

FDI, International Outsourcing and Linkages

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Abstract

We investigate the trade-off between FDI and international outsourcing of intermediate inputs by a producer of a final good. To this extent, we characterize an industry equilibrium where fixed sunk costs exist for the setting up of foreign subsidiaries and the latter are heterogeneous in productivity levels. We relate the resulting trade-off between outsourcing and FDI to the degree of contract completeness prevailing in the host country and explore its implications in terms of linkages existing between final producers and local suppliers. We find that an increase in competition levels has a non-monotonic effect on the profit of the local suppliers. Therefore, the host country has an incentive to contrast the entry of new final producers with a reduction in the degree of contract completeness.

JEL classification: F12, L22, D23

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1 Introduction

In the recent months the debate on the international outsourcing of economic activities has been high on the agenda of policymakers. The story goes that it is no longer manufacturing that is feeling the pressure of foreign competition, but also jobs in the services sector are now migrating. Since services constitute the bulk of employment in a modern market economy, the fear arises of rising unemployment. The debate is particularly hot in the United States, where IT tasks are being outsourced to countries like China or India, and in the European Union, where there are fears of job relocations taking place in the countries of Central and Eastern Europe, now that they have acquired full membership.

Starting from the survey work of Feenstra (1998), several pieces of evidence have documented this phenomenon of integration of trade flows and disintegration of production activities world wide, both in the US and in the European Union¹. Some authors (Altomonte, 2004) have also claimed that this particular way of organising production activities might be in part associated with the parallel evolution of trade and FDI flows taking place in several regions of the world once tariff barriers are reduced.

From a theoretical point of view, in fact, the range of the possible ways in which organise production is composite: a firm producing a final good for which intermediate products are needed can choose to produce its inputs in-house (thus vertically integrating production), to outsource production of the same inputs to intermediate suppliers, themselves possibly located at home or in a foreign country, or to de-localise altogether the production of inputs in a subsidiary located in a foreign country, through a so-called vertical FDI.

Grossman and Helpman (2002 b,a) have studied the trade-off between outsourcing and in-house production in a closed economy, and between outsourcing from the home country and from abroad, respectively. Grossman and Helpman (2003) study instead the trade-off between FDI and outsourcing in a foreign country. In order to isolate the latter trade-off among the different possible ways of organising production, they assume that the producers of final goods, located in a Northern region, find it convenient to buy inputs from a Southern

¹Hummels et al. (2001) and Yeats (2001) document the phenomenon with a focus on the US, while Baldone et al. (2002) perform a similar exercise on the EU trade and production patterns with Central and Eastern Europe.

region, since wages in the South are lower than wages in the North. In addition, Grossman and Helpman (2003) suppose the local suppliers in South to be more efficient with respect to a production unit eventually setup in the Southern region by the final producers through a vertical FDI. However, the eventual relationship with the suppliers is plagued with contractual difficulties, linked to the uncertain legal framework of the South, and therefore for the final producers a trade-off arises between the greater efficiency gained through outsourcing, and the contract incompleteness they might avoid if they produce their required inputs through a FDI.

This paper contributes with some refinements to the latter model as far as the treatment of the FDI alternative is concerned and explores the extent to which the production strategies of the final producers are sensitive to the degree of contract incompleteness of a host country, and how in turn the latter affects the establishment of linkages between the final producers and the local suppliers.

In particular, two main refinements of the Grossman and Helpman (2003) framework are presented in this paper. First, we introduce some degree of heterogeneity in the productivity of the final good producers: the hypothesis of a superior technology with which the local suppliers are endowed might hold with respect to some foreign producers, but not for others, which therefore, *ceteris paribus*, would opt for a FDI rather than outsourcing². Since the issue of firms' heterogeneity and FDI has already been discussed in the literature (Helpman, Melitz and Yeaple, 2003), in this paper we offer a way to generalize in this direction the Grossman and Helpman (2003) framework, although the issue will not constitute the focus of our research. A second generalization we present is related to the fixed costs of starting-up the production facility if the FDI option is chosen. While the latter are absent in the Grossman and Helpman (2003) framework, being them sunk they are however relevant for the considered trade-off, and hence they will be included in the determination of our industry equilibrium.

The refinements are presented in Section 2, where the basic setup of the model is analyzed. Section 3 solves for the industry equilibrium, discussing some of its properties with respect to

²It is known that MNEs tend in general to have a superior production technology with respect to domestic firms, a finding which seems in contrast with one of the key hypothesis of Grossman and Helpman (2003).

a changing degree of contract incompleteness, while Section 4 explores how different industry equilibria affect eventual linkages between the final producers and the local suppliers. Section 5 concludes presenting some testable implications to be explored in future lines of research.

2 The model

We consider a two-country (North and South), two-sectors economy. One sector produces an homogeneous good z , which is also used as an intermediate for the production of a differentiated, composite good y , whose n varieties are considered as imperfect substitutes in the eyes of consumers. While the z good is produced in both countries, the production of the differentiated good is only located in North. Due to differences in production costs, it is however cheaper for producers to source inputs (i.e. the z good) from the Southern country, since wages in South are lower than wages in North and normalised to 1. The producers of the final good (from here on, simply the producers) can thus decide whether to establish a plant for the production of intermediate inputs in the South (i.e. undertake a FDI to take advantage of the lower wages) or purchase the same inputs from specialised foreign suppliers (from here on, the suppliers).

On the demand side, each consumer maximizes a utility function of the form:

$$u = z^{1-\beta} \left[\int_0^n y(j)^\alpha dj \right]^{\frac{\beta}{\alpha}} \quad \text{with } \alpha, \beta \in (0, 1) \quad (1)$$

subject to the following constraint:

$$I = p_z z + \int_0^n p(j) y(j) dj \quad (2)$$

with α representing the degree of product differentiation, whereas β is the share of spending that consumers optimally devote to the differentiated good. The world income I is fixed and derived from the total amount of labour L in each country, i.e. the analysis is a partial equilibrium one, and hence there are no income effects on demand.

We focus on the production and demand of good y , since it identifies the industry employing some intermediate inputs whose production generates the trade-off between FDI and

international outsourcing. From the consumer's maximizing problem, we derive the demand for any differentiated products $y(i)$, given by:

$$y(i) = Ap(i)^{-\varepsilon} \quad (3)$$

where $\varepsilon = 1/(1 - \alpha)$ represents the elasticity of demand. As it is well known, the CES utility function also implies

$$A = \frac{\beta I}{\int_0^n p(j)^{1-\varepsilon} dj} \quad (4)$$

where $I = wL_N + L_S$ is the aggregate level of income in the two countries, with wage w in the South equalised to one and $p(j)$ is the price of each variety j . Thus, consumers spend a constant fraction β of their income I on output from the industry; then, βI can be a proxy of the industry size, since it's the total expenditure devoted to the industry producing the differentiated good.

