Incomplete Contracts and the Impact of Globalization on Consumer Welfare

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Abstract

We embed a North-South trade model into an incomplete contracts setting where the production of heterogeneous firms can be geographically separated. When a Northern headquarter contracts with a Southern supplier instead of a Northern supplier, the presence of international incomplete contracts may lead to a higher price. As a result, trade liberalization, that induces offshoring, is not necessarily welfare-enhancing for consumers, despite the lower cost of labor in the South. In addition, firms which use the supplier's component intensively, offshore their supplier in the South using outsourcing. As trade costs fall, less component-intensive firms also offshore, but by vertically integrating their supplier. We argue that this organizational change increases production-shifting in the South, implying that a larger number of varieties will be produced in the South where contracts are incomplete. We show that, this may reduce consumer welfare in both countries.

JEL-Code: F230, L220, R300.

Keywords: consumer welfare, incomplete contracts, hold-up problem.

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1 Introduction

One commonly-observed pattern corresponding to the increasing fragmentation of production is that an increasing number of firms have relocated their production to low-wage countries while siting their strategic functions (e.g. Headquarters, and Research & Development centers) in developed countries. A good example is the opening of Eastern European markets in the Nineties which triggered a wave of production relocation.[1] This phenomenon led to the closing of many Western plants,[2] which may explain the layman's suspicion of such relocations. Recently, the main trade union at Renault, the French car-maker, denounced a "strategy which consists in looking for the highest profit on each vehicle [without any] fall in price to stimulate consumer demand".[3] This remark may seem bizarre, as the main argument in favor of relocating to low-wage countries is precisely the expected fall in costs and retail prices.

Nevertheless, consumer welfare may well be reduced if each sub-contractor extracts a share of the profit before passing any savings on to consumers. Thus, offshoring could lead to greater profits but not necessarily to lower prices; in the limit consumers may even end up worse off. In this paper, we argue that the incompleteness of international contracts may well be at the heart of this distortion. Under incomplete contracts the well-known hold-up problem induces relationship-specific under-investment by agents, leading to higher profit margins and higher prices/mark-ups, which in turn likely affect consumer welfare negatively. Hence, the weak contractual environment in low-wage countries may help us to understand why increasing world trade does not seem to have squeezed consumer prices as much as might have been expected.[4]

[1] Notably in the Automobile sector: in only two years, most of the production capacity of Central and Eastern European producers was acquired by only four Western carmakers: Volkswagen, General Motors (Opel) and Renault in 1991, and Fiat in 1992.

[2] The following examples are from the automobile sector. Renault: Billancourt (France) in 1991, Setubal (Portugal) in 1996, Vilvoorde (Belgium) in 1997. Fiat: Chivasso (Italy) in 1992, Rivalta (Italy) in 2001.

[3] Liberation (a daily French newspaper), November, 10th 2006, our translation.

[4] A recent study published by the OECD (2006) has confirmed that globalization has only a small impact on consumer prices. Over the period 1995 to 2005, the net effect of imports from low-wage countries was small and consumer price inflation in Japan and the US "might have even been lower in the absence of globalization" (see OECD, 2006, p.38). Empirical work by Kamin et al. (2006) has also suggested that the impact of Chinese exports on global import prices over the 1993-2001 period was fairly modest. Using firm-level data, Halpern and Koren (2007) propose evidence of a pricing behavior directly related to the "double marginalization" problem. In their study, the firm' market power raises its mark-up, and ultimately increases the import price. This counter infinitive result has also been found in sectoral analysis. Using a panel of 66 industries and 12 countries of the European Union, Egger and Egger (2004) find a positif effect of import of intermediate inputs into firms' markup. As a result, the price-cost margins would have decrease faster if the observed increase in offshoring had not taken place in the 90s. Boulhol (2008) also confirms the absence of impact of the increase of imports on price-cost margins using 13 OECD countries

Recently, papers have introduced search frictions or inefficient organization form to study the effect of trade liberalization. Using incomplete contract as a source of distortion, we see our paper as part of this ongoing literature. Antràs and Costinot (2011) develop a model of international trade with intermediation. In a perfect competition framework, they study the impact of regional integration on welfare. In their model, producers must be matched with a trader in order to have access to these markets. Search frictions and high bargaining power of Northern intermediaries may lead the South to be worth off. Under certain circumstances it may even lead to a possible aggregate welfare losses. Another interesting paper for us is Conconi et al. (2009). Their framework is quite different from ours, as it is a perfectly-competitive trade model and it considers a distinct setting of organization design. Interestingly, they show that trade liberalization can lead to inefficient organizational form and adversely affect consumers, as in our paper.

A growing literature has introduced incomplete contracts into Dixit-Stiglitz-Krugman monopolistic-competition models in order to examine firms' organizational choices (see Grossman and Helpman, 2002, Antràs, 2003 and Antràs and Helpman, 2004).[5] Surprisingly, while it is well-known that Dixit and Stiglitz (1977) and Krugman (1980) models have been developed to deal with welfare questions, the recent developments in New Trade Theory do not usually address the specific welfare implications of contract incompleteness. Mitra and Ranjan (2008) and Naghavi and Ottaviano (2010) are two notable exceptions.[6]

The economic-geography framework is a simple way in which to analyze the welfare impact of globalization, both in the North and the South. However, standard economic-geography models only seldom consider multinational firms. A number of papers such as Fujita and Thisse (2006) and Robert-Nicoud (2008) allude to their existence, but relate the fragmentation of production solely to communication costs. We extend this literature by instead considering that international relationships are plagued by incomplete contracts. To this end, we embed an an economic-geography model into an incomplete-contract setting. Our results are consistent with the empirical findings mentioned above, since offshoring is shown to lead to higher profit margins and potentially higher prices.

over the last three decades.

[5]See also Grossman and Helpman (2004), who apply the incentive-systems framework of Holmstrom and Milgrom (1994) to managerial compensation in global production. Verdier and Marin (2003) and Puga and Trefler (2002) extend the Aghion and Tirole (1997) theory of delegating authority to a full general-equilibrium model. See Helpman (2006) and Spencer (2005) for surveys of the literature.

[6]See also the first working paper version of Antràs (2005), which considers the welfare impact of the product cycle when contracts are incomplete in a dynamic Ricardian model.

Producing a final good requires the use of relationship-specific inputs from both a supplier and headquarters, but only the former's production can be located abroad. When a Northern headquarters (HQ for short) transacts with a local supplier, the setting is one of complete contracts. On the contrary, when headquarters chooses to contract with a Southern supplier, contracts are considered as incomplete. Building on the seminal work of Williamson (1985) and Grossman and Hart (1986), the presence of incomplete contracts creates hold-up problems, which in turn give rise to suboptimal relationship-specific investments by the parties involved in an international transaction. This leads to suboptimal prices and higher profit margins. A key mechanism is that the profitability of offshoring is not directly related to the level of prices under incomplete contracts. Thus, as trade is liberalized, offshoring may become profitable for some firms even if it corresponds to an increase in prices. If the lower Southern cost of labor is not sufficient to overcome the higher costs associated with international contractual incompleteness, the relocation process leads to a higher "average price" which is detrimental to consumers' (workers') welfare. Hence, the crux of our analysis is that, contrary to the existing literature, trade liberalization can lower consumer welfare in both countries.

In our model, firms are heterogeneous in terms of supplier's component intensity (i.e. the fraction of the inputs involved in the production that can potentially be offshored).[7] For component-intensive firms, the benefits associated with lower wages in the South tend to outweigh the distortions from contractual incompleteness. As in Antràs (2003) and Antràs and Helpman (2004), the relative importance of the supplier in production also determines the ownership structure, i.e. component-intensive firms prefer outsourcing instead of integration. As we reduce transport costs the number of firms offshoring their production in the South increases. As a result, component-intensive firms offshore first via outsourcing. Then, as trade becomes increasingly free, the less component-intensive firms start to offshore also, but by vertically integrating their supplier. We argue that switching from outsourcing to integration increases production-shifting in the South. This implies more suppliers in the South, such that fewer goods need to be imported there. Moreover, vertical integration limits the price distortion due to the incomplete contracts. In this case, the South should benefit from the change of organization. Strikingly, this is not the case if the costs associated with contractual incompleteness are sufficiently high

[7]Defever and Toubal (2007) provides empirical evidence of heterogeneity among firms in terms of supplier's component intensity.

that firms with a vertically-integrated Southern supplier have a higher price than firms using insourcing. In fact, combined with the greater production-shifting, this implies that a larger number of varieties will be produced in the South at a higher price. Hence, the change of organizational mode is not necessarily beneficial in terms of welfare.

The remainder of this paper is organized as follows. Section 2 introduces the framework of the model and, in particular, develops the contractual setting. Section 3 studies offshoring considering only outsourcing as a possible organizational mode; Section 4 then extends the argument by allowing firms to choose between vertical integration and outsourcing. Finally, Section 5 presents our concluding comments.

2 The Model

2.1 Framework

Consider a world with two countries, North (N) and South (S), and two internationally-immobile factors of production: capital (K) and labor (L). The North is endowed with capital owners and workers, while the South only possesses workers. Workers supply one unit of labor while capitalists own one unit of capital. The utility function of the representative consumer is quasi-linear (in order to abstract from income effects) with upper-tier preferences and CES sub-utility:

$$U^l = C_T^l + \mu \ln C_M^l \ ; \quad C_M^l \equiv \left(\int_{i=0}^{n^w} {c_i}^{\alpha} di \right)^{\frac{1}{\alpha}} \ , \ for \ \ l = N, S \tag{1}$$

where $\alpha \equiv 1 - 1/\sigma$, with $\sigma > 1$ being the elasticity of substitution between varieties. C_T^l and C_M^l are the consumptions of, respectively, the homogenous traditional good (T) and the composite industrial good (M) in country l, n^w is the total number of varieties worldwide, and μ measures the demand for M-goods.

