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Multinational Firms, Exclusivity, and the Degree of Backward Linkages

by

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Abstract

This paper develops a two-tier oligopoly model in which the entry of a multinational firm results in technology transfer to its local suppliers and also impacts the degree of backward linkages in the local industry. The model endogenizes the multinational's choice between anonymous market interaction with its suppliers and contractual relationships with them under which the multinational transfer technology to its suppliers who in turn agree to serve the multinational exclusively. The multinational's entry under an exclusive contract has a *de-linking effect* that can reduce the degree of competition among suppliers thereby leading to a decline in the level of backward linkages and local welfare. With its emphasis on the supply-side effects of the multinational's entry on local industry, this paper complements existing studies of backward linkages that focus more on demand-side effects.

Keywords: Multinational Firms, Backward Linkages, Vertical Technology Transfer, Exclusivity.

JEL Classification: F23, F12, O19, O14, L13.

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1 Introduction

It is well recognized that two important channels through which the entry of multinational firms can affect a host country are technology transfer and the generation of backward linkages.[1] While these two channels have been studied extensively in isolation, no existing analysis allows them to operate simultaneously. Two questions are of immediate interest: First, what is the relationship between vertical technology transfer (VTT) from a multinational to its local suppliers and the equilibrium degree of backward linkages? Second, and perhaps 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?[2] The objective of this paper is to shed light on 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. The model focuses on the entry decision of a multinational firm that produces the final good. Upon entry, the multinational sources the intermediate good locally and also engages in vertical technology transfer (VTT) to its suppliers if it enters into a contractual relationship with them. Under a contractual relationship, the selected suppliers must abide by an exclusivity condition that precludes them from serving other customers.

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

[1] The concept of linkages is due to Albert O. Hirschman (1958).

[2] To the best of our knowledge, contractual relationships between multinationals and their suppliers have not received any attention in related analytical literature. Existing analyses of backward linkages focus mainly on market interaction between multinationals and local firms.

(2000) found that 61 percent of the automobile parts manufacturers had received technology from their customers (automobile assemblers, which are mostly multinational companies), and 36 percent 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 the following types: (1) the exclusive type which supply over 75% of total production to their principal car manufacturers; (2) the semi-exclusive type which supply 50-75 percent of total production to their principal car manufacturers; and (3) the dispersed type (and the independent type) which supply below 50% of their total production to their principal car manufacturers.[3]

Our focus on contractual relationships uncovers an interesting new effect called the *de-linking effect*. In fact, in our model, exclusivity necessarily implies de-linking between local final good firms and their suppliers. Such de-linking makes the intermediate good market less competitive due to market separation (or foreclosure of competition) and can cause total output of the intermediate good (as well the final good) to shrink. This point emerges most sharply in the case where the intermediate good is produced by a duopoly and this case is discussed in detail toward the latter part of the paper.

The de-linking 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 multination-

[3]It is worth noting that multinationals have an incentive to impose exclusivity even in the absence of VTT. Driven by strategic considerations, a multinational may impose exclusivity on its suppliers so as to foreclose its local rivals from having access to a wide range of suppliers. As the number of their suppliers declines, the multinational's local rivals are forced to pay a higher price for the intermediate goods, thereby giving a cost-advantage to the multinational. This raising the rivals' cost motive and the potential anti-competitive effects of exclusivity practices on the part of multinational companies are discussed in the *World Investment Report* of 1997 (UNCTAD, 1997). See Salop and Scheffman (1987) for the seminal contribution on cost raising strategies.

als don't 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 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). Thus, the present paper highlights an independent mechanism via which multinationals alter the degree of linkages in the host country.

Our model 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 the following conflicting incentives. On the one hand, exclusivity seems natural when viewed from the intellectual property protection perspective of the multinational: it has a strategic incentive to prevent its local rivals from benefitting from VTT and this 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 is shown 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 exclusivity, leading the multinational to prefer market interaction.

The literature on multinationals and technology transfer is vast and has been surveyed by Blomstorm and Kokko (1996), and Saggi (2002). With the exception of Pack and Saggi (2001) much of the analytical literature has ig-

nored technology transfer between multinationals and their suppliers.[4] This is unfortunate since empirical evidence on productivity spillovers indicates that there is no guarantee that (horizontal) spillovers from multinationals to their local rivals will materialize whereas the evidence on VTT is quite positive – see Aitken and Harrison (1999), Moran (1998), Blalock and Gertler (2002), Javorcik (2004). In his empirical study of VTT in the Indian trucking industry, Lall (1980) notes that VTT can take places 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; and (3) provide training and help in management and organization. Our model captures channel (2) of VTT.

There exists a voluminous informal as well as empirical literature on backward linkages. For example, the 1996 issue of the *World Investment Report* was devoted entirely to the effects of foreign direct investment on backward linkages in host countries. However, analytical models that explore the relationship between multinationals and backward linkages in the host country are hard to come by. To the best of our knowledge, there exist only two such studies: Markusen and Venables (1999) and Rodriguez-Clare (1996). Both these studies provide important insights regarding the two-way relationship between multinationals and linkages. Markusen and Venables (1999) note that the entry of multinationals can have profound effects on backward linkages, industrial development, and welfare of the host country if such entry impacts the structure of imperfectly competitive industries. In fact, one can make a stronger statement: Since multinationals operate mostly in oligopolistic industries (see Markusen, 1995), their entry must have substantial effects on local market structure, especially in small developing countries. In the

[4]Pack and Saggi (2001) study VTT but their analysis assumes that the multinational cannot contractually prevent its suppliers from serving other firms.

models of Rodriguez-Clare (1996) and Markusen and Venables (1999) the intermediate goods sector is monopolistically competitive so that foreign investment alters 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, which is in turn derived from Dixit and Stiglitz (1977), is at the heart of the interaction between multinationals and local suppliers. By contrast, we consider an environment where further entry into intermediate production is ruled out and the multinational's entry affects strategic interaction amongst suppliers and final good producers, as well as local market structure (the delinking effect).

