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Multinational firms, exclusivity, and backward linkages

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Abstract

How does the nature of contractual relationships between a multinational and its local suppliers affect backward linkages and welfare in the local industry? We address this question in a two-tier oligopoly model where a multinational transfers technology to its suppliers if they accept an exclusive contract that precludes them from serving its local rivals. Invited suppliers balance the benefits of gaining access to new technology and the derived demand of the multinational against the opportunity of selling to other local firms. Exclusivity reduces competition among local suppliers and can lower backward linkages and local welfare relative to autarky.

Keywords: Multinational firms; Backward linkages; Vertical technology transfer; Exclusivity

JEL classification: F23; F12; O19; O14; L13

1. Introduction

Two important channels through which the entry of multinational firms can affect a host country are technology transfer and the generation of backward linkages. While these two channels have been studied extensively in isolation, no existing model allows them to operate simultaneously. What is the relationship between vertical technology transfer (VTT) from a multinational to its local suppliers and the degree of backward linkages?[2] Second, and perhaps more importantly, how

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[2] In his empirical study of VTT in the Indian trucking industry, Lall (1980) notes that VTT can occur in several ways. A multinational might (1) help prospective suppliers set up production capacities; (2) provide technical assistance/information to raise the quality of suppliers' products and/or to facilitate innovations; or (3) provide training and help in management and organization.

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does the nature of vertical contracts between a multinational and its local suppliers affect welfare in the host industry? We address these questions in a two-tier oligopoly model that focuses on the entry decision of a single multinational firm. Upon entry, the multinational sources a required intermediate good locally and provides VTT to its suppliers if they agree to abide by an exclusivity condition that precludes them from serving its local rivals.

Exclusivity requirements in the context of international technology transfer are empirically relevant. In a recent survey of 413 companies in the automobile sector in Central and Eastern Europe, Lorentzen and Mollgaard (2000) found that 61% of the automobile parts manufacturers had received technology from their customers (automobile assemblers, which are mostly multinational companies), and 36% of the customers imposed an exclusivity condition on their suppliers. Similarly, according to Mizuno (1995), car component suppliers in South Korea can be classified into three categories: (1) the exclusive type that supplies over 75% of their total production to their principal car manufacturers; (2) the semi-exclusive type for whom this measure lies in the 50–70% range; and (3) the dispersed/independent type for whom this measure falls below 50%.

In our model, exclusivity delinks local rivals of the multinational from (some of) their suppliers. Such delinking makes the intermediate good market less competitive and can cause local welfare to decline due to the multinational's entry. The delinking effect is reminiscent of an astute observation made by Rodriguez-Clare (1996): multinationals do not just create new linkages—they also displace pre-existing linkages between local firms and suppliers. In our context, such displacement occurs contractually, whereas in Rodriguez-Clare (1996), it occurs if the multinational chooses to source intermediates from its headquarters.

We argue that exclusivity confers two strategic advantages upon the multinational. First, VTT under exclusivity lowers the production cost of only those suppliers that serve the multinational. Second, exclusivity limits the number of suppliers that sell to local producers—i.e., it can act as a strategy via which the multinational can foreclose competition in the intermediate market (Salop and Scheffman, 1987). On the other hand, since an exclusive contract with the multinational requires local suppliers to forego the opportunity of serving local firms, only a limited number of them are interested in accepting such a contract. In fact, in equilibrium, the multinational is able to implement exclusivity if and only if the extent of VTT exceeds a critical level.

The analytical literature on multinationals and technology transfer is vast, but with the exception of Pack and Saggi (2001), much of this literature has ignored technology transfer between multinationals and their suppliers. This is unfortunate since empirical evidence indicates that VTT is quite pervasive—see Lall (1980), Moran (1998), Javorcik (2004), and Blalock and Gertler (2005). To the best of our knowledge, there exist only two analytical models that explore the relationship between multinationals and backward linkages in the host country: Markusen and Venables (1999) and Rodriguez-Clare (1996).[3] In both models, the intermediate goods sector is monopolistically competitive and foreign investment induces entry into such markets by generating derived demand for intermediates. These models emphasize demand creation effects of multinationals whereas our paper focuses more on supply-side effects.[4]

The rest of the paper is organized as follows. Section 2 contains the basic model, including the benchmark case prior to the entry of the multinational. Section 3 highlights the demand creation

[3] See Lin and Saggi (2005) for a critical survey of the existing analytical literature on the linkage effects of FDI.

[4] The Markusen and Venables model also allows for a competition effect wherein the entry of a multinational hurts its local rivals. In Rodriguez-Clare (1996), the host country is assumed to be in a 'bad' equilibrium where the final good is produced only by multinationals. As a result, the competition effect is absent in his model (which has substantial richness along other dimensions).

Table 1
Autarkic equilibrium

$Q_i^A = \frac{n\alpha}{(m+1)(n+1)}$	$\Pi_i^A = \frac{n\alpha^2}{(m+1)^2(n+1)}$
$w^A = \frac{\alpha}{m+1} + c_I$	$\pi_j^A = \frac{\alpha^2 m^2}{(m+1)^2(n+1)^2}$

effect of the multinational's entry, while Section 4 derives the market equilibrium under exclusivity. In Section 5, the equilibrium of the entry game is studied and conditions under which exclusivity occurs are derived. Section 6 focuses on the effects of exclusivity on backward linkages and local welfare for the case of two local suppliers. Section 7 extends the basic model to the case where the multinational is able to contract on the price of the intermediate good. Section 8 concludes.