On the supply side the production of a unit of any variety of final goods requires one unit of specialised input. The homogeneous good z is used as an input for the production of the differentiated good, with one unit of input necessary for the production of one unit of output. However, given the differentiated nature of the final product, in order to be used as an input the intermediate good z has to undergo an investment in customization. The latter changes according to the two possible ways in which the production of the intermediate good can be organised in South: outsourcing to local suppliers or foreign direct investment.

We shall now in turn analyze these two possible alternatives.

2.1 Outsourcing

If the final producer opts for the outsourcing relationship, in order to provide intermediate goods sufficiently close to the needs of the downstream firm the local supplier has to undertake an investment in customization $c(X)$, where c is any monotonous function and X a vector of firm-specific characteristics. The level of investment in customization concerns the first stage of the negotiation process, when the final producer and the potential supplier decide the extent of the supplier's investment in customization and the amount of compensation. Later, they negotiate the quantity of the input order. The first stage of the negotiation

process is therefore characterised by an investment contract, whereas the second stage by an order contract. However, while the latter is complete, since quantities are verifiable, the investment contract is incomplete, as the supplier's investment and then the quality of the input are only partially verifiable by outside parties. We assume that an outside party, for instance a Court, can verify only a fraction $\gamma \in (0, 1)$ of the total investment in customization undertaken by the intermediate supplier³. If γ approaches 1, a Court is able to verify almost the whole level of investment and hence the quality of the input. As a result, γ measures the degree to which it is possible to enforce a given contract, and hence we can consider it to be a parameter reflecting the state of legal system in the host (Southern) country. Therefore, it is possible to study how the choice between FDI and outsourcing is affected by the degree of contract incompleteness in a host economy.

In particular, given the contract incompleteness, the supplier's initial investment is likely to be suboptimal, due to a potential hold up problem: since the intermediate inputs are fully tailored to a particular variety i of the final product, the supplier may fear that, after having made the necessary investment to produce the inputs, the final producer denies the due payment, claiming that some contingencies, uncovered by the contract, have occurred. In order to prevent this situation, the investment contract specifies a payment P the producer provides to the supplier in order to make sure that the latter carries out the agreed investment in customization $c(X)$. The payment function P hence covers for the contingency of default of the counterparts, itself decreasing as the level of verifiability γ of the contract increases. As a result, the payment function can be considered as covering a variable share $(1 - \gamma)g$ of the required investment in customization $c(X)$. Assuming $c(X) = c$, it can be written as⁴:

$$\begin{aligned} P &= \int_0^{(1-\gamma)g} c(X) dx \\ &= \int_0^{(1-\gamma)g} c dc = \frac{1}{2} (1 - \gamma)^2 g^2 \end{aligned} \tag{5}$$

³Note that Grossman and Helpman (2003) assume $\gamma < \frac{1}{2}$, whereas, given our goal of studying the industry equilibrium with different degrees of contract incompleteness, in our model we consider $\gamma \in (0, 1)$.

⁴In other words, if $\gamma \rightarrow 1$, i.e. the contract is perfectly verifiable and hence enforceable, the payment function $P \rightarrow 0$. If $\gamma \rightarrow 0$, then the payment function covers a share g of the investment in customization $c(X)$ agreed by the counterparts. Note also that a value $P < \int_0^{(1-\gamma)g} c(X) dx$ is not incentive compatible, while a value $P > \int_0^{(1-\gamma)g} c(X) dx$ is not rational since the payment P is then discounted by the total profits redistributed equally among the counterparts (no discount rate is considered in the model).

As shown above, the payment function takes into account all the different degrees of contract completeness that the final producer might find, and it covers just the unverifiable part $(1 - \gamma)g$ of the investment the intermediate producer should undertake. In this way, the intermediate producer has to bear the cost of investment that equals the verifiable part γg , not covered by P , and the final producer is sure that the whole investment of customization is undertaken in order to guarantee the quality of the intermediate goods.

Once specified the payment function, let S denote the total surplus arising from the sales of the final good when the two stages of the negotiation process are completed successfully. The downstream firm produces the i^{th} variety of good y , and operates in a monopolistic competitive framework, while the production of the homogeneous good, which also serves as an input, is characterised by a perfect competitive market. The producers then have to choose the price p to maximize the profits on the sales of the differentiated good $y(i)$, minus the cost of the input z .

$$\max \pi = py(i) - p_z z \quad (6)$$

In order to produce one unit of output, one unit of input is needed, and hence $y(i) = z$. Moreover, in case of outsourcing one unit of labor λ is required to manufacture one unit of intermediate good by the suppliers, i.e. $\lambda = 1$. Given the perfect competitive environment in which the input is produced, then its price is equal to its marginal cost, and hence $p_z = \lambda w = 1$ (the latter equality holds since the intermediate goods are produced employing labor in the South, whose wage we have normalised to 1). Then we can rewrite Eq. (6) as $\max \pi = py(i) - y(i)$. Substituting Eq. (3) and taking the derivative we obtain the following profit maximising price set by the final producer in case of outsourcing:

$$p_{out} = 1/\alpha \quad (7)$$

which, when substituted back into the profit equation, yields:

$$S = (1 - \alpha)A\left(\frac{1}{\alpha}\right)^{1-\varepsilon} \quad (8)$$

where S is the total surplus to be shared by the contracting parties. The negotiation process is governed by Nash bargaining determining an equal share of the surplus for the two partners,

since both the producer and the supplier have an outside option equal to 0⁵. Once the first stage of the negotiation ends up successfully with the transfer of the payment P from the producer to the supplier, the partners can then write an order contract defining the quantity of intermediate inputs needed for manufacturing the final goods. Then, the total profits for the final producer in case of outsourcing are:

$$\pi_{out} = \frac{1}{2}S - \frac{1}{2}(1 - \gamma)^2 g^2 \quad (9)$$

i.e. its share of total surplus as defined in (8) minus the payment P it has to guarantee to the local supplier for the enforcement of the contract.

2.2 Foreign direct investment

If instead the producer chooses to vertically integrate its firm and produce the intermediate goods through a FDI, the total profits he or she makes are:

$$\pi_{fdi} = \lambda_i^{1-\varepsilon} S - F \quad (10)$$

The producer in this case gets the entire surplus S but faces higher costs of production, with $\lambda_i > 1$ representing the units of labor required to assemble the intermediate input inside the i^{th} subsidiary⁶. One can think at λ_i as the marginal cost in case of vertical integration for the i^{th} producer, and thus the optimal price set up by the firms deciding to internalize the whole production process is $p_{fdi} = \left(\frac{\lambda_i}{\alpha}\right)$. Alternatively, since $\varepsilon > 1$, the value $\lambda_i^{1-\varepsilon}$ measures the heterogeneous productivity level of the i^{th} subsidiary. In particular, following the results of a recent literature on firm heterogeneity (Helpman, Melitz and Yeaple, 2003), λ_i is drawn from a distribution $G(\lambda)$. Upon observing this draw, final producers assess their

⁵Indeed, there is an exclusive dealing between supplier and producer: the former produces specialized inputs that are designed for a particular variety of final good on which the producer is a monopolist, and hence they have no value for other downstream firms. At the same time, if the negotiation with a potential supplier fails, the profit opportunity disappears due to entry by other downstream firms.