Both Rodriguez-Clare (1996) and Markusen and Venables (1999) emphasize *demand creation* effects of multinationals on the host economy: multinationals generate derived demand for intermediate goods, thereby promoting local industrial development. In addition, the Markusen and Venables model also allows for a *competition effect* wherein the entry of a multinational hurts its local rivals.[5] Our model focuses on the *supply-side* effects of multinationals on local suppliers, although the demand creation and competition effects are also present in our model.

The rest of the paper is organized as follows. Section 2 contains the model, including the benchmark case of auraky. Section 3 examines the subgame of market interaction and it highlights the demand creation effect of the multinational's entry. In Sections 4, entry via an exclusive contract is studied. Section 5 derives the subgame perfect equilibrium of the entire game while section 6 focuses on the effects of exclusivity on backward linkages and local welfare in the case with two local suppliers. Section 7 concludes.

[5]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).

2 Model

There are $n \geq 1$ local producers of the final product, indexed by j, where $j = 1, ..., n$. One unit of the final good requires one unit of an intermediate good. The intermediate good is produced at unit cost $c_I > 0$ by $m \geq 2$ firms indexed by i, where $i = 1...m$. From hereon, intermediate good producers are called 'suppliers' and 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 $c > 0$). The demand for the final good is assumed to be linear $p = a - Q$ and all firms are assumed to compete in the Cournot fashion (at both the upstream and downstream levels).

Our interest lies in examining the effects of the entry of a 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.[6] As a benchmark, we first describe market equilibrium in the absence of the multinational.

2.1 The benchmark case: autarky

Prior to the entry by the multinational (referred to as autarky), producers and suppliers are linked in the following way: All producers buy the intermediate good via the open market wherein all suppliers compete. Denote the price of the intermediate by w.

Given w, Cournot competition between local producers yields the aggre-

[6] A large body of literature documents that multinational firms have technological advantages over their local rivals (see Markusen, 1995).

gate quantity Q produced by them

$$Q = \frac{n(a-c-w)}{n+1}, \quad i = 1, ..., n. \tag{1}$$

From above, the derived demand for the intermediate equals

$$w = a - c - \frac{n+1}{n}Q. \tag{2}$$

Competition among suppliers yields the following equilibrium output of a typical supplier:

$$q_i^A = \frac{n\alpha}{(m+1)(n+1)}, \quad i = 1, ..., m \tag{3}$$

where $\alpha \equiv a - c - c_I > 0$. Substituting the equilibrium quantities into the demand equation for the intermediate yields the equilibrium price of the intermediate:

$$w^A = \frac{\alpha}{m+1} + c_I, \tag{4}$$

The profit of each supplier is easily calculated:

$$\pi_i^A = (w^A - c_I)q_i^A = \frac{n\alpha^2}{(m+1)^2(n+1)} \tag{5}$$

Similarly, the profit of each producer equals:

$$\pi_j^A = (a - mq_i - c - w^A)\frac{mq_i^A}{n} = \frac{\alpha^2 m^2}{(m+1)^2(n+1)^2}. \tag{6}$$

Let the aggregate level of output of the intermediate good measure the degree of backward linkages (BL^A) under autarky:

$$BL^A = mq_i^A = \frac{mn\alpha}{(m+1)(n+1)} \tag{7}$$

To explore the effects of the multinational's entry on local industry we now study an entry game wherein the multinational's choice regarding the mode of interaction with its local suppliers is endogenous.

2.2 Entry by the multinational firm

Upon its entry, the multinational competes with local producers in supplying the final product. We assume that the multinational does not import the intermediate from abroad and sources it locally. Such 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 government in the host country).[7] Furthermore, as Rodriguez-Clare (1996) notes, producer services (such as banking, auditing, consulting, wholesale services, transportation, machine repair etc.) are nontradable goods and proximity between suppliers and producers is essential. In any case, our focus is on *how* the multinational is linked with local suppliers, *given* that it sources the intermediate locally.

The sequence of moves is as follows:

- First, the multinational chooses between two alternatives (i) an arms 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).

- If a contractual relationship is chosen, the multinational approaches k suppliers called 'invited suppliers', with the offer (VTT, EX).

- Then, the invited suppliers simultaneously decide whether or not to accept the multinational's offer. Let $S(k)$ denote the number of suppliers

[7] See Qiu and Tao (2001) for an analysis of local content requirements when the final good market is oligopolistic.

that accept the multinational's offer.

- Fourth, the multinational carries out VTT to its suppliers. The other $m - S(k)$ suppliers serve local producers with their old technologies. Payoffs of all parties equal their respective Cournot profits given market structure. If no suppliers accept the multinational's offer (i.e. $S(k) = 0$), then all firms engage in anonymous market interaction.

We model VTT as a reduction in the marginal cost of the supplier from c_I to $c_I - d$ where the parameter d captures the degree of VTT. Alternatively, we can interpret VTT as an improvement in the quality of the intermediate good. Specifically, with the help of the multinational, the product quality of local suppliers is improved so that one-unit of the intermediate becomes equivalent to λ units where $\lambda \geq 1$. This means that a typical supplier's marginal cost of producing one effective unit of the intermediate becomes $\frac{c_I}{\lambda}$. Clearly, the reduction in the supplier's cost equals $d = (1 - 1/\lambda)c_I$.

We next derive the subgame perfect equilibrium of the entry game, using the standard backward induction procedure.

