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ABSTRACT

Foreign Direct Investment and Spillovers through Backward Linkages*

Foreign direct investment projects can generate spillovers through backward linkages in the host economy. This will be the case if local competitors in the project's own industry can benefit from the upstream efficiency improvements that were induced by the foreign firm. We provide microfoundations for this spillover effect and argue that its creation depends crucially on the supplier arrangement that is chosen by the multinational corporation (MNC). We use an incomplete contract framework to study the optimal supplier arrangement. The MNC will produce the inputs itself if the supplier's investment is neither too human capital nor too asset specific. The MNC will use several independent suppliers if its own investment is not too supplier specific, competition between suppliers is neither too strong nor too weak and competition in the project's own industry is not too strong. Finally, the MNC will use only one independent supplier if its own investment is very supplier specific, competition between suppliers is either very strong or very weak and the supplier's investment is either very human capital or asset specific. The foreign investment only generates spillovers to the local industry if the MNC uses several independent suppliers.

JEL Classification: D23, F23, L22
Keywords: foreign direct investment, property rights, vertical integration

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NON-TECHNICAL SUMMARY

The entry of a multinational corporation (MNC) can lead to significant efficiency and quality improvements in the local upstream industry. If there are increasing returns in the upstream industry the efficiency improvements may simply be due to the increased demand for local inputs that is generated by the project. The MNC can also cooperate with the local suppliers more directly to encourage upstream improvements. For instance, MNCs sometimes transfer know-how to local suppliers and provide training for their workforce. Also, some foreign investors encourage upstream investments by agreeing to long-term contracts or indeed by providing direct financial assistance.

The upstream improvements that are induced by the entry of the MNC can spill over to local downstream firms. This will be the case if the local suppliers do not sell to the MNC exclusively but also serve other local downstream firms. While the local industry can benefit from the more efficient provision of high quality inputs the foreign firm might be adversely affected by this spillover effect since it now faces more efficient competitors.

In this paper we argue that the creation of this kind of spillover depends on the supplier arrangement that is chosen by the MNC. For instance, the MNC could avoid the spillover by producing the input itself. Alternatively, the MNC could contract with only a small number of suppliers and just generate enough high quality upstream production to cover its own demand. Only if the MNC chooses a supplier arrangement that generates a net increase in the local production of high quality inputs can there be a spillover effect.

Given that the MNC may be adversely affected by the spillover effect the key question is why it would choose a supplier arrangement that generates such a spillover. We argue that the MNC may itself have an interest in a net increase of local upstream production since such an increase improves its bargaining position relative to its local suppliers. Only when the total supply of high quality inputs is larger than the MNC’s demand can it engage in what we call a ‘double procurement policy'. Under such a policy the MNC establishes trading relationships with several suppliers for the same input. The MNC can then always threaten to leave one supplier and buy more of the input from the other suppliers. If the total local supply of the input just covers the MNC's demand such a threat is not credible since the suppliers know that the MNC has to buy the input from them. In this case the foreign firm may face a standard hold-up problem.

We analyse different supplier arrangements and derive the conditions under which the MNC optimally chooses an arrangement that leads to a net increase

in upstream production. In this sense we provide microfoundations for the type of spillover effect described above.

We argue that it may be problematic for the foreign firm to contract with only one independent supplier. In this case the foreign firm may under-invest since it anticipates being held-up *ex post*. Integration with the supplier does not improve the foreign firm's investment incentives if the local supplier's investment is either very human capital or very asset specific. If the supplier's investment is very human capital specific (e.g. if the supplier has to learn how to use a new technology), then ownership of this technology does not improve the foreign firm's bargaining position since it still has to agree with the supplier to get access to its human capital. If the supplier's investment is largely embodied in the asset then integration only improves the foreign firm's bargaining position at a very high cost, namely a strong deterioration in the supplier's own investment incentives.

The effectiveness of a double procurement policy in improving investment incentives depends on the degree of competition in the upstream and the downstream industry. Double procurement only improves the investment incentives if upstream competition is neither too strong nor too weak. If upstream competition is very strong then suppliers cannot be induced to invest under a double procurement policy. In the opposite case, where upstream competition is very weak the existence of a second upstream firm does not lead to strong improvements in the foreign firm's bargaining position. The degree of competition in the downstream industry matters since a double procurement policy generates a spillover effect that can lead to efficiency improvements of local competitors. Only if downstream competition is not very strong does the benefit of an improved bargaining position outweigh the cost of the spillover effect.

1 Introduction

The impact of foreign direct investment (FDI) projects on host economies has been a controversial issue among academics and policy makers for some time. In the 1970s the majority opinion was largely critical of the presence of multinational corporations (MNCs) in developing countries. This opinion was mainly based on the argument that the competitive advantage of an MNC can lead to the monopolisation of the local industry thereby generating negative welfare e¤ects in the host economy. In the last few years the view of multinational activity has become more optimistic. This shift in opinion is partly due to a large number of empirical studies which have identi…ed various channels through which FDI projects can be bene…cial for the host economy[1]. Also, these empirical …ndings have been complemented by a number of theoretical papers[2] that provide a theoretical framework to rigorously analyse the costs and bene…ts of multinational activity.

This paper tries to contribute to the theoretical analysis by providing microfoundations for a particular channel which has received attention in the literature, namely the generation of spillovers through backward linkages. It is well understood that the entry of an MNC can lead to quality and e¢ciency improvements in the local upstream industry. If there are increasing returns in the upstream industry the e¢ciency improvements may simply be due to the increased demand for local inputs that is generated by the project. The MNC can also co-operate with the local suppliers more directly to encourage upstream improvements. For instance, MNCs sometimes transfer know-how to local suppliers and provide training for their work force. Also, some foreign investors encourage upstream investments by agreeing to long term contracts or indeed by providing direct …nancial assistance.

[1] For a comprehensive survey article see Blomstrom and Kokko (1996).

[2] See, for example, Rodriguez-Clare (1996), Markusen and Venables (1999) and Matouschek and Venables (1999a)

The upstream improvements that are induced by the entry of the MNC can spill over to local downstream …rms. This will be the case if the local suppliers do not sell to the MNC exclusively but also serve other local downstream …rms. While the local industry can bene…t from the more e¢cient provision of high quality inputs the foreign …rm might be adversely a¤ected by this spillover e¤ect since it now faces more e¢cient competitors.

In this paper we argue that the creation of this kind of spillover depends on the supplier arrangement that is chosen by the MNC. For instance, the MNC could avoid the spillover by producing the input itself. Alternatively, the MNC could contract with only a small number of suppliers and just generate enough high quality upstream production to cover its own demand. Only if the MNC chooses a supplier arrangement that generates a net increase in the local production of high quality inputs can there be a spillover e¤ect.

Given that the MNC may be adversely a¤ected by the spillover e¤ect the key question is why it would choose a supplier arrangement that generates such a spillover. We argue that the MNC may itself have an interest in a net increase of local upstream production since such an increase improves its bargaining position relative to its local suppliers. Only when the total supply of high quality inputs is larger than the MNC's demand can it engage in what we call a 'double procurement policy'. Under such a policy the MNC establishes trading relationships with several suppliers for the same input although any single supplier would be willing and able to satisfy the MNC's demand. The MNC can then threaten to leave one supplier and buy more of the input from the other suppliers. If the total local supply of the input just covers the MNC's demand such a threat is not credible since the suppliers know that the MNC has to buy the input from them. In this case the foreign …rm may face a standard hold-up problem. The observation that …rms sometimes solve a hold-up problem by engaging in a double procurement policy rather

than by integrating with a supplier has been made in context of transition economies by Matouschek and Venables (1999b). In their case study of several recent FDI projects in Eastern Europe they report on cases in which the foreign investor actively encouraged the development of a local independent upstream industry. Foreign investors were certain that such a development was in their interest since it allows them to engage in a double procurement policy. Such a policy, in turn, was perceived to reduce their hold-up problem.