2. Basic model

There are $n \geq 1$ local firms (denoted by $j = 1 \ldots n$) that produce a (final) good the demand for which is given by $Q = a - p$. One unit of the final good requires one unit of an intermediate good that is produced at unit cost c_I by $m \geq 2$ firms (denoted by $i = 1 \ldots m$). From hereon, intermediate good producers are called 'suppliers' while final good producers are called just 'producers.' The marginal cost of a producer equals the sum of the price of the intermediate good and the unit cost of transforming the input into the final product (given by c).

Our benchmark model is a variant of the successive Cournot model developed in Salinger (1988). In this model, each stage of production is characterized by Cournot competition between firms, with the downstream firms taking the price of the intermediate as given, and the suppliers taking the demand curve for the intermediate generated by downstream Cournot competition as given.

We examine the effects of the entry of a single multinational firm (who produces the final good) on domestic industry. The multinational's marginal cost of transforming the intermediate good is $(1-\delta)c$, where $\delta \in [0,1]$ measures the degree of its cost-advantage over local producers. As a benchmark, we first describe market equilibrium in the absence of the multinational.

2.1. Autarky

Prior to the entry of the multinational (referred to as autarky), all producers buy the intermediate good in the open market. Given the price of the intermediate (denoted by w), Cournot competition downstream yields the derived demand for the intermediate. Facing this derived demand, suppliers compete in Cournot fashion, leading to the equilibrium of the entire industry. The equilibrium output (Q_i^A) and profit of each supplier ($\prod_i^A$), price of the intermediate (w^A), and the profit of each downstream producer (π_j^A) are given in Table 1.

An obvious way to measure the degree of backward linkages (BL) in this two-tier industry is to use the aggregate output level of the intermediate good:

$$BL^A \equiv mQ_i^A = \frac{mn\alpha}{(m+1)(n+1)} \tag{1}$$

where $\alpha \equiv a - c_I - c > 0$. Clearly, backward linkages increase with the number of firms at each level of the industry as well as with market size.

We now study an entry game that endogenizes the multinational's mode of interaction with its local suppliers.

2.2. Entry by the multinational firm

Upon entry, the multinational sources the intermediate good locally and competes with local producers in supplying the final good.[5] The sequence of moves is as follows:

- First, the multinational chooses between two alternatives: (i) an arm's length arrangement with its suppliers (i.e., market interaction) wherein it simply buys the intermediate from the market as an anonymous buyer and (ii) a contractual relationship that involves vertical technology transfer (VTT) from the multinational to its suppliers. In exchange for VTT, the selected suppliers agree to serve the multinational exclusively (EX). We assume that VTT reduces the marginal cost of producing the intermediate from c_I to $c_I - d$, where d captures the degree of VTT.[6]
- If a contractual relationship is chosen, the multinational approaches k suppliers (called invited suppliers) with the offer (VTT, EX) and invited suppliers simultaneously decide whether or not to accept the multinational's offer.
- Next, the multinational carries out VTT to those suppliers that accept its offer. The other suppliers serve local producers with their old technologies. Given market structure, payoffs of all parties equal their respective profits in the successive Cournot model. If no supplier accepts the multinational's offer, market interaction prevails.

It is worth noting here that our basic model assumes that the multinational cannot specify a price for the intermediate while contracting with its suppliers. Following Antràs (2003) and Antràs and Helpman (2004), such an assumption can be justified on the basis of contract incompleteness (the source of which is not considered in our basic model). In any case, in Section 7, we examine how our main results change if the multinational can contract over the price of the intermediate good. This analysis considers two frequently used vertical contracts: a two-part contract and a bundling contract.

3. Market interaction and demand creation

Under market interaction, the multinational buys the intermediate good in the open market, as do all local final good producers.[7] As under autarky, firm behavior at both levels of the industry is described by the successive Cournot model. The only difference with respect to autarky is that the multinational's entry increases the number of final goods producers by one. Equilibrium expressions

[5] Local sourcing might arise because of technological reasons (such as high transportation costs or the costs of relying on far away suppliers) or due to policy restrictions such as local content requirements imposed by the host country government—see Qiu and Tao (2001).

[6] Alternatively, we can interpret VTT as an improvement in the quality of the intermediate good. Specifically, due to the multinational's help, the product quality of local suppliers improves so that one unit of the intermediate becomes equivalent to λ units where $\lambda \geq 1$. This is equivalent to a typical supplier's marginal cost becoming c_I/λ with the reduction in cost equalling $d=(1-1/\lambda)c_I$.

[7] This case is standard in the literature and it allows a comparison of our results with those of Markusen and Venables (1999) and Rodriguez-Clare (1996).

