Tariffs on Final and Intermediate Goods under Global Sourcing

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Abstract

This paper studies the effects of trade barriers in the internal and the international organization of firms. It builds on the Antràs and Helpman (2004) North-South model in which firms choose from among four organizational form types corresponding to the combined decisions: outsource vs. integrate, and North vs. South. I show that a tariff imposed by the South on the North country's exports of differentiated final goods does not change (1) the productivity cutoffs at which each organizational form is chosen (2) nor the resulting fraction of firms in each of the four organizational form buckets. However, it decreases the resulting mass of entering firms and worsens the South's country terms of trade. In contrast, a tariff on the South country's exports of inputs decreases the productivity cutoffs for firms operating in the North and increases the thresholds for offshoring firms. Additionally, it not only decreases the fraction of firms that source in the South but also decreases the outsourcing-integration ratio in both countries. Finally, both tariffs result in a reduction of the overall volume of international trade.

1 Overview

Over the last fifteen years, the world has experienced two major economic transformations regarding (a) the organization of firms and (b) import tariffs reductions.

On the one hand, firms' organizational forms became more complex as the new production processes made firm and national borders less important than in the past. In this way, the production of a final good usually includes the cooperation among several agents, who may be located in different countries and may be workers of the final good firm or may be part of an independent firm. The phenomenon by which firms internationalize their production processes is called "offshoring" – whereas the acquisition of inputs or services from unaffiliated firms is called "outsourcing" (Helpman (2006)).[1,2]

On the other hand, over the 1990's different groups of countries reached tariff agreements and several free trade areas were created. Examples of these processes include the consolidation of Europe as a sole market and, in the Americas, Nafta (and Cafta) and Mercosur. Thus, in addition to the negotiations at the WTO level, different countries agreed to reduce (or eliminate) their tariffs to their partners.

This paper's purpose is to study the effects of exogenous tariff changes on the optimal organization of firms. Thus, the paper claims that tariff reductions may not only explain offshoring, which may seem obvious, but also the increasing prevalence of outsourcing over vertical integration.

Ideally, we would like to have a unified theory explaining the interactions between both

[1] As evidence of increasing offshoring, Feenstra and Hanson (1996) report that the share of imports in total purchases of inputs more that doubled from 1972 to 1990 in the U.S: from 5% to 11.6%. See Helpman (2006).

[2] See Bartel et al (2005), Abraham and Taylor (1996), Baker and Hubbard (2003, 2004) and Autor (2001, 2002) for evidence in favor of increased outsourcing. For a "trade" (rather than IO) empirical paper on outsourcing see Feenstra and Hanson (2005).

phenomena (i.e., a model where both, firms' organizational forms and tariffs, are endogenously determined). Unfortunately, such a theory is not yet available.

Trade literature has shown considerable interest in outsourcing and offshoring in recent years, including several papers that offer suitable theoretical frameworks to explain the determinants of these processes.[3] However, little attention has been given to its connection with tariffs. The most typical analyses follow the so-called "incomplete contract approach to the theory of the firm" – i.e., environments where production requires cooperation between agents (such as final good producers and input suppliers) but where *ex-ante* commitments are not possible. "Contractual input intensity", the relative requirement of inputs under direct control of the final good producer and of inputs controlled by the suppliers, is identified as a key determinant of the firms' choices.[4] Some papers combine differences in contractual input intensity across sectors with differences in productivities across firms within sectors (*à la* Melitz (2003)). The resulting equilibrium involves a rich variety of firm behaviors: integrating in the home country, outsourcing at home, integrating in a foreign country (FDI) and outsourcing abroad. Under the last two types there will be international trade – intrafirm trade when the firm decides to integrate and arm's-length trade when the decision is to outsource.[5]

Antràs and Helpman (2004) develop a North-South model, with incomplete contracts, in which entrepreneurs decide whether to integrate or outsource and, regardless of this decision, in

[3] See Helpman (2006) for an excelent survey on this new literature.

[4] The naming of this concept as "contractual input intensity" is found in Helpman (2006).

