Clare (1996) are two prominent examples. Both studies provide important insights regarding the two-way relationship between multinationals and linkages. Markusen and Venables (1999) note that multinationals can have a profound effect on backward linkages, industrial development, and the welfare of the host country if their entry affects the structure of imperfectly competitive industries. In fact, one can make a stronger statement: Since multinationals operate mostly in oligopolistic industries, their entry must have substantial effects on local market structure, especially in small developing countries.

In the models of Rodriguez-Clare (1996) and Markusen and Venables (1999) the intermediate goods sector is monopolistically competitive so that the effects of foreign investment occur by altering the incentives for entry into such markets. In both models, Ethier's (1982) formulation of the so-called love-of-variety production function for final goods lies at the heart of the interaction between multinationals and local suppliers. These models omit strategic considerations that arise in oligopolistic environments and instead emphasize the demand-side effects of multinationals' entry on the host economy. In addition, the Markusen and Venables model also allows for a competition effect wherein the entry of a multinational damages its local rivals.

Alfaro and Rodriguez-Clare (2003) use plant-level data from several Latin American countries to evaluate the linkage effects of multinational firms. Their empirical work is motivated by a modified version of the model presented in Rodriguez-Clare (1996); they make the important point that many empirical studies lack a tight link to existing theoretical models and often use inappropriate measures to evaluate the linkage effects of multinationals. However, with a few exceptions, it appears that empirical

researchers have not been provided with theoretical models that provide tight empirical predictions.

While existing models focus mostly on the demand pulling effect of the entry of multinationals, in Lin and Saggi (2004) we consider how such an entry might affect the supply side of the intermediate good sector. In particular, we raise the following questions: First, what is the relationship between VTT from a multinational to its local suppliers and the equilibrium degree of backward linkages? Second, and more importantly, how does the nature of contractual relationships between multinationals and their local suppliers affect the degree of backward linkages in the local industry?

To address these questions, we develop a two-tier model in which the production of a final good requires an intermediate good and market structure at both stages of production is oligopolistic. Upon entry, the multinational sources the intermediate good locally and also engages in VTT to its suppliers guided by a contractual agreement. Two types of contractual relationships are considered: one in which suppliers must abide by an exclusivity condition that precludes them from serving the multinational's local rivals and another in which they face no such restriction.

We note that exclusivity necessarily implies delinking between local firms and their suppliers. Such delinking makes the intermediate good market less competitive due to market separation (or foreclosure of competition) and causes the total output of the intermediate good (as well as the final good) to shrink. The delinking effect is reminiscent of an astute observation made by Rodriguez-Clare (1996): When analyzing the effect of multinationals on backward linkages in a host country, it is important to recognize that multinationals do not just create new linkages—they also displace preexisting linkages between local firms and suppliers. In our model, such displacement occurs contractually whereas in Rodriguez-Clare (1996) it occurs if the multinational finds it optimal to source intermediates from its source country headquarters (which is the case when communication costs are high).

Our model (Lin and Saggi's 2004) permits an investigation of conditions under which the multinational prefers to impose exclusivity on its local suppliers as well as factors that lead the latter to accept such a condition. In general, a multinational faces conflicting incentives regarding the usages of exclusivity. On the one hand, the multinational has a strategic incentive to prevent its local rivals from benefiting from VTT, which can be accomplished via exclusivity. On the other hand, the multinational would also like a large number of suppliers to serve it in order to secure the intermediate at a more competitive price. However, exclusivity tends to discourage local suppliers from serving the multinational since they have to give up the opportunity of serving other local producers. It turns out that, in equilibrium, the multinational is able to implement exclusivity if and only if the extent of VTT exceeds a critical level. By contrast, when the degree of VTT is low, only a

small number of local suppliers are willing to accept an exclusivity contract, which leads the multinational to prefer nonexclusivity.

While several insightful analyses of backward linkages exist, the model developed below and the one presented in Lin and Saggi (2004) are among the few that allow for oligopolistic competition in the product market and market power in the intermediate good's production. These models complement the insights provided by existing literature that focuses mostly on models of monopolistic competition in which free entry typically erodes all rents.