In the model that is presented below we analyse di¤erent supplier arrangements and derive the conditions under which the MNC optimally chooses an arrangement that leads to a net increase in upstream production. In this sense we provide microfoundations for the type of spillover e¤ect described above.

Our model is related to papers by Hart and Tirole (1990) and Bolton and Whinston (1991 & 1993) which study vertical integration and market foreclosure in an incomplete contract setting. These models analyse how the supplier arrangement that is chosen by a downstream …rm can a¤ect other upstream and downstream …rms. In particular, they show that as long as downstream farms compete in either input or output markets there is "an excessive tendency towards integration"[3] since …rms may use integration as a means to engage in market foreclosure. In contrast to these papers we focus on a downstream …rm's incentive to foster upstream competition. Our paper is also related to Rajan and Zingales (1998) who show how an agent can use his power to regulate access to an asset to in‡uence the (relationship speci…c) investments of other agents. One of the main di¤erences between the papers is the spillover e¤ect which is a central element in our model and which is absent from their set-up.

The paper is organised as follows: in the next section we describe the basic model. In section (3) we then solve the model and discuss the implications in section (4). Section

[3] Bolton and Whinston (1991), p. 214.

(5) summarises and concludes.

2 The Model

In the economy there are two vertically linked industries. At most two …rms can operate in the downstream industry. We call one of these …rms 'foreign' and the other 'local'. In the upstream industry there are many potential …rms. The downstream industry uses inputs produced by the upstream industry to manufacture a …nal good that is demanded by consumers.

2.1 Demand

The goods that are produced by the downstream …rms are perfect substitutes[4]. The price for the good in the local market is given by the inverse demand function so that

$$p(q_l + q_f) = tP(q_l + q_f)$$

where q_l and q_f are the quantities sold by the local and the foreign …rm and t is some measure of the size of the local market. We assume that $\frac{@P(Q)}{@Q} < 0 \; 8Q$, where $Q = q_f + q_l$. We also assume that the foreign …rm can sell its product in an export market at price p^E where $p^E = P^E(q_f^E)$ and $\frac{@P^E(q_f^E)}{@q_f^E} < 0 \; 8q_f^E$. By assumption the local …rm cannot sell in this market.

2.2 The Upstream Technology

Initially there is a large number of identical suppliers and each one is endowed with an asset a. The foreign …rm can choose which local suppliers to transfer know-how to.

[4] A more general model would allow for di¤erent elasticities of substitutions. Note, however, that a spill-over e¤ect that makes the local …rm more competitive is most harmful for the foreign …rm if the competitors produce perfect substitutes. Hence showing that the foreign …rm may optimally choose a supplier arrangement that generates a spill-over is more di¢cult under the assumption that the …rms produce perfect substitutes.

We assume that transferring know-how does not involve any direct costs for the foreign …rm. After having received the know-how a local supplier can make an unobservable investment $e \in \{0, \bar{e}\}$, where e indicates both the level and the cost of the investment. After the investment has been made a supplier's asset a can be used to produce one unit of the input at zero marginal cost. Inputs can di¤er with respect to their quality v. If the asset is used together with the supplier's human capital then the quality of the input that is being produced is given by $v = e$. If, however, the asset a is used without the supplier's human capital then the produced input is of quality $v = \bar{\gamma}e$ where $\bar{\gamma} \in [0, 1]$: Production without the asset is impossible. We follow Nodelke and Schmidt (1999) in interpreting $\bar{\gamma}$ as a parameter that captures the degree to which the supplier's ex ante investment is embodied in the physical asset a. The investment is entirely speci…c to the supplier's human capital if $\bar{\gamma} = 0$ and it is entirely embodied in the asset a if $\bar{\gamma} = 1$. Note that our formulation implies that while the supplier's investment decision is discrete input quality v is de…ned continuously ($v \in [0, \bar{e}]$).

We follow the recent literature on incomplete contracts and property rights[5] in assuming that the upstream and downstream …rms do not know ex ante what type of high quality input is appropriate for trade ex post. Furthermore, because of the large number of potential input types it is too costly to write contingent forward contracts. Instead of writing forward contracts the …rms bargain over the input price ex post. The bargaining process is described in section (2.4) below.

2.3 The Downstream Technology

The local and the foreign …rm's operational …xed costs are given by $F_l(v_l)$ and $F_f(v_f; i; n)$ respectively. To engage in production the downstream …rms need to use one unit of the input that is produced by the local upstream industry. The quality of the input used by the foreign and the local …rm is given by v_f and v_l respectively, while i indicates the

[5] See, for example, Hart (1995).

level of foreign investment and n the number of suppliers used by the foreign …rm. We assume that the …xed costs of both …rms is decreasing at a decreasing rate in the input quality, i.e.

$$\frac{@F_l(v_l)}{@v_l} \cdot 0 \qquad \frac{@F_f(v_f;i;n)}{@v_f} \cdot 0 \qquad 8\, i;n$$

$$\frac{@^2F_l(v_l)}{@v_l^2} > 0 \qquad \frac{@^2F_f(v_f;i;n)}{@v_f^2} > 0 \qquad 8\, i;n:$$

We also assume that without access to higher quality inputs downstream production is infeasible, i.e. $F_l(0) = F_f(0;i;n) = ¡\ 1\ \ 8\, i;n$. To be able to engage in production itself the foreign …rm must therefore encourage a least one supplier to invest in the development of the local production of high quality inputs.

The foreign …rm's …xed costs also depend on the level of foreign investment i, where i indicates both the level and the cost of the investment. The more the foreign …rm invests the lower will be its local production costs, i.e. $\frac{@F_f(v_f;i;n)}{@i} \cdot 0$ and also $\frac{@^2F_f(v_f;i;n)}{@i^2} > 0$: The investment i is unobservable. We also assume that the input quality and the foreign investment are independent, i.e. $\frac{@^2F_f(v_f;i;n)}{@v_f@i} = 0$. This assumption only simpli…es the analysis and is not necessary for the main results.

Next to the level of the investment the foreign …rm can also choose whether to make its investment speci…c to one or to two suppliers. If the foreign …rm's investment is made speci…c to one particular supplier then ex post trade with this supplier will be more pro…table than trade with any other supplier. The cost of making the investment speci…c to more than one supplier is modelled as an opportunity cost in the sense that $F_f(v_f;i;2)\ ¸\ F_f(v_f;i;1)$ and $\bar{-}\frac{@F_f(v_f;i;2)}{@i}\bar{-} \cdot \bar{-}\frac{@F_f(v_f;i;1)}{@i}\bar{-}\ \ 8\, v_f;i$: For instance, the foreign …rm can decide whether to locate its plant near one supplier or in between two suppliers. If there are transport costs for the input then a plant that is located half way between two potential suppliers is less pro…table than a plant that minimises transport costs by being located adjacent to one supplier.