Table 2
Equilibrium under market interaction

$Q_i^M = \frac{(n+1)\alpha + \delta c}{(m+1)(n+2)}$	$\Pi_i^M = \frac{(n+2)}{n+1}\left(Q_i^M\right)^2$
$\pi_f^M = \left[\frac{m(n+1)\alpha+\delta c(n(m+1)(n+2)+m)}{(n+2)(n+1)(m+1)}\right]^2$	$\pi_j^M = \left[\frac{m(n+1)\alpha-\delta c((m+1)(n+1)+1)}{(n+2)(n+1)(m+1)}\right]^2$

for the output (Q_i^M) and profit of each supplier ($\prod_i^M$), and the profit of each producer (π_j^M) and that of the multinational (π_j^M) are reported in Table 2.Using Table 2, we have

$$BL^M \equiv mQ_i^M = m\frac{(n+1)\alpha + \delta c}{(m+1)(n+2)} \tag{2}$$

Comparing with autarky, it is easy to show that BL^M always exceeds BL^A (see Table 1): when the multinational buys the intermediate in the open market, its entry always raises the degree of backward linkages in the local industry. The multinational's entry provides a boost to the upstream sector through two channels. First, the demand for the intermediate increases because of greater competition in the final good (the number of producers increases from n to $n+1$). Second, since the multinational enjoys a cost-advantage over its rivals ($\delta>0$), it generates greater derived demand than a typical local producer.

4. Exclusive contract

Under exclusivity, local suppliers are divided into two groups: those that serve only the multinational and receive VTT from it and those that supply only local producers. Suppose (without loss of generality) that suppliers 1… k serve the multinational while suppliers $k+1$… m cater to local producers. Below, we derive market equilibrium for a given k and then explore the multinational's optimal k. Let w_f and w_h denote the unit prices of the intermediate paid by the multinational and local producers, respectively, where the price within each group is determined as in the successive Cournot model. Given these prices, the multinational's marginal cost of production equals $w_f+(1-\delta)c$ while that of local producers equals w_h+c. Using the derived demands of the multinational and local producers, it is easy to solve for the equilibrium output level of a supplier that caters to the multinational (Q_f^{EX}) and that of a supplier that serves local producers (Q_h^{EX}):

$$Q_f^{EX}(k) = \frac{(m+n-k+1)\alpha + (n+1)(m-k+1)(\delta c + d)}{2(n+1)(k+1)(m-k+1)-k(m-k)n} \tag{3}$$

and

$$Q_h^{EX}(k) = \frac{n(k+2)\alpha - nk(\delta c + d)}{2(n+1)(k+1)(m-k+1)-k(m-k)n} \tag{4}$$

while the prices of the intermediate paid by the multinational and the local producers are

$$w_f^{EX}(k) = 2Q_f^{EX}(k) + c_I - d \quad \text{and} \quad w_h^{EX}(k) = \frac{n+1}{n}Q_h^{EX}(k) + c_I \tag{5}$$

respectively. Using the above expressions, the equilibrium profit of a typical supplier to the multinational equals

$$\Pi_f^{EX}(k) = 2[Q_f^{EX}(k)]^2 \tag{6}$$

while that of a supplier serving local producers is

$$\Pi_h^{EX}(k) = \frac{n+1}{n}[Q_h^{EX}(k)]^2 \tag{7}$$

Finally, the profit of each local producer equals

$$\pi_j^{EX}(k) = \left[\frac{(m-k)Q_h^{EX}(k)}{n}\right]^2 \tag{8}$$

whereas that of the multinational equals

$$\pi_f^{EX}(k) = [kQ_f^{EX}(k)]^2 \tag{9}$$

which increases with k, d and δ. As before, backward linkages under exclusivity are defined as

$$BL^{EX} \equiv kQ_f^{EX}(k) + (m-k)Q_h^{EX}(k) \tag{10}$$

We are now in a position to consider the trade-off facing each invited supplier. On the one hand, by serving the multinational a supplier captures a share of the multinational's demand for the intermediate while also receiving VTT from it. On the other hand, it must forego the option of serving local producers. Whether or not it is profitable for a supplier to serve the multinational depends on (i) how many other suppliers accept the multinational's offer; (ii) the extent of VTT; and (iii) the magnitude of derived demand for the intermediate generated by local producers.

To make exclusivity an attractive option for suppliers, the following assumption is necessary (it ensures that at least one invited supplier accepts the multinational's offer):

Assumption 1. $\prod_f^{EX}(1) \geq \prod_h^{EX}(0)$.

The right-hand-side of the inequality $\prod_h^{EX}(0)$ is the profit of a typical supplier under market interaction (i.e., when no supplier accepts the multinational's offer), whereas $\prod_f^{EX}(1)$ is the profit of a supplier when it is the only one serving the multinational. Assumption 1 holds if d is not too small.

To preclude the uninteresting case where all local suppliers become the multinational's exclusive suppliers (thereby driving all local producers out of the market), we make the following assumption.

Assumption 2. $\prod_h^{EX}(m-1) \geq \prod_f^{EX}(m)$

This assumption says that a supplier prefers to be the sole supplier to all local producers than to serve only the multinational (together with all other $m-1$ suppliers). Assumption 2 requires that $(d+\delta c)/\alpha$ be not too big—in other words, the technological advantage of the multinational over its local rivals and the degree of VTT be not too large relative to the local market size.