The consumer program is solved in two steps: first, the consumer allocates his total spending between consumption of the M-sector composite good and the traditional good. From (1) we obtain:

$$C_T^l = Y^l - \mu \ ; \ C_M^l = \frac{\mu}{(\Delta^l)^{-(1-\alpha)/\alpha}} \ ; \ \Delta^l \equiv \int_{i=0}^{n^w} p_i^{-\alpha/(1-\alpha)} di \tag{2}$$

where Δ^l is roughly the inverse of the price index and Y^l is nominal income. Then, in a second stage, C_M is allocated between the different varieties. This yields the following

demand for an industrial variety i:

$$c_i^l = \frac{\mu E^l}{\Delta^l} p_i^{-1/(1-\alpha)} \tag{3}$$

where $E^l \equiv L^l + K^l$, stands for endowments, and not for "income" as is usual in the literature. This is because we have assumed quasi-linear preferences which ensure that the consumption of the M-good is independent of nominal income. We denote the share of Northern endowment by $s_E \equiv E^N/(E^N + E^S)$.

Both countries produce both type of goods. The T-sector is perfectly competitive in which a homogeneous good is produced using labor under constant returns to scale. We denote the wage in the North by w^N, and that in the South by w^S. As in Fujita and Thisse (2006) and Antràs and Helpman (2004), we assume that workers in the North are more productive than those in the South in producing traditional goods, which leads in general equilibrium to a constant wage differential between the two countries, denoted by $\omega \equiv w^N/w^S > 1$.

The M-sector uses both labor and capital to design horizontally-differentiated goods. More specifically, starting the production of a new variety requires one unit of capital, so that n^w, the "fixed" total number of firms, equals K^N. Due to a substantial comparative advantage in headquarters' activities, we consider that all headquarters are located in the North.[8] In addition to the fixed cost, the production of a variety i of the final good requires the use of two inputs. The production function is given by:

$$y_i = {x_h}^{1-z} {x_m}^z . \xi_z \tag{4}$$

where $\xi_z \equiv z^{-z}(1-z)^{-(1-z)}$, x_h is the input produced by the HQ, x_m is the input produced by the supplier M, and z is the share of component provided by the supplier and required to produce the final good. Both inputs require only one unit of labor per unit produced. In the spirit of Williamson (1985), we assume that inputs are relationship-specific such that they have no value outside this particular relationship. To obtain an input, each Headquarter forms a contract with a supplier. The contract includes an allocation of the residual rights and an up-front lump-sum transfer t paid by the Supplier. Considering an

[8] Another argument put forth by Fujita and Thisse (2006) is that co-location externalities between HQs are strong enough to ensure that they are all located in the same country. This hypothesis could also apply in our case.

infinite supply of suppliers in each country, competition among them will ensure that t adjusts in order to make the chosen supplier break even.

The headquarters' input x_h is necessarily produced near the HQ, i.e. in the North.[9] However, Headquarters can choose to obtain the supplier's input x_m from a supplier located either at home (insourcing) or abroad (offshoring). In this latter case, they also choose their organizational mode (vertical integration offshore or outsourcing offshore).[10] When the headquarters chooses to transact with a supplier located in the North, the parties can always appeal to an outside party to enforce an ex-ante contract. Alternatively, Headquarters can transact with a Southern supplier, but the parties cannot write enforceable contracts contingent on the quantity of inputs at a specific price: this reflects the fact that protection of property rights is weak in the South. In this latter case, after the inputs have been produced, i.e ex-post, the two parties will bargain over the surplus of the relationship. Since the two parties renegotiate ex-post and the value of the inputs are nil outside the relationship, this creates a *hold-up problem*. We assume that Generalized Nash Bargaining leaves the HQ with a share $\beta \in [0, 1]$ of the revenues. The location of the supplier and the organizational form are chosen ex ante by the HQ to maximize profit.

We assume that the headquarters' input is freely transferred between countries.[11] Thus, if the supplier M is located in the South, x_h can be sent there costlessly. The final good is then sold to both countries from where the supplier is located: selling abroad incurs an Iceberg transport cost, i.e. $\tau > 1$ units of the good have to be sent abroad to effectively sell one unit there. Appendix A provide a general picture of the model.

We also introduce *heterogeneity* at the firm level: firms will produce final goods that embed different levels of component-intensity, something we model as a distribution of z. That is, some final goods will be mainly composed of supplier's input while others will mostly encompass the headquarters' input. Concretely, we assume that z has a cumulative distribution function of $F(z)$. In this framework, entrepreneurs pay the fixed cost (i.e. one

[9] In a related setting, Antràs (2005) assumes that the North has such a productivity advantage in technological activities that x_h will be produced in the North.

[10] In what follows, we distinguish between three organizational forms, i.e. Outsourcing, Vertical integration and Insourcing to which we associate the subscripts O, V and I respectively. We do not attach traditional meanings to the terms "outsourcing " and "integration". Here, it should read "outsourcing offshore" and "integration offshore" instead, that is, the production of the inputs is made by an supplier in a *foreign country*.

[11] We can imagine that headquarters' activities cover everything that is R&D-related, and are as such immaterial and easily transferable. For instance, considering a Nike shoe, the headquarters' input might be a drawing of the shoe to be produced by the supplier. Conversely, the supplier's input concerns the manufacturing and assembly processes.

unit of capital) and then draw their z from this distribution. Contrary to Melitz (2003), there are neither entry nor "beachhead" costs, which means that in equilibrium all firms will be active and sell to both countries.

3 Offshoring using outsourcing

In the short run, firms maximize profits, taking the organizational structure and spatial distribution of all other firms as given. We start by considering only two possible organizational structures: insourcing and outsourcing offshore.

3.1 Profits and Prices

Insourcing Consider first the case where the headquarters decides to deal with a local supplier. As noted earlier, the setting here is one of complete contracts and the HQ simply maximizes its profit by choosing x_h and x_m, which is given from equation (3) and (4) by $\pi_{\mathrm{I}}^{\mathrm{HQ}} = \mu \left(\lambda^{\mathrm{N}}\right)^{1-\alpha} {x_h}^{\alpha(1-z)} {x_m}^{\alpha z} \xi_z^{\alpha} - w^N x_h - w^N x_m$. This yields the following optimal price for the final good:

$$p_{\mathrm{I}} = \frac{w^{\mathrm{N}}}{\alpha} \tag{5}$$

Since the headquarters faces a constant elasticity of demand, the optimal price is equal to a constant mark-up over marginal cost. Hence, the headquarters' ex-ante profits are:

$$\pi_{\mathrm{I}}^{\mathrm{HQ}} = \mu \lambda^{\mathrm{N}} \psi_{\mathrm{I}} \qquad \text{with} \quad \psi_{\mathrm{I}} \equiv (1-\alpha) \left(p_{\mathrm{I}}\right)^{\frac{-\alpha}{1-\alpha}} \tag{6}$$

where λ^{N} corresponds to the demand faced by the Northern firm. It should be noted that, despite the heterogeneity among firms, the headquarters which locate their supplier in the North earn the same profit, as can be seen by the absence of z in (6).

Outsourcing Consider now the profit of a HQ that decides to deal with an independent supplier located in the South. The two parties choose the quantities of inputs non-cooperatively so that their own payoff is maximized. If both firms agree in the bargaining, the potential revenues from the sale of the final good are $Q = py = \mu(\lambda^{\mathrm{N}})^{1-\alpha} {x_h}^{\alpha(1-z)} {x_m}^{\alpha z} \xi_z^{\alpha}$. In contrast, if the parties fail to agree in the bargaining, both are

left with nothing. Going back in time, the headquarters sets x_h to maximize $\beta_o Q - w^{\mathrm{N}} x_h$, while the supplier simultaneously chooses x_m to maximize $(1-\beta_o)Q - w^{\mathrm{S}} x_m$. Using (3) and (4), standard calculations yield the investments in the intermediate inputs. Because the parties fail to capture the full marginal return to their investments in the ex-post bargaining, they underinvest in x_h and x_m. As a result, output is suboptimal and the price is inefficiently high. Combining the two first-order conditions yields the following optimal price for the final good:

$$p_{\mathrm{O}} = \frac{(w^{\mathrm{N}})^{1-z}\,(w^{\mathrm{S}})^{z}}{\alpha(\beta_o)^{1-z}(1-\beta_o)^{z}} \tag{7}$$

It is obvious that the price under outsourcing can be either higher or lower than p_I. For example, if the wage-gap is low, the gains stemming from the lower cost of labor in the South do not compensate for the higher mark-up associated with contractual incompleteness, and $p_{\mathrm{O}} > p_I$. This property will play a significant role in the welfare analysis of Section 3.3.

Recall that ex ante, the supplier pays a transfer of t to the headquarters, which ensures the supplier's participation in the relationship. In equilibrium, the supplier's profit minus the transfer is equal to its ex-ante outside option, i.e. zero. The profit of the headquarters is thus equal to:

$$\pi_{\mathrm{O}}^{\mathrm{HQ}} = \mu \lambda^{\mathrm{S}} \psi_{\mathrm{O}} \qquad \text{with} \quad \psi_{\mathrm{O}} \equiv (1 - \alpha z + \alpha\beta_o(2z-1))\,(p_{\mathrm{O}})^{\frac{-\alpha}{1-\alpha}} \tag{8}$$

with λ^{S} being the Southern demand function. The first term in parentheses represents the profit margin, which is always higher than that under insourcing. Finally, as shown in (8), firms with different z earn different profits, which produces different incentives to locate their supplier in the South.