[5] Making use of the different contractual input intensities alone, without productivity heterogeneity, Antràs (2003, 2005) finds that there should be more intrafirm trade in inputs for capital-intensive sectors and more arm's-length trade in inputs for labor-intensive sectors. An alternative approach to productivity heterogeneity can be found in Grossman and Helpman (2002, 2005) and in McLaren (2000). They emphasize the searching and matching problems faced by final good producers and input producers. In both papers outsourcing is more likely to occur the thicker the input market is.

which country to acquire the intermediate goods. Both decisions determine the organizational form of the firm. Given corresponding fixed costs for each organizational form, firms optimally sort as a result of the headquarter-intensity of the industry and of firm-specific productivity.[6]

My purpose, as already said, is to study how the firms' optimal organization of production is affected by trade barriers such as tariffs. Specifically, I aim to address two questions. (1) How do firms organize their production in response to the imposition of tariffs? (2) What are the similarities and differences in the firms' reactions to different kinds of tariffs?

To address these questions I build on Antràs and Helpman (2004) theoretical framework. Each final good producer (located in the North) simultaneously chooses (a) to get their inputs domestically or abroad, and (b) whether to get them within (integration) or outside (outsourcing) the firm. The producer faces two trade-offs. On the one hand, North has lower fixed costs but South has lower variable costs. On the other, outsourcing requires lower fixed costs than vertically integration but the producer's *ex-post* share of the surplus is lower. Additionally, firms may face a tariff on either final or intermediate goods.

The main findings are the following. First, a tariff on final goods does not affect productivity cutoffs at which each organizational form is chosen. However, it reduces the resulting mass of firms entering into the market. Second, this same tariff does not change the fraction of active firms choosing each institutional form – since all final good producers are located in the North, they all have the same costs for serving each market; hence, all are affected by the tariff in the same way. Third, a tariff on intermediate goods, imposed by the South government,

[6] Grossman and Helpman (2004) provide an alternative explanation for outsourcing. Altough contracts are still constrained, the paper emphasizes the role of managerial incentives. In particular, Grossman and Helpman assume that an entrepreneur is not able to perfectly observe his manager's efforts; and that the ability to monitor his manager depends on location. Additionally, he cannot monitor the efforts of an independent supplier. Thus, the optimal contract generates a different sorting from that found in Antràs and Helpman (2004).

decreases the productivity thresholds for domestically-sourced firms while increases those of the offshoring firms. Fourth, this kind of tariff reduces fraction of active firms that get their inputs abroad. Intuitively, this tariff makes more expensive to look for inputs in the South and therefore some firms will now source in the North. Finally, this same tariff decreases the fraction of outsourcing firms, relative to those vertically integrating, in *both* countries.

The rest of the paper is organized as follows. Section 2 describes the model's basic set up. Section 3 presents the equilibria that would arise in the absence of trade barriers. Sections 4 and 5 study how the equilibria are affected by a tariff on final and intermediate goods, respectively. Section 6 compares the effects of both kinds of tariffs. Section 7 concludes.

2 The Model

The basic model follows Antràs and Helpman (2004). Thus, consider a world composed of two countries, North and South. There are two kinds of goods, homogeneous and differentiated. The homogeneous good, labeled x_0, is used as a numeraire. In addition, there are J sectors with each one producing differentiated goods $x_j(i)$.

In the world there is a unit measure of consumers sharing the same Dixit-Stiglitz preferences represented by the following utility function:

$$U = x_0 + \frac{1}{\mu} \sum_j X_j^{\mu} \tag{1}$$

where $\mu \in (0, 1)$ and

$$X_j = \left[\int x_j(i)^{\alpha} di \right]^{\frac{1}{\alpha}} \tag{2}$$

is the aggregate consumption index for sector j, with $\alpha \in (0, 1)$ and $\varepsilon \equiv \frac{1}{1-\alpha}$ is the elasticity of substitution between varieties. As usual in the literature, I assume $\alpha > \mu$, which implies that varieties within a sector are more substitutable for each other than for x_0 or $x_k(i)$, $k \neq j$.