To simplify the analysis we assume that marginal costs in the downstream industry are constant and normalised to zero. This is, of course, a strong assumption since it implies that investments only a¤ect …xed costs and not marginal costs. While relaxing this assumption might make the model a more "realistic" we believe that it would distract from the main points of the paper by making the analysis more cumbersome than necessary.

The assumptions about the demand for the …nal good and the downstream production costs can be summarised in the pro…t functions for the local and the foreign …rm

$$¼_f = p(q_l + q_f)q_f + p^E(q_f^E)q_f^E - F_f(v_f; i; n)$$

$$¼_l^E = p(q_l + q_f)q_l - F_l(v_l):$$

We assume that the downstream …rms engage in Cournot competition. Finally, we assume that if the foreign …rm's investment level is at …rst best then investment by the supplier is e¢cient, i.e. we assume that

$$¼_f^¤(0; \bar{e}; i_{FB}) - \bar{e} - i_{FB} > 0 \tag{1}$$

where i_{FB} solves

$$-\frac{@F(\bar{e}; i; 1)}{@i} = 1$$

and $¼_f^¤(:)$ indicates the foreign …rm's equilibrium pro…ts. If this was not the case there would never be any investment and hence there would be no need to study the di¤erent supplier arrangements.

2.4 The Bargaining Process

When the downstream …rms want to buy an input they need to bargain with the suppliers over the input price. In this section we specify a bargaining process that covers the di¤erent bargaining situations which can arise in the game.

We assume that whenever one upstream …rm bargains with either one or two downstream …rms then the supplier has all the bargaining power and can make a take-it-or-leave-it o¤er to the downstream …rms[6]. If both …rms accept the o¤er then the foreign …rm receives the good.

Whenever two suppliers bargain with two downstream …rms then we again assume that only the suppliers can make o¤ers. However, with probability ± the two upstream …rms have to make their o¤ers simultaneously while with probability 1 ¡ ± one randomly chosen supplier can make a take-it-or-leave-it o¤er to the foreign …rm and the other supplier can make a take-it-or-leave-it o¤er to the local downstream …rm. This formulation allows us to vary the degree of competition in the upstream industry which, in turn, depends on a number of country and industry speci…c factors. We do not model these factors speci…cally and instead take as given that industries face di¤erent degrees of competition[7]. In our formulation the two suppliers engage in Bertrand price competition if ± = 1: If ± = 0 then there is essentially no competition between the two suppliers and the downstream …rm's bargaining position is not improved by existence of a second supplier. Note that this set-up implies that the foreign …rm cannot reach an agreement with both suppliers in which it buys the input from one supplier and the other supplier agrees not to sell to the local downstream …rm. While such an agreement would increase the total surplus that can be divided between the …rms we rule it out on anti-trust grounds.

The bargaining process which we have speci…ed is, of course, entirely ad hoc. One could think of many other bargaining solutions that could arise in the situations which

[6] In general one could, of course, specify a bargaining game that distributes bargaining power more evenly and leads to a split of ® and 1 ¡ ® of the gains from trade. We can slightly simplify notation and analysis by assuming that the supplier has all the bargaining power since the essence of the results does not depend on the distribution of the gains from trade.

[7] A more micro-founded bargaining model could be a Rubinstein alternating o¤ers game in which in the two suppliers alternate in making o¤ers to the customer who can accept or reject any o¤er. We conjecture that the length of time between o¤ers would be one way to justify di¤erences in the degree of competition between the suppliers.

we consider. For instance, the Shapley value has been used extensively in the property rights literature (see, for example, Hart and Moore (1990)). We do not use the Shapley value for two main reasons. Firstly, while the Shapley value would imply some competition between suppliers it does not allow us to vary the degree of competition, which is a central element in our model. Secondly, we conjecture that it would imply a "collusive" outcome in which two downstream …rms and the suppliers agree to an anti-competitive arrangement. We have chosen the bargaining game speci…ed above since it is fairly straightforward and enables us to parameterise the degree of ex-post competition between the two suppliers, allowing for any outcome between the two extremes of no competition and Bertrand price competition.

2.5 The Game

The game is summarised in the time-line below

t_1	t_2	t_3	t_4
Supplier arrangement chosen	Supplier invest e Foreign …rm invests i	Trade	Downstream competition

At t_4 production of the …nal output occurs and the downstream …rms compete in quantities taking as given input quality and production costs. At t_3 the downstream …rms bargain with the suppliers over the input price. At t_2 the local suppliers decide on the level of their input quality improving investment e. The foreign …rm decides on the level of its foreign investment i. At t_1 the foreign …rm chooses the optimal supplier arrangement.

3 The Analysis

In this section we solve the game by backward induction. We …rst describe the equilibrium in the downstream competition subgame and then analyse the investment in-

centives under di¤erent supplier arrangements. In particular, we consider the following three supplier arrangements: the foreign …rm contracts with only one independent supplier (S or 'single procurement'), the foreign …rm integrates with one local supplier (I or 'integration') and the case where the foreign …rm uses two independent suppliers (D or 'double procurement'). In section (4) we use the analysis to discuss the conditions under which the di¤erent supplier arrangements are optimal.

3.1 Downstream Competition

In the …nal stage the local and the foreign …rm compete in quantities. The Nash equilibrium of the …nal stage subgame is given by the simultaneous solution to the following maximisation problems

$$\max_{q_l;q_l^E} q_f^E p^E(q_f^E) + q_f p(q_l + q_f) - F(v_f; i; n)$$

$$\max_{q_l} q_l p(q_l + q_f) - F(v_l):$$

Let the equilibrium quantities be denoted by $q_l^¤(v_l; v_f)$, $q_f^¤(v_l; v_f)$ and $q_f^{E¤}(v_l; v_f)$ (see the appendix for details). Note that the equilibrium quantities only depend on the input qualities in a discrete manner: if the input quality is very low then production is not pro…table because of the high …xed costs. Once input quality is high for production to be pro…table further input quality improvements do not a¤ect the equilibrium quantities. The equilibrium revenues are given by $R_f^¤$; $R_f^{E¤}$ and $R_l^¤$ and the equilibrium operating pro…ts (i.e. revenue minus …xed costs) for the local and the foreign …rm are given by $¼_l^¤(v_l; v_f)$ and $¼_f^¤(v_l; v_f; i)$ respectively.

3.2 Single Procurement (S)

In this case the foreign …rm transfers its know-how to only one independent supplier at t_1: As a result there is at most one independent supplier at the bargaining stage from which the foreign …rm can buy the input. By assumption this supplier has all

the bargaining power at t_2. If the foreign …rm buys the input from the supplier then it makes an operating pro…t of $¼_f^¤(0;e;i)$ at t_3. Note that these are monopoly pro…ts since the local downstream …rm cannot enter the market without access to the high quality input. If the foreign …rm does not buy the input it simply makes zero operating pro…ts. The highest o¤er that the foreign …rm is willing to accept is therefore given by

$$T_S^¤ = ¼_f^¤(0;e;i):$$

Anticipating the bargaining outcome the expected payo¤ for the foreign …rm and the upstream …rm at t_2 is given respectively by

$$¦_f^S = ¼_f^¤(0;e;i) ¡ T_S^¤ = 0$$

$$¦_u^S = T_S^¤ = ¼_f^¤(0;e;i):$$

At t_2 the foreign …rm and the local supplier choose their respective investment levels so as to maximise the expected payo¤ functions $¦_f^S$ and $¦_u^S$ minus investment costs. The foreign …rm sets $i_S^¤ = 0$ since it never receives any return from its investment. The supplier invests in the development of the input if it is pro…table to do so even in the absence of any foreign investment. Hence, the supplier invests $\bar{e}$ if $¼_f^¤(0;\bar{e};0) ¸ \bar{e}$ and zero otherwise. In summary, under single procurement the optimal investment levels are given by

(2)
$$i_S^¤ = 0$$
$$e_S^¤ = \begin{cases} \bar{e} & \text{if } ¼_f^¤(0;\bar{e};0) ¸ \bar{e} \\ 0 & \text{otherwise:} \end{cases}$$

The foreign …rm's underinvestment is of course due to the standard hold-up problem. The foreign …rm realises that it does not receive the full return from its investment since the local supplier is able to extract all the gains from trade. Since the foreign …rm incurs the full investment cost it therefore underinvests.