3 Market interaction and demand creation

Under market interaction, the multinational sources the intermediate locally and all producers buy the intermediate good in the open market at the price w.[8] Given w, downstream Cournot competition yields the following quantities for the multinational and the local producers:

$$q_f = \frac{a - c + (n+1)\delta c - w}{n+2} \quad \text{and} \quad q_j = \frac{a - c - \delta c - w}{n+2}, \quad j = 1...n. \qquad (8)$$

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

The derived demand for the intermediate equals

$$Q = q_f + nq_j \;\Leftrightarrow w = a - c + \frac{\delta c}{n+1} - \frac{n+2}{n+1}Q. \tag{9}$$

Comparing the above equation with equation (2), shows that the multinational's entry raises the derived demand for the intermediate through two channels. First, the number of producers increases from n to $n+1$ thereby increasing the total output of the final product (as well as the quantity demanded of the intermediate – i.e. the demand creation effect). Such demand creation is evident in the fact the derived demand for the intermediate becomes flatter relative to autarky (its slope decreases from $-(n+1)/n$ to $-(n+2)/(n+1)$). The second channel through which the multinational raises demand for the intermediate is through its technological advantage (δc) over local producers and this is captured by the term $\delta c/(n+1)$ in equation (9). Because of this cost-advantage, the multinational producers a larger quantity than its local rivals. However, the flip side of this cost-advantage effect is the competition effect that is reflected in the decrease in the output of each local producer. Furthermore, the larger is δ the greater the reduction in local producers' outputs. However, the aggregate output level increases with δ. Note that the magnitudes of the competition and cost-advantage effects are negatively related to the number of local producers n.

The following observation is useful in understanding some of the results derived later in the paper.

Remark 1: *The demand creation effect of the multinational's entry decreases with the number of local producers (n).*

Given the derived demand for the intermediate good, the Cournot output level of a typical supplier equals

$$q_i^M = \frac{(n+1)\alpha + \delta c}{(n+2)(m+1)}, \qquad \text{for } \; i = 1, ..., m. \tag{10}$$

and its equilibrium profit equals

$$\pi_{i}^{M} = \frac{(n+2)}{n+1}\ \left(q_{i}^{M}\right)^{2}, \qquad \text{for } i = 1, ..., m. \tag{11}$$

The profit of the multinational equals

$$\pi_{f}^{M} = \left[q_{f}^{M}\right]^{2} = \left[\frac{m(n+1)\alpha + \delta c\left(n(m+1)(n+2)+m\right)}{(n+2)(n+1)(m+1)}\right]^{2}, \tag{12}$$

whereas that of each local producer equals

$$\pi_{j}^{M} = \left[\frac{m(n+1)\alpha - \delta c\left((m+1)(n+1)+1\right)}{(n+2)(n+1)(m+1)}\right]^{2}, \quad \text{for } j = 1, ...n. \tag{13}$$

As under autarky, the degree of backward linkages in the economy under market interaction equals $BL^{M} = mq_{i}^{M}$. We have

$$BL^{M} - BL^{A} = m(q_{i}^{M} - q_{i}^{A}) = \frac{m[\alpha + (n+1)\delta c]}{(m+1)(n+2)(n+1)} > 0. \tag{14}$$

Proposition 1: *When the multinational buys the intermediate good via the market, its entry increases the degree of backward linkages in the local industry relative to autarky.*

Consider next how the multinational's entry under an exclusive contract affects local industry.

4 Exclusive contract

Under an exclusive contractual relationship, local suppliers are divided into two groups: those who supply the multinational only and those who supply local producers only. Without of loss of generality, suppose that the $1...k$ supply the multinational while $k+1...m$ supply local producers. While the suppliers of the multinational are delinked from the rest of the local final good producers, they receive VTT from the multinational. Let w_f and w_h

denote the unit prices of the intermediate paid by the multinational and local producers respectively. Given these prices, the multinational's marginal cost of production equals $w_f + (1-\delta)c$ while that of local producers equals $w_h + c$. Under Cournot competition downstream, the equilibrium output of the multinational equals

$$q_f = \frac{a - c + (n+1)\delta c - (n+1)w_f + nw_h}{n+2} \tag{15}$$

while that of a typical local producer equals

$$q_j = \frac{a - c - \delta c - 2w_h + w_f}{n+2} \text{ for } j = 1...n. \tag{16}$$

Rewriting the above two equations in terms of prices gives the derived demands from the multinational and local producers respectively:

$$w_f = a - c + \delta c - 2q_f - \sum_{j=k+1}^{m} q_j \text{ and } w_h = a - c - q_f - \frac{n+1}{n} \sum_{j=k+1}^{m} q_j. \tag{17}$$

Below, we first derive the market equilibrium for given k, and then explore the optimal k for the multinational.

4.1 Market equilibrium under exclusivity

A typical supplier to the multinational solves the following problem:

$$\underset{q_i}{Max}\ [w_f - c_I + d]q_i \text{ for } i = 1...k \tag{18}$$

whereas a typical supplier to local producers solves:

$$\underset{q_i}{Max}\ [w_h - c_I]q_i \text{ for } i = k+1...m. \tag{19}$$

where the demand functions for the intermediate are given by equation (17). The total amount of intermediate supplied to the multinational equals $Q_f =$

$\sum_{i=1}^{k} q_i$ and that supplied to local producers equals $Q_h = \sum_{i=k+1}^{m} q_i$.The first order conditions for the above problems can be written as

$$\alpha + d + \delta c = 2(2q_i + \sum_{z=1, z\neq i}^{k} q_z) + Q_h \text{ for } i = 1...k \tag{20}$$

and

$$\alpha = Q_f \ + \frac{n+1}{n}\left(2q_i + \sum_{z=k+1, z\neq i}^{m} q_z\right) \text{ for } i = k+1...m. \tag{21}$$

Let the equilibrium output of a supplier that caters to the multinational equal q_m^{EX} while that of a supplier that caters to local firms equal q_h^{EX}. Thus, the above first order conditions become

$$\alpha + d + \delta c = 2(k+1)q_m^{EX} + (m-k)q_h^{EX} \tag{22}$$

and

$$\alpha = kq_m^{EX} + \frac{n+1}{n}(m-k+1)\, q_h^{EX}. \tag{23}$$

The solution to the above system is

$$q_m^{EX}(k) = \frac{(m+n-k+1)\,\alpha + (n+1)(m-k+1)(\delta c + d)}{2(n+1)(k+1)(m-k+1) - k(m-k)n} \tag{24}$$

for each supplier to the multinational and

$$q_h^{EX}(k) = \frac{n\,(k+2)\,\alpha - nk(\delta c + d)}{2(n+1)(k+1)(m-k+1) - k(m-k)n}, \tag{25}$$

for each of the other suppliers.