Given that $k-1$ suppliers accept the multinational's offer, the kth supplier is willing to serve the multinational if and only if

$$\Pi_f^{EX}(k) \geq \Pi_h^{EX}(k-1) \tag{11}$$

Remark 1. *The profit of a supplier that accepts the multinational's offer decreases with k, whereas the profit of a supplier that rejects the multinational's offer increases with k.*

The intuition behind Remark 1 is simple: As more suppliers switch to serving the multinational exclusively, competition among them intensifies, whereas competition among those that supply local producers declines. Let $\bar{k}$ be the largest integer that satisfies (11). From Remark 1 we know that $\bar{k}$ is unique. Clearly, the multinational announces $k=\bar{k}$ and all invited suppliers accept its offer. Although $\bar{k}$ cannot be solved for analytically, it is easy to see that it increases with the degree of VTT (d), as well as the technological gap between the multinational and its local rivals (δ). As d or δ rises, the function $\prod_f^{EX}(k)$ shifts upwards and the function $\prod_h^{EX}(k-1)$ shifts downwards, implying that $\bar{k}$ goes up. Intuitively, for larger d or δ, the option of becoming an exclusive supplier to the multinational becomes more attractive, leading a larger number of suppliers to accept the multinational's offer. Since $\pi_f^{EX}(k)$ is an increasing function of k, the optimal strategy for the multinational, given that it chooses exclusivity, is to set $k=\bar{k}$ and its equilibrium profit equals $\pi_f^{EX}(\bar{k})$.

5. Equilibrium mode of entry

From the multinational's perspective, exclusivity is attractive for two reasons. First, exclusivity prevents the multinational's local rivals from being able to enjoy the benefits of VTT provided by the multinational to its suppliers. Second, exclusivity limits the number of suppliers that serve the multinational's local rivals. Both of these advantages raise the production costs of the multinational's rivals. The disadvantage of exclusivity is that the multinational is served by only $\bar{k}$ ($< m$) suppliers while if it buys the intermediate in the open market, it is served by m competing suppliers. One thus naturally expects that either exclusivity or market interaction can be optimal for the multinational firm depending on parameter values. Exclusivity occurs in equilibrium if and only if $\Delta\pi_f \equiv \pi_f^{EX}(\bar{k}) - \pi_f^M \geq 0$.

Since $\pi_f^{EX}(k)$ increases with d and k and the number of equilibrium suppliers of the multinational ($\bar{k}$) also rises with d, the profit differential $\Delta\pi_f$ definitely increases with d. It follows that $\Delta\pi_f > 0$ if and only if d exceeds a critical threshold d^*.[8]

Proposition 1. *Exclusivity occurs in equilibrium if and only if the extent of VTT undertaken by the multinational firm is sufficiently large (i.e., $d > d^*$).*

The multinational's entry under exclusivity impacts local industry in three ways: (i) it increases competition downstream and, all else equal, this raises the level of backward linkages (and thus consumer surplus); (ii) delinking reduces the degree of competition among suppliers and this tends to lower the aggregate output level of the intermediate good (as well as consumer surplus); and (iii) local suppliers benefit from VTT and this tends to raise the level of backward linkages. The net effect of these three forces can be either negative or positive.

[8] We assume that there exists a d^* such that $\Delta\pi_f|_{d=d^*} = 0$. If d^* does not exist, $\Delta\pi_f$ is either always negative or positive and such cases are of limited interest.

Local producers are affected in two separate ways by the multinational's entry under exclusivity. First, their market shares decline due to increased competition from a more efficient producer. Second, local producers suffer from the decline in the number of suppliers that sell to them. The delinking of $\bar{k}$ producers changes market structure of the two-tier industry and raises the market power of the $m-\bar{k}$ suppliers that serve local producers.

How do suppliers fare under exclusivity relative to autarky? Since the equilibrium number of suppliers serving the multinational ($\bar{k}$) cannot be solved for analytically, we are unable to derive general analytical results regarding the effects on suppliers. However, in the special case of upstream duopoly (considered in the next section), we show that, relative to autarky, if the extent of VTT is large then the supplier that serves the multinational is always better off while the other supplier is worse off. Nevertheless, the average profit across the two types of suppliers goes up.

6. Two local suppliers

To further explore the choice between exclusivity and market interaction, this section considers the case of upstream duopoly (i.e., $m=2$). Assumptions 1 and 2 imply that the equilibrium number of exclusive suppliers equals one (i.e., $\bar{k}=1$). Thus, exclusivity obtains in this case if and only if $\pi_f^{EX}(1)\geq\pi_f^M$, which is equivalent to

$$H\equiv\frac{(n+2)\alpha+2(n+1)(d+\delta c)}{7n+8}-\frac{2(n+1)\alpha+(3n^2+6n+2)\delta c}{3(n+2)(n+1)}\geq 0 \tag{12}$$

As per Proposition 1, the above inequality holds if and only if $d>d^*$. Furthermore, we can show the following:

Lemma 1. *Suppose Assumptions 1 and 2 hold and $m=2$. Then, the larger the cost-advantage of the multinational over its local competitors (i.e., the larger is δ), the weaker its incentive to choose an exclusive contract over market interaction* ($\frac{\partial H}{\partial \delta}<0$).

This result can be understood as follows. If the multinational has a large cost-advantage in transforming the intermediate good into the final product, then it is less worried about lowering the production cost of the intermediate and is more concerned about creating competition among its suppliers. As a result, when δ is big, the multinational is more likely to prefer market interaction to exclusivity with technology transfer.