⁶We recall that in case of outsourcing one unit of labor is required to manufacture one unit of intermediate good, i.e. the local suppliers have $\lambda = 1$. In a sense, $\lambda_i > 1$ can be considered as the counterpart, for the vertically integrated firm, of the customization costs $c(X)$ incurred by the local supplier when they have to tailor the (homogeneous) intermediate input z to the variety i of the final product.

productivity level, calculate the value of π_{fdi} and decide whether to produce the intermediate inputs in-home or to outsource this stage of production.

Finally, we also consider that, once a firm decides to set up a subsidiary to produce the components, it incurs in a sunk cost F . In particular, in order to avoid a trivial solution of the trade-off, we assume that the sunk cost of investment is always larger than the payment P the producer faces in case of outsourcing. Thus, given our assumptions on P , we have $F > \frac{1}{2} (1 - \gamma)^2 g^2$.

2.3 The trade-off between FDI and outsourcing

Before entering the market, a generic final producer has therefore to choose whether to outsource intermediates from a local supplier or to set up a foreign subsidiary for their internal production. Comparing the profits associated with these two options, and reported in (9) and (10), respectively, it is possible to calculate the probability ρ of doing outsourcing:

$$\begin{aligned} \rho &= \text{prob}(\pi_{fdi} \leq \pi_{out}) \\ &= \text{prob}(\lambda_i^{1-\varepsilon} S - F \leq \frac{1}{2} S - \frac{1}{2} (1 - \gamma)^2 g^2) \\ &= \text{prob}(\lambda_i^{1-\varepsilon} \leq \frac{S - (1 - \gamma)^2 g^2 + 2F}{2S}) \end{aligned} \tag{11}$$

where $\lambda_i^{1-\varepsilon}$ represents the productivity level (i.e. the cut off condition) under which for the i^{th} final producer it is indifferent to choose either FDI or outsourcing. As it can be seen from Equation (11), the higher the productivity $\lambda_i^{1-\varepsilon}$ of the i^{th} subsidiary, the higher, *ceteris paribus*, the probability of opting for the FDI alternative, in line with the findings of Helpman, Melitz and Yeaple (2003). Outsourcing is instead more likely the greater the sunk cost F of setting up a foreign subsidiary and the greater the level of contract completeness γ in the Southern region.

The expected profits gained by the final producer once he chooses to enter the market are the following:

⁷In a sense, the sunk cost is therefore also positively related to the degree of contract incompleteness $(1 - \gamma)$ prevailing in the host region.

$$\pi_n = \rho \pi_{out} + (1 - \rho) \pi_{fdi} = \rho \left[\frac{1}{2} S - \frac{1}{2} (1 - \gamma)^2 g^2 \right] + (1 - \rho) [\lambda_i^{1-\varepsilon} S - F] \quad (12)$$

On the other hand, the expected profit condition of the intermediate suppliers is completely driven by the existence of the contractual relationship with the final producers, which takes place with probability ρ , given that their outside option is equal to zero. In addition, the intermediate suppliers face the cost of customization $c(X)$, discounted by the payment function P they get. Since we have written the payment function as covering a share $(1 - \gamma)g$ of the required investment in customization $c(X)$, the share γg is born by the suppliers. Hence, recalling our assumption $c(X) = c$, we can write their expected profit as:

$$\begin{aligned} \pi_m &= \rho \left(\frac{1}{2} S - \int_0^{\gamma g} c(X) dx \right) \\ &= \rho \left(\frac{1}{2} S - \frac{1}{2} \gamma^2 g^2 \right) \end{aligned} \quad (13)$$

We now turn to the determination of the industry equilibrium.

3 Solving for the industry equilibrium

Our aim is to check how changes in the degree of contract completeness γ affects the industry equilibrium and hence the trade-off between FDI and outsourcing. In order to do this, we focus on how changes in γ affects the zero profit condition $\pi_n = 0$, from which we derive the endogenous number of final entrants n .

As a first step, in order to maintain the model tractable, we assume that both $G(\lambda)$ and $G(\lambda^{1-\varepsilon})$ are uniformly distributed, i.e. all productivity levels for the final producers are equally probable. This type of distribution allows us to forego any assumption on which productivity level occurs with greater frequency once a firm puts in place the delocalisation of its production process. Hence, in the remaining of the paper we will exploit this assumption for the determination of the industry equilibrium and leave the discussion of the heterogeneity issue to further lines of research. In particular, if $G(\lambda)$ and $G(\lambda^{1-\varepsilon})$ are uniformly distributed, Equation (11) becomes:

$$\rho = \text{prob}(\lambda_i^{1-\varepsilon} \leq \frac{S - (1-\gamma)^2 g^2 + 2F}{2S}) = \frac{S - (1-\gamma)^2 g^2 + 2F}{2S} \quad (14)$$

The latter expression can be rewritten as follows: considering Eq. (3) and employing the expressions for the prices p_{out} and p_{fdi} we find an expression for the parameter A in Eq. (4) in terms of n and ρ which we substitute into (8) to derive:

$$\rho = \frac{(1-\alpha)\beta I - (1-\gamma)^2 g^2 n \lambda^{1-\varepsilon} + 2F n \lambda^{1-\varepsilon}}{2(1-\alpha)\beta I + (1-\gamma)^2 g^2 n - (1-\gamma)^2 g^2 n \lambda^{1-\varepsilon} - 2F n + 2F n \lambda^{1-\varepsilon}} \quad (15)$$

The number of final producers n is endogenously determined by the zero profit condition $\pi_n = 0$. To calculate this, we substitute in Eq. (12) the expression for the surplus S of our Eq. (8) where again the expression for A in Eq. (4) has been considered in terms of n and ρ . Then, we get:

$$n = \frac{(1-\alpha)\beta I [(1-\rho)\lambda^{1-\varepsilon} + \frac{1}{2}\rho]}{[\rho + (1-\rho)\lambda^{1-\varepsilon}] [F(1-\rho) + \frac{1}{2}(1-\gamma)^2 g^2 \rho]} \quad (16)$$

Unfortunately, this is not a closed form solution, since in the latter expression n still depends on ρ . In turn, Eq. (15) shows that also ρ depends from n . In order to solve for the the industry equilibrium, the reciprocal effects of n and ρ have to move in opposite directions, such that $\rho = f(n)$ and $n = f(\rho)$ cross at least once. Moreover, if they are strictly monotonic functions, for a given level of contract completeness γ the industry equilibrium is unique. We are hence interested in exploring the conditions under which such a unique equilibrium exists; after that, we analyze the effects caused by changes in the parameter γ .