Demand and prices From (3), and recalling that the final good is sold from where the supplier is located, the demand functions λ^l with $l = N, S$ of representative North- and South-based suppliers are respectively:

$$\lambda^{\mathrm{N}} \equiv \frac{s_E}{\Delta_{\mathrm{IO}}^{\mathrm{N}}} + \phi \frac{1-s_E}{\Delta_{\mathrm{IO}}^{\mathrm{S}}}\,, \qquad \lambda^{\mathrm{S}} \equiv \phi \frac{s_E}{\Delta_{\mathrm{IO}}^{\mathrm{N}}} + \frac{1-s_E}{\Delta_{\mathrm{IO}}^{\mathrm{S}}} \tag{9}$$

where the Δ_{IO}'s encompass the two organizational modes (I, O), and $\phi \equiv \tau^{-\alpha/(1-\alpha)}$ mea-

sures the freeness of trade, with values between $\phi = 0$, for infinite trade costs, and $\phi = 1$ for costless trade.

In standard economic-geography models all firms are identical, and only the number of firms located in the North and in the South is important in determining prices. However, with heterogeneous firms the offshoring of a supplier affects prices in a number of different ways, depending on the component-intensity of the firm (i.e. z). In addition, not all firms have the same incentives to offshore their supplier. It seems intuitive that the firms who find it the most profitable to offshore production are those that have the most to gain from low wages, namely the most component-intensive firms, i.e firms with the highest value of z. However, for a given demand, the profit under outsourcing may fall with z if the wage-gap ω is low and β_o is high. This is easily understood from the price equation under outsourcing in (7), both the numerator and denominator of which may fall with z. [12]

As the main purpose of our model is to examine production offshoring in low-wage countries, it seems reasonable to assume a sufficient wage-gap between the North and the South, so that relocation is mainly driven by the benefits accruing to firms from the lower cost of labor in the South.[13]

Condition 1 $\omega = \frac{w^N}{w^S} \geq \max\left\{\frac{1}{\beta_o}, \frac{1}{1-\beta_o}\right\}$

Lemma 1 *Under Condition 1, the firm that finds it the most profitable to offshore its supplier in the South is the firm that is the most component-intensive (i.e. $z = 1$). The threshold value $\widehat{z}$ is defined as the component-intensity of the firm which is indifferent between offshoring and insourcing. All firms with $z < \widehat{z}$ remain in the North using insourcing.*

Proof 1 *See Appendix B.1*

Lemma (1) allows us to identify the component-intensity of firms which have already offshored (using Outsourcing) and those which have not (using Insourcing) in order to

[12] The intuition behind this effect comes from the presence of two opposing forces: on the one hand, we know that the supplier tends to underinvest, especially when β_o is high. This distortion is more severe when z is high, because the higher is z, the greater the contribution of the supplier to production. On the other hand, the higher is z, the larger the share of production the HQ can delocate to the South to benefit from the lower cost of labor. Hence, for a given β_o, when the wage-gap between the two countries is substantial, the latter effect dominates and profit increases in z.

[13] In a dynamic setting, Antràs (2005) analyzes the case where β_o is high and the wage gap is sufficiently low to ensure that π_O falls in z. Considering a product-cycle, firms decide to relocate their production when their product is sufficiently standardized. The ensuing sequence of relocation is mainly driven by firms' minimization of the inefficiency associated with incomplete contracting.

determine the Northern and Southern Δ:

$$\begin{aligned}\Delta_{\mathrm{IO}}^{\mathrm{N}} &= P_{\mathrm{I}}(\widehat{z}) + \phi P_o(\widehat{z}) = \int_0^{\widehat{z}} (p_{\mathrm{I}})^{\frac{-\alpha}{1-\alpha}} dF(z) + \phi \int_{\widehat{z}}^1 (p_o)^{\frac{-\alpha}{1-\alpha}} dF(z) \\ \Delta_{\mathrm{IO}}^{\mathrm{S}} &= \phi P_{\mathrm{I}}(\widehat{z}) + P_o(\widehat{z}) = \phi \int_0^{\widehat{z}} (p_{\mathrm{I}})^{\frac{-\alpha}{1-\alpha}} dF(z) + \int_{\widehat{z}}^1 (p_o)^{\frac{-\alpha}{1-\alpha}} dF(z)\end{aligned} \tag{10}$$

In the first expression, P_{I} represents the varieties produced in the North and sold in the North, while P_o reflects the varieties produced in the South and sold in the North. The second expression is the analogy for the South.

3.2 Equilibrium

Each headquarter chooses the location of its supplier by comparing its profit under insourcing to that under outsourcing and, in the long run, the spatial distribution of suppliers is such that no firm has an incentive to change the location of its supplier. Using equations (5)-(9), the profit gap can then be written as $\Lambda_\pi^{IO}(z, \widehat{z}) \equiv \pi_I(\widehat{z}) - \pi_{\mathrm{O}}(z, \widehat{z})$:

$$\Lambda_\pi^{\mathrm{IO}}(z, \widehat{z}) = \mu \left[\frac{s_E}{\Delta_{\mathrm{IO}}^{\mathrm{N}}(\widehat{z})} (\psi_I - \phi\psi_{\mathrm{O}}) + \frac{1 - s_E}{\Delta_{\mathrm{IO}}^{\mathrm{S}}(\widehat{z})} (\phi\psi_I - \psi_{\mathrm{O}}) \right] \tag{11}$$

Note the presence of both z and $\widehat{z}$ in (11): firm profits depend on both its z and the $z's$ of the other firms that have already offshored their suppliers.[14]

To find the threshold, we solve the following condition for the marginal firm (i.e. the firm that is indifferent between moving and staying): $\Lambda_\pi^{\mathrm{IO}}(\widehat{z}) = 0$. This gives us the location function, namely, $\widehat{z}$ as a function of the parameters. To this end, we need to find the Δ's. In order to solve the integrals in (10), we have to specify the shape of the probability function. Concretely, we assume that z follows a continuous uniform distribution over $[0, 1]$.[15] Since the support interval for the mass of firms is the same as the support interval for the distribution of the $z's$, $\hat{z}$ thus also represents the total number of firms in the North. The introduction of heterogeneous firms and incomplete contracts does not produce a simple analytical location function. The location function is actually a transcendental equation in $\widehat{z}$, which precludes obtaining closed-form solutions. However, we would be able to derive

[14] Note that since firms are atomistic, the first firm to relocate has no impact on prices, and since they are myopic they do not consider the impact of their relocation on prices.

[15] We choose a uniform distribution due to its essential "fractal" property, i.e. any fraction of a uniform distribution is also uniform. The use of the more standard Pareto distribution (which also has this fractal property) would have rendered the calculation of prices intractable, which are essential for the welfare analysis in Section 3.3.

our key results on consumer's welfare without resorting to numerical simulations.

Our framework remains, in essence, similar to that of Fujita and Thisse (2006). The pattern of agglomeration is thus very rich since it depends on the interplay between ω and s_E. Two typical agglomeration patterns result, as shown in figure 1. Whenever the Home-Market Effect is strong enough to offset the cost disadvantage, i.e. s_E is high and ω is low, the North attracts firms as trade becomes freer but trade costs remain high; as trade is further liberalized, suppliers locate in the South. Whenever wages are much lower in the South, so that wage-gap is large, firms steadily and gradually offshore their suppliers in the South, even when trade costs are high. In what follows, we focus for simplicity's sake on the case where firms always gradually shift their production in the South and never agglomerate in the North:

Condition 2 *ω is high enough and s_E is low enough such that, for any value of ϕ, $\frac{d\hat{z}}{d\phi} < 0$*

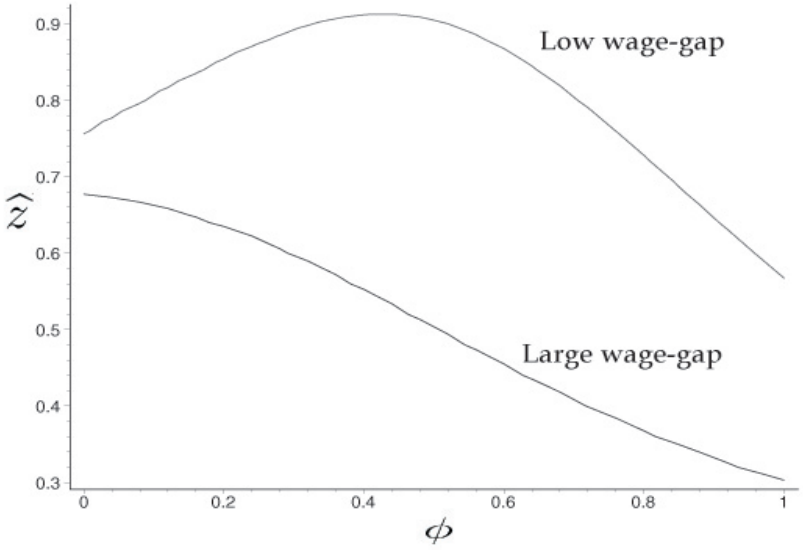


Figure 1: The two patterns of the location function

3.3 Comparing Northern and Southern welfare

As nominal wages are independent of the location of suppliers, and as the number of firms (varieties) is fixed, the changes in consumer welfare result only from changes in national prices. As the South is only composed of workers (consumers), movements in Southern

welfare are only driven by changes in Southern prices. In the North, there are both capital owners and workers, but we will focus on the analysis of workers' welfare. We use $\Delta_{\text{IO}}^{\text{N}}$ and $\Delta_{\text{IO}}^{\text{S}}$ as indirect measures of the Northern and Southern consumer's welfare: an increase of the price index, which reduces the Δ's, is detrimental to welfare. In order to tidy up the results, we set $w^N = \alpha$ and $w^S = \alpha/\omega$ in the following calculations.