To explore the effects of exclusivity on backward linkages and local welfare, we next confine our attention to the case where $\delta=0$. Based on (12), we can show the following result:

Proposition 2. *Suppose Assumptions 1 and 2 hold, $m=2$, and $\delta=0$. Then, (i) if $n\geq 2$ exclusivity always occurs in equilibrium; and (ii) if $n=1$ exclusivity arises iff $d/\alpha>1/12$.*

When the final good market is a duopoly (i.e., $n=1$) and the extent of VTT is large ($d/\alpha>1/12$), the benefit to the multinational of improving its supplier's technology dominates the cost of having only a single supplier. By contrast, when the final good market is relatively competitive ($n\geq 2$), delinking drives the multinational's choice: the multinational's strategic benefit of reducing the number of suppliers that serve its (many) local competitors is so significant that it prefers exclusivity regardless of the degree of VTT.[9]

[9] It is useful to note that Assumption 1 is less likely to hold when n is large: supplier 1's opportunity cost of becoming an exclusive supplier to the multinational is high when the number of local producers (n) is large.

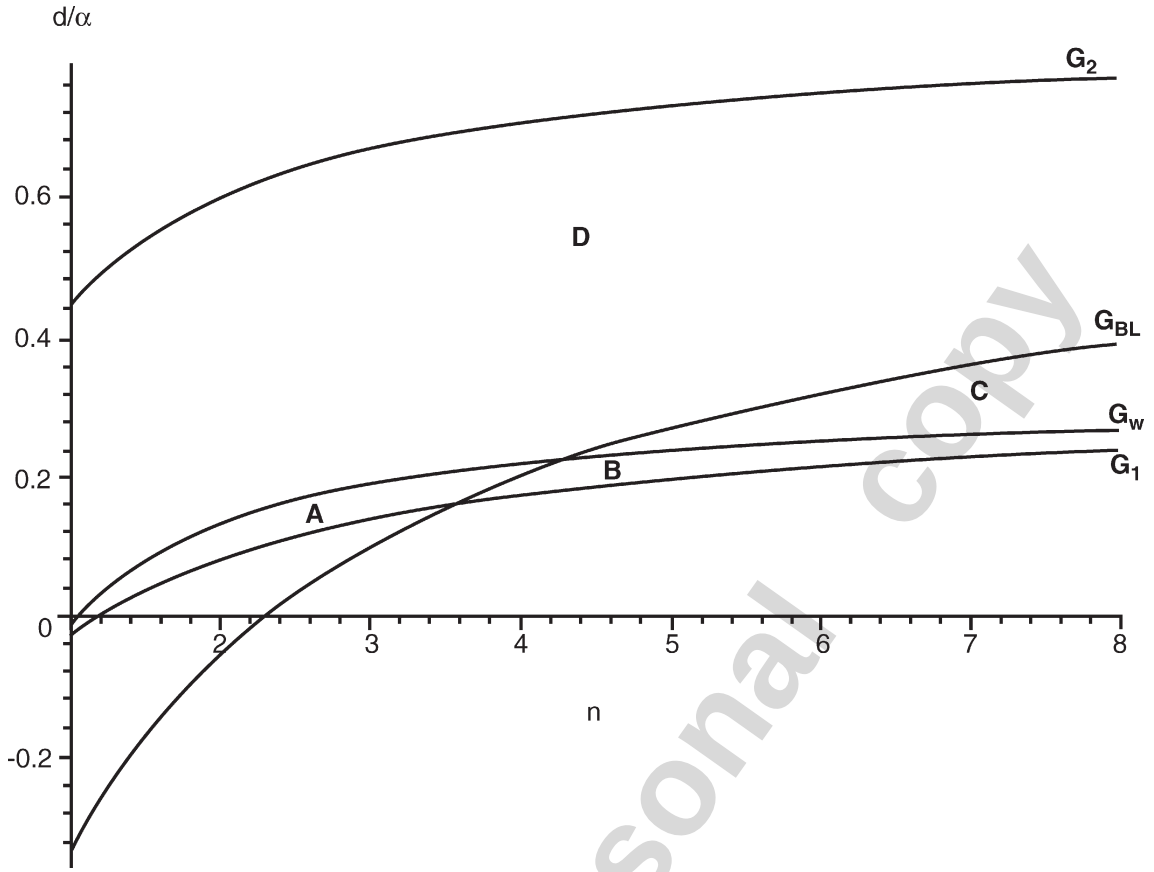

Fig. 1. Backward linkages and welfare under exclusivity ($m=2$).

How does exclusivity affect the two local suppliers? Assumption 1 guarantees that supplier 1 is better off relative to market interaction (and thus also relative to autarky). Straightforward calculations show that supplier 2 is better off under exclusivity if and only if $d/\alpha<(2n+1)/(3n+3)$. Thus, if VTT to supplier 1 is not significant, supplier 2 also gains from the multinational's entry under exclusivity. This is because exclusivity reduces the competition facing supplier 2 (in fact eliminates it in the case of upstream duopoly). But if VTT is substantial, then the multinational commands too large a market share, leading to a sharp decline in the derived demand facing supplier 2. In such a case, supplier 2 is worse off relative to autarky. Recall that at the contracting stage of the game where the multinational selects suppliers, the equilibrium probability of a supplier being invited to become an exclusive supplier to the multinational equals $\bar{k}/m$ (1/2 in the present case). It is easy to show that the average profit across the two suppliers is higher under exclusivity relative to autarky.