The aggregate amount of the intermediate supplied to the multinational equals $kq_m^{EX}(k)$, while (by the first order conditions) the prices of the intermediate paid by the multinational and the local producers are

$$w_f^{EX}(k) = 2q_m^{EX}(k) + c_I - d \text{ and } \ w_h(k) = \frac{n+1}{n} q_h^{EX}(k) + c_I \ . \tag{26}$$

The equilibrium profit of a typical supplier to the multinational equals

$$\pi_m^{EX}(k) = (w_f^{EX}(k) - c_I + d)q_m^{EX}(k) = 2\left[q_m^{EX}(k)\right]^2, \tag{27}$$

and that for a supplier serving local producers is

$$\pi_h^{EX}(k) = (w_h^{EX}(k) - c_I)q_h^{EX}(k) = \frac{n+1}{n}\left[q_h^{EX}(k)\right]^2. \tag{28}$$

The profit of the multinational equals

$$\pi_f^{EX}(k) = \left[kq_m^{EX}(k)\right]^2 \tag{29}$$

which increases with k, d and δ. Finally, the profit of each local producer equals

$$\pi_j^{EX}(k) = \left[\frac{(m-k)q_h^{EX}(k)}{n}\right]^2, \quad j = 1...n. \tag{30}$$

4.2 Best response of invited suppliers

Once invited, a supplier has two options: either to become an exclusive supplier for the multinational or to serve home producers only. The trade-off behind this choice is as follows. On the one hand, by serving the multinational, a supplier captures a share of the multinational's demand for the intermediate and also receives 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) and the magnitude of the intermediate demand generated by local producers. Specifically, given that $k-1$ suppliers accept the multinational's offer, the kth supplier is willing to serve the multinational if and only if

$$\pi_m^{EX}(k) \geq \pi_m^{EX}(k-1). \tag{31}$$

Remark 2: *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 the above result 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 $\overline{k}$ be the largest integer that satisfies (31). Obviously, such $\overline{k}$ is unique and in general is between 0 and m. If the multinational announces a k that is smaller than (or equal to) $\overline{k}$, then all invited suppliers accept its offer because (31) holds. If $k \geq \overline{k} + 1$, then (31) is violated at k by the definition of $\overline{k}$ so that the k^{th} supplier, even if invited, will choose to reject the offer and stay as a supplier of home producers. We thus have the following result.

Lemma 1: *Given the k announced by the multinational, its equilibrium number of exclusive suppliers $S(k)$ is as follows:*

$$S(k) = \left\{ \begin{array}{ll} k, & if\ k \leq \overline{k} \\ \overline{k}, & if\ k > \overline{k}. \end{array} \right\} \tag{32}$$

Although we cannot obtain an analytical expression for $\overline{k}$, it is easy to show that it increases with the degree of VTT (d), as well as the technological gap between the multinational and its local rivals (δ). In fact, as d or δ rises, function $\pi_m^{EX}(k)$ shifts upwards and function $\pi_m^{EX}(k-1)$ shifts downwards, implying that $\overline{k}$ 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 exclusivity offer.

To preclude the uninteresting case that all suppliers become the exclusive suppliers of the multinational thereby driving all local producers out of the market, we make the following assumption which guarantees that $\overline{k} \leq m-1$.

Assumption 1: $\pi_h^{EX}(m-1) > \pi_m^{EX}(m)$.

The right-hand-side in the above assumption $\pi_m^{EX}(m)$ is the Cournot profit of a supplier when the multinational is the only producer of the final good.[9] This assumption says that a supplier prefers to be the sole supplier to all local producers than to serve the multinational exclusively (together with all other $m-1$ suppliers). Assumption 1 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.

Using the expression for $\pi_h^{EX}(m-1)$, Assumption 1 can be written as

$$\frac{n+1}{n}\left[\frac{n\,(m+1)-n(m-1)g}{4(n+1)m-(m-1)n}\right]^2 > \frac{1}{2}\left[\frac{1+g}{m+1}\right]^2 \text{ where } g \equiv (\delta c+d)/\alpha. \tag{33}$$

Similarly, to make exclusivity an attractive option for suppliers, the following assumption is necessary (it ensures that $\overline{k} \geq 1$):

Assumption 2: $\pi_m^{EX}(1) \geq \pi_h^{EX}(0)$

$$2\left[\frac{(m+n)\,\alpha+(n+1)m(d+\delta c)}{4(n+1)m-(m-1)n}\right]^2 > \frac{n+2}{n+1}\left[\frac{(n+1)\,\alpha+\delta c}{(n+2)(m+1)}\right]^2. \tag{34}$$

The right-hand-side of the inequality $\pi_h^{EX}(0)$ is the profit of a typical supplier under market interaction (see equation (11)) – i.e. when no supplier accepts the multinational's offer whereas $\pi_m^{EX}(1)$ is the profit of a supplier when it is the only one serving the multinational. Assumption 2 implies that once the multinational offers (VTT, EX) to certain suppliers, it is not a Nash equilibrium for all of those suppliers to reject the offer; at least one will choose to accept the offer. Assumption 2 holds, for example, if d is not too small.

[9] Derivation of this profit is straightforward. One way to obtain it is to substitute $n=1$ into the supplier's profit function in the case of autarky derived in section 2.

Since $\pi_f^{EX}(k)$ is an increasing function of k, the multinational would announce $k = \overline{k}$ and, by Lemma 1, earn a profit of $\pi_f^{EX}(\overline{k})$ under exclusivity.