Trade liberalization has three effects on Northern and Southern welfare. First, an increase in ϕ obviously increases the welfare of both countries since it lowers the cost of importing foreign goods. Second, firms offshore in the South, which is detrimental for the North as more goods need to be imported, and beneficial for the South for the same reason. This effect is of course all the stronger with higher trade costs. These two effects are standard in economic-geography models. Finally, the third effect stems from incomplete contracts: since the price under outsourcing can be higher or lower than the insourcing price, the "average price" (excluding trade costs) of varieties might increase as firms offshore in the South.

Formally, the interplay of these different forces can be evaluated by totally differentiating the Δ's. For a Southern worker, this yields:

$$\frac{d\Delta^{\text{S}}}{d\phi} = \hat{z} + \frac{d\hat{z}}{d\phi}\left[\phi - \left(\omega^{\hat{z}}(1-\beta_o)^{\hat{z}}(\beta_o)^{1-\hat{z}}\right)^{\frac{\alpha}{1-\alpha}}\right] \tag{12}$$

Note first that trade liberalization is more likely to increase Southern welfare if $\hat{z}$ is high, that is if there are a lot of firms in the North. This is logical and reflects the first effect alluded to in the previous paragraph. The second term (i.e. $\phi.d\hat{z}/d\phi$) corresponds to the second effect and is negative, and all the more so that ϕ is high: this tells us that an additional supplier offshored becomes less and less beneficial for the South as trade is liberalized. The term inside square brackets is equivalent to $\phi(p_I)^{-\alpha/(1-\alpha)} - (p_{\text{O}})^{-\alpha/(1-\alpha)}$.[16] This shows the impact of an additional supplier offshored on local prices. If this is positive, then even though Southern consumers benefit from not having to import the newly-relocated variety, they pay a higher price to buy it (excluding trade costs). This is so if and only if $(p_I)^{\alpha/(1-\alpha)}/\phi < p_{\text{O}}^{\alpha/(1-\alpha)}$. In that case, as firms offshore in the South, local prices rise and welfare falls. This is all the more true with higher ϕ. Further, note that p_{O} is decreasing in $\hat{z}$ under Condition 1: the gap between p_I and p_{O} rises as firms relocate in the South.

[16] As we have set $w^N = \alpha$ and $w^S = \alpha/\omega$ in the calculations.

Regarding Northern welfare, differentiation gives us:

$$\frac{d\Delta^{\mathrm{N}}}{d\phi} = P_o(\hat{z}) + \frac{d\hat{z}}{d\phi}\left[1 - \phi\left(\omega^{\hat{z}}(1-\beta_o)^{\hat{z}}(\beta_o)^{1-\hat{z}}\right)^{\frac{\alpha}{1-\alpha}}\right] \tag{13}$$

There are two main differences from the previous analysis of Southern welfare. First, since $P_o(\hat{z})$ is a decreasing function of $\hat{z}$, trade liberalization is now more likely to decrease Northern welfare when $\hat{z}$ is high. Second, the term inside square brackets, which is equivalent to $(p_I)^{-\alpha/(1-\alpha)} - \phi(p_{\mathrm{O}})^{-\alpha/(1-\alpha)}$, shows that Northern welfare is more likely to fall with trade liberalization when trade costs are high: as in (12), the term inside square brackets shows the impact of an increase in the number of suppliers offshored in the South on local prices. Hence, Northern consumers will only benefit from such an increase if the price of the newly-located firm is low enough to compensate for the trade costs: formally, this holds if and only if $\phi(p_I)^{-\alpha/(1-\alpha)} > p_{\mathrm{O}}^{-\alpha/(1-\alpha)}$.

As trade costs fall and the number of firms which offshore in the South rises, the strength of the different effects listed above change. As trade becomes perfectly free, note that the location of firms becomes irrelevant, and, as such, the two countries' welfare levels converge. In this case, the key determinant of welfare is the tension between the lower cost of labor in the South and contractual incompleteness. The following proposition summarizes:

Proposition 1 *Trade liberalization is likely to be welfare-reducing for both Southern and Northern workers if the wage-gap is not high enough to offset the costs associated with contractual incompleteness. This is all the more true if trade is free.*

Two comments are in order with respect to Proposition 1. First, we assume that the nominal wage is independent of the firms' location choice and that the number of firms is fixed. With these simplifications, we abstract from other potential consumers' welfare gains, such as an increase in the number of varieties available or an increase of the nominal wage associated with the globalization process. Nevertheless, even if we had integrated these additional effects, the welfare analysis would still balance the positive gains of the trade liberalization with the distortion associated with the contracts' incompleteness. Secondly, our study does not argue against trade liberalization. In fact, our model is silent about the impact of globalization on the aggregate welfare. We only argue that it may negatively affect the real labor income. When profits generate by firms are only marginally

distributed to the workers, it is a direct measure of consumers' welfare. This is the case in our model, as we assume that firms' profits are completely allocated to capital owners.

3.4 Benchmark scenario with complete contracts.

To highlight the implications of contract incompleteness, we now present a scenario with complete contracts in both the North and the South. In this case, firms are more likely to offshore in the South as they can beneficiate from low wages without being affected by the contract incompleteness. However, firms still face the trade-off between low wages in the South and being close to the biggest market, the North, to avoid paying too much trade cost. As in the incomplete contract case, the firm that finds it the most profitable to offshore its supplier in the South is the firm that is the most component-intensive (i.e. $z = 1$). All firms with z below a certain threshold value remain in the North.

When contracts are complete in both the North and the South, the price in the North remains equal to $p_{\mathrm{I}} = \frac{w^{\mathrm{N}}}{\alpha}$, as in equation (5), while the price in the South, which where previously given by (7), is now equal to $p_{\mathrm{O}} = \frac{\left(w^{\mathrm{N}}\right)^{1-z}\left(w^{\mathrm{S}}\right)^{z}}{\alpha}$. For simplification, we continue to set $w^N = \alpha$ and $w^S = \alpha/\omega$ in the following calculations. Thus, when contracts are complete in both countries, equation (12) become:

$$\frac{d\Delta^{\mathrm{S}}}{d\phi} = \hat{z} + \frac{d\hat{z}}{d\phi}\left[\phi - \left(\omega^{\hat{z}}\right)^{\frac{\alpha}{1-\alpha}}\right] \tag{14}$$

As previously mentioned, the term inside square brackets is equivalent to $\phi(p_I)^{-\alpha/(1-\alpha)} - (p_{\mathrm{O}})^{-\alpha/(1-\alpha)}$. However, under complete contracts, p_I is now always higher than p_{O}. Thus, the term under bracket is always negative and equation (14) always positif. We can conclude that under complete contracts, the South consumers always benefit from the trade liberalization. This result contrasts with our result previously highlighted in the Proposition 1.

As under incomplete contracts, the Northern welfare is ambiguous and depends of the value of ϕ:

$$\frac{d\Delta^{\mathrm{N}}}{d\phi} = P_o(\hat{z}) + \frac{d\hat{z}}{d\phi}\left[1 - \phi\left(\omega^{\hat{z}}\right)^{\frac{\alpha}{1-\alpha}}\right] \tag{15}$$

The term inside square brackets is equivalent to $(p_I)^{-\alpha/(1-\alpha)} - \phi(p_{\mathrm{O}})^{-\alpha/(1-\alpha)}$. As under incomplete contacts, the term under bracket is negative for high trade costs (low value of ϕ), implying that the North beneficiate from lowering trade barriers for high trade costs. However, the term does not integrate anymore the negative welfare effect associate with

the price distortion.

4 Offshoring and the change in organization

We now introduce a third type of possible organization mode, which consists in the vertical integration of a Southern supplier. Conditions 1 and 2 continue to apply.

4.1 Profits and Prices

Vertical Integration Following the property-rights approach to the firm developed by Grossman and Hart (1986) and Hart and Moore (1990), ex-post bargaining will take place under both outsourcing and integration. However, the distribution of surplus is sensitive to the mode of organization. As in Antràs (2003) and Antràs and Helpman (2004), we assume that the HQ will obtain a greater share of the surplus under vertical integration than under outsourcing, i.e. $\beta_v > \beta_o$.