Given equations (1) and (2) a differentiated product has inverse demand given by

$$p_j(i) = x_j(i)^{\alpha-1} P_j^{\frac{\alpha-\mu}{1-\mu}}. \tag{3}$$

where $P \equiv \left(\int p(i)^{\frac{\alpha}{\alpha-1}} di\right)^{\frac{\alpha-1}{\alpha}}$ is the aggregate price index of industry j

I assume that the North is more productive than the South at producing x_0. In the North, one unit of labor is needed per unit of x_0, while in the South $1/w > 1$ units of labor are required. Due to this, Northern wages are higher than Southern ones: $w^N > w^S = w$. Following Antràs and Helpman (2004) I assume that the labor supply is large enough in both countries so that, in equilibrium, they both produce the homogeneous good.

The production of differentiated products requires collaboration between individuals of two types: entrepreneurs (E) and managers (M). Entrepreneurs provide headquarter services $(h_j(i))$; managers produce an intermediate good $(m_j(i))$. Each agent needs one unit of labor to get one unit of $h_j(i)$ or $m_j(i)$, respectively. Entrepreneurs are located only in the North while managers can be found in both countries. Thus, only the North is able to produce differentiated goods. In order to produce a differentiated good, an entrepreneur must follow the process described below.

First, he pays an entry fixed cost of f_E Northern labor units. This gives the entrepreneur the right to draw a productivity level θ from a known cumulative distribution function $G(\theta)$. Then, having observed θ, the entrepreneur decides whether to exit the market or not. If he stays in the market he must bear an additional fixed cost to organize production. Meanwhile, production of variety i in sector j depends on $h_j(i)$ and $m_j(i)$ according to the Cobb-Douglas production function

$$x_j(i) = \theta_i \left(\frac{h_j(i)}{\nu_j}\right)^{\nu_j} \left(\frac{m_j(i)}{1-\nu_j}\right)^{1-\nu_j} \tag{4}$$

where $\nu_j \in (0,1)$ measures the relative (industry) headquarter intensity or, using Helpman's (2006) terminology, the contractual input intensity.

With his decision problem now clearly defined, the entrepreneur next undertakes two simultaneous decisions: (1) to contact a type M agent in either North or South; (2) to decide whether to insource or outsource the production of the inputs $m_j(i)$.

Since the environment is one of incomplete contracts, E and M cannot commit not to renegotiate an initial contract. This implies, for example, that there can be no *ex-ante* enforceable contracts that specify in advance quantity or price or the quantity of labor to be hired. As a result, parties bargain over the relationship's *ex-post* surplus. Bargaining is Nash type and the entrepreneur's bargaining weight is equal to $\beta \in (0,1)$ of the resulting revenue. Bargaining takes place under both possible ownership structures (outsourcing and integration). However, the entrepreneur's outside options are different in each case. Under outsourcing, if there is no agreement on the distribution of the surplus both agents get nothing: since both h and m are specially customized for each other, the lack of any of them makes the other worthless. In contrast, under integration E has actually a right to seize M's production. However, if E could get all the revenue by simply firing the manager *ex-post*, M would always choose not to produce *ex-ante*; hence, integration would never be chosen. To avoid this situation, I assume that if the entrepreneur fires the manager, he gets only a fraction δ^l of the output: the entrepreneur, even though he owns the input, is not able to use it as efficiently as the manager.[7] Each entrepreneur E offers a contract in order to attract a manager M. The contract specifies a fee (positive or negative) that must be paid by M - the goal of the fee is to satisfy M's participation constraint at the lowest possible cost. Since there is an infinitely elastic supply of M agents, the manager's profits (net of the fee) are equal, in equilibrium, to the outside option.[8]

[7] Additionally, I assume $\delta^N \geq \delta^S$, reflecting that the lack of agreement is more costly to the entrepreneur when the manager is located in the South.

[8] I assume that the manager's outside option is zero in both countries.

The location of M (North N or South S) and the ownership structure (integrate V or outsource O) determine the firm's *organizational form.* There are different fixed costs associated with each form and all are denominated in terms of Northern labor. Thus, $w^N f_k^l$ is the fixed cost associated with a firm whose inputs are manufactured at location $l \in \{N, S\}$ and has ownership structure $k \in \{V, O\}$. Following Antràs and Helpman (2004) I assume that

$$f_V^S > f_O^S > f_V^N > f_O^N \tag{5}$$

In this way, integration has higher fixed costs than outsourcing. This means that the additional managerial activities outweigh any potential economies of scope (due to integration). In addition, note that under these assumptions, South has lower variable costs (lower wages) but higher fixed costs than North.