At this purpose, it is important to prove the following two propositions.

Proposition 1 *The probability of outsourcing ρ always raises when the total number of final producers n increases, i.e. $\frac{\partial \rho}{\partial n} > 0$.*

Proof. The proposition holds under the condition that $F > P$, i.e. FDI always implies greater sunk costs than outsourcing, for every level of contract incompleteness. For the rest of the proof: see the Appendix. ■

The implication of Proposition 1 is that $\rho = f(n)$ is upward sloping, i.e, if direct investments require greater sunk costs than outsourcing and productivity levels are uniformly

distributed, whenever the number of entrants raises, the probability of outsourcing always increases.

Proposition 2 *The total number of final producers n depends negatively on the probability of outsourcing ρ under certain conditions. In particular, if $\frac{1}{2} \frac{F}{P} < \lambda^{1-\varepsilon} < 1$, then $\frac{\partial n}{\partial \rho} < 0$ is always verified, whereas if $\frac{1}{2} < \lambda^{1-\varepsilon} < \frac{1}{2} \frac{F}{P}$ the relationship holds for intermediate levels of ρ .*

Proof. See the Appendix. ■

The probability of doing outsourcing ρ affects negatively the number of entrants n on the basis of the productivity level of firms $\lambda^{1-\varepsilon}$ and the ratio between the sunk costs of doing FDI F and the payment function P ⁸. In particular, if $\lambda^{1-\varepsilon}$ is greater than $\frac{1}{2} \frac{F}{P}$, i.e. the sunk costs of doing FDI are not too high with respect to outsourcing, then $n = f(\rho)$ is downward sloping and thus an industry equilibrium exists and can be unique under plausible assumptions⁹.

3.1 Industry equilibrium and contract incompleteness

Having shown that a unique industry equilibrium exists, we are now interested in assessing how the legal framework in the Southern region, as measured by the parameter γ , affects the industry equilibrium. At this purpose, recall that γ appears in both Eq. (15) and (16), thus influencing both the parameters n and ρ . Hence, it is possible to prove the following Proposition 3 and Proposition 4.

Proposition 3 *The probability of outsourcing ρ always increases when the degree of contract completeness γ increases, i.e. $\frac{\partial \rho}{\partial \gamma} > 0$.*

Proof. See the Appendix. ■

Proposition 4 *As γ increases the equilibrium number of final entrants n raises, i.e. $\frac{\partial n}{\partial \gamma} > 0$*

⁸Recall that, given our assumptions on F , we have that $F/P > 1$.

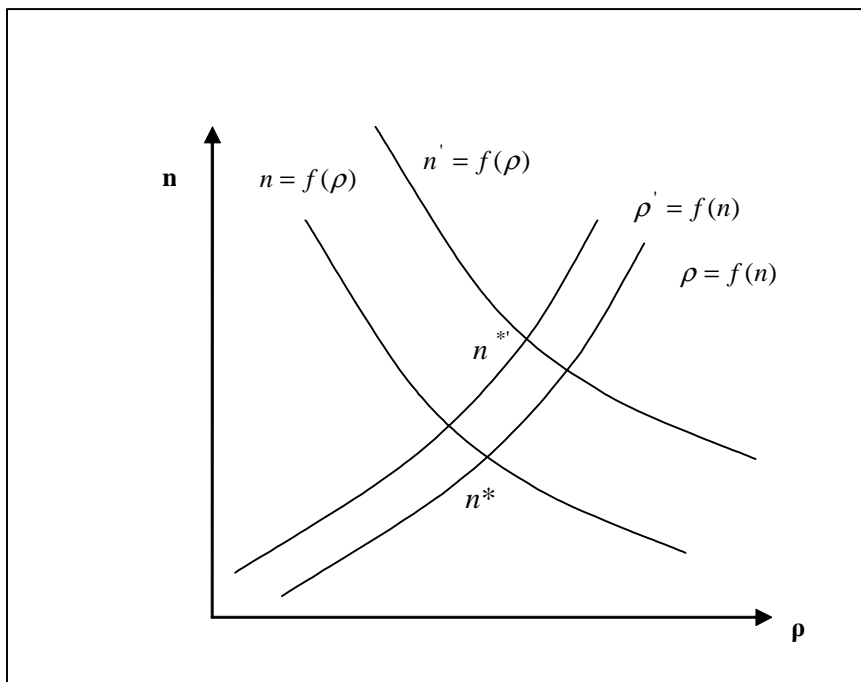
⁹Note that an equilibrium might still exist even if $\frac{1}{2} < \lambda^{1-\varepsilon} < \frac{1}{2} \frac{F}{P}$, provided that $\rho = f(n)$ and $n = f(\rho)$, now both upward sloping, cross at some point in the (ρ, n) space. We leave the exploration of this case to future lines of research.

Proof. See the Appendix. ■

As we could expect, an improvement in the level of contract completeness γ implies a lower value of the payment function P for producers, thus higher profits (see Eq. 12) leading to an increase in the number of entrants in equilibrium and hence an higher probability that the final producers choose to outsource the production of intermediates.

Revisiting Proposition 3 and 4 in light of Propositions 1 and 2, it can be thus shown that an improvement in contract verifiability γ causes a shift upward of both $n = f(\rho)$ and $\rho = f(n)$ and hence an increase of the equilibrium number of final entrants from n^* to $n^{*'}$, as shown by Figure 1:

Figure 1. Contract completeness and industry equilibrium



In order to have a better understanding of the way the model works, and its implications for the local economy, the following section investigates the interaction between foreign firms and local producers once the legal framework in the South, γ , improves.

4 Producers-suppliers linkages

We have seen that a change in the legal framework of the host economy affects the number of firms operating in the final sector, with an increase in contract completeness γ leading in equilibrium to a higher number n^* of entrants. However, recalling Eq. (13), it is possible to show that the degree of contract completeness influences also the profits of the local suppliers. In particular, considering again Eq. (3) and employing the expressions for the prices p_{out} and p_{fdi} in Eq. (4) and then in Eq. (8), it is possible to rewrite Eq. (13) as follows:

$$\pi_m = \rho\left(\frac{1}{2}S - \frac{1}{2}\gamma^2g^2\right) = \frac{1}{2}\left[\frac{(1-\alpha)\beta I\rho}{n[\rho + (1-\rho)\lambda^{1-\varepsilon}]} - \gamma^2g^2\right] \quad (17)$$

From Eq. (17), one can see that the degree of contract completeness γ , the probability of outsourcing ρ and the equilibrium number of downstream firms n all influence the suppliers' expected profits.