The headquarters maximizes $\beta_v Q - w^N x_h$ by its choice of x_h, whereas the supplier at the same time chooses x_m to maximize $(1-\beta_v)Q - w^S x_m$. Combining the first-order conditions of these two programs yields the following optimal price:

$$p_{\mathrm{V}} = \frac{(w^{\mathrm{N}})^{1-z}\,(w^{\mathrm{S}})^{z}}{\alpha(\beta_v)^{1-z}(1-\beta_v)^{z}} \tag{16}$$

Setting t so as to make the integrated manufacturing plant break even leads to the following operating profits for the HQ:

$$\pi_{\mathrm{V}}^{\mathrm{HQ}} = \mu\lambda^{\mathrm{S}}\psi_{\mathrm{V}} \quad \text{with} \quad \psi_{\mathrm{V}} \equiv (1-\alpha z+\alpha\beta_v(2z-1))\,(p_{\mathrm{V}})^{\frac{-\alpha}{1-\alpha}} \tag{17}$$

Demand and prices The demand function λ^k with $l = N, S$ is analogous to that in equation (9), with $\Delta^{\mathrm{N}}_{\mathrm{IOV}}$ and $\Delta^{\mathrm{S}}_{\mathrm{IOV}}$ replacing $\Delta^{\mathrm{N}}_{\mathrm{IO}}$ and $\Delta^{\mathrm{S}}_{\mathrm{IO}}$, since the Δ's now encompass the three organizational modes (I, O, V). When considering both vertical integration and outsourcing, we compare $\pi_{\mathrm{O}}^{\mathrm{HQ}}$ and $\pi_{\mathrm{V}}^{\mathrm{HQ}}$ in order to determine the firm's organizational choice depending on its component-intensity. Comparing $\pi_{\mathrm{O}}^{\mathrm{HQ}}$ and $\pi_{\mathrm{V}}^{\mathrm{HQ}}$ for a given level of demand yields the combinations of parameters so that Headquarters is indifferent between the two modes:

$$\Theta \equiv \frac{\pi_{\mathrm{V}}^{\mathrm{HQ}}}{\pi_{\mathrm{O}}^{\mathrm{HQ}}} = \frac{1-\alpha z+\alpha\beta_v(2z-1)}{1-\alpha z+\alpha\beta_o(2z-1)}\left(\frac{(\beta_v)^{1-z}(1-\beta_v)^{z}}{(\beta_o)^{1-z}(1-\beta_o)^{z}}\right)^{\frac{\alpha}{1-\alpha}} = 1 \tag{18}$$

Equation (18) thus implicitly defines a unique value of z, $\overline{z}$, "the cutoff", which is the component-intensity of the firm which is indifferent between outsourcing and integration. A key result is that the cutoff value of z is independent of the respective size of the two countries, their respective costs of labor, and the level of integration between these countries. As shown by Antràs (2003), $\partial\Theta/\partial z < 0$. Hence, whenever $z < \overline{z}$, vertical integration is preferred, while for $z > \overline{z}$ firms prefer to outsource their production. The economic rationale is the following: it is optimal to give the residual rights of control to the party which undertakes the highest ex-ante investment. For instance, if z is high, the final good is composed mainly of the supplier's input, so the supplier is allocated the residual rights of control and outsourcing is chosen. Furthermore, we henceforth assume:[17]

Condition 3 $\beta_v = 1 - \beta_o$

Plugging this equality into (18) shows that the cutoff is now explicitly determined, as summarized in the following proposition:

Lemma 2 *Under Condition 3, the cutoff always takes on the value* $\overline{z} = 1/2$. *In addition, under Condition 1, for a given level of demand, profits under Vertical integration and outsourcing are monotonically increasing in* z. *Hence, all firms with* $z < \widehat{z}$ *remain in the North using insourcing. Firms with* $z > \overline{z} = 1/2$ *find it the most profitable to offshore and will use outsourcing. When the number of firms which offshore is high, i.e.* $\widehat{z} < \overline{z}$, *firms with* $z < \overline{z} = 1/2$ *offshore using integration.*

Proof 2 *See Appendix B.2*

Lemma (2) allows us to obtain a constant "cutoff" $\overline{z} = 1/2$. This simplification will help us to compute the price index (see below). It also permits to clearly identify the impact of the change in organization on firm' price (mark-up). The following proposition compares the price for value of z below the cutoff, where firms are not allowed to integrate their supplier (outsourcing-only world) and where they can.

Proposition 2 *Under condition (3), when the number of firms which offshore is high, i.e.* $\widehat{z} < \overline{z}$, *Vertical integration leads to a lower price as compared to outsourcing. Vertical integration alleviates the price (mark-up) distortion associate with contract incompleteness, as compared to an outsourcing-only world.*

[17] Our results do not fundamentally depend on this assumption. It is only made for convenience since it will allow us to obtain some analytical results in the equilibrium analysis ***(see also footnote)***.

Proof 3 *See Appendix B.3*

Lemma (2) allows us to identify prices when the marginal firm which is just indifferent between the North and the South (i.e. $z = \hat{z}$) has a lower z than the cut-off i.e. $\overline{z}$, and as such chooses to integrate its supplier. Meanwhile, the firms that have chosen to outsource their production (i.e. $z > \overline{z}$) continue to do so. The Northern and Southern deltas can then be written as follows:

$$\begin{aligned}
\Delta^{\mathrm{N}}_{\mathrm{IOV}} &= P_{\mathrm{I}}(\widehat{z}) + \phi\left(P_v(\widehat{z},\overline{z}) + P_o(\widehat{z},\overline{z})\right) \qquad (19)\\
&= \int_0^{\widehat{z}} (p_{\mathrm{I}})^{\frac{-\alpha}{1-\alpha}} dF(z) + \phi\left(\int_{\widehat{z}}^{\overline{z}} (p_v)^{\frac{-\alpha}{1-\alpha}} dF(z) + \int_{\overline{z}}^{1} (p_o)^{\frac{-\alpha}{1-\alpha}} dF(z)\right)\\
\Delta^{\mathrm{S}}_{\mathrm{IOV}} &= \phi P_{\mathrm{I}}(\widehat{z}) + \left(P_v(\widehat{z},\overline{z}) + P_o(\widehat{z},\overline{z})\right) \qquad (20)\\
&= \phi\int_0^{\widehat{z}} (p_{\mathrm{I}})^{\frac{-\alpha}{1-\alpha}} dF(z) + \left(\int_{\widehat{z}}^{\overline{z}} (p_v)^{\frac{-\alpha}{1-\alpha}} dF(z) + \int_{\overline{z}}^{1} (p_o)^{\frac{-\alpha}{1-\alpha}} dF(z)\right)
\end{aligned}$$

where $P_v(\widehat{z},\overline{z})$ represents the varieties produced in the South under vertical integration, and $P_o(\widehat{z},\overline{z})$ represents the varieties that are produced under Outsourcing.[18]

4.2 Equilibrium

The headquarters chooses both the location of its supplier and its mode of organization, and in the long run the spatial distribution of suppliers is such that no firm has an incentive to change the location of its supplier or its mode of organization. At first, outsourcing dominates vertical integration, as firms with a high z start to offshore. In this first stage, as in Section 3.1, the headquarters compare their profit under insourcing to that under outsourcing. Using equations (5)-(9), the profit gap in this first stage can be written as $\Lambda^{IO}_{\pi}(z,\widehat{z}) \equiv \pi_I(\widehat{z}) - \pi_{\mathrm{O}}(z,\widehat{z})$:

$$\Lambda^{\mathrm{IO}}_{\pi}(z,\widehat{z}) = \mu\left[\frac{s_E}{\Delta^{\mathrm{N}}_{\mathrm{IO}}(\widehat{z})}\left(\psi_I - \phi\psi_{\mathrm{O}}\right) + \frac{1-s_E}{\Delta^{\mathrm{S}}_{\mathrm{IO}}(\widehat{z})}\left(\phi\psi_I - \psi_{\mathrm{O}}\right)\right] \qquad (21)$$

In the second stage, vertical integration dominates outsourcing: when the cutoff is reached, the firms with a relatively high z which have outsourced their production will continue to do so, while the new firms that offshore choose integration as their mode of organization.

[18] Note that, for $\widehat{z} < \overline{z}$, $P_o(\widehat{z},\overline{z})$ is actually a constant since the number of firms that outsource their production remains constant.

The profit gap in the second stage can then be written as $\Lambda_{\pi}^{IO}(z,\widehat{z}) \equiv \pi_I(\widehat{z}) - \pi_{\mathrm{V}}(z,\widehat{z})$:

$$\Lambda_{\pi}^{\mathrm{IOV}}(z,\widehat{z}) = \mu\left[\frac{s_E}{\Delta_{\mathrm{IOV}}^{\mathrm{N}}(\widehat{z})}\left(\psi_I - \phi\psi_{\mathrm{V}}\right) + \frac{1-s_E}{\Delta_{\mathrm{IOV}}^{\mathrm{S}}(\widehat{z})}\left(\phi\psi_I - \psi_{\mathrm{V}}\right)\right] \tag{22}$$

A critical feature of our model is that the switch between outsourcing and integration depends on the level of integration between the two countries. Even though $\overline{z}$ does not depend on ϕ (see equation 18), this switch occurs for one particular value of trade costs, the "Switch point" [19], ϕ^{SW}. The remainder of the analysis is similar to that in Section 3.1.

4.3 Change in organizational form and the greater production-shifting

In this section, we compare the behavior of two location functions: one where firms are not allowed to integrate their supplier (i.e. $\Lambda_{\pi}^{IO}(\hat{z}) = 0$) and one where they can (i.e. $\Lambda_{\pi}^{IV}(\hat{z}) = 0$), for values of ϕ greater than the switch point (where $\widehat{z} < \overline{z}$). An illustration is provided in Figure 2. We observe that the two location functions are initially identical up to the switch point, after which they diverge, as more suppliers are offshored under integration than under outsourcing. We show that production-shifting in the South is always higher under Condition 3:[20]

Proposition 3 *Under Condition 3, at the cutoff, switching to Vertical integration increases production-shifting in the South, as compared to an outsourcing-only world.*

Proof 4 *See Appendix B.4*

As shown in the Appendix, the greater number of suppliers offshored in the South stems solely from $\partial(\psi_V - \psi_O)/\partial\hat{z}$, that is, from the comparison of firm profits (for a given level of demand) under the two modes of organization as in equation (18). Firms with lower z fare better under vertical integration than under outsourcing, and vice versa. Considering the behavior of a Northern firm in the second stage, it is clear that the firm's incentive to

[19] Note that the term "Switch Point" does not mean that firms switch from one organizational mode to another: it means that, for trade costs lower than the Switch Point, the new firms that relocate their supplier in the South (i.e. as trade becomes freer) will choose integration over outsourcing, whereas the firms that have already relocated their supplier will continue to outsource their production.