At t_1 the foreign …rm can extract the supplier's entire expected surplus. Potential suppliers are willing to pay up to $¦^S_u ¡ e^¤_S$ to learn how to produce the inputs. Hence, at t_1 the foreign …rm optimally sets the participation fee equal to $¦^S_u ¡ e^¤_S$. The foreign …rm's total expected surplus at t_1 is then given by

$$W^¤_S = \begin{cases} ¼^¤_f(0;\bar{e};0) ¡ \bar{e} & \text{if } ¼^¤_f(0;\bar{e};0) ¸ \bar{e} \\ 0 & \text{otherwise:} \end{cases}$$

3.3 Integration (I)

In this case the foreign …rm again transfers its know-how to only one supplier. However, in contrast to the previous case the foreign …rm now owns the asset which the supplier needs to engage in production. In the case of disagreement the supplier's only option is to withdraw its human capital. The foreign …rm can then use the asset to produce the input itself. In this case its operating pro…t is given by $¼^¤_f(0;\bar{e};i)$. Since the local supplier cannot produce the input without access to the asset its disagreement payo¤ is zero. If the two parties do agree to trade the total payo¤ is given by $¼^¤_f(0;e;i)$. The equilibrium price that the foreign …rm has to pay its supplier is then given by

$$T^¤_l = ¼^¤_f(0;e;i) ¡ ¼^¤_f(0;\bar{e};i):$$

The expected bargaining payo¤s are given by

$$¦^l_f = ¼^¤_f(0;e;i) ¡ T^¤_l = ¼^¤_f(0;\bar{e};i)$$

$$¦^l_u = T^¤_l = ¼^¤_f(0;e;i) ¡ ¼^¤_f(0;\bar{e};i):$$

At t_2 the foreign …rm and the local supplier choose their respective investment levels so as to maximise their expected payo¤ functions $¦^l_f$ and $¦^l_u$ minus investment costs. It can be shown (see appendix for details) that the optimal investment levels are given by

$$(3)\qquad i_l^{\alpha} = \begin{cases} \phi_l & \text{if } \underline{\beta} \cdot \beta \cdot \bar{\beta} \\ 0 & \text{otherwise} \end{cases}$$

$$e_l^{\alpha} = \begin{cases} \bar{e} & \text{if } \underline{\beta} \cdot \beta \cdot \bar{\beta} \text{ or } \beta \cdot \bar{\beta}_1 \\ 0 & \text{otherwise} \end{cases}$$

where $\underline{\beta}$, $\bar{\beta}$ and $\bar{\beta}_1$ are implicitly defined by

$$\pi_f^{\alpha}(0; \underline{\beta}\bar{e}; \phi_l) = 0$$

$$\pi_f(0; \bar{e}; i_l) - \pi_f(0; \bar{\beta}\bar{e}; \phi_l) = \bar{e}$$

$$\pi_f^{\alpha}(0; \bar{\beta}_1\bar{e}; 0) - \pi_f^{\alpha}(0; \bar{e}; 0) = \bar{e}$$

and ϕ_l solves

$$-\frac{\partial F(\bar{e}; \phi_l; 1)}{\partial i} = 1.$$

It is easy to prove (see appendix) that $0 \cdot \underline{\beta} < \bar{\beta} \cdot 1$ and $\bar{\beta}_1 < \bar{\beta}$. The intuition for condition (3) is straightforward. The foreign firm is in a weak bargaining position even after integrating if the supplier's investment is very human capital specific ($\beta < \underline{\beta}$). In this case the asset is not useful to the foreign firm without the supplier's human capital. Hence, buying the asset does not improve the foreign firm's bargaining position and investment incentives since it still has to agree with the supplier to provide its human capital. If, instead, the supplier's investment is very asset specific ($\beta > \bar{\beta}$) then integration leads to a strong deterioration of the supplier's investment incentives. The supplier is in a weak bargaining position after its investment has taken place since the foreign firm can use the asset without the its human capital. Anticipating this hold-up problem the local supplier has little incentive to invest ex ante. Without the local supplier's investment, however, the foreign firm also has no incentive to invest. It follows that the foreign firm and the supplier only invest under integration if the upstream investment is neither too asset nor too human capital specific ($\underline{\beta} \cdot \beta \cdot \bar{\beta}$).

At stage t_1 the foreign …rm can again extract the entire surplus from the local supplier and thereby ensure itself a payo¤ of

$$W_l^{\alpha} = \frac{1}{4}_f^{\alpha}(0; e_l^{\alpha}; i_l^{\alpha}) \; ¡ \; e_l^{\alpha} \; ¡ \; i_l^{\alpha}$$

3.4 Double Procurement (D)

In the double procurement case the foreign …rm transfers its know-how to two independent suppliers who can then both invest and set-up upstream production facilities. Transferring the know-how to two rather than to only one independent supplier can only be optimal if both suppliers can be induced to invest. Clearly, a double procurement policy is not feasible if only one supplier invests. In this section we derive the conditions under which two suppliers can be induced to invest.

Assume that two suppliers did indeed invest at t_2. At the bargaining stage the two independent suppliers then bargain with the two downstream …rms in the way speci…ed in section (2.4). With probability $1 ¡ \pm$ one randomly chosen supplier can make a take-it-or-leave-it o¤er to the foreign …rm. Since the foreign …rm knows that the second supplier provides the local …rm with the high quality input it is willing to pay at most $\frac{1}{4}_f^{\alpha}(\bar{e}; \bar{e}; i)$ for the input itself. Hence, in this case the equilibrium input price that the foreign …rm will pay is $\frac{1}{4}_f^{\alpha}(\bar{e}; \bar{e}; i)$. The other supplier sells its input to the local …rm at a price of $\frac{1}{4}_l^{\alpha}(\bar{e}; \bar{e})$: With probability $\pm$ the two suppliers have to make simultaneous o¤ers to the downstream …rms. It can be shown (see appendix for details) that in equilibrium both …rms make an o¤er of $\frac{1}{4}_l^{\alpha}(\bar{e}; \bar{e})$: The expected input price that the foreign …rm has to pay is then given by

$$T_D^{\alpha} = (1 ¡ \pm)\frac{1}{4}_f^{\alpha}(\bar{e}; \bar{e}; i) + \pm\frac{1}{4}_l^{\alpha}(\bar{e}; \bar{e})$$

and the expected bargaining payo¤s are given by

$$¦_f^D = \pm(\frac{1}{4}_f^{\alpha}(\bar{e}; \bar{e}; i) ¡ \frac{1}{4}_l^{\alpha}(\bar{e}; \bar{e}))$$

$$\Pi_{u_j}^{D} = \frac{1}{2}((1 - \pm)\pi_f(\bar{e}; \bar{e}; i) + (1 + \pm)\pi_l(\bar{e}; \bar{e})) \qquad j = 1; 2:$$