3 Equilibrium

Suppose there are no trade costs and that the governments of both countries follow a free trade policy. Then there is only one (global) market for the differentiated goods. The revenue that each firm collects is given by $R_j(i) = p_j(i)x_j(i)$ or:

$$R_j(i) = X_j^{\mu-\alpha}\theta^\alpha \left(\frac{h_i}{\nu_j}\right)^{\nu_j\alpha} \left(\frac{m_i}{1-\nu_j}\right)^{\alpha(1-\nu_j)} \tag{6}$$

If under integration there is no agreement about the sharing of the *ex-post* surplus our assumptions imply that the entrepreneur can sell $\delta^l(x_i)$ of output to get a revenue $\left(\delta^l\right)^\alpha R(i)$. In the bargaining, E gets this outside option plus a fraction β of the gains from trade, i.e., $\left(\delta^l\right)^\alpha R(i) + \beta[1 - \left(\delta^l\right)^\alpha]R(i)$. Hence, the *ex-post* bargaining shares are given by

$$\beta_V^N = (\delta^N)^\alpha + \beta\left[1 - (\delta^N)^\alpha\right] \geq \beta_V^S = (\delta^S)^\alpha + \beta\left[1 - (\delta^S)^\alpha\right] > \beta_O^N = \beta_O^S = \beta \tag{7}$$

The actual revenue is the result of the non-cooperative decisions taken by the entrepreneur and the manager (see the Appendix for the details)

$$R = (P)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \theta^{\frac{\alpha}{1-\alpha}} \left[\alpha \left(\frac{\beta_k^l}{w^N} \right)^{\nu} \left(\frac{(1-\beta_k^l)}{w^l} \right)^{1-\nu} \right]^{\frac{\alpha}{1-\alpha}} \tag{8}$$

As a result, the total operating profits of a firm that gets its inputs at location l and has ownership structure k are given by[9]

$$\pi_k^l(\theta, P, \nu) = \Psi_k^l(P)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \theta^{\frac{\alpha}{1-\alpha}} - f_k^l w^N \tag{9}$$

where

$$\Psi_k^l(\nu) = \frac{1 - \alpha \left[\beta_k^l \nu + (1 - \beta_k^l(1-\nu) \right]}{\left[\frac{1}{\alpha} \left(\frac{w^N}{\beta_k^l} \right)^{\nu} \left(\frac{w^l}{1-\beta_k^l} \right)^{1-\nu} \right]^{\frac{\alpha}{1-\alpha}}} \tag{10}$$

Each entrepreneur's problem is to choose the optimal organizational form. Analogously, his problem is to select of one of the four triplets $\left(\beta_k^l, w^l, f_k^l\right)$ for $l \in \{N, S\}$ and $k \in \{V, O\}$.[10] Under this second interpretation, we have to determine how do profits depend on wages, fixed costs and the bargaining shares. It is clear from equation (9) that profits are decreasing in both w^l and f_k^l. However, it is not so clear how do profits depend on β. Ideally, if β were a continuous variable, each entrepreneur would maximize equation (10) and set

$$\beta^*(\nu) = \frac{\nu(\alpha\nu + 1 - \alpha) - \sqrt{\nu(1-\nu)(1-\alpha\nu)(\alpha\nu+1-\alpha)}}{2\nu - 1} \tag{11}$$

As explained by Antràs and Helpman (2004), $\beta^*(\nu) \in [0,1]$ is the optimal surplus share that an entrepreneur would chose (*ceteris paribus*) if there were a continuum of possible organizational forms. However, since each entrepreneur chooses from among only four values of

[9] Hereafter, I drop the j subscripts.

[10] Interestingly, even though each agent solves non-cooperatively a particular problem, total profits equal the entrepreneur's profits. That is, E chooses $h(i)$ to maximize $\beta_k^l R(i) - w^N h(i)$, while M chooses $m(i)$ to maximize $(1-\beta_k^l)R(i) - w^l m(i)$. However, given the particular contracting environment considered, E will set the fee that M has pay so as to drive his profits down to zero.