[20] We also observe this divergence for a wide range of parameter values in numerical simulations. Nevertheless, considering that β_o and β_v are symmetric around 1/2 simplifies the model and avoids non-linear behavior around the cutoff. Without this assumption, the firm which is indifferent between the two modes of organization has a different price and a different profit margin in the two modes, which complicates the comparison between the two around the cutoff point. In this case, it is possible to find some configurations of the parameters such that, around the cutoff, the divergence does not take place. However, as we move away from the switch point, the divergence always occurs.

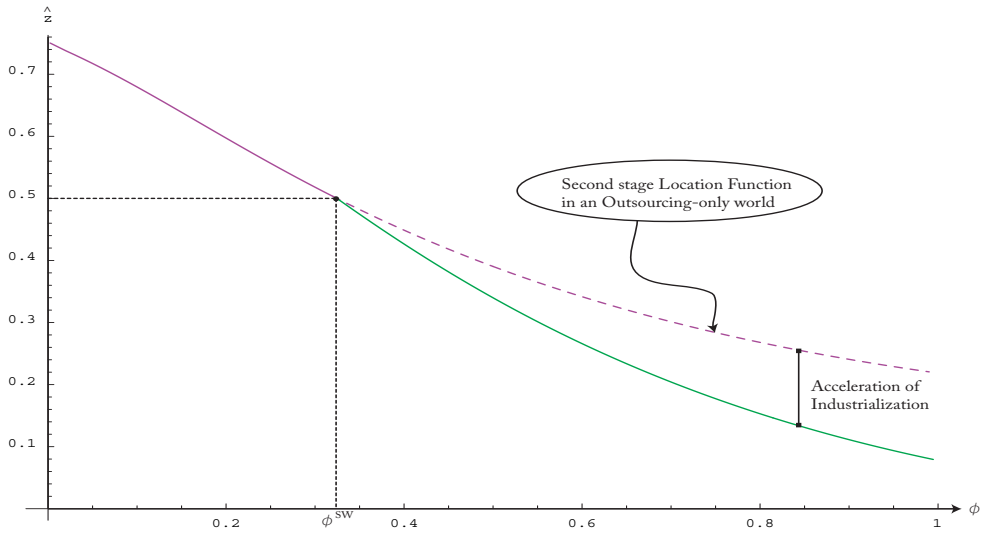


Figure 2: Greater production-shifting in the South under integration

offshore is smaller if it has to outsource its production than if it can internalize it, as its shadow Southern profit is smaller in the first case. This is all the more true with a lower value of z. Thus, for a given value of trade costs, the marginal firm which offshores has a smaller z than in an outsourcing-only world, because in that world this same firm would find it more profitable to remain in the North.

This feature of the model shows that, *a priori*, the South should welcome further integration, not only for the standard reason that it magnifies its comparative advantage compared to the size-advantage of the other country, but also because, after the switch point, the firms that offshore switch to integration so that production-shifting in the South increases, which would appear beneficial. The next section nuances this first impression by investigating how the welfare of both countries changes with trade liberalization.

4.4 Is Vertical integration welfare-enhancing?

It is of interest to examine in greater depth the impact of trade liberalization on the relationship between Southern welfare and mode of organization. In particular, we would like to know whether, after the Switch Point, the welfare of Southern workers under integration is higher than that under outsourcing-only. We thus consider the *welfare-gap*, i.e. $\Delta^{S}_{IOV} - \Delta^{S}_{IO}$, as trade is liberalized.

We first focus on Southern welfare. As shown above, vertical integration and outsourcing have different characteristics. First, integration increases the shift of production to

the South, which should be beneficial for Southern workers since, for a given level of trade costs, fewer goods are produced abroad (see Proposition 3). Further, when the cutoff is reached, i.e. $\widehat{z} < 1/2$, the price of individual varieties under vertical integration is lower than that under outsourcing (see Proposition 2). This should also benefit the South (as well as the North). However, a small wage-gap, $p_I < p_{\mathrm{V}}$, combined with the increase in production-shifting, implies that a greater number of varieties are now produced in the South at a higher price. This is detrimental for welfare since the average price of varieties is then higher. Formally, these forces can again be demonstrated by totally differentiating the Δ's under the two modes of organization and calculating the gap:

$$\frac{d\Delta^{\mathrm{S}}_{\mathrm{IOV}}}{d\phi} - \frac{d\Delta^{\mathrm{S}}_{\mathrm{IO}}}{d\phi} = (\hat{z}_{\mathrm{V}} - \hat{z}_{\mathrm{O}}) + \phi\left(\left.\frac{d\hat{z}}{d\phi}\right|_{\mathrm{V}} - \left.\frac{d\hat{z}}{d\phi}\right|_{\mathrm{O}}\right) + \left(\left.\frac{\partial P_v}{\partial \hat{z}}\frac{d\hat{z}}{d\phi}\right|_{\mathrm{V}} - \left.\frac{\partial P_o}{\partial \hat{z}}\frac{d\hat{z}}{d\phi}\right|_{\mathrm{O}}\right) \tag{23}$$

where $\hat{z}_{\mathrm{V}}$ and $\hat{z}_{\mathrm{O}}$ represent the number of firms in the North associated with the $\Lambda^{\mathrm{IV}}_{\pi} = 0$ and $\Lambda^{\mathrm{IO}}_{\pi} = 0$ location functions respectively. As we move away from the switch point, $\hat{z}_{\mathrm{V}}$ becomes smaller than $\hat{z}_{\mathrm{O}}$ (i.e. there are more Northern firms in an outsourcing-only world). The first term in (23) is thus negative because the more firms there are in the North, the more beneficial is a given rise in ϕ. The second term is also negative, since the higher is ϕ the less beneficial is an increase in the number of Southern suppliers. That is, the increase in production-shifting is less beneficial for the South with lower trade costs. The last term is positive (since $\partial P_v/\partial\hat{z} < \partial P_o/\partial\hat{z}$) and represents the gains associated with the lower price under vertical integration compared to outsourcing.[21] Finally, if the latter term outweighs the first two negative terms, the expression in (23) is positive, so that the welfare-gap rises with ϕ. Moreover, the three terms do not change in the same way with ϕ, which means that trade liberalization has a non-monotonic impact on the welfare-gap.

We now focus on the welfare-gap around the cutoff (bearing in mind that the welfare-gap is zero at the cutoff point). This simplifies the previous analysis and aids our intuition. By definition, $\hat{z}_{\mathrm{V}} = \hat{z}_{\mathrm{O}} = \bar{z} = 1/2$; moreover, as we show in Appendix B.4, $\partial P_v/\partial\hat{z} =$

[21] The impact of β_o on the welfare-gap is non-monotonic, since it reflects two separate effects. First, switching from outsourcing to integration lowers the price of the marginal variety: comparing p_{V} and p_{O} shows that the gap between the two falls with β_o, so the switch is all the more beneficial when β_o is lower. Second, under integration, there are more Southern firms with price p_{V} which may be higher than p_I: if $p_{\mathrm{V}} > p_I$ and $\hat{z}_{\mathrm{V}} > \hat{z}_{\mathrm{O}}$, the average price of the Southern consumer basket is higher under integration; with lower β_o the price of a Northern variety is much less than the price of a Southern variety, so that the second effect may well offset the first.

$\partial P_o/\partial \hat{z}$ around the cutoff level. Thus, (23) reduces to:

$$\left(\frac{d\Delta^{\mathrm{S}}_{\mathrm{IOV}}}{d\phi} - \frac{d\Delta^{\mathrm{S}}_{\mathrm{IO}}}{d\phi}\right)\Bigg|_{\hat{z}=1/2} = \left(\left.\frac{d\hat{z}}{d\phi}\right|_{\mathrm{V}} - \left.\frac{d\hat{z}}{d\phi}\right|_{\mathrm{O}}\right)\left(\phi^{\mathrm{SW}} - (\omega\beta_o(1-\beta_o))^{\frac{\alpha}{2(1-\alpha)}}\right)$$

The first term is simply the increase in production-shifting associated with the switch from outsourcing to integration as discussed in Section 4.3; as such, this term is negative, so that a given marginal increase in ϕ leads to more suppliers being offshored under integration than under outsourcing. The sign of the second term is more complicated. This represents the impact of a change in $\hat{z}$ (i.e. a new Southern location) on Southern prices.[22] Since $p_{\mathrm{V}} = p_{\mathrm{O}}$ around the cutoff, the sole impact of an additional Southern supplier comes from the change in the price of the marginal firm, namely, from p^N to p^S. Of course, the greater the wage-gap, the lower the price of a Southern compared to a Northern variety. Moreover, it can be checked that the gap between the price of a Northern and Southern variety falls with β_o. That is, with lower β_o the costs from contractual incompleteness are higher so that an additional Southern supplier might increase prices. In this case, the switch from outsourcing to integration reduces welfare as it increases production-shifting in the South. Also, as the second term rises with ϕ^{SW}, the switch is more likely to be welfare-reducing if it occurs at low trade costs.