A Research Agenda

In our view, there are at least three main areas that deserve further research:

- Existing literature has not adequately addressed the connection between technology transfer and backward linkages. The analytical literature on multinationals and technology transfer is vast and has been surveyed by Blomström and Kokko (1998) and Saggi (2002). However, with the exception of Pack and Saggi (2001) much of this literature has ignored VTT between multinationals and their suppliers. This is unfortunate since empirical evidence on VTT is quite positive—see Lall (1980), Moran (1998), Blalock and Gertler (2002), and Javorick (2004).[4] In the model below, we consider the impact of both horizontal and VTT on the degree of backward linkages.
- In general, the literature on backward linkages has ignored strategic interaction among multinationals despite the evidence that multinationals are quite responsive to each other's choices. For example, one feature of Markusen and Venables' (1999) model is that there is free entry in the intermediate market and suppliers do not behave strategically. While facilitating the discussion of variety-enhancing backward linkage effects, models of monopolistic competition cannot address issues for which strategic interaction between firms is important. For instance, by raising the demand for the intermediate goods, the entry of multinationals may strengthen the research and development (R&D) incentives of local suppliers (to lower production costs and/or to improve quality). Such R&D-type backward linkage effects may be better addressed in an oligopolistic model rather than in a monopolistic competition model.[5]

4. Cheung and Lin (2004) allow for both horizontal and vertical spillovers in their recent empirical study of FDI and innovation in China.

5. We plan to pursue such R&D type backward linkage effects in an oligopolistic model in future research.

- Not enough is known about the nature of vertical relationships between multinationals and their local suppliers. In particular, the literature has focused exclusively on market interaction and paid insufficient attention to the nature of contracts between multinationals and their local suppliers. As argued in the introduction, contractual relationships are particularly relevant in the context of technology transfer, as they might help multinationals safeguard their intellectual property. Contractual agreements may cause market separation in the intermediate good sector, thus affecting the degree of backward linkages. Our model (Lin and Saggi 2004) provides some analysis but substantial further work is needed in this area.

Model

Preferences in the domestic economy are quasi-linear over two goods x and y: $U(x,y) = u(x) + y$. Good y serves as a numeraire good, and it is produced under perfect competition with constant returns-to-scale (CRS) technology: one unit of labor produces one unit of y. Labor is the sole factor of production. Because of the CRS technology in the y sector, the wage rate ϖ in the local economy in terms of the numeraire good equals 1.

There are n local firms (also called home firms, or h, and denoted by $j = 1 \ldots n$) and one foreign firm (called multinational and denoted by f) that produce good x. Producers of good x are called firms from hereon. The multinational and its local competitors choose their output levels in a Cournot fashion—i.e., each firm chooses its output taking as given the output levels of its rivals.

For producing one unit of good x the multinational requires λ_f units of labor and μ units of an intermediate good (or service) z. The corresponding technological parameters for local firms are λ_h and μ_h (normalized to 1), where $\lambda_h \geq \lambda_f$ and $1 \geq \mu$. Thus, the multinational's technology can be superior in two different ways: it might either require fewer workers per unit of output or fewer units of the intermediate good z (or both). Note that if $\mu < \lambda_f/\lambda_h$ then the multinational is a less intensive user of the intermediate good z than the local firm (as in Markusen and Venables 1999).

Given these technologies, the marginal cost of production under FDI for firm j is given by

$$c_j^F = \lambda_j.1 + \mu_j \omega^F = \lambda_j + \mu_j \omega^F \tag{7.1}$$

where ω^F denotes the price of the intermediate under FDI and $j = h, f$. The intermediate good z is produced by m local producers (which we call suppliers from hereon). One unit of the intermediate requires θ units of labor.[6]

6. Later in the chapter, we allow for cost-lowering technology transfer from the multinational to local suppliers.

By assumption, the multinational must source the intermediate from local suppliers. Of course, the greater the extent to which production of good x requires some nontradable services the greater the relevance of the assumption of local sourcing.[7]