In order to derive a better understanding of these interactions, it is useful to prove the following propositions:

Proposition 5 *For any given n and γ , the profit condition for intermediate suppliers depends positively on the probability of doing outsourcing, i.e. we have $\left.\frac{\partial\pi_m}{\partial\rho}\right|_{n,\gamma} > 0$.*

Proof. See the Appendix. ■

Proposition 6 *For any given ρ and γ , the profit condition for intermediate suppliers depends negatively on the equilibrium number of final entrants n , i.e. $\left.\frac{\partial\pi_m}{\partial n}\right|_{\rho,\gamma} < 0$.*

Proof. See the Appendix. ■

Proposition 7 *For any given n , it exists a value of contract completeness γ^* such that $\left.\frac{\partial\pi_m}{\partial\gamma}\right|_{\gamma^*} = 0$.*

Proof. See the Appendix. ■

Proposition 5 and 6 can be reconducted to some of the traditional effects identified by the literature on linkages and spillovers¹⁰. In particular, Proposition 5 represents a (positive)

¹⁰See Gorg and Greenaway (2002) for an updated survey.

backward linkage effect, with the increase in the probability ρ of choosing outsourcing by final producer creating, *ceteris paribus*, higher profit opportunities for the suppliers. Proposition 6 identifies a (negative) *competition effect*: an higher number of final producers in equilibrium leads to a reduction of the total surplus available for the local suppliers.

Proposition 7 states that for any given number of final producers, there exist an optimal value of contract completeness γ^* for which the suppliers' profits π_m possibly reach a maximum (we have not characterised in so far second order derivatives). In order to explore this result, and recalling Eq. (17), one has to consider that an increase in the degree of contract completeness γ affects the suppliers' profits π_m via three channels: a direct negative effect, through a reduction of the payment P the suppliers obtain from the producers; an indirect effect, through the change that γ induces in the probability of outsourcing ρ and the equilibrium number of downstream firms n , as shown in Proposition 3 and 4. Since all the effects move in opposite directions, in order to keep the derivations tractable we have separated in Proposition 7 the competition effect from the other two¹¹.

We can then use a numerical calibration to explore whether π_m reaches a maximum given the (γ, n) space. In particular, given a set of exogenous parameters¹², we will generate an endogenous value of ρ via Eq. (15) for any combination of (γ, n) and then use Eq. (17) to explore the combined effects of (γ, n) and ρ on the suppliers' profits π_m .

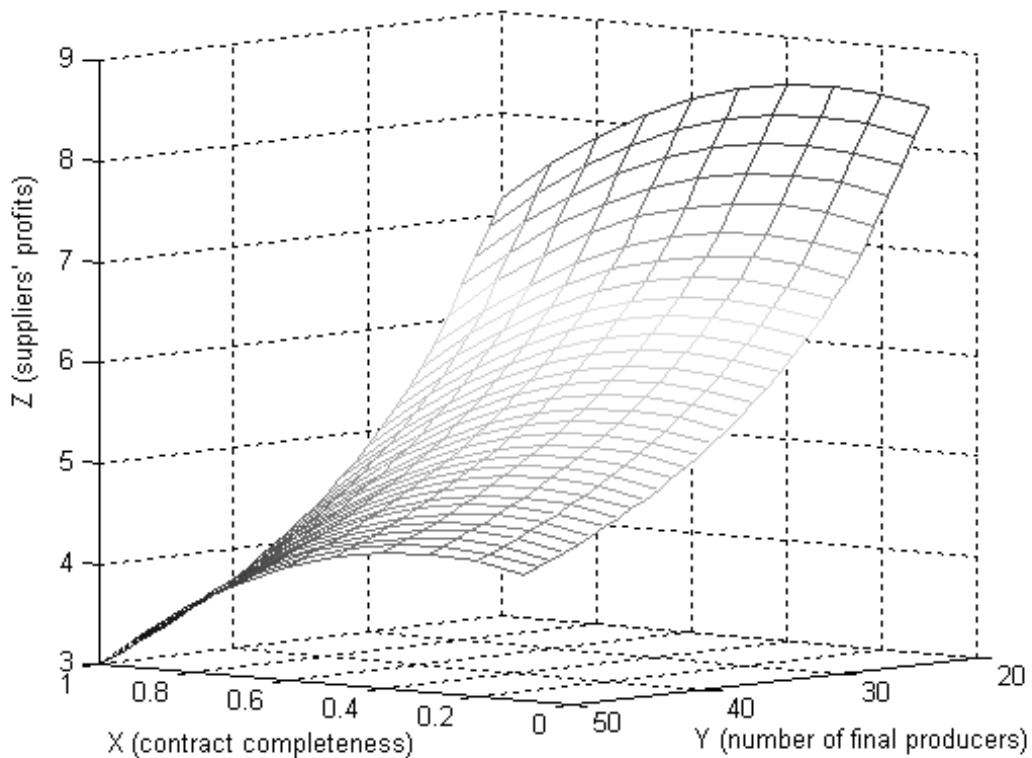
Figure 2 below depicts the results of the numerical calibration. Reading it along the Y axis, the analysis reveals that profits tend to be higher the lower the competition effect, i.e. the lower the number of final producers n operating in the market, thus confirming our Proposition 6. Reading Figure 2 along the X axis, it is shown that for a given n the suppliers' profits reach their maximum for an intermediate level γ^* of contract completeness: the idea is that, once the legal framework in the country starts to improve, this generates an increase in the probability of outsourcing ρ (the result of Proposition 3), thus inducing a positive backward linkage on the suppliers' profits, as indicated by Proposition 5. However,

¹¹Note that in our setup an increase in the degree of contract completeness γ leads to an increase in the total number of entrants n , which leads to a reduction in π_m ; however, an increase in n leads also to an increase in the probability of outsourcing ρ , as shown in Proposition 1, and hence in a positive effect on π_m . Essentially, the latter is the traditional backward linkage identified by the literature (e.g. Markusen and Venables, 1999), with the entry of foreign firms in the market strenghtening local demand for intermediates.

¹²In the simulation we have considered $g = 2$, $F = 5$, $(1 - \alpha)\beta I = 500$ and $\lambda^{1-\varepsilon} = 0.8$.

for $\gamma > \gamma^*$ the loss induced on π_m by the cost of customization (the $\gamma^2 g^2$ term in Eq. 17) becomes stronger and leads to a decrease in total profits, thus confirming Proposition 7. This result is however partial, since it holds for a given number of final producers n , itself endogenous to γ , as indicated by Proposition 4.