β, he will pick the pair $\{l, k\}$ that is closest to the ideal β^*. Note that since $\beta^*(0) = 0$ and $\beta^*(1) = 1$ we have that

$$\text{Low } \nu \text{ (close to 0):} \quad \beta^*(\nu) < \beta_O^N = \beta_O^S = \beta < \beta_V^S \leq \beta_V^N \quad \Rightarrow \quad \frac{\partial}{\partial \beta}\pi(\cdot) < 0$$

$$\text{High } \nu \text{ (close to 1):} \quad \beta^*(\nu) > \beta_V^N \geq \beta_V^S > \beta_O^N = \beta_O^S = \beta \quad \Rightarrow \quad \frac{\partial}{\partial \beta}\pi(\cdot) > 0$$

This means that in a relatively headquarter-intensive sector (with high ν), if there were no other cost/benefit differences among the four organizational forms, the entrepreneur would choose to integrate in the North. In contrast, in a relative input-intensive industry (with low ν), it would be optimal to outsource. Intuitively, the factor that is relatively more important should get the best incentives in the form of a higher surplus share. However, since there actually are other differences in costs and benefits among the different forms, the optimal choice of $\{l, k\}$ will depend on the firm specific productivity parameter θ.[11] Throughout the paper I assume that ν is "high" and therefore focus on sectors with relatively high headquarters intensity. In Appendix B, I present results for alternative parameter values.

Suppose that, initially, for some *ad-hoc* reason (technological or legal), entrepreneurs must look for managers only in the North. Each entrepreneur decides whether to integrate or outsource in the North. From equation (9) it follows that the most (least) productive firms will integrate (outsource). In this setting, South is unable to produce any inputs m. Thus, North has a comparative advantage in the production of differentiated goods (and an absolute advantage in every single production). With international trade, North will export differentiated goods in exchange for homogeneous goods.

If we allow Southern managers to produce m for Northern entrepreneurs, Antràs and

[11] A free-entry condition, equating the expected profits of a potential entrant to the fixed entry cost, closes the model. Specifically,

$$\int_{\underline{\theta}(X)}^{\infty} \pi(\theta, P, \nu) dG(\theta) = w^N f_E$$

From this expression we can solve for P, and the other variables.

Helpman (2004) show that all four possible organizational forms may occur in equilibrium (implying that South can export m). The analysis follows from the alternative profits given by equation (9). First, note that π^l_O is flatter than π^l_V for both N and S. In contrast, it is unclear whether π^N_V is steeper or flatter that π^S_O. The reason for this is two-fold. On the one hand, (N, V) gives the entrepreneur a larger surplus share, which makes π^N_V steeper. On the other hand, Southern wages are lower, making π^S_O steeper. To avoid this ambiguity, I assume that the wage differential is large relative to the difference between β and β^N_V. Specifically,

$$\left(\frac{w^N}{w}\right)^{1-\nu} > \phi(\beta^N_V, \nu)/\phi(\beta, \nu) \tag{12}$$

where $\phi(\gamma, \nu) \equiv \{1 - \alpha[\gamma\nu + (1-\gamma)(1-\nu)]\}^{(1-\alpha)/\alpha}\gamma^{\nu}(1-\gamma)^{1-\nu}$.[12] When this condition is satisfied we can be sure that the following ordering holds:

$$\Psi^S_V(\nu) > \Psi^S_O(\nu) > \Psi^N_V(\nu) > \Psi^N_O(\nu) \tag{13}$$

Using this fact (see Figure 1) it follows that the least productive firms – those with productivities below $\underline{\theta}$– will exit immediately. Of the remaining firms, the more (less) productive ones get their inputs in the South (North). Within each of these two groups, those with higher θ integrate, while the others outsource.[13, 14]

[12] See Appendix B for the analysis of the opposite case.