The analysis of the Northern welfare-gap is similar, except that the increase in production-shifting is beneficial for the South and detrimental to the North (everything else equal, Northern consumers import more goods under integration). This effect will of course tend to disappear as trade becomes increasingly costless, so that the two welfare-gaps converge. The next proposition brings together these results:

Proposition 4 *The switch from outsourcing to vertical integration can be welfare reducing for both Southern and Northern workers if the wage-gap is not high enough to offset the costs associated with contractual incompleteness. This is all the more likely as trade becomes freer.*

5 Conclusion

This paper has introduced both incomplete contracts and heterogeneous firms in terms of component-intensity into an economic-geography framework. We have investigated the

[22] Actually, the inverse of the price index.

trade-offs faced by firms deciding whether to shift a part of production abroad and whether to integrate its supplier. We show that, as trade is liberalized, firms shift their production to the South using outsourcing; as trade becomes even freer, new firms offshore in the South, but prefer to integrate their suppliers.

Regarding consumer welfare, we show that trade liberalization does not necessarily enhance the welfare of the country where the number of firms rises: if the costs associated with contractual incompleteness are substantial, and offset the gains associated with lower labor-costs, the price of a Southern variety is higher than the price of a Northern variety. In this case, as trade is liberalized and firms relocate in the South, the average price of the consumer basket increases, which is detrimental for consumer welfare in both the North and the South.

Finally, we have also shown that switching from outsourcing to integration increases production-shifting in the low-wage country. Additionally, the price of a given variety produced under vertical integration is lower than that under outsourcing. *A priori*, these reasons should be sufficient to convince backward countries of the advantages emanating from further trade liberalization, since this should be beneficial for them. However, our analysis suggests that the outcome is actually not that clear-cut since, as trade becomes freer, the switch in organization might actually decrease both Northern and Southern welfare.

Over the last decade, the number of regional agreements between developed and less-developed countries has increased rapidly. The two best-known cases of regionalism are undoubtedly the European Union (EU) system and the North American Foreign Trade Agreement (NAFTA). These two types of integration are very different however. The EU does not only concern a reduction in trade barriers: its scope is much wider since it also includes a variety of institutional criteria that all countries should adhere to. Our results underline the importance of such institutional convergence, notably in terms of the quality of the judicial system, since this can alleviate the costs associated with international contractual incompleteness. Further research is required to draw out more precisely the links between economic integration, institutional reform and consumer welfare.

References

Aghion, P. and J. Tirole (1997). Formal and real authority in organizations. *Journal of Political Economy 105*(1), 1–29.

Antràs, P. (2003). Firms, contracts, and trade structure. *Quarterly Journal of Economics 118*(4), 1375–1418.

Antràs, P. (2005). Incomplete contracts and the product cycle. *American Economic Review 95*(4), 1054–1073.

Antràs, P. and A. Costinot (forthocming 2011). Intermediated trade. *Quarterly Journal of Economics*.

Antràs, P. and E. Helpman (2004). Global sourcing. *Journal of Political Economy 112*(3), 552–580.

Boulhol, H. (2008). The convergence of price–cost margins. *Open Economies Review 19*(2), 221–240.

Conconi, P., P. Legros, and A. Newman (2009). Trade liberalization and organizational change. *CEPR Discussion Paper* (No. 7028).

Defever, F. and F. Toubal (2007). Productivity and the sourcing modes of multinational firms: Evidence from french firm-level data. *CEP Discussion Papers 842*.

Dixit, A. K. and J. Stiglitz (1977). Monopolistic competition and optimum product diversity. *American Economic Review 67*(3), 297–308.

Egger, H. and P. Egger (2004). On the relationship between international outsourcing and price–cost margins in european industries. *Review of Industrial Organization 25*(1), 45–69.

Fujita, M. and J.-F. Thisse (2006). Globalization and the evolution of the supply chain: Who gains and who loses? *International Economic Review 47*(3), 811–836.

Grossman, G. and E. Helpman (2002). Integration versus outsourcing in industry equilibrium. *Quarterly Journal of Economics 117*, 85–120.

Grossman, G. and E. Helpman (2004). Managerial incentives and the international organization of production. *Journal of International Economics 63*(2), 237–262.

Grossman, S. J. and O. D. Hart (1986). The costs and benefits of ownership: A theory of vertical and lateral integration. *Journal of Political Economy 94*(4), 691–719.

Halpern, L. and M. Koren (2007). Pricing to firm: an analysis of firm- and product-level import prices. *Review of International Economics 15*(3), 574–591.

Hart, O. and J. Moore (1990). Property rights and the nature of the firm. *Journal of Political Economy 98*(6), 1119–1158.

Helpman, E. (2006). Trade, fdi, and the organization of firms. *Journal of Economic Literature 44*(3), 589–630.

Holmstrom, B. and P. Milgrom (1994). The firm as an incentive system. *American Economic Review 84*, 972–991.

Kamin, S. B., M. Marazzi, and J. W. Schindler (2006). The impact of chinese exports on global import prices. *Review of International Economics 14*, 179–201.

Krugman, P. (1980). Scale economies, product differentiation, and the pattern of trade. *American Economic Review 70*(5), 950–959.

Melitz, M. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica 71*, 1695–1725.

Mitra, D. and P. Ranjan (2008). Temporary shocks and offshoring: The role of external economies and firm heterogeneity. *Journal of Development Economics 87*(1), 76–84.

Naghavi, A. and G. Ottaviano (2010). Outsourcing, complementary innovations and growth. *Industrial and Corporate Change 19*(4), 10091035.

OECD (2006). Globalisation and inflation in the OECD economies. *Economics Department Working Papers 524*.

Puga, D. and D. Trefler (2002). Knowledge creation and control in organizations. *CEPR Discussion Paper* (3516).

Robert-Nicoud, F. (2008). Offshoring of routine tasks and deindustrialisation: Threat or opportunity -and for whom? *Journal of Urban Economics 63*(2), 517–535.

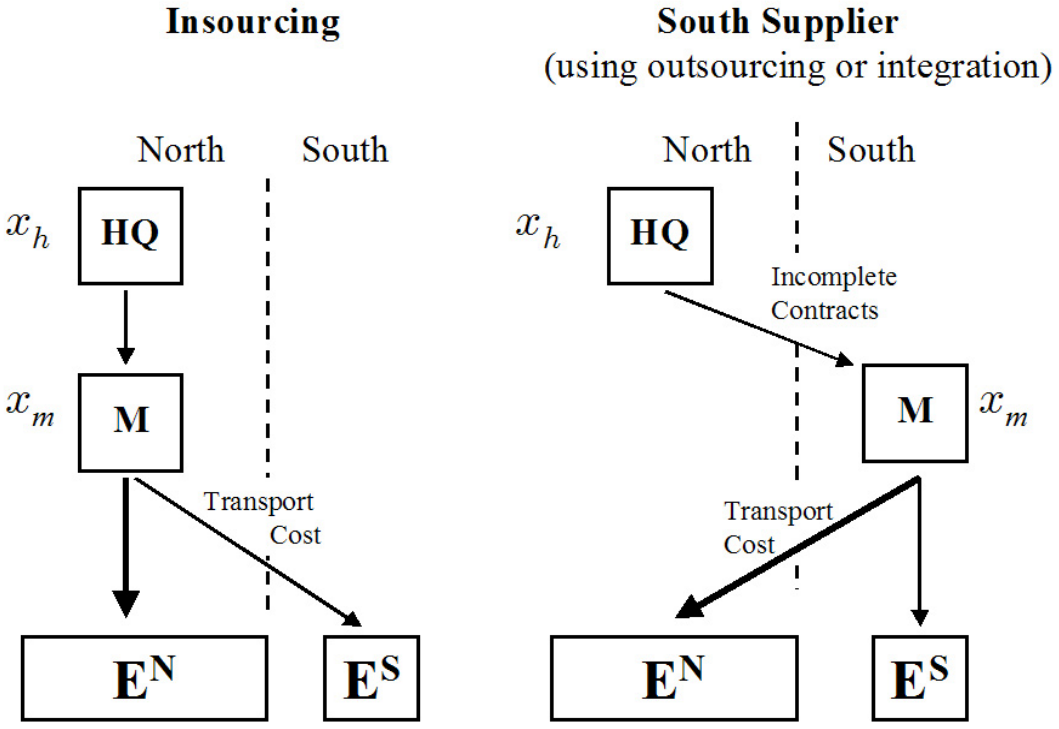
Spencer, B. (2005). International outsourcing and incomplete contracts. *Canadian Journal of Economics 38*(4), 1107–1135.

Verdier, T. and D. Marin (2003). Globalization and the new enterprise. *Journal of the European Economic Association 1(2-3)*, 337–44.

Williamson, O. E. (1985). *The Economic Institutions of Capitalism*. Free Press.

A Appendix: General picture of the model

The Headquarters (HQ) produces an input x_h necessarily in the North. In addition, the production of a final good also requires another input from a supplier M. The HQ can choose to obtain the supplier's input x_m from a supplier located either in the North (insourcing) or in the South (offshoring). In the latter case, the contracts are incomplete and the HQ also chooses an organization mode (vertical integration offshore or outsourcing offshore). The final good is then sold in both the Northern market, E^N, and the Southern market, E^S, from where the supplier is located: selling abroad incurs transport costs.