Lemma 2: *Suppose assumptions 1 and 2 hold. Then, the optimal strategy for the multinational, given that it chooses exclusivity, is to set* $k = \overline{k}$ *and its equilibrium profit equals* $\pi_f^{EX}(\overline{k})$. [10]

5 Equilibrium mode of entry

Regarding the choice between an exclusive contractual arrangement or market interaction, the basic trade-off facing the multinational is as follows. First, exclusivity prevents the multinational's local rivals from enjoying the benefits of VTT that the multinational undertakes to its suppliers. Second, by its very nature, exclusivity limits the number of competing suppliers that serve the multinational's local rivals. Both of these advantages raise the costs of the multinational's rivals. The disadvantage of exclusivity is that the multinational is able to attract only $\overline{k}$ suppliers under exclusivity while it buys the intermediate in an open market where all m suppliers compete with one another. One thus naturally expects that either exclusive contract or market interaction can be optimal for the multinational firm depending on parameter values. Clearly, exclusivity occurs in the subgame perfect equilibrium of the entry game if and only if $\Delta \equiv \pi_f^{EX}(\overline{k}) - \pi_f^M \geq 0$.

Since protection of VTT is the primary reason for the choice of exclusive contract by the multinational, exclusivity becomes more attractive the larger the extent of VTT. In fact, because $\pi_f^{EX}(k)$ increases with d and k, and the number of equilibrium suppliers of the multinational $(\overline{k})$ also rises with d, the

[10] Strictly speaking, any announcement k by the multinational where $k \geq \overline{k}$ would constitute an equilibrium. However, if conveying the extent of VTT to a potential supplier incurred even a minute cost (say $\varepsilon > 0$ where ε is arbitrarily small), the multinational would not approach more than $\overline{k}$ suppliers.

profit differential Δ increases as d goes up. Noting that π_f^M is independent of d (there is no VTT under market interaction), we have that $\Delta > 0$ if and only if d exceeds a threshold. Assume that there exists d^* such that $\Delta|_{d=d^*} = 0$.[11]

Proposition 2: *The multinational firm opts for an exclusive contract if and only if the extent of* VTT *undertaken by it is sufficiently large (i.e.* $d > d^*$*).*

An important parameter of the model is the magnitude of the multinational firm's cost advantage in transforming the intermediate good into the final product (δ). If δ rises, both $\pi_f^{EX}(\overline{k})$ and π_f^M go up. So in general it is not clear whether exclusivity becomes more or less attractive with an increase in δ. For the case with two suppliers considered in the next section, it is shown that exclusivity is less likely to occur for larger δ.

How does exclusivity affects the degree of backward linkages, consumer surplus and local welfare? As mentioned earlier, the multinational's entry with exclusive contract impacts local industry in three ways: (i) it increases competition downstream and this tends to raise the level of backward linkages (and thus consumer surplus); (ii) de-linking reduces the degree of competition among suppliers which tends to lower the aggregate output level of the intermediate good (as well as consumer surplus); and (iii) local suppliers benefit from VTT, which tends to raise the level of backward linkages. The net effect of the three forces can either be negative or positive – we explore these three effects in greater detail below for the case of two local suppliers..

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

[11] If such a d^* does not exist, then Δ is either always negative or positive and such cases are of limited interest.

also from the decline in the number of suppliers who serve them. The delinking of $\overline{k}$ producers changes market structure of the two-tier industry and raises the market power of the $m - \overline{k}$ suppliers who serve local producers.[12]

How do suppliers fare under exclusivity relative to autarky? Since the equilibrium number of suppliers serving the multinational ($\overline{k}$) cannot be solved for analytically in the general case, 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 the supplier who serves the multinational is better off and the other supplier is worse off relative to autarky. Nevertheless, the *average profit* of the two suppliers exceeds the profit of a typical supplier under autarky.

6 Two local suppliers

To further explore the choice between the two contracting arrangements, this section considers the case of two local suppliers (i.e. $m = 2$). First note that, if the multinational opts for exclusivity, then under Assumptions 1 and 2 in the previous section the equilibrium number of exclusive suppliers is one (i.e. $\overline{k} = 1$). From derivations in the previous section, the equilibrium quantities for the two suppliers (where 1 serves the multinational and 2 serves local firms) are:

$$q_1^{EX} = \frac{(n+2)\alpha + 2(n+1)(d+\delta c)}{7n+8} \text{ and } q_2^{EX} = \frac{3n\alpha - n(d+\delta c)}{7n+8}. \quad (35)$$

[12] To see this, note from (30) that a local producer's profit declines with k. Thus,

$$\pi_j^{EX}(\overline{k}) < \pi_j^{EX} \mid_{k=0} = \frac{m^2\alpha^2}{(m+1)^2(n+1)^2}.$$

The right-hand-side of the above equation equals the profit of a local producer under autarky.

The prices for the intermediate good equal

$$w_f^{EX} = 2q_1^{EX} + c_I - d \text{ and } \; w_h^{EX} = \frac{n+1}{n} q_2^{EX} + c_I \; . \tag{36}$$

and the profit of the two suppliers are

$$\pi_{_1}^{EX} = (w_f^{EX} - c_I + d) q_1^{EX} = 2\left[q_1^{EX}\right]^2, \tag{37}$$

and

$$\pi_2^{EX} = (w_h^{EX} - c_I \,) q_2^{EX} = \frac{n+1}{n}\left[q_2^{EX}\right]^2. \tag{38}$$

The multinational's profit is

$$\pi_f^{EX} = [a - q_1^{EX} - q_2^{EX} - w_f^{EX} - c] q_1^{EX} = \left[\frac{(n+2)\alpha + 2(n+1)(d+\delta c)}{7n+8}\right]^2. \tag{39}$$

Straightforward comparison of intermediate good prices shows the following:[13]

$$w_f^{EX} < w_h^{EX} \Longleftrightarrow (n-1)\alpha + (2n+3)d > 5(n+1)\delta c.$$