Let $p(Q)$ be the inverse demand function for good x generated by consumer optimization, where Q is total consumption of good x and p denotes its price. Let q_j denote the output produced by firm j, where $j = h, f$. Given the demand function, firm j's profit function under regime k, where $k = A$ (autarky), F is given by

$$\pi_j^k(q_j, q_{-j}) = [p(Q) - c_j^k] q_j \tag{7.2}$$

where $j = h, m$, and c_j^k denotes a firm's marginal cost of production under regime k. To simplify the analysis, assume that the inverse demand function is linear:

$$p(Q) = \alpha - Q \tag{7.3}$$

where Q denotes the total output of the final good and α denotes home market size. To establish a benchmark for our analysis, we begin by describing the market equilibrium under autarky—a situation where the multinational cannot enter the local market.

Autarky

Under autarky, the multinational cannot supply any output to the local market (so $q_f = 0$) and home firms compete with each other buying the intermediate good z from local suppliers. Taking the price of the intermediate ω as given, a typical home firm, h, chooses its output q_j to maximize its profit

$$\text{Max}(p(Q) - \lambda_h - \omega) q_j \tag{7.4}$$

where Q denotes the aggregate output of all local firms. The first-order condition for this problem is given by

$$p(Q) + p'q_j - \lambda_h - \omega = 0 \tag{7.5}$$

Using the linear demand function specified in equation 7.3, we have

$$q_j = (\alpha - \lambda_h - \omega)/(n + 1), j = 1 \ldots n \tag{7.6}$$

7. Trade in services has not been liberalized to the same extent as trade in goods. Under the General Agreement on Trade in Services (GATS), countries have made limited commitments to liberalize their services markets. See Hoekman and Saggi (2000).

Summing the above equation yields the derived demand curve for the intermediate good:

$$\omega = \alpha - \lambda_h - Q(n+1)/n \tag{7.7}$$

where $Q = n\, q_j$. Facing the above derived demand curve, suppliers of the intermediate good compete by choosing their respective quantities in Cournot-Nash fashion. The equilibrium output of a typical supplier equals

$$q_i^A = n(\alpha - \lambda_h - \theta)/[(m+1)(n+1)], i = 1 \ldots m \tag{7.8}$$

The price of the intermediate good equals

$$\omega^A = [\alpha - \lambda_h + m\theta]/[m+1] \tag{7.9}$$

The level of backward linkages (BL) under autarky (A) is defined as the total amount of the intermediate good demanded by local firms:

$$BL^A = mq_i^A \tag{7.10}$$

Remark 1: *The degree of backward linkage under autarky increases in the home market size (α) while it decreases in the supplier's unit labor requirement (θ) and in a local firm's unit labor requirement (λ_h).*

Finally, the profit of each supplier equals

$$\pi_i^A = [n/(n+1)]\left[(\alpha - \lambda_h - \theta)/(m+1)\right]^2, i = 1 \ldots m \tag{7.11}$$

while that of each local firm equals

$$\pi_j^A = \left[m^2/(n+1)^2\right]\left[(\alpha - \lambda_h - \theta)/(m+1)\right]^2, j = 1 \ldots n \tag{7.12}$$

In what follows, we next consider market competition under the multinational's entry.

Multinational's Entry into the Market

We are interested in the effect of the multinational's entry on the degree of backward linkages in the economy. In order to determine this effect, the equilibrium in the local market needs to be derived. Given the price of the intermediate good (ω), firms choose their output levels. The multinational firm's output equals

$$q_f = \{\alpha - (n+1)\lambda_f + n\lambda_h - \omega[(n+1)\mu - n]\}/(n+2) \tag{7.13}$$

whereas that of a typical local firm equals

$$q_j = [\alpha - 2\lambda_h + \lambda_f - \omega(2 - \mu)]/(n + 2), j = 1 \ldots n \tag{7.14}$$