Turning to effect on the degree of backward linkages, we have that $BL^{EX}>BL^{A}$ if and only if

$$\frac{d}{\alpha}>\frac{2(n^2-n-3)}{3(n+1)(n+2)}\equiv G_{BL}(n) \tag{13}$$

That is, for a given n, exclusivity increases the level of backward linkages if and only if the extent of VTT exceeds a certain threshold level: i.e., $\frac{d}{\alpha}>G_{BL}(n)$. Furthermore, this critical threshold $G_{BL}(n)$ increases with n: i.e., as the number of local rivals of the multinational increases, exclusivity is less likely to raise the degree of backward linkages in the host industry. The intuition for this is that if n is small, the increase in the derived demand for the intermediate caused by the multinational's entry is relatively large. As a result, the level of backward linkages rises despite the

delinking effect of exclusivity. However, when n is big, the extra demand for the intermediate generated by the multinational's entry is too small to offset the negative effect of exclusivity on the degree of backward linkages in the local industry.

The entry of the multinational certainly hurts downstream producers. For the host economy, aggregate local welfare equals $W^{EX}=\prod_f^{EX}+\prod_h^{EX}+n\pi_j^{EX}+0.5[BL^{EX}]^2$. Prior to the entry of the multinational, the level of local welfare is $W^A=2\prod_i^A+n\pi_j^A+0.5[BL^A]^2$. It is tedious but straightforward to show that $W^{EX}>W^A$ if and only if the extent of VTT is above a certain threshold level: $\frac{d}{\alpha}>G_W(n)$.

Fig. 1 illustrates the effects of the multinational's entry on backward linkages and local welfare in the $(n,\frac{d}{\alpha})$ space. Assumptions 1 and 2 require that the feasible parameter values lie above curve $G_1(n)$ and below $G_2(n)$. Within the feasible region, Fig. 1 can be divided into four regions: A, B, C, and D. In region D, the multinational's entry raises both the level of backward linkages and local welfare. In region B, however, the multinational's entry lowers both the level of backward linkages and local welfare. For the other two areas, the degree of backward linkages and welfare do not move in the same direction: in region C, the multinational's entry raises local welfare even as it lowers the degree of backward linkages, whereas the opposite is true in region A.

The intuition for why the multinational's entry enhances both backward linkages and local welfare in region D is simple: If VTT is substantial, the multinational's entry is beneficial to the host country despite the negative effects of exclusivity. Likewise, if the extent of VTT is small and the local final good market is relatively competitive (i.e., n is big), such as in region B, the negative effect of exclusivity dominates the positive effects of demand creation and VTT and both local welfare and the level of backward linkages decline due to the multinational's entry.

For the other two areas (A and C), the multinational's entry increases either local welfare or the level of backward linkages (but not both), depending on the value of n. If n is small and VTT is not very substantial (region A), backward linkages increase but welfare declines. This is because when n is small, the multinational's entry leads to a substantial increase in the output of the intermediate good which translates into higher consumer surplus and greater profits for suppliers. However, for small n, the erosion of the profits of local producers that results from the multinational's entry is large and this negative effect on local producers leads to a reduction in local welfare. Area C can be similarly understood: If n is large and VTT is moderate, backward linkages decrease but local welfare increases with entry. The negative effect on backward linkages stems from the fact that the demand–creation effect of entry is weak when n is large. Local welfare increases despite the reduction in backward linkages because the benefits of VTT dominate the losses of local producers.

The following proposition highlights the possible negative effect of exclusivity on backward linkages:

Proposition 3. *Suppose Assumptions 1 and 2 hold, $m=2$, and $\delta=0$. Then, there exist parameter values (regions B and C in Fig. 1) for which the multinational firm enters with an exclusive contract and its entry lowers the level of backward linkages.*

7. Extensions of the basic model

We now consider several extensions of our basic model. First, we discuss the implications of entry and exit for our main results. Next, we establish that exclusivity can obtain in equilibrium even if the multinational transfers technology under market interaction. Finally, we examine exclusive contracts that, in addition to forbidding the multinational's suppliers from serving local

producers, can also specify the price and/or quantity of the intermediate input. Throughout these extensions, we focus on the case of two local suppliers (i.e., $m=2$) in order to highlight the main forces at work.

7.1. Possibility of induced entry

In the basic model, the numbers of local producers and suppliers are assumed to be fixed. We now consider a situation where entry into each level of production is feasible and it involves a fixed (sunk) cost. Let free entry under autarky yield m suppliers and n producers. Also, assume that the multinational's cost advantage (δ) over local producers is such that it finds entry profitable whereas local producers do not. Under market interaction, the increase in derived demand generated by the multinational's entry can induce further entry into the intermediate market even in the absence of VTT (as in Markusen and Venables, 1999). If such induced entry does occur, the positive effect of the multinational's entry on the degree of backward linkages relative to autarky is even stronger.