B Appendix: Technicalities

B.1 Proof of lemma 1

We prove that, under Condition 1, profit under outsourcing always increases in z by computing its partial derivative with respect to z:

$$\frac{\partial \pi_{\mathrm{O}}^{HQ}}{\partial z} = \mu\alpha \left(p_{\mathrm{O}}\right)^{\frac{-\alpha}{1-\alpha}} \left[2\beta_o - 1 - \frac{(1-\alpha z + \alpha\beta_o(2z-1)) \ln\left(\frac{\beta_o}{\omega(1-\beta_o)}\right)}{1-\alpha} \right]$$

Profit under integration increases with z if and only if the term in brackets is positive.

For $\beta_o \in [1/2, 1]$, this is obviously true if $\ln(\beta_o/(\omega(1-\beta_o))) < 0$, that is if $\omega > \beta_o/(1-\beta_o)$. For $\beta_o \in [1/2, 1]$, Condition 1 entails that $\omega \geq \frac{1}{1-\beta_o} > \frac{\beta_o}{1-\beta_o}$. Hence, Condition 1 is sufficient.

For $\beta_o \in [0, 1/2]$, the derivative is increasing in z if and only if $(2\beta_o - 1)(1-\alpha) > (p_{\mathrm{O}})^{\frac{-\alpha}{1-\alpha}} \ln(\beta_o/\omega(1-\beta_o))$. The two sides of the inequalities are both functions of β_o. Let $G(\beta_o)$ be the left-hand side term and $H(\beta_o)$ the right-hand side term. It can be shown that: (i) for $\beta_o \in [0, 1/2]$, the endpoints of $H(\beta_o)$ are lower than the endpoints of $G(\beta_o)$; (ii) the two curves are monotonically increasing in β_o; and (iii) the two curves are concave and do not change concavity. These three points taken together ensure that the function $H(\beta_o)$ is always under $G(\beta_o)$ for $\beta_o \in [0, 1/2]$ and, as such, that the derivative is positive.[23]

■

B.2 Proof of lemma 2

First, as shown by Antràs (2003), $\partial\Theta/\partial z < 0$ and equation (18) has a unique solution.[24] Using Condition 3, and replacing β_v by $1-\beta_o$ in equation (18), it is obvious that z=1/2 is a solution.

Second, as shown in the proof of Lemma 1, profit under outsourcing is increasing in z under Condition 1. We now prove that the profit under integration is also increasing in z under Conditions 1 and 3. Using Condition 3, we can substitute β_o by $1-\beta_v$ in Condition 1. The wage Condition remains identical, except for β_v. In addition, as Condition 3 implies

[23] Note that, for $\beta_o \in [0, 1/2]$, Condition 1 is not necessary to ensure that π_o increases in z. However, this second part of Condition 1 will be useful in Section 4 in order to prove that profit under vertical integration is also increasing in z under Condition 1.

[24] See Antràs (2003) for details, where his β corresponds to our $1-z$ here.

that β_v is a function of β_o, we can simply use the proof of Lemma 1 to also prove that π_v is increasing in z. ■

B.3 Proof of Proposition 2

Using $\beta_v = 1 - \beta_o$ from Condition (3), and as by definition $\beta_v > \beta_o$, then $\beta_v > 1/2$ and $\beta_o < 1/2$. Using the price under outsourcing p_{O} and under vertical integration p_{V} defined respectively in equation (7) and (16), it is straightforward to show that $p_{\mathrm{O}}/p_{\mathrm{V}} > 1$ for a given $z < 1/2$. ■

B.4 Proof of Proposition 3

We wish to show that the location function derived from $\Lambda_\pi^{IO} = 0$ is above that derived from $\Lambda_\pi^{IV} = 0$ just after the cutoff. As firms relocate in the South as trade becomes freer, the two location functions are monotonically decreasing in ϕ.

We thus need to prove that, at the cutoff, the slope of the second location function is higher in absolute value than the slope of the first function. We totally differentiate those two location functions around the cutoff point. First, $\Lambda_\pi^{IO} = 0$:

$$d\phi \left[(\psi_{\mathrm{I}} P_o + \psi_{\mathrm{O}} \widehat{z}) \left(\frac{1 - s_E}{(\phi \widehat{z} + P_o)^2} - \frac{s_E}{(\widehat{z} + \phi P_o)^2} \right) \right]$$
$$= d\widehat{z} \left[\frac{s_E \left(\phi \frac{\partial \psi_{\mathrm{O}}}{\partial \widehat{z}} (\widehat{z} + \phi P_o) + (1 + \phi \frac{\partial P_o}{\partial \widehat{z}})(\psi_{\mathrm{I}} - \phi \psi_{\mathrm{O}}) \right)}{(\widehat{z} + \phi P_o)^2} \right]$$
$$+ d\widehat{z} \left[\frac{(1 - s_E) \left(\frac{\partial \psi_{\mathrm{O}}}{\partial \widehat{z}} (\phi \widehat{z} + P_o) + \left(\phi + \frac{\partial P_o}{\partial \widehat{z}} \right) (\phi \psi_{\mathrm{I}} - \psi_{\mathrm{O}}) \right)}{(\phi \widehat{z} + P_o)^2} \right]$$

where ψ_{O}, ψ_{I}, and P_o are defined in section 3.1. The total differentiation of $\Lambda_\pi^{IV} = 0$ is carried out analogously with $P_v(\bar{z}, \hat{z}) + P_o(\bar{z})$ replacing $P_o(\hat{z})$ and ψ_{V} replacing ψ_{O}, where ψ_{V} and P_v are defined in Section 4.1. Recall that Condition 1 entails that $\overline{z} = 1/2$. Two important corollaries follow automatically: $\psi_{\mathrm{O}} = \psi_{\mathrm{V}}$ and $P_v = 0$. These two simplifications ensure that the terms multiplying the $d\phi$ in the two total differentiations, that is the partial derivative of the profit-gap with respect to ϕ, are identical. Since firms relocate in the South, this must be negative. Hence, we simply need to compare the two terms that multiply $d\hat{z}$, that is the partial derivatives of the two profit-gaps with respect to $\hat{z}$ (which are positive since the slope is negative) and show that $\frac{\partial \Lambda_\pi^{IV}}{\partial \hat{z}} < \frac{\partial \Lambda_\pi^{IO}}{\partial \hat{z}}$. Further manipulations

show that this difference reduces to:

$$\frac{\partial \Lambda_{\pi}^{IV}}{\partial \hat{z}} - \frac{\partial \Lambda_{\pi}^{IO}}{\partial \hat{z}} = \left(\frac{\partial P_v}{\partial \widehat{z}} - \frac{\partial P_o}{\partial \widehat{z}}\right)\left(\frac{s_E\phi\left(\psi_{\mathrm{I}} - \psi_{\mathrm{O}}\phi\right)}{\left(\frac{1}{2} + \phi P_o\right)^2} + \frac{(1-s_E)\left(\phi\psi_{\mathrm{I}} - \psi_{\mathrm{O}}\right)}{\left(\frac{\phi}{2} + P_o\right)^2}\right) + \left(\frac{\partial \psi_{\mathrm{V}}}{\partial \widehat{z}} - \frac{\partial \psi_{\mathrm{O}}}{\partial \widehat{z}}\right)\left(\frac{\phi s_E}{\frac{1}{2} + \phi P_o} + \frac{1-s_E}{\frac{\phi}{2} + P_o}\right)$$

Differentiating P_v and P_o and evaluating them around $z = 1/2$ reveals that they are identical, so that the first term on the right-hand side is zero. Differentiating ψ_{V} and ψ_{O} around the cutoff yields:

$$\frac{\partial \psi_{\mathrm{V}}}{\partial \widehat{z}} - \frac{\partial \psi_{\mathrm{O}}}{\partial \widehat{z}} = \frac{\alpha\left(\alpha\sqrt{\omega(1-\beta_o)\beta_o}\right)^{\frac{\alpha}{1-\alpha}}\left[2(2\beta_o - 1)(\alpha - 1) + (\alpha - 2)\left(\ln(1-\beta_o) - \ln\beta_o\right)\right]}{1-\alpha}$$

the sign of which depends on the sign of $2(2\beta_o - 1)(\alpha - 1) + (\alpha - 2)\left(\ln(1-\beta_o) - \ln\beta_o\right) \equiv B$. Note that $B = 0$ for $\beta_o = 1/2$. Furthermore, the sign of its derivative with respect to β_o depends on the sign of $(1-\alpha)[4\beta_o(\beta_o - 1) + 1] + 1$. The term inside the brackets has one obvious root, namely, $\beta_o = 1/2$. It is greater than zero if $\beta_o < 1/2$. This is always the case under Condition 3, which requires that $\beta_o < 1/2 < 1 - \beta_o < 1$. Hence, B is an increasing function of β_o and reaches its maximum at $\beta_o = 1/2$, where it is equal to zero: it is thus negative for $\beta_o \in [0, 1/2[$. Hence, so is the difference $\partial\psi_V/\partial\widehat{z} - \partial\psi_O/\partial\widehat{z}$. Finally, since $\partial\Lambda_\pi/\partial\phi < 0$, it must be true that $\frac{\partial\Lambda_\pi^{IV}}{\partial\hat{z}} < \frac{\partial\Lambda_\pi^{IO}}{\partial\hat{z}}$, which entails that $\left|\frac{d\hat{z}}{d\phi}\big|_{\mathrm{IV}}\right| > \left|\frac{d\hat{z}}{d\phi}\big|_{\mathrm{IO}}\right|$. ■