To get a more general result one has therefore to look at the simultaneous impact of γ and n on π_m . At this purpose, Figure 2 shows that the effect of an increase in the number of final producers n has a non-monotonic effect on the profit of the local suppliers. As n increases, any value of $\gamma > \gamma^*$ induces in fact a proportionally higher reduction in the suppliers' profit, and hence it is rational for the local suppliers to contrast the entry of new final producers with a reduction in the degree of contract completeness of the host country.



5 Conclusions

In this paper we have been able to characterize under a general set of conditions an industry equilibrium with a trade-off between outsourcing and FDI, where fixed sunk costs exist for the setting up of foreign subsidiaries and the latter are heterogeneous in productivity levels. We have then explored the relation existing between such an industry equilibrium and the degree of contract completeness prevailing in the host country, finding that a proper legal framework, not surprisingly, leads in equilibrium to a higher number of final producers with an higher probability of doing outsourcing.

The model allows also to characterize the relationship between this industry equilibrium and the profits available to the local suppliers, thus exploring the evolution of the linkages between the two classes of firms. Here, the results obtained are more controversial. On the one hand, the model replicates the traditional competition and backward linkage effects found by the literature on linkages and spillovers. On the other hand, however, a surprising result emerges when analyzing the effect of the contract completeness on the profits available to the local suppliers, relating this result to the number of final producers and their probability of doing outsourcing. We find in fact that an increase in competition levels has a non-monotonic effect on the profit of the local suppliers, since as the number of entrants increase, the higher is the degree the contract completeness, the lower are the profits available for the local suppliers. As a result, it becomes rational for the local suppliers to contrast the entry of new final producers with a reduction in the degree of contract completeness of the host country.

Although the latter result seems to be consistent with the empirical evidence of a non-increasing protection of property rights in most developing countries once they open up to international trade, it has however to be further explored by future lines of research. We suggest here some of them.

First of all, the robustness of the result has to be checked against a different set of exogenous parameters, and in particular the level of sunk costs of setting up the FDI subsidiary. Second, the model should be characterized for a distribution of the heterogeneous productivity levels of final producers different from the uniform one. This would allow to generalize the results of the model, although preliminary experiments we have performed suggest that the qualitative conclusions that we reach should not change.

Finally, in order to overcome the limitations of the numerical calibration, the formal propositions of the paper should be tested with data. The main problem here relates to the availability of firm level data on the amount of outsourcing, for both the local suppliers and the final producers, since we feel that indirect measures of outsourcing elsewhere employed in the literature (e.g. Hummels et al., 2001) are not able to grasp all the interactions among the different parameters that the model is able to measure.

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Appendix

Proof of Proposition 1. Recalling (15)

$$\rho = \frac{(1-\alpha)\beta I - (1-\gamma)^2 g^2 n c + 2Fn\lambda^{1-\varepsilon}}{2(1-\alpha)\beta I + (1-\gamma)^2 g^2 n - (1-\gamma)^2 g^2 n \lambda^{1-\varepsilon} - 2Fn + 2Fn\lambda^{1-\varepsilon}}$$

we compute the following derivative:

$$\begin{aligned} \frac{\partial \rho}{\partial n} &= \frac{[-(1-\gamma)^2 g^2 \lambda^{1-\varepsilon} + 2Fa^{1-\varepsilon}] [2(1-\alpha)\beta I + (1-\gamma)^2 g^2 n - (1-\gamma)^2 g^2 n \lambda^{1-\varepsilon} - 2Fn + 2Fn\lambda^{1-\varepsilon}]}{[2(1-\alpha)\beta I + (1-\gamma)^2 g^2 n - (1-\gamma)^2 g^2 n \lambda^{1-\varepsilon} - 2Fn + 2Fn\lambda^{1-\varepsilon}]^2} \\ &= \frac{[(1-\alpha)\beta I - (1-\gamma)^2 g^2 n c + 2Fn\lambda^{1-\varepsilon}] [(1-\gamma)^2 g^2 - (1-\gamma)^2 g^2 \lambda^{1-\varepsilon} - 2F + 2F\lambda^{1-\varepsilon}]}{[2(1-\alpha)\beta I + (1-\gamma)^2 g^2 n - (1-\gamma)^2 g^2 n \lambda^{1-\varepsilon} - 2Fn + 2Fn\lambda^{1-\varepsilon}]^2} \\ &= \frac{-(1-\alpha)\beta I(1-\gamma)^2 \lambda^{1-\varepsilon} + 2Fa^{1-\varepsilon}(1-\alpha)\beta I - (1-\alpha)\beta I(1-\gamma)^2 g^2 + 2F(1-\alpha)\beta I}{[2(1-\alpha)\beta I + (1-\gamma)^2 g^2 n - (1-\gamma)^2 g^2 n \lambda^{1-\varepsilon} - 2Fn + 2Fn\lambda^{1-\varepsilon}]^2} > 0 \end{aligned}$$

for $F > \frac{1}{2}(1-\gamma)^2$ ■

Proof of Proposition 2. From the zero profit condition for the final producers, defined in (16) we have

$$n = \frac{(1-\alpha)\beta I[(1-\rho)\lambda^{1-\varepsilon} + \frac{1}{2}\rho]}{[\rho + (1-\rho)\lambda^{1-\varepsilon}] [F(1-\rho) + \frac{1}{2}(1-\gamma)^2 g^2 \rho]}$$

Denoting $\psi = (1-\gamma)^2 g^2$, $c = \lambda^{1-\varepsilon}$, and calculating $\frac{\partial n}{\partial \rho}$, we get:

$$\begin{aligned} \frac{\partial n}{\partial \rho} &= \frac{2Fc\rho - \frac{1}{2}Fc - \psi\rho c + Fc^2 - \frac{1}{2}\psi c^2 + \frac{1}{2}F\rho^2 - \frac{1}{4}\psi\rho^2 - \frac{3}{2}Fc\rho^2 - 2F\rho c^2}{\{[\rho + (1-\rho)c] [F(1-\rho) + \frac{1}{2}\psi\rho]\}^2} + \\ &\quad + \frac{\frac{3}{4}\psi\rho^2 c + \psi c^2 \rho + F\rho^2 c^2 - \rho^2 c^2 \frac{1}{2}\psi}{\{[\rho + (1-\rho)c] [F(1-\rho) + \frac{1}{2}\psi\rho]\}^2} \end{aligned}$$

This derivative has not always the same sign. We are interested in identifying the conditions under which it is negative. Since the denominator is always positive, we focus on the numerator, that is negative on a range of intermediate values of ρ , i.e. $\rho_1 \leq \rho \leq \rho_2$. In particular

we have that

$$\rho_{1,2} = \frac{2Fc - c\psi - 2Fc^2 + c^2\psi \mp \sqrt{-\frac{1}{2}F\psi + F^2c - \frac{1}{2}Fc^2\psi + c^3F\psi - F^2c^2 + \psi^2c^2 - c^3\psi^2}}{\frac{1}{2}\psi - F + 3Fc - \frac{3}{2}\psi c - 2Fc^2 + \psi c^2}$$