At t_2 the foreign …rm and the suppliers choose the investment levels so as to maximise their expected payo¤s minus the investment costs. We show in the appendix that both suppliers invest $\bar{e}$ if only if

$$\pm \in [\underline{\pm}; \bar{\pm}] \tag{4}$$

where $\underline{\pm}$ is the smallest and $\bar{\pm}$ the largest $\pm$ that solves

$$\frac{1}{2}((1 - \pm)\pi_f(\bar{e}; \bar{e}; \phi(\pm)) + (1 + \pm)\pi_l(\bar{e}; \bar{e})) = \bar{e}: \tag{5}$$

Under condition (4) the foreign …rm's optimal investment is given by $\phi(\pm)$ which solves

$$-\frac{\partial F(\bar{e}; \phi_D; 2)}{\partial i} = \frac{1}{\pm}:$$

The intuition for condition (4) is straightforward. Compared to single procurement a double procurement policy improves the foreign …rm's investment incentives only if it puts the foreign …rm in a stronger ex post bargaining position. For this to be the case competition between the two suppliers has to be strong enough (i.e. $\pm \geq \underline{\pm}$). However, competition cannot be too strong (i.e. $\pm \leq \bar{\pm}$) since otherwise the suppliers' ex post payo¤s are too small to induce them to invest ex ante. Without investments by the local suppliers, however, the foreign …rm has also no incentive to invest.

At t_1 the foreign …rm can again extract the entire surplus from both suppliers. If both suppliers make the same investment $e_D^¤$ the foreign …rm's total surplus is then given by

$$W_D^¤ = \pi_f(e_D^¤; e_D^¤; i_D^¤) + \pi_l(e_D^¤; e_D^¤) - 2e_D^¤ - i_D^¤:$$

4 Discussion

We are interested in the case in which the entry of the foreign …rm generates a spillover e¤ect that can lead to the emergence of a local competitor. The foreign investment will

only generate such a spillover e¤ect if its entry leads to a net increase in the local supply of high quality inputs. Since the foreign …rm itself uses one unit of the high quality input we therefore need to study the conditions under which the local industry is induced to produce at least two units of the critical input. The only supplier arrangement that might achieve this outcome is the double procurement policy in which the foreign …rm enables two local suppliers to set-up upstream production facilities. Single procurement does not generate the spillover e¤ect because of the assumed capacity constraint[8]. In this section we use the above analysis to derive the conditions under which the foreign …rm optimally engages in a double procurement policy.

4.1 Double Procurement versus Single Procurement

The foreign …rm chooses the supplier arrangement that maximises its total expected surplus. It therefore prefers double procurement to single procurement if and only if $W^{¤}_{D} \geq W^{¤}_{S}$, which can be written as

$$(6) \quad R^{¤}_{f;D} + R^{¤}_{l;D} - F_f(e^{¤}_{D}; i^{¤}_{D}; 2) - F_l(e^{¤}_{D}) - 2e^{¤}_{D} - i^{¤}_{D} \geq R^{¤}_{f;S} - F_f(e^{¤}_{S}; 0; 1) - e^{¤}_{S}:$$

The problem with a single procurement policy is that it makes the foreign …rm very dependent on one supplier and puts it in a weak bargaining position ex post. To mitigate its hold-up problem the foreign …rm needs to improve its ex post bargaining position. The foreign …rm may be able to improve its bargaining position and investment incentives by engaging in a double procurement policy. It can be seen from condition (6) that a double procurement incurs a direct resource cost since the upstream investments

[8] We could relax the assumption of an exogenously given capacity constraint without a¤ecting the results if we replace it with one of the following assumptions: …rstly, we could allow the foreign …rm to sign an exclusive dealing agreement with the single independent supplier. Even the supplier has an interest in such an agreement since it reduces downstream competition and therefore increases the gains from trade at the expense of the consumers. Alternatively, we could extend the game to allow suppliers ex ante to choose the capacity of their plant. If the suppliers cannot commit to exclusive dealing agreements (e.g. because of anti-trust legislation) they have an incentive to optimally choose the capacity constraint that we assume exogenously, i.e. they optimally choose to build a plant that just covers the demand of the foreign …rm.

have to be undertaken by two …rms (in condition (6) we have $2e^{¤}_{D}$ on the LHS but only $e^{¤}_{S}$ on the RHS). To analyse whether double procurement generates larger pro…ts than single procurement in spite of this resource cost we need to look at the investment incentives of the local suppliers and foreign …rm and the spillover e¤ect:

Upstream Investment Next to incurring a direct resource cost double procurement also reduces the investment incentives of the upstream …rms, as can be seen by comparing the expected payo¤ functions $¦^{D}_{u_j}$ and $¦^{S}_{u}$: The reason, of course, is that under double procurement the foreign …rm does not depend on one single supplier to provide the input. This puts the suppliers in a weaker bargain position. For double procurement to be optimal it must be the case that both suppliers can be induced to invest $\bar{e}$. We have shown in section (3.4) that this will only be the case if condition (4) is satis…ed, that is to say that competition between suppliers in neither too strong nor too weak. If upstream competition is too high, i.e. $± ¸ \bar{±}$, then the foreign …rm can extract so much of the gains from trade that the suppliers' investment returns do not cover their costs. If competition is too low, i.e. $± · \underline{±}$, then the suppliers do not invest because of the low level of foreign investment. It follows that double procurement can only more pro…table than single procurement if $\underline{±} · ± · \bar{±}$:

Spillover Consider next the spillover e¤ect. Under double procurement two suppliers invest in the development of upstream production facilities. Both suppliers would prefer to sell their product to the foreign …rm since this …rm is more e¢cient and trading with it is more pro…table. Since the foreign …rm only needs one unit of the input, however, one of the suppliers has to …nd another customer[9]. The only other potential customer

[9]It was already mentioned earlier that in spite of only requiring one unit of the input the foreign …rm and the suppliers would like to agree to an exclusive dealing contract whereby the suppliers sell only to the foreign …rm and "boycott" the local competitor. Indeed such a contract would increase the joint pro…t of all …rms, including the local downstream …rm. We rule out such a contract on anti-trust grounds since it only increases joint pro…ts at the expense of the consumers by monopolising

is the local downstream …rm. Note that this …rm always makes weakly positive pro…ts. Hence, under double procurement the foreign …rm's local competitor can always a¤ord to buy the crucial input and start production.

In condition (6) the extent to which the foreign …rm is a¤ected by the spillover is captured by the di¤erence in revenues $R^{¤}_{f;S} ¡ R^{¤}_{f;D} ¡ R^{¤}_{l;D}$. Note that this di¤erence is always weakly positive even though, in this stylised model, the foreign …rm is able to extract the local …rm's entire pro…t. The reason for this is simply that in the case of perfect substitutes joint duopoly pro…ts must be smaller than monopoly pro…ts. In general the di¤erence in revenues between the two regimes depends on two factors. Firstly, it depends on the extent to which the local …rm's costs are reduced by using the high quality input. If the input is very speci…c to the foreign …rm's production technology then the local …rm may not have much use for the high quality input. In this case the local …rm's cost reduction is so small that it cannot cover its …xed costs even if it has access to the high quality input. The foreign …rm is then a monopoly producer independent of the supplier arrangement and there is no di¤erence in revenues (since $R^{¤}_{f;S} = R^{¤}_{f;D}$ and $R^{¤}_{l;D} = 0$) and no spillover e¤ect.