Remark 3: *Under exclusivity, the multinational pays a lower price for the intermediate good than other local producers if* VTT *is substantial (i.e. d is large) or if its cost advantage over local competitors is not too large (i.e. δ is small).*

Obviously, VTT lowers the unit cost of suppliers of multinational and thus tends to reduce the intermediate price for the multinational. An increase in the cost-advantage of the multinational in transforming the intermediate

[13] Comparing (36) with (4), we can show that $w_h^{EX} > w^A$ if $d + \delta c$ is not too big. Thus, the multinational's entry under exclusivity can raise the costs of local producers by lowering the number of suppliers who serve local producers. By contrast, when $d + \delta c$ is large, the market shares of local producers is small and their demand for the intermediate good is low. Under such a scenario, the multinational's entry can actually lower the price they pay for the intermediate relative to autarky.

good erodes the market share of a typical local producer, thereby lowering its demand for the intermediate good.

Exclusivity occurs in equilibrium if and only if it is more profitable for the multinational firm relative to market interaction: i.e., if and only if $\pi_f^{EX}(1) \geq \pi_f^M$, which in this case is equivalent to

$$\Delta \equiv \frac{(n+2)\alpha + 2(n+1)(d+\delta c)}{7n+8} - \frac{2(n+1)\alpha + (3n^2+6n+2)\delta c}{3(n+2)(n+1)} \geq 0. \quad (40)$$

Taking partial derivatives of Δ with respect δ yields the following result.

Lemma 3: *Suppose assumptions 1 and 2 hold and m=2. Then, the larger the cost-advantage of the multinational over its local competitors, the weaker its incentive to choose an exclusive contract over market interaction* ($\frac{\partial \Delta}{\partial \delta} < 0$).

This result can be understood as follows. If the multinational possesses a larger cost-advantage (δ) in transforming the intermediate good into the final product, then it is less worried about protecting its VTT and is more concerned about creating competition among its suppliers. As a result, the multinational is more likely to prefer market interaction.

To concentrate on the role of VTT, we next consider the case where the multinational has no direct cost advantage over its local rivals ($\delta = 0$).

6.1 Isolating the role of VTT

When $\delta = 0$ condition (40) is equivalent to

$$\frac{d}{\alpha} \geq \frac{1}{2(n+1)} \left[\frac{2}{3} \frac{7n+8}{n+2} - (n+2) \right] \quad (41)$$

which always holds as long as $n \geq 2$. If $n = 1$, then (41) holds if and only if $d/\alpha \geq 1/12$.

Proposition 3: *Suppose assumptions 1 and 2 hold (so* $\overline{k} = 1$*), m=2, and* $\delta = 0$*. Then, the following hold:*

(i) If $n \geq 2$ *then exclusivity always occurs in equilibrium; and*

(ii) If n=1 then exclusivity arises iff the extent of VTT *is sufficiently large (i.e.* $d/\alpha > 1/12$*).*

If $n = 1$, the local industry is a double duopoly after the entry of the multinational. When the extent of VTT is large ($d/\alpha > 1/12$), the benefit of preventing its suppliers from serving its local rival is high so that exclusivity is a better choice. By contrast, when VTT is minor the multinational prefers market interaction so as to enjoy more competition among suppliers. If the number of rival producers of the multinational exceeds 2, the incentive to prevent VTT to leak to its downstream rival firms dominates the incentive to create competition among suppliers so that the multinational opts for exclusivity.

We next focus on the case that exclusivity emerges in equilibrium ($n \geq 2$) and examine its effects on the local economy.

6.1.1 Effects of exclusivity on local industry

As mentioned for the general case, local producers are certainly worse off under exclusivity relative to autarky because of competition from the multinational as well as due to reduction of competition among suppliers.

For suppliers, Assumption 2 guarantees that supplier 1 is better off relative to market interaction and thus is better off relative to autarky as well. For supplier 2, straightforward comparison of π_2^{EX} and π_2^{A} shows 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 *gains* from the multinational's entry under an exclusive contract with supplier 1. 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 $\overline{k}/m$ (which in the present case equals1/2). Thus, the average profits of a typical supplier in the two-supplier case equals

$$\frac{\pi_1^{EX} + \pi_2^{EX}}{2} = \frac{1}{2}\frac{[(n+2)\alpha + 2(n+1)d]^2}{(7n+8)^2} + \frac{1}{2}\frac{(n+1)\,n\,[3\alpha - d]^2}{(7n+8)^2}.$$

It is easy to show that the above average profit is an increasing function of d and that

$$\left(\frac{\pi_1^{EX} + \pi_2^{EX}}{2}\right) |_{d=0} > \pi_{U_2}^A.$$

Lemma 4: *Suppose m=2, $n \geq 2$, and $\delta = 0$. A typical supplier earns greater expected profit under the multinational's entry with exclusivity relative to autarky.*

This result is consistent with both case-study evidence and formal econometric investigations of the effects of multinational firms on local suppliers (see Moran, 1998 for an overview of such evidence; also Javorcik, 2004).

6.1.2 Backward linkages and local welfare under exclusivity

As under autarky, the degree of backward linkages here can be measured by aggregate output

$$BL^{EX} = q_1^{EX} + q_2^{EX} = \frac{(4n+2)\alpha + (n+2)d}{7n+8} \tag{42}$$

Comparing to autarky, we have that the multinational's entry raises the degree of backward linkages (i.e., $BL^{EX} > BL^A$) if and only if

$$\frac{d}{\alpha} > \frac{2(n^2-n-3)}{3(n+1)(n+2)} \equiv G_{BL}(n). \tag{43}$$

That is, for given n, exclusivity increases the level of backward linkages if and only if VTT or the cost-advantage of the multinational exceeds a critical value (Proposition 2). Furthermore, the critical value, $G_{BL}(n)$, increases with n, so that for lager n, it is *less* likely that exclusivity will 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 de-linking effect caused by exclusivity. If n is big, on the other hand, the market share of the multinational is small after its entry. This implies that the extra demand for the intermediate caused by such entry is small. In fact, it is so small that it cannot offset the negative effect on backward linkages generated by exclusivity.