Now consider exclusivity under free local entry. When (VTT, EX) is offered to local suppliers, the possibility of further entry affects their decisions regarding whether or not to accept the multinational's offer. Suppose $m=2$ and let supplier 1 be the invited supplier. If supplier 1 accepts the multinational's offer, supplier 2 becomes the sole supplier to local producers and competition in the intermediate market is softened due to exclusivity. Such reduction in competition may lead to further entry in the intermediate market where all new suppliers compete with supplier 2 in serving local producers. However, as was shown in the basic model, if the extent of VTT is large, supplier 2 is worse off under exclusivity despite that fact that it becomes the sole supplier to local producers: the multinational's entry significantly lowers the market share of local producers thereby lowering the derived demand facing supplier 2. Therefore, when VTT is large, further entry into the intermediate market does not occur. As a result, supplier 1's profit if it accepts the multinational's offer (VTT, EX) is the same as that in the basic model. If supplier 1 rejects the multinational's offer, market interaction takes place and the expansion in derived demand for the intermediate can encourage the entry of new suppliers (thereby lowering supplier 1's profit). Therefore, the possibility of further entry makes it more likely that the multinational's exclusivity offer is accepted by supplier 1 (i.e., Assumption 1 is more likely to hold).

One can also show that Assumption 2 is also more likely to hold when further entry into the intermediate market is feasible. Recall that Assumption 2 guarantees that if both suppliers are invited by the multinational, then at least one of them rejects its offer. Consider supplier 2's decision regarding the multinational's offer given that supplier 1 has accepted an exclusive contract. If supplier 2 also accepts the multinational's offer and further entry occurs, then new suppliers serve local producers and this causes supplier 2's profits to decline. On the other hand, if supplier 2 rejects the multinational's offer (given that supplier 1 accepts) then, as said before, no further entry takes place. Thus, compared to the basic model, the possibility of entry reduces supplier 2's payoff from accepting the multinational's offer while leaving its payoff from rejecting it unchanged.

In sum, we have argued that even when further entry into the intermediate market is feasible, no new suppliers enter the market when the extent of VTT is sufficiently large. While softening competition in the intermediate market, delinking also lowers the demand for local suppliers that are not invited by the multinational by creating a 'squeezing out' effect on local producers. In fact, if this squeezing out effect is strong enough, delinking may actually drive out some suppliers, further hurting local producers and lowering the degree of backward linkages in the local industry.

7.2. VTT under market interaction

In the model studied so far, only those suppliers that agree to exclusively serve the multinational receive VTT from it. Would the multinational find it profitable to transfer technology to local suppliers without restricting them from serving local producers (i.e., under market interaction)? The trade-off from the multinational's perspective is that VTT to both local suppliers reduces the market price of the intermediate relatively more compared to that under exclusivity but this price reduction also benefits its local competitors. Straightforward derivations show that the multinational's profit under market interaction with VTT equals

$$\pi_f^M(d) = \left[\frac{2(n+1)(\alpha+d)+(3n(n+2)+2)\delta c}{3(n+2)(n+1)}\right]^2 \tag{14}$$

while the profit of each supplier equals

$$\Pi_i^M(d) = \frac{n+2}{n+1}\left[\frac{(n+1)(\alpha+d)+\delta c}{3(n+2)}\right]^2 \text{ for } i=1,2, \tag{15}$$

where the dependence of both profit levels on d has been noted to emphasize that market interaction now involves VTT.

Since VTT incurs no direct costs in our model, it is easy to see that the multinational always prefers market interaction with VTT than without it: the own cost reduction effect of VTT dominates the indirect loss resulting from the decline in rivals' costs. Thus, if VTT is possible under market interaction, the entry decision of the multinational depends on the comparison between $\pi_f^{EX}(1)$ (i.e., its profit under (VTT, EX)) and $\pi_f^M(d)$ above. This comparison yields the following result:

Proposition 2B. *Suppose Assumptions 1 and 2 hold, $m=2$, and $\delta=0$. Then, (i) if $n\geq 2$ exclusivity always occurs in equilibrium; and (ii) if $n=1$ exclusivity arises iff $d/\alpha>1/2$.*

Thus, when the local final good market is a duopoly (i.e., $n=1$), exclusivity is less likely to occur if VTT occurs under market interaction. However, if $n\geq 2$, once again, the multinational prefers exclusivity because of the delinking it creates, i.e., the strategic incentive of raising rivals' costs proves dominant when the number of such rivals is large.

7.3. Exclusivity under input price contracting

Here we consider the case where the multinational can not only impose exclusivity in return for VTT but can also specify the price at which its (exclusive) suppliers provide the intermediate good. Such a contract is realistic if the multinational has substantial bargaining power over its suppliers and can use that power to implement contracts that local producers cannot. We consider two possible contracts under exclusivity: one in which the multinational adopts a two-part pricing scheme and the other in which the contract is a quantity–price package. As in the case of other extensions, we limit our attention to the case of two local suppliers (i.e., $m=2$). The contract proposed by the multinational is carried out if the approached supplier accepts its offer and market interaction with VTT prevails otherwise. Thus, $\prod_i^M(d)$ in equation (15) is the reservation payoff of the approached supplier.[10]

[10] We assume throughout that the multinational's entry does not change the nature of interaction between local firms and their suppliers. That is, the local industry continues to interact via the market after the multinational's entry. See Conclusions for further discussion of this issue.