We need to specify the conditions for which the expression under the square root is positive, that are (recalling that $c = \lambda^{1-\varepsilon}$), $\lambda^{1-\varepsilon} < \frac{1}{2} \frac{F}{\frac{1}{2}\psi}$ and $\lambda^{1-\varepsilon} > 1$. The latter never occurs given that $\lambda > 1$ and $\varepsilon > 1$, whereas we cannot exclude the former inequality¹³. Since ρ is a probability, we further have that $0 < \rho < 1$ and hence we need to check that the two roots are positive. Given that $\rho_2 > \rho_1$, it is enough to find the necessary condition for which ρ_2 is greater than 0. The numerator in the previous expression is always positive, given that the square root is always positive and $2Fc - c\psi - 2Fc^2 + c^2\psi > 0$ for $0 < \rho < 1$. As a result, we can limit our analysis to the denominator. Then, it must be that

$$\frac{1}{2}\psi - F + 3Fc - \frac{3}{2}\psi c - 2Fc^2 + \psi c^2 > 0$$

This condition is verified for $\frac{1}{2} < \lambda^{1-\varepsilon} < 1$. Summing up, if $\frac{1}{2} < \lambda^{1-\varepsilon} < \frac{1}{2} \frac{F}{\frac{1}{2}\psi}$, then $\frac{\partial n}{\partial \rho} < 0$ for $\rho_1 \leq \rho \leq \rho_2$; instead, if $\lambda^{1-\varepsilon} < \frac{1}{2}$, then $\frac{\partial n}{\partial \rho}$ is always positive. Alternatively, if $\frac{1}{2} \frac{F}{\frac{1}{2}\psi} < \lambda^{1-\varepsilon} < 1$, it implies that $\frac{\partial n}{\partial \rho} < 0$. ■

Proof of Proposition 3. In order to simplify the derivation of this result, it is convenient to calculate the derivative with respect to $1 - \gamma$, i.e. the degree of contract incompleteness rather than contract completeness. Proving that $\frac{\partial \rho}{\partial (1 - \gamma)} < 0$ then implies that $\frac{\partial \rho}{\partial \gamma} > 0$. Let us start from

$$\rho = \frac{(1 - \alpha)\beta I - (1 - \gamma)^2 g^2 n c + 2Fna^{1-\varepsilon}}{2(1 - \alpha)\beta I + (1 - \gamma)^2 g^2 n - (1 - \gamma)^2 g^2 n \lambda^{1-\varepsilon} - 2Fn + 2Fn\lambda^{1-\varepsilon}}$$

¹³Instead, if $\frac{1}{2} \frac{F}{\frac{1}{2}\psi} > 1$ the square root always exists.

Replacing $\delta = (1 - \alpha)\beta I$, and calculating $\frac{\partial \rho}{\partial(1 - \gamma)}$ we get:

$$\begin{aligned} \frac{\partial \rho}{\partial(1 - \gamma)} &= \frac{[-2(1 - \gamma)g^2n\lambda^{1-\varepsilon}] [2\delta + (1 - \gamma)^2g^2n - (1 - \gamma)^2g^2n\lambda^{1-\varepsilon} - 2Fn + 2Fn\lambda^{1-\varepsilon}]}{[2\delta + (1 - \gamma)^2g^2n - (1 - \gamma)^2g^2n\lambda^{1-\varepsilon} - 2Fn + 2Fn\lambda^{1-\varepsilon}]^2} - \\ &\quad - \frac{[\delta - (1 - \gamma)^2g^2n\lambda^{1-\varepsilon} + 2Fn\lambda^{1-\varepsilon}] [2n(1 - \gamma)^2g^2 - 2(1 - \gamma)n\lambda^{1-\varepsilon}]}{[2\delta + (1 - \gamma)^2g^2n - (1 - \gamma)^2g^2n\lambda^{1-\varepsilon} - 2Fn + 2Fn\lambda^{1-\varepsilon}]^2} \\ &= \frac{-2(1 - \gamma)g^2n\lambda^{1-\varepsilon}\delta - 2(1 - \gamma)g^2n\delta}{[2\delta + (1 - \gamma)^2g^2n - (1 - \gamma)^2g^2n\lambda^{1-\varepsilon} - 2Fn + 2Fn\lambda^{1-\varepsilon}]^2} < 0 \end{aligned}$$

We need to discuss just the numerator, since the denominator is a quadratic expression. It is easy to see that both terms $2(1 - \gamma)g^2n\lambda^{1-\varepsilon}(1 - \alpha)\beta I$ and $2(1 - \gamma)g^2n(1 - \alpha)\beta I$ are positive, due to the fact that $\delta = (1 - \alpha)\beta I$ is the total income devoted to consumption of the final goods, the term $(1 - \gamma)$ is positive, and the parameters n and $\lambda^{1-\varepsilon}$ are greater than zero. Hence the numerator is negative, and thus $\frac{\partial \rho}{\partial(1 - \gamma)} < 0$. ■

Proof of Proposition 4. Recalling

$$n = \frac{(1 - \alpha)\beta I[(1 - \rho)\lambda^{1-\varepsilon} + \frac{1}{2}\rho]}{[\rho + (1 - \rho)\lambda^{1-\varepsilon}] [F(1 - \rho) + \frac{1}{2}(1 - \gamma)^2g^2\rho]}$$

Then,

$$\frac{\partial n}{\partial \gamma} = \frac{(1 - \alpha)\beta I g^2 \rho [(1 - \rho)\lambda^{1-\varepsilon} + \frac{1}{2}\rho] [\rho + (1 - \rho)\lambda^{1-\varepsilon}] (1 - \gamma)}{\{[\rho + (1 - \rho)\lambda^{1-\varepsilon}] [F(1 - \rho) + \frac{1}{2}(1 - \gamma)^2g^2\rho]\}^2} > 0$$

The derivative is always positive for γ and ρ different from zero (otherwise it could be that $\frac{\partial n}{\partial \gamma} = 0$): indeed $(1 - \alpha)\beta I > 0$, given that it represents the total income devoted to the industry producing the differentiated good, ρ is the probability of doing outsourcing and then $1 - \rho$ is positive. ■