Secondly, if the spillover e¤ect does lead to the emergence of a local competitor then the revenue loss depends on the extent to which the two downstream …rms compete in the same markets. For reasons that we do not model explicitly the foreign …rm may, for instance, sell most of its production in an export market while the local …rm may concentrate all its sales in the local market. In this case the spillover e¤ect only has a small impact on the foreign …rm's pro…t. In terms of the model this can be shown by noting that $\frac{@(R^{¤}_{f;S} ¡ R^{¤}_{f;D} ¡ R^{¤}_{l;D})}{@t} > 0$; i.e. the larger the local market relative to the export market the larger the revenue loss.

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the downstream industry.

Foreign Investment So far we have looked at the costs of a double procurement policy and have seen that it leads to a direct resource cost, reduces the upstream investment incentives and generates a negative spillover effect. In this section we turn to the potential benefit of engaging in a double procurement policy, namely the improvement in the foreign firm's investment incentives.

We have seen above that the upstream firms only invest if $\underline{\alpha} < \alpha < \bar{\alpha}$. Whether or not double procurement leads to higher foreign investment levels in this range depends on two opposing effects. To understand these effects consider again the foreign firm's first order condition in the double procurement case

$$-\frac{\partial F(\bar{e}, \hat{\alpha}_D, 2)}{\partial i} = \frac{1}{\alpha} \tag{7}$$

On the one hand, the double procurement policy improves the foreign firm's bargaining position. When deciding on the investment level the foreign firm therefore puts more weight on the agreement payoff (under double procurement the firm puts a weight of α on the agreement payoff while it puts no weight on the agreement payoff under single procurement) which, ceteris paribus, leads to a higher investment level. As can be seen from the first order condition (7) this effect is increasing in the degree of competition between the two suppliers α. On the other hand, however, there is also an opportunity cost to making the investment specific to two suppliers. The marginal cost reduction from foreign investment is smaller in the case of the double procurement policy since, by assumption

$$\left|\frac{\partial F(e; i; 2)}{\partial i}\right| > \left|\frac{\partial F(e; i; 1)}{\partial i}\right|.$$

Whether the double procurement policy improves the foreign firm's investment incentives therefore also depends on the extent to which the investment is supplier specific. The foreign firm will only invest more under double procurement if ex post competition between the suppliers is strong relative to the foreign investment's supplier specificity.

Double procurement is more profitable than single procurement if the improvement in the foreign firm's investment incentives outweighs the cost of the policy. It follows from condition (6) and the discussion above that the foreign firm will engage in double procurement rather than single procurement if and only if $\pm \in [\underline{\pm}; \bar{\pm}]$ and $\pm \geq \hat{\pm}$; where $\hat{\pm}$ is implicitly defined by

$$\pi_f(\bar{e}; \bar{e}; \phi(\hat{\pm})) - \phi(\hat{\pm}) = \pi_f(0; \bar{e}) + \bar{e} - \pi_I(\bar{e}; \bar{e}).$$

4.2 Single Procurement versus Integration

It was argued above that a single procurement policy may lead to underinvestment by the foreign firm. In the previous section we analysed how a double procurement policy can mitigate the foreign firm's hold-up problem by improving the foreign firm's bargaining position. In this section we look at another option for the foreign firm which has received a lot of attention in the literature. This is the possibility for the foreign firm to integrate with the supplier. Integration is more profitable than single procurement if $W_I^* = \pi_f(0; e_I^*; i_I^*) - e_I^* - i_I^* > W_S^* = \pi_f(0; e_S^*; 0) - e_S^*$. This condition can only hold if integration leads to higher foreign investment levels, i.e. $i_I^* > 0$.

Whether or not integration improves the foreign firm's investment incentives depends on the degree of asset specificity of the supplier's investment $\bar{}$. It can be seen from the expected payoff function Π_f^S that, for given upstream investments, the improvement in investment incentives for the foreign firm is increasing in $\bar{}$, i.e. the better the foreign firm is in producing the input without the supplier's human capital the better its bargaining position. However, as can be seen from the expected payoff function Π_u^S integration also worsens the supplier's investment incentives. This deterioration in investment incentives is also increasing in $\bar{}$. When $\bar{}$ is too large, i.e. $\bar{} > \bar{\bar{}}$; then the supplier cannot be induced to invest. Note that the foreign firm will then also not invest since it cannot engage in production without access to higher quality inputs.

Hence, for $\beta > \bar{\beta}$ integration leads to lower investment levels than single procurement and the latter arrangement generates a higher total surplus for the foreign …rm.

If the supplier's investment is very human capital speci…c, i.e. $\beta < \underline{\beta}$, then integration does not improve the foreign …rm's investment incentives since the asset is not very useful for the foreign …rm in absence of the supplier's human capital. Hence, for $\beta < \underline{\beta}$ the foreign …rm does not invest under integration.

It follows that integration only leads to more e¢cient investment levels than single procurement if β is in an intermediate range, i.e. $\underline{\beta} \cdot \beta \cdot \bar{\beta}$. In this case the investment levels are given by $e_S^{\alpha} = e_I^{\alpha} = \bar{e}$ and $\phi_I > i_S^{\alpha} = 0$ and integration generates larger pro…ts than single procurement. The analysis in this section can be summarised in the following lemma:

Lemma 1 Integration is more pro…table than single procurement, i.e. $W_I^{\alpha} \geq W_S^{\alpha}$, if $\underline{\beta} \cdot \beta \cdot \bar{\beta}$. Otherwise single procurement is more pro…table than integration, i.e. $W_S^{\alpha} \geq W_I^{\alpha}$.

4.3 Double Procurement versus Integration

In the previous section we have considered two ways in which the foreign …rm can mitigate the hold-up problem it faces when there is only one independent supplier. We have seen that integration is very e¤ective when the supplier's investment are neither too human capital nor to asset speci…c. Note that for $\underline{\beta} \cdot \beta \cdot \bar{\beta}$ the investment levels under integration are actually at …rst best since $\phi_I = i_{FB}$[10]. For these intermediate values of β integration is therefore more pro…table than double procurement. When β is outside of this range, however, then integration is less e¤ective in solving the hold-up problem and double procurement might be a better solution. The e¤ectiveness of

[10] This is an artifact of the model and is due to the assumptions that the foreign and the upstream investments are independent and that the supplier's investment is discrete. If the investments were instead complements then even for intermediate levels of β foreign investment would be below …rst best levels. Nevertheless, foreign investment would still be positive and increasing in β.

double procurement depends on the degree of upstream competition. If competition is in an intermediate range ($\underline{\pm} \cdot \pm \cdot \bar{\pm}$) then double procurement does indeed lead higher investment levels than integration. If, however, upstream competition is either very strong or very weak ($\pm > \bar{\pm}$ or $\pm < \underline{\pm}$) then neither arrangement leads to positive investment levels and they both generate zero pro…ts.

4.4 The Optimality of Double Procurement

We can summarise the analysis in proposition (1).