7.3.1. Two-part pricing

Under two-part pricing, the contract offered by the multinational is of the form (VTT, EX, $F+(c_I-d)q$). That is, the multinational provides VTT to supplier 1 and secures the intermediate at marginal cost (c_I-d) for a lump sum fee F. The intermediate price w paid by local producers to supplier 2 is determined by the successive Cournot model and the marginal cost of a typical local firm equals $w+c$. The resulting Cournot quantities determine their derived demand for the intermediate input. Facing this derived demand, supplier 2 chooses its output (which in turn determines w). Straightforward derivations yield the multinational's profit under the two-part pricing contract:

$$\pi_f^{TP} = \left[\frac{(n+4)\alpha + (3n+4)(d+\delta c)}{4(n+2)}\right]^2 - F \tag{16}$$

The multinational prefers a two-part pricing contract if and only if it leads to greater joint profits for it and its supplier relative to market interaction with VTT:

$$\pi_f^{TP} + F > \pi_f^M(d) + \Pi_1^M(d) \tag{17}$$

Assuming $\delta=0$, it is easy to show that, as in the basic model, exclusivity occurs under two-part pricing if and only if $n<n^{TP}(d)$.[11] The intuition for this is that as n increases, the multinational has to compensate supplier 1 more for agreeing to be its exclusive supplier because its reservation profit, $\prod_1^M(d)$, increases with n.

With regard to the effect on the backward linkages, it can be shown that the multinational's entry under an exclusive two-part pricing contract always raises the degree of backward linkages relative to autarky. This is because a two-part pricing contract eliminates the double markup problem that exists under linear contracts and market interaction. However, the effect on local welfare is ambiguous: While a larger output enhances consumer welfare, local producers and their suppliers get hurt under two-part pricing since such a contract allows the multinational to obtain the intermediate good at marginal cost thereby giving it a sharp cost advantage over its local rivals.

7.3.2. A bundling contract

Suppose now that the multinational proposes a bundling (or price–quantity package) contract of the form (q_f,T), where q_f is the amount of intermediate input delivered by supplier 1 in exchange for total payment T. As before, the multinational makes a take-it-or-leave-it offer and market interaction with VTT occurs if there is disagreement between the multinational and the approached supplier (i.e., supplier 1). If the multinational's offer is accepted by supplier 1, then local producers compete in a Cournot fashion observing the contract (q_f,T). Therefore, under a bundling contract,

[11] It is easy to show using Maple that $n^{TP}(d)$ is given by

$$n^{TP}(d) \equiv \frac{4(\alpha+d)(3\alpha+21d+\sqrt{30\alpha^2+60\alpha d+246d^2})}{(7\alpha+13d)(\alpha-5d)}$$

and that $n^{TP}(d)$ increases with d, i.e., the likelihood of a two-part pricing contract being chosen over market interaction increases with the degree of VTT.

the multinational effectively becomes a Stackelberg leader (as in Milliou et al., 2003). It can be shown that the joint profits of the multinational and its exclusive supplier equal:

$$\pi_f^B + \Pi_1^B = \frac{[(n+2)\alpha + 2(n+1)(d+\delta c)]^2}{8(n+1)(n+2)} \tag{18}$$

and that $\pi_f^B + \prod_1^B > \pi_f^M(d) + \prod_1^M(d)$ for all parameter values. In other words, exclusivity always occurs under bundling. Furthermore, $\pi_f^B + \prod_1^B > \pi_f^{TP} + F$, i.e., a bundling contract always dominates a two-part pricing contract.

Similar to the case of two-part pricing, the multinational's entry under a bundling contract always raises the level of backward linkages in the local industry. However, as under two-part pricing, the welfare effects of such entry on the local industry can be negative.

8. Concluding remarks

This paper adds value to the literature on backward linkages and FDI in two main respects. First, while existing literature focuses primarily on the demand-creating effects of the entry of multinationals on local industry (e.g., Markusen and Venables, 1999), we analyze the supply-side effects of such entry. In particular, the possibility of VTT from a multinational to its suppliers coupled with an exclusivity condition is a novel feature of our analysis. Second, our model considers oligopolistic competition at both stages of production. Such a setting enables us to examine how the contractual relationship between the multinational and its local suppliers affects strategic interaction in the local industry.

We show that, in addition to the competition effect identified in Markusen and Venables (1999), the multinational's entry can also create a delinking effect: When exclusivity arises in equilibrium, local producers lose some of their old suppliers to the multinational. Put differently, while the entry of the multinational creates additional demand for the intermediate good, it can also reduce the number of suppliers available to local producers. This negative supply-side effect can dominate the positive demand-side effect so that the total output of the intermediate good (as well as the final good) can shrink due to the multinational's entry.

In the present model, under an exclusive contract, the multinational buys the intermediate good only from its exclusive suppliers. In reality, an exclusive contract may entail a commitment only from the suppliers' side. Under such an exclusive contract, the multinational would be free to source the intermediate from all available suppliers (i.e., it can 'mix' between exclusive and non-exclusive suppliers). The benefit to the multinational of such a mixing strategy is that it can put competitive pressure on its exclusive suppliers. But such pressure, if effective, will make exclusivity less attractive to local suppliers. Furthermore, mixing on the part of the multinational will increase the profitability of those suppliers that do not commit to serving the multinational exclusively. We believe that an exclusive contract that leaves the multinational free to source from all suppliers can still emerge in equilibrium. However, the number of local suppliers that accept such a contract is likely to be smaller relative to the case where the multinational commits to sourcing only from its exclusive suppliers.

Our model assumes that local producers cannot engage in exclusive relationships with their suppliers. This assumption is made for tractability and to capture the idea that the ability to transfer technology gives the multinational leverage over its suppliers that is not available to local producers. Finally, the model does not consider competition amongst multinational firms. Further research is needed to determine how the possibility of such competition will alter the main results of this paper.

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