The derived demand for the intermediate good is thus given by

$$Q = nq_j + \mu q_f \tag{7.15}$$

which, after simplification, can be written as

$$\omega = [\alpha' - (n + 2)/H(n, \mu)]Q \tag{7.16}$$

where

$$H(n, \mu) \equiv 2n(1 - \mu) + (n + 1)\mu^2 \tag{7.17}$$

and

$$\alpha' \equiv \{(n + \mu)\alpha - n\lambda_h(2 - \mu) + \lambda_f[n - \mu(n + 1)]\}/H(n, \mu) \tag{7.18}$$

Given this, Cournot competition among suppliers yields the equilibrium quantity of each supplier:

$$q_i^F = \{(n + \mu)\alpha - n\lambda_h(2 - \mu) + \lambda_f[n - \mu(n + 1)] - \theta H(n, \mu)\}/[(m + 1)(n + 2)],$$
$$i = 1 \ldots m \tag{7.19}$$

To ease exposition, for the rest of the chapter, assume that $\lambda_h = \lambda_f = \lambda$. Then, the derived demand for the intermediate good can be written as

$$\omega = [(n + \mu)(\alpha - \lambda) - (n + 2)Q]/H(n, \mu) \tag{7.20}$$

Using the above derived demand curve, we can solve for the equilibrium of the model. In particular, the equilibrium quantity of a supplier equals:

$$q_i^F = [(n + \mu)(\alpha - \lambda) - \theta H(n, \mu)] / [(m + 1)(n + 2)] \tag{7.21}$$

and its profit equals

$$\pi_i^F = [(n + 2)/H(n, \mu)][q_i^F]^2 \tag{7.22}$$

The price of the intermediate good is given by

$$\omega^F = [(n + \mu)(\alpha - \lambda) + m\theta H(n, \mu)] / [(m + 1) H(n, \mu)] \tag{7.23}$$

As before, the level of backward linkages (*BL*) under FDI (*F*) is defined by the total output of the intermediate good produced by local suppliers:

$$BL^F = mq_i^F \tag{7.24}$$

Multinational's Effect on Backward Linkages

Relative to autarky, the multinational's entry has two conflicting effects on the degree of backward linkages in the domestic industry. On the one hand, such entry lowers the degree of backward linkages because the output level of a typical home firm shrinks relative to autarky due to competition from the multinational (competition effect). On the other hand, the multinational also starts sourcing the intermediate locally, thereby generating additional demand for the locally produced intermediate good (demand effect). We explore below the conditions under which FDI generates a net positive linkage effect.

The degree of backward linkages under FDI (BL^F) simplifies to

$$BL^F = [m(n+\mu)(\alpha-\lambda) - \theta H(n,\mu)] / [(m+1)(n+2)] \tag{7.25}$$

Comparison with the level of backward linkages in autarky (BL^A) yields the main result of the model, which is:

$$BL^F \geq BL^A \text{ iff } \mu \geq \mu^*(n) \equiv n/(n+1) \tag{7.26}$$

Proposition 1: *The multinational's entry raises the level of backward linkages in the host industry iff its technological advantage over local firms falls below a critical threshold* (i.e., $\mu > \mu^*(n)$).

If μ (the multinational's technological advantage over its local rivals) is small, then the competition effect of the multinational's entry is strong whereas the demand effect (measured by μq_f) is weak. As a result, the multinational's entry lowers the level of backward linkages. If μ is large, the opposite happens: The competition effect is weak, and the demand effect is strong. As a result, the multinational's entry raises the level of backward linkages. It is worth emphasizing that local suppliers actually suffer from FDI when the multinational's technological superiority over local firms is large. This might seem paradoxical, but it is not so. For example, in the limit where $\mu \to 0$, local suppliers are clearly worse off under FDI, since the multinational generates no demand for the local intermediate so that only the competition effect remains.

The fact that $\mu^*(n)$ increases in n, implies that the more competitive the local market (for the final good) is, the less likely it is that the multinational's entry raises the level of backward linkages. This occurs because when a large number of competing firms are in the market, the derived demand effect created by the multinational's entry is rather weak.

The following corollary is worth noting.