Proposition 1 The foreign …rm will engage in a double procurement policy if and only if:

i. The supplier's investment is either very asset or very human capital speci…c, i.e. either $\bar{} > \bar{=}$ or $\bar{} < \bar{\_}$.

ii. Ex post competition between the suppliers is not "too strong" ($\pm \cdot \bar{\pm}$) so that suppliers can still be induced to make ex ante investments.

iii. Ex post competition between the suppliers is not "too weak" ($\pm \, ¸ \, \max(\underline{\pm}; \underline{\pm}^{e})$) so that the improvement in the foreign investment level outweighs the cost of the double procurement policy.

5 Summary and Conclusion

In this paper we tried to rationalise the observation that foreign investors sometimes use supplier arrangements that generate spillovers to local competitors. We argued that it may be problematic for the foreign …rm to contract with only one independent supplier. In this case the foreign …rm may underinvest since it anticipates to be held-up ex post. Integration with the supplier does not improve the foreign …rm's investment incentives if the local supplier's investment is either very human capital or very asset speci…c. If the supplier's investment is very human capital speci…c (e.g. if the supplier

has to learn how to use a new technology) then ownership of this technology does not improve the foreign …rm's bargaining position since it still has to agree with the supplier to get access to its human capital. If the supplier's investment is largely embodied in the asset then integration only improves the foreign …rm's bargaining position at a very high cost, namely a strong deterioration in the supplier's own investment incentives.

The e¤ectiveness of a double procurement policy in improving investment incentives depends on the degree of competition in the upstream and the downstream industry. Double procurement only improves the investment incentives if upstream competition is neither too strong nor too weak. If upstream competition is very strong then suppliers cannot be induced to invest under a double procurement policy. In the opposite case, where upstream competition is very weak the existence of a second upstream …rm does not lead to strong improvements in the foreign …rm's bargaining position. The degree of competition in the downstream industry matters since a double procurement policy generates a spillover e¤ect that can lead to e¢ciency improvements of local competitors. If downstream competition is very strong then the foreign …rm has a strong incentive to avoid this spillover e¤ect by not engaging in a double procurement policy.

APPENDIX

A Downstream Competition

Let φ_f^E; $\varphi_f(q_l)$ and $\varphi_l(q_f)$ be implicitly de…ned by

$$p^E(\varphi_f^E) + \varphi_f^E p^{E\prime}(\varphi_f^E) = 0$$

$$p(q_l + \varphi_f) + \varphi_f p'(q_l + \varphi_f) = 0$$

$$p(\varphi_l + q_f) + \varphi_l p'(\varphi_l + q_f) = 0$$

The optimal quantities are then given by

$$q_f^{E\alpha} = \begin{cases} \varphi_f^E & \text{if } \varphi_f^E p^E(\varphi_f^E) + \varphi_f(q_l^\alpha)p(\varphi_f(q_l^\alpha) + q_l^\alpha) \geq F(v_f; i; n) \\ 0 & \text{otherwise} \end{cases}$$

$$q_f^\alpha = \begin{cases} \varphi_f(q_l^\alpha) & \text{if } \varphi_f^E p^E(\varphi_f^E) + \varphi_f(q_l^\alpha)p(\varphi_f(q_l^\alpha) + q_l^\alpha) \geq F(v_f; i; n) \\ 0 & \text{otherwise} \end{cases}$$

$$q_l^\alpha = \begin{cases} \varphi_l(q_f^\alpha) & \text{if } \varphi_l(q_f^\alpha)p(\varphi_l(q_f^\alpha) + q_f^\alpha) \geq F(v_l) \\ 0 & \text{otherwise} \end{cases}$$

Note that the second order conditions

$$2p^{E\prime}(q_f^E) + q_f^E p^{E\prime\prime}(q_f^E) \leq 0$$

$$2p'(Q) + qp''(Q) \leq 0$$

are satis…ed since $p'(Q) < 0$ and $p''(Q) < 0$:

Also the stability condition is satis…ed since

$$\begin{vmatrix} 2p'(Q) + q_f p''(Q) & p'(Q) + q_f p''(Q) \\ p'(Q) + q_l p''(Q) & 2p'(Q) + q_l p''(Q) \end{vmatrix} = p'(Q)(3p'(Q) + p''(Q)Q) > 0:$$

B Optimality of Integration

The optimal investment levels are given by the simultaneous solution to the maximisation problems

$$\max_{i} \; \pi_f(0; \bar{e}; i) - i$$

$$\max_{e} \; \pi_f(0; e; i) - \pi_f(0; \bar{e}; i) - e:$$

Let $\hat{\theta}_l$ be the investment level that solves the foreign firm's optimality condition, i.e.

$$-\frac{\partial F(\bar{e}; \hat{\theta}_l; 1)}{\partial i} = 1:$$

Note that if production is profitable $\hat{\theta}_l$ maximises the foreign firm's profit since the second order condition is given by

$$-\frac{\partial^2 F(\bar{e}; \hat{\theta}_l; 1)}{\partial i^2} < 0:$$

Consider the foreign firm's best response to an upstream investment level of $e = \bar{e}$: The foreign firm will then set $i^* = \hat{\theta}_l$ if $\pi_f(0; \bar{e}; \hat{\theta}_l) \geq \hat{\theta}_l$: Note that since $\frac{\partial \pi_f(0; \bar{e}, \hat{\theta}_l)}{\partial \bar{e}} \geq 0$ it follows that $\pi_f(0; \bar{e}; \hat{\theta}_l) \geq \hat{\theta}_l$ if $\bar{e} \geq \underline{\bar{e}}$ where $\underline{\bar{e}}$ is implicitly defined by $\pi_f(0; \underline{\bar{e}}; \hat{\theta}_l) = \hat{\theta}_l$: Hence, the foreign firm will respond by setting $i^* = \hat{\theta}_l$ if $\bar{e} \geq \underline{\bar{e}}$. Note also that since $\pi_f(0; 0; \hat{\theta}_l) = 0$, $\pi_f(0; \bar{e}; \hat{\theta}_l) > \hat{\theta}_l$ and $\frac{\partial \pi_f(0; \bar{e}, \hat{\theta}_l)}{\partial \bar{e}} \geq 0$ it follows that $\underline{\bar{e}} \in [0; 1]$:

Consider next the foreign firm's best response to $e = 0$: Since in this case production is not feasible the foreign firm optimally sets $i^* = 0$.

Consider now the supplier's best response to $i = \hat{\theta}_l$: The supplier will then set $e^* = \bar{e}$ if $\pi_f(0; \bar{e}; \hat{\theta}_l) \leq \pi_f(0; \bar{e}; \hat{\theta}_l) - \bar{e}$: Note that since $\frac{\partial \pi_f(0; \bar{e}, \hat{\theta}_l)}{\partial \bar{e}} \geq 0$ it follows that $\pi_f(0; \bar{e}; \hat{\theta}_l) \leq \pi_f(0; \bar{e}; \hat{\theta}_l) - \bar{e}$ if $\bar{e} \leq \overline{\bar{e}}$ where $\overline{\bar{e}}$ is implicitly defined by $\pi_f(0; \overline{\bar{e}}; \hat{\theta}_l) = \pi_f(0; \bar{e}; \hat{\theta}_l) - \bar{e}$: Hence, the supplier will respond by setting $e^* = \bar{e}$ if $\bar{e} \leq \overline{\bar{e}}$: Note also that since $\pi_f(0; 0; \hat{\theta}_l) \leq \pi_f(0; \bar{e}; \hat{\theta}_l) - \bar{e}$, $\pi_f(0; \bar{e}; \hat{\theta}_l) > \pi_f(0; \bar{e}; \hat{\theta}_l) - \bar{e}$ and $\frac{\partial \pi_f(0; \bar{e}, \hat{\theta}_l)}{\partial \bar{e}} \geq 0$ it follows that $\overline{\bar{e}} \in [0; 1]$:

If the foreign …rm sets $i = 0$ then the supplier's best response is $e^{¤} = \bar{e}$ i¤ $¼_f^{¤}(0;\bar{\bar{e}};0) \cdot ¼_f^{¤}(0;\bar{e};0) ¡ \bar{e}$: This condition can again be restated in terms of $\bar{\bar{e}}$ since $¼_f^{¤}(0;\bar{\bar{e}};0) \cdot ¼_f^{¤}(0;\bar{e};0) ¡ \bar{e}$ i¤ $\bar{\bar{e}} \cdot \bar{\bar{e}}_2$ where $\bar{\bar{e}}_2$ is implicitly de…ned by $¼_f^{¤}(0;\bar{\bar{e}}_2\bar{e};0) = ¼_f^{¤}(0;\bar{e};0) ¡ \bar{e}$. Note that $\bar{\bar{e}}_2 \cdot \bar{\bar{e}}$ since $¼_f^{¤}(0;\bar{e};\phi_l) \cdot ¼_f^{¤}(0;\bar{e};0)$ and $\frac{@^2F_f(v_f;i;n)}{@v@i} = 0$.

Given the de…nitions of $\bar{\bar{e}}$ and $\bar{\bar{e}}$ it will be the case that $\bar{\bar{e}}$ ¸ $\bar{\bar{e}}$ i¤ $¼_f^{¤}(0;\bar{e};\phi_l) ¡ \bar{e}$ ¸ ϕ_l: Because of assumption (1) and since $\phi_l = i_{FB}$ it will always be the case that $¼_f^{¤}(0;\bar{e};\phi_l) ¡ \bar{e}$ ¸ ϕ_l and hence $\bar{\bar{e}}$ ¸ $\bar{\bar{e}}$:

In summary, the optimal investment levels are given by

$$i_l^{¤} = \begin{cases} \phi_l & \bar{\bar{e}} \cdot \bar{\bar{e}} \cdot \bar{\bar{e}} \\ 0 & \text{otherwise:} \end{cases}$$

$$e_l^{¤} = \begin{cases} \bar{e} & \bar{\bar{e}} \cdot \bar{\bar{e}} \cdot \bar{\bar{e}} \text{ or } \bar{\bar{e}} \cdot \bar{\bar{e}}_2 \\ 0 & \text{otherwise:} \end{cases}$$

B.1 Double Procurement

Solution to the simultaneous o¤er bargaining game Since each downstream …rm receives one unit of the input the maximum willingness to pay for the foreign and the local downstream …rm is given by $¼_f^{¤}(\bar{e};\bar{e};i)$ and $¼_l^{¤}(\bar{e};\bar{e})$ respectively. Let p_1 and p_2 be the o¤er by supplier 1 and 2 respectively. Consider the case where one …rm sets $p_i = ¼_l^{¤}(\bar{e};\bar{e})$. If the other …rm sets $p_j^i < p_i$ its o¤er is accepted and the …rm makes $p_j^i < ¼_l^{¤}(\bar{e};\bar{e})$: If the second …rm sets $p_j^+ > p_i$ then neither downstream …rm accepts the good and …rm j's pro…t is zero. Finally, if …rm j sets $p_j = p_i$ then it makes a pro…t of $p_j = ¼_l^{¤}(\bar{e};\bar{e})$. Hence $p_1 = p_2 = ¼_l^{¤}(\bar{e};\bar{e})$ is an equilibrium of the bidding game. Any situation in which the suppliers set prices above $¼_l^{¤}(\bar{e};\bar{e})$ is not an equilibrium since it is always pro…table for one to deviate by undercutting the competitors price. Also any situation in which prices are below $¼_l^{¤}(\bar{e};\bar{e})$ is not an equilibrium since either …rm can deviate by asking a slightly higher price and thereby make a higher pro…t. The only

equilibrium in this game is one where $p_1 = p_2 = \pi_l^{\natural}(\bar{e};\bar{e})$.

Optimal investment levels under double procurement If both suppliers invest then the foreign …rm solves the following maximisation problem

$$\max_i \pm(\pi_f^{\natural}(e;e;i) - \pi_l^{\natural}(e;e)) - i:$$

The optimal foreign investment level $\beta_D(\pm)$ is given by the solution to the …rst order condition

$$\pm\frac{\partial F(\bar{e};i;2)}{\partial i} = 1:$$

Note that

$$\frac{\partial \beta_D(\pm)}{\partial \pm} = (\pm\frac{\partial^2 F(\bar{e};i;2)}{\partial i^2})^{-1} > 0$$

and

$$\frac{\partial^2 \beta_D(\pm)}{\partial \pm^2} = -2(\pm^3\frac{\partial^2 F(\bar{e};i;2)}{\partial i^2})^{-1} < 0:$$

If $i = \beta_D(\pm)$ then the suppliers both invest $\bar{e}$ i¤

$$Z(\pm) = \frac{1}{2}((1-\pm)\pi_f^{\natural}(\bar{e};\bar{e};\beta_D(\pm)) + (1+\pm)\pi_l^{\natural}(\bar{e};\bar{e})) \geq \bar{e} \tag{8}$$

It follows from (8) that $Z(0) = \pi_l^{\natural}(\bar{e};\bar{e})$ since $\beta_D(0) = 0$ and $\pi_f^{\natural}(\bar{e};\bar{e};0) = \pi_l^{\natural}(\bar{e};\bar{e})$: Note also that $Z(1) = \pi_l^{\natural}(\bar{e};\bar{e})$:

Taking the derivative of (8) gives $Z'(\pm) = \frac{1}{2}(-\pi_f^{\natural}(\bar{e};\bar{e};\beta_D(\pm)) + \pm\pi_l^{\natural}(\bar{e};\bar{e}) - (1-\pm)\frac{\partial F(\bar{e};i;2)}{\partial i}\frac{\partial \beta_D(\pm)}{\partial \pm})$: Note that $Z'(0) > 0$ and $Z'(1) < 0$.

The second derivative is given by $Z''(\pm) = \frac{1}{2}(2\frac{\partial F(\bar{e};i;2)}{\partial i}\frac{\partial \beta_D(\pm)}{\partial \pm} - (1-\pm)(\frac{\partial^2 F(\bar{e};i;2)}{\partial i^2}(\frac{\partial \beta_D(\pm)}{\partial \pm})^2 + \frac{\partial F(\bar{e};i;2)}{\partial i}\frac{\partial^2 \beta_D(\pm)}{\partial \pm^2}) < 0$ for $\pm \in [0;1]$.

It follows from condition (8) that $Z(\pm) \geq \bar{e}\ \forall \pm \in [0;1]$ if $\pi_l^{\natural}(\bar{e};\bar{e}) \geq \bar{e}$. If $\pi_l^{\natural}(\bar{e};\bar{e}) < \bar{e}$ then $Z(\pm) \geq \bar{e}\ \forall \pm \in [\underline{\pm};\bar{\pm}]$.

Hence, only when $\pm \in [\underline{\pm};\bar{\pm}]$ do both suppliers invest. In this case the optimal investment levels are given by $i^{\natural} = \beta_D(\pm)$ and $e_1^{\natural} = e_2^{\natural} = \bar{e}$:

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