[13] It is easy to check that any of the three types $\{(N, O), (N, V), (S, O)\}$ may not exist in equilibrium. In contrast, as long as there is no upper bound in the support of $G(\theta)$ there will always be firms that choose (S, V). Moreover, if in any equilibrium there is more than one type, firms are going to sorted in this way: if there is a firm choosing (S, O) it has to be more productive than another one choosing (N, V) and (N, O). And among these last two, the former more productive than the latter.

[14] To guarantee that all four types will exist in equilibrium we need $\underline{\theta} < \theta^N_O < \theta^N_V < \theta^S_O$. This requires $\frac{f^N_O}{\Psi^N_O} < \frac{f^N_O - f^N_V}{\Psi^N_O - \Psi^N_V} < \frac{f^N_V - f^S_O}{\Psi^N_V - \Psi^S_O} < \frac{f^S_O - f^S_V}{(\Psi^S_O - \Psi^S_V)}$.

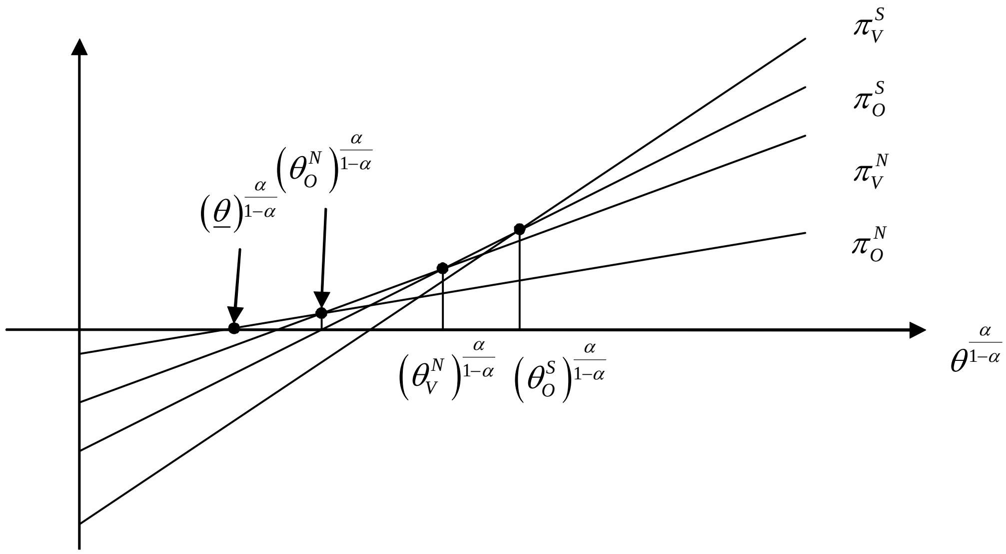

Figure 1: Profit lines - Equation (10)

$\theta_i \in$	$Firm - type$
$(\underline{\theta}, \theta_O^N)$	(N, O)
(θ_O^N, θ_V^N)	(N, V)
(θ_V^N, θ_O^S)	(S, O)
(θ_O^S, ∞)	(S, V)

Intuitively, low productivity firms will have low levels of production and will try to reduce their fixed costs by sourcing their inputs from the North. In contrast, high productivity firms will have high levels of output (and so low average fixed costs) and will therefore be more concerned in reducing their variable costs. Thus, they source in the low wage South.

4 Tariffs on final goods

Suppose that the Southern government imposes an *ad-valorem* tariff $\tau \equiv 1 + t^S$ on imports of Northern differentiated goods.[15] Firms will face two different demands and therefore will have to make two decisions – the quantities to offer in the North and in the South.[16]

$$p_N(i) = x_N(i)^{\alpha-1} P_N^{\frac{\alpha-\mu}{1-\mu}}; \qquad p_S(i) = x_S(i)^{\alpha-1} P_S^{\frac{\alpha-\mu}{1-\mu}} \tau^{\frac{\alpha-1}{1-\mu}}$$

where $x_N(i) + x_S(i) = x(i)$. Assuming that there are γ consumers in the North and $(1-\gamma)$ consumers in the South, the revenue of a firm will be given by

$$R = \gamma^{1-\alpha} P_N^{\frac{\alpha-\mu}{1-\mu}} x_N(i)^{\alpha} + (1-\gamma)^{1-\alpha} P_S^{\frac{\alpha