Proof of Proposition 5. Given the profit function for the intermediate suppliers:

$$\pi_m = \frac{1}{2} \left[\frac{(1 - \alpha)\beta I \rho}{n[\rho + (1 - \rho)\lambda^{1-\varepsilon}]} - \gamma^2 g^2 \right]$$

denoting $\delta = (1 - \alpha)\beta I$, $c = a^{1-\varepsilon}$,

$$\begin{aligned} \left. \frac{\partial \pi_m}{\partial \rho} \right|_{n,\gamma} &= \frac{[\delta - \gamma^2 g^2 n (2\rho + c - 2\rho c)] [2n(\rho + c - c\rho)] - [\delta\rho - \gamma^2 g^2 n (\rho^2 + c\rho - \rho^2 c)] [2n(1 - c)]}{[2n(\rho + c - c\rho)]^2} \\ &= \frac{2n\delta(\rho + c - c\rho) - 2n\gamma^2 g^2 n (2\rho + c - 2\rho c)(\rho + c - c\rho)}{[2n(\rho + c - c\rho)]^2} - \\ &\quad - \frac{2n\delta\rho(1 - c) - 2n\gamma^2 g^2 n (\rho^2 + c\rho - \rho^2 c)(1 - c)}{[2n(\rho + c - c\rho)]^2} \\ &= \frac{2n\delta c - 2n^2 g^2 \gamma^2 (\rho + c - \rho c)^2}{[2n(\rho + c - c\rho)]^2} \end{aligned}$$

Notice that the denominator is always positive; also the numerator is positive, under the plausible assumption that $\delta > \frac{\gamma^2 g^2 n}{c}$, i.e. $(1 - \alpha)\beta I > \frac{\gamma^2 g^2 n}{\lambda^{1-\varepsilon}}$, since the left hand side can be considered a proxy of the total demand faced by final good producers. ■

Proof of Proposition 6. Rearranging Eq. (17) we get:

$$\pi_m = \left[\frac{(1 - \alpha)\beta I \rho - \gamma^2 g^2 n \rho (\rho - \rho \lambda^{1-\varepsilon} + \lambda^{1-\varepsilon})}{2n[\rho + (1 - \rho)\lambda^{1-\varepsilon}]} \right]$$

Again, we impose $\delta = (1 - \alpha)\beta I$, $c = \lambda^{1-\varepsilon}$. Calculating $\frac{\partial \pi_m}{\partial n}$ we get:

$$\begin{aligned} \left. \frac{\partial \pi_m}{\partial n} \right|_{\gamma} &= \frac{[\delta \frac{\partial \rho}{\partial n} - \gamma^2 g^2 (\rho^2 + c\rho - c\rho^2) - \gamma^2 g^2 n (2\rho \frac{\partial \rho}{\partial n} + c \frac{\partial \rho}{\partial n} - 2\rho \frac{\partial \rho}{\partial n} c)] [2n[\rho + (1 - \rho)c]]}{2n[\rho + (1 - \rho)c]^2} - \\ &\quad - \frac{[\delta\rho - \gamma^2 g^2 n \rho (\rho - \rho c + c)] [2(\rho - \rho c + c) + 2n(\frac{\partial \rho}{\partial n} - c \frac{\partial \rho}{\partial n})]}{2n[\rho + (1 - \rho)c]^2} \\ &= \frac{2n \frac{\partial \rho}{\partial n} \delta c - 2\gamma^2 g^2 n^2 \frac{\partial \rho}{\partial n} (\rho + c - \rho c)^2 - 2\delta\rho(\rho + c - \rho c)}{2n[\rho + (1 - \rho)c]^2} < 0 \end{aligned}$$

To check the sign of the numerator, we find that it is negative for $n < n_1$ and $n > n_2$, where

$$n_{1,2} = \frac{\delta \frac{\partial \rho}{\partial n} c \mp \sqrt{(\delta \frac{\partial \rho}{\partial n} c)^2 - 4\delta \rho \frac{\partial \rho}{\partial n} \gamma^2 g^2 (\rho + c - \rho c)^2}}{2 \frac{\partial \rho}{\partial n} \gamma^2 g^2 (\rho + c - \rho c)^2}$$

Recalling Proposition 1, i.e. $\frac{\partial \rho}{\partial n} > 0$, it can be shown that $n_2 < 1$, $\frac{\partial \pi_m}{\partial n} < 0$ is verified. ■

Proof of Proposition 7. Recalling the profit condition for the local suppliers, i.e.

$$\pi_m = \rho \left(\frac{1}{2} S - \frac{1}{2} \gamma^2 g^2 \right) = \frac{1}{2} \left[\frac{(1-\alpha)\beta I \rho}{n[\rho + (1-\rho)a^{1-\varepsilon}]} - \gamma^2 g^2 \right]$$

denoting $\delta = (1-\alpha)\beta I$, $c = a^{1-\varepsilon}$, and computing its derivative with respect to γ , it results:

$$\begin{aligned} \frac{\partial \pi_m}{\partial \gamma} &= \frac{2n \left[\delta \frac{\partial \rho}{\partial \gamma} - 2\gamma g^2 n (\rho^2 + c\rho - c\rho^2) - \gamma^2 g^2 n \left(2\rho \frac{\partial \rho}{\partial \gamma} + c \frac{\partial \rho}{\partial \gamma} - 2\rho c \frac{\partial \rho}{\partial \gamma} \right) \right] [\rho + (1-\rho)c] -}{4n^2 [\rho + c(1-\rho)]^2} \\ &= \frac{2n [\delta \rho - \gamma^2 g^2 n (\rho^2 + c\rho - \rho^2 c)] \left[\frac{\partial \rho}{\partial \gamma} - \frac{\partial \rho}{\partial \gamma} c \right]}{4n^2 [\rho + c(1-\rho)]^2} \\ &= \frac{\delta \frac{\partial \rho}{\partial \gamma} c - (\rho - \rho c + c)^2 (\gamma^2 g^2 n \frac{\partial \rho}{\partial \gamma} + 2\gamma g^2 n \rho)}{4n^2 [\rho + c(1-\rho)]^2} \end{aligned}$$

To verify whether the derivative is positive we focus on the numerator, that is positive if $\gamma_1 < \gamma < \gamma_2$, where

$$\gamma_{1,2} = \frac{g^2 n \rho (\rho - c\rho + c)^2 \mp \sqrt{g^4 n^2 \rho^2 (\rho - \rho c + c)^4 + \delta \left(\frac{\partial \rho}{\partial \gamma} \right)^2 c g^2 n (\rho - c\rho + c)^2}}{g^2 n \frac{\partial \rho}{\partial \gamma} (\rho - \rho c + c)^2}$$

Proposition 3 proves that $\frac{\partial \rho}{\partial \gamma} > 0$, and we employ this results to verify that $\gamma_1 < 0$, whereas $0 < \gamma_2 < 1$. It means that there exists a range of values of γ , that is $\gamma < \gamma_2$, for which $\left. \frac{\partial \pi_m}{\partial \gamma} \right|_n > 0$, whereas for $\gamma > \gamma_2$ it results that $\left. \frac{\partial \pi_m}{\partial \gamma} \right|_n < 0$. ■