Aggregate local welfare equals

$$W^{EX} = \pi_{1}^{EX} + \pi_{2}^{EX} + n\pi_{j}^{EX} + \frac{[q_1^{EX} + q_2^{EX}]^2}{2} \tag{44}$$

Prior to the entry of the multinational, the level of local welfare (when $m = 2$) is

$$W^{A} = 2\pi_{i}^{A} + n\pi_{j}^{A} + \frac{\left[BL^{A}\right]^{2}}{2} \tag{45}$$

Entry by the multinational enhances local welfare ($W^{EX} > W^{A}$) if and only if

$$\frac{d}{\alpha} > G_W(n) \tag{46}$$

where $g = G_W(n)$ is the (positive) solution to $W^{EX} = W^{A}$.

For the special case considered here, Assumption 1, which guarantees that at least one supplier prefers to be the sole supplier of local producers than to serve the multinational exclusively along with the other supplier, is equivalent to

$$\frac{d}{\alpha} \leq G_1(n) \equiv \frac{9\sqrt{4n(n+1)} - (7n+8)}{3\sqrt{4n(n+1)} + 7n + 8}, \tag{47}$$

and Assumption 2, which guarantees that the supplier is no worse-off serving the multinational exclusively relative to market interaction, becomes

$$\frac{d}{\alpha} \geq G_2(n) \equiv \frac{1}{2(n+1)} \left[\frac{7n+8}{3\sqrt{2}} \sqrt{\frac{n+1}{n+2}} - (n+2) \right]. \tag{48}$$

For a supplier to be willing to accept the exclusivity offer, the extent of VTT must be large enough. Function $G_2(n)$ represents the VTT threshold for given n. As noted earlier, a larger n implies a higher opportunity cost of serving the foreign exclusively. As a result, $G_2(n)$ increases with n.

Figure 1 illustrates the effects of the multinational's entry on backward linkages and local welfare in the $(n, \frac{d}{\alpha})$ space.

— Figure 1 here —

Assumptions 1 and 2 require that the feasible parameter values lie below $G_1(n)$ and above $G_2(n)$. Within the feasible region, Figure 1 can be divided into four areas labelled as I, II, III, and IV. In region IV, the extent of VTT is so large that the multinational's entry raises both the level of backward linkages and local welfare. In region II, 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 III the multinational's entry raises local welfare even as it lowers the degree of backward linkages but, whereas the opposite is true in region I.

The intuition for why the multinational's entry enhances both backward linkages and local welfare in region IV 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 low and local market structure downstream is relatively competitive (i.e. n is big), such as in

region II, the negative effect of exclusivity dominates the positive effects of demand creation and VTT, in which case both local welfare and the level of backward linkages decline due to the multinational's entry.

For the other two areas (I and III), 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 I), backward linkages increase but welfare declines. This is because when n is small, the demand creation effect of the multinational's entry is large (as noted in Remark 1) and the resulting increase in the output of the intermediate good translates into higher consumer surplus as well and greater profits of suppliers. However, for small n, the market is concentrated and the erosion of the profits of local firms that results from entry is large and this negative effect on local producers leads to a reduction in local welfare. Area III 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:

Proposition 4: *Suppose assumptions 1 and 2 hold,* $m = 2$, *and* $\delta = 0$. *Then, there exist parameter values for which the multinational firm chooses to enter with an exclusive contract and its entry lowers the level of backward linkages (ranges II and III in Figure 1).*

7 Conclusion

The model developed in this paper differs from existing literature on backward linkages in two main respects. First, while existing literature focuses on the demand-creating effects of the entry of multinational firms on local industry (e.g. Markusen and Venables, 1999), we focus on the supply-side effects of such entry. In particular, VTT and the possibility of exclusive contract between the multinational and its local suppliers are two key ingredients of our model. Existing literature has given us important insights regarding the scenario where multinationals purchase required intermediates via the market. However, such research, by design cannot shed light on issues that surface once the contractual options available to the multinational are considered. For example, an important insight of our model is that while VTT is beneficial for the local economy, it comes at an implicit price when accompanied with exclusivity: under such a contractual arrangement the recipients of VTT are no longer able to supply local producers they supplied prior to the entry of the multinational.

Our second point of departure from existing literature is that our model considers oligopolistic competition at both the upstream and downstream stages of production. Such a setting enables us to examine how the contractual relationship between the multinational and its suppliers affects strategic interaction in the local industry. For example, in addition to the competition effect identified in Markusen and Venables (1999), entry by the multinational into the final good market also hurts its local rivals through 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 does create additional demand for the intermediate good, it may also reduce the number of suppliers available to its local rivals. This nega-

tive supply side effect can dominate the positive demand side effects so that the total output of the intermediate good (as well as the final good) shrinks due to the multinational's entry. Our model identifies delinking as another channel, in addition to importing of intermediate goods as recognized in the literature, via which foreign direct investment may lower industrial linkages in the host country. However, it is worth noting that the entry of the multinational even under exclusivity increases aggregate local welfare (and the degree of backward linkages) so long as the degree of VTT is not too small .

The model focuses on the entry decision of a single multinational and does not consider competition amongst multinationals. Further research is needed to determine how strategic competition amongst multinationals affects their incentives to impose exclusivity conditions on their local suppliers.

References

[1] Aitken, Brian, and Ann E. Harrison, 1999. "Do Domestic Firms Benefit from Direct Foreign Investment?" *American Economic Review* 89: 605-18.

[2] Blalock, Garrick and Paul Gertler, 2002. "Technology Diffusion from Foreign Direct Investment through Supply Chain," Working Paper, Cornell University.