Corollary 1: *If the multinational has the same technology as local firms (i.e.* $\mu = 1$*), its entry necessarily raises the level of backward linkages:*

$$BL^F\big|_{\mu=1} = m(n+1)(\alpha-\lambda-\theta) / [(m+1)(n+2)] > BL^A \tag{7.27}$$

Consider now how the multinational's entry affects other equilibrium variables and the profitability of local firms and suppliers. Comparing the price of the intermediate (ω) under FDI (F) to that under autarky (A) yields:

$$\omega^F \geq \omega^A \text{ iff } \mu \geq \mu^*(n) \tag{7.28}$$

Proposition 2: *Compared to autarky, the price of the intermediate (as well as the profit of a typical local supplier) is higher under FDI iff* $\mu > \mu^*(n)$.[8]

How does the multinational's entry affect local firms? The above analysis informs us that local firms stand to lose for two separate reasons. First, they lose because of the competition effect—local firms lose market share to the multinationals. Second, they also lose if the intermediate good becomes more expensive due to the multinational's entry. However, an interesting point to note is the following observation.

Remark 2: *The losses that the local firms suffer from an increase in competition may be partly offset by a reduction in the intermediate price (which happens when* $\mu < \mu^*(n)$*).*

Local suppliers can benefit from FDI not only because of an increase in derived demand but also via technology transfer. We next consider such a scenario.

Vertical Technology Transfer

To facilitate analytical progress, we set $n = m = 1$ (there is only one supplier and one local competitor of the multinational). Under VTT, the multinational transfers technology to the local supplier that lowers its marginal cost from θ to $(\theta - t)$. The variable t can be thought of as the extent (or the quality) of technology transfer. Our first point is the following:

Remark 3: *Technology transfer to the home supplier creates a trade-off for the multinational. On the one hand, it benefits the multinational by lowering the price of the home intermediate. On the other hand, such technology transfer also lowers the cost of production of the multinational's local competitor.*

An immediate question arises: Do conditions under which technology transfer by the multinational makes all three agents (the local supplier, the multinational, and the local firm) better off under FDI exist? It is trivial

8. To see the effect on the profit of a typical supplier, note that

$$\pi_i^F \geq \pi_i^A \Leftrightarrow [(n+\mu)(\alpha-\lambda) - \theta H(n,\mu)]^2 \big/ [(m+1)^2(n+2)H(n,\mu)] \geq n/(n+1)(\alpha-\lambda-\theta)^2 \big/ (m+1)^2 .$$

At $\mu = \mu^*(n)$, we have $n + \mu = H(n, \mu) = n(2 + n)/(n + 1)$ and the above inequality binds. Since π_i^F increases in μ, Proposition 2 holds.

to note that technology transfer always benefits the supplier. The multinational's profit increases with t if and only if

$$\partial \pi_m^F / \partial t > 0 \Leftrightarrow 2q_m^F \left(\partial q_m^F / \partial t\right) > 0 \Leftrightarrow 2\mu > 1 \tag{7.29}$$

Similarly, the local firm's profit increases with technology transfer if and only if

$$\partial \pi_h^F / \partial t > 0 \Leftrightarrow 2q_h^F \left(\partial q_h^F / \partial t\right) > 0 \Leftrightarrow 2 > \mu \tag{7.30}$$

which always holds. The above inequalities imply our second main point.

Remark 4: *While the local firm always benefits from VTT to the supplier, the multinational gains only when its technological advantage over the local firm is moderate.*

Thus, what is not clear is whether the multinational gains from VTT although the local firm necessarily benefits. The intuition for this result is that the reduction in the intermediate price matters more for the local firm, since its technology uses the intermediate more intensively. For the multinational to also gain, its usage of the intermediate good must not be too small. Note also that when the technologies of the two firms are almost symmetric (which happens when μ is close to 1) both firms gain from VTT.