[3] Blomström, Magnus, and Ari Kokko, 1998. "Multinational Corporations and Spillovers," *Journal of Economic Surveys* 12, 247-77.

[4] Dixit, Avinash and Joseph E. Stiglitz, 1977. "Monopolistic Competition and Optimum Product Diversity," *American Economic Review* 67, 297-308.

[5] Ethier, Wilfred J., 1982. "National and International Returns to Scale in the Modern Theory of International Trade," *American Economic Review* 72, 389-405.

[6] Javorcik, Beata S., 2004. "Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers Through Backward." *American Economic Review* 94, 605-627.

[7] Lall, Sanjaya, 1980. "Vertical Inter-Firm Linkages in LDCs: An Empirical Study." *Oxford Bulletin of Economics and Statistics* 42, 203-206.

[8] Lorentzen, Jochen and Peter H. Mollgaard, 2000. "Vertical Restraints and Technology Transfer: Inter-firm agreements in Eastern Europe's car component industry, Working Paper, Copenhagen Business School.

[9] Markusen, James R., 1995. "The Boundaries of Multinational Enterprises and the Theory of International Trade," *Journal of Economic Perspectives* 9, 169-89.

[10] Markusen, James R. and Anthony Venables, 1999. "Foreign Direct Investment as a Catalyst for Industrial Development," *European Economic Review* 43, 335-356.

[11] Mizuno, Junko, 1995. "The Present Condition and Problems of the Automobile Industry in the Republic of Korea," Mimeo, Institute of Developing Economics.

[12] Moran, Theodore, 1998. *Foreign Direct Investment and Development*, Institute for International Economics, Washington D.C.

[13] Institute of Developing Economics, 1995. *The Automobile Industry in Asia: The Great Leap Forward?* Institute of Development Economics, Tokyo.

[14] Pack, Howard and Kamal Saggi, 2001. "Vertical Technology Transfer via International Outsourcing," *Journal of Development Economics* 65, 389-415.

[15] Qiu, Larry D.. and Zhigang Tao, 2001. "Export, Foreign Direct Investment, and Local Content Requirement," *Journal of Development Economics* 66, 101-125.

[16] Rodriguez-Clare, Andre, 1996. "Multinationals, Linkages, and Economic Development," *American Economic Review* 86, 852-873.

[17] Saggi, Kamal, 2002. "Trade, Foreign Direct Investment, and International Technology Transfer: A Survey," *World Bank Research Observer* 17, 191-235.

[18] Salop, Steven C. and David T. Scheffman, 1987. "Cost Raising Strategies," *Journal of Industrial Economics* 36, 19-34.

[19] United Nations Conference on Trade and Development (UNCTAD), 1997. *World Investment Report 1997: Transnational Corporations, Market Structure and Competition Policy*, United Nations, NY.

[20] United Nations Conference on Trade and Development (UNCTAD), 1996. *World Investment Report 1997: Promoting Linkages*, United Nations, NY.

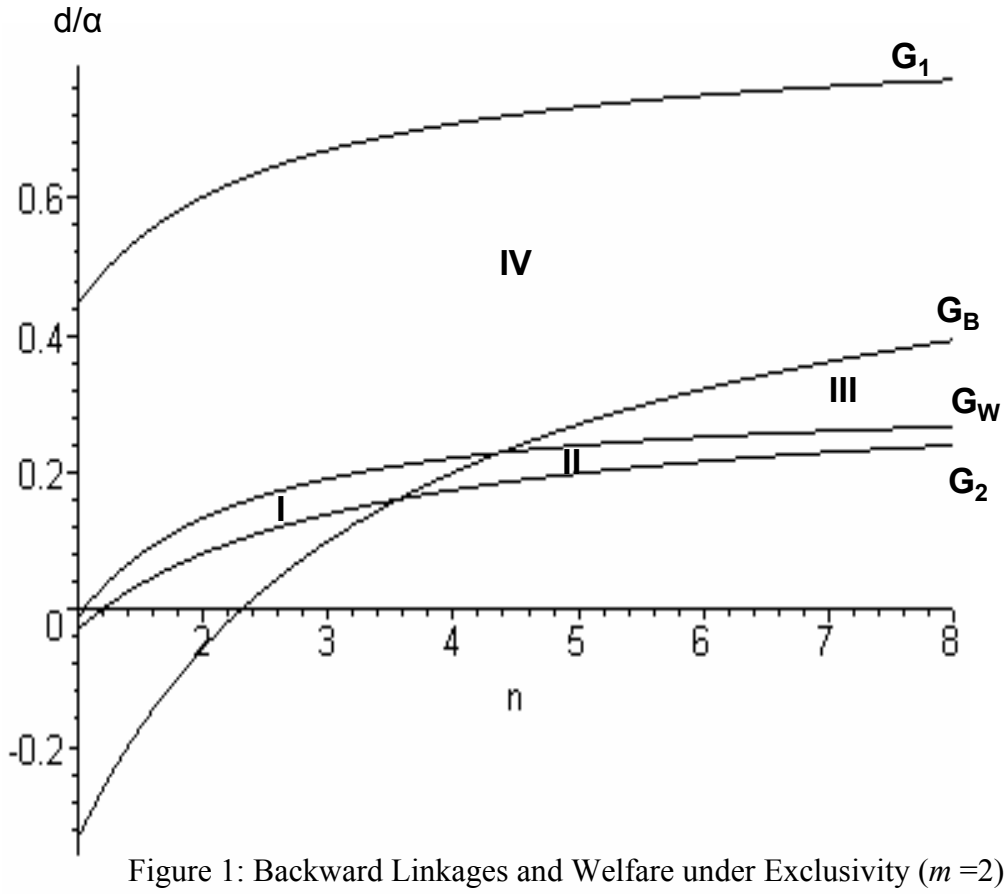

Figure 1: Backward Linkages and Welfare under Exclusivity (m =2)