A harder question remains unanswered: Can it be the case that the improvement in the supplier's technology is sufficient to offset the loss the local firm suffers (due to the multinational's entry) relative to autarky? Let t_h define the threshold level of VTT that leaves the local firm indifferent between autarky and FDI:

$$\pi_h^F\left(\omega^F[t_h]\right) = \pi_h^A \tag{7.31}$$

where

$$\omega^F(t) = (\alpha/4)(1+\mu)/(1-\mu+\mu^2) + (\theta - t)/2 \tag{7.32}$$

and

$$t_h = (\alpha/2)[2\mu(\mu-1)-1] / \{[\mu(\mu-1)+1](\mu-2)\} + (2\mu-1)\theta / (2\mu-4) \tag{7.33}$$

Clearly, the bigger the local market, the larger the extent of technology transfer required for the local firm to be indifferent between FDI and autarky. While the algebra gets complicated, intuition suggests (and numerical examples show) that the bigger the technological advantage of the multinational over its local competitor, the larger the threshold t_h. In other words, the local firm would need to be compensated by a large drop in the price of the intermediate when the technology used by the multinational is much superior to its own.

Suppose that the multinational has enough knowledge capital to actually transfer technologies equal to or better than t_h. Given that, is it willing to do so? The answer depends upon how costly technology transfer is for the multinational. If such costs are low (or near zero), the multinational does so when $2\mu > 1$.

Finally, how does technology transfer to local suppliers alter the degree of backward linkages in the local industry? As expected, technology transfer by the multinational enhances the degree of backward linkages in the local industry.[9]

Conclusion

A classic issue in economic development is the effect multinational firms have on the industrial development of host countries. Within this general theme, those that view FDI to be beneficial to the host country's development have often stressed its role in generating linkages within the economy. Perhaps the further encouragement of backward linkages is one reason why many countries impose domestic content requirements on multinationals: Such policies require multinationals to source a certain amount of their inputs (or a certain proportion of their value added) within the local market.

However, very few analytical studies of backward linkages of FDI exist. We have surveyed the existing literature and based on that survey suggest three areas for future research: the interplay between VTT and backward linkages; strategic interactions among multinational firms; and the nature of contractual relationships between multinationals and their local suppliers.

A simple model incorporating both horizontal and vertical technology transfer in a two-tier oligopolistic structure is also presented. This model captures in a straightforward way both the competition effect and the demand effect of FDI. Entry of a multinational firm raises the demand for locally made intermediate goods, while creating competition for incumbent producers of the final good and thereby lowering their demand for the intermediate good. In our model, the multinational's entry raises the degree of the backward linkages in the local economy if, and only if, its technological advantage in producing the final good is not too large over its local competitors—under such circumstances the demand creation effect dominates the competition effect. The results of the model conform to those of several empirical studies: although multinationals have a negative impact on their local competitors, they have a positive impact on their local suppliers especially when they transfer technology to them.[10]

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9. Even in the general case, technology transfer lowers the threshold μ^* above which the multinational's entry raises the degree of backward linkages. We have $\partial\mu^*/\partial t = -\partial BL^F/\partial\mu / \partial BL^F/\partial t < 0$.

10. See Saggi (2002, 2004) for discussions of the horizontal and vertical effects of multinational firms on host industries.

While our model provides some interesting insights, it does make some strong assumptions. In particular, the model considers only one multinational firm. Furthermore, we cannot study the development of the intermediate good sector since further entry of suppliers is ruled out. Regarding the first limitation, the model can be extended to allow for multiple multinationals, and we speculate that our main conclusions would remain valid under such a setting. When multiple multinationals may enter the local market, the aggregate effect of such entry would continue to depend on the relative magnitudes of both the competition effect and the demand effect. Of course, the balance between these effects will depend upon the technological advantages of a typical multinational over local producers and the number of such local producers as well as the number of multinationals.

Now consider the issue of further entry of suppliers. Recall that Rodriguez-Clare (1996) has already developed a framework where the increase in demand for intermediate goods generated by multinationals leads to an expansion in the variety of such goods available in the local economy via the entry of new suppliers. Such expansion benefits competitors of the multinational firm by increasing their productivity. However, in Rodriguez-Clare's model, price effects are not crucial because of the setup of monopolistic competition. By contrast, the present model allows for price effects while ruling out further entry of suppliers. Thus, an oligopoly model of linkages with free entry of multinationals and local suppliers seems worthy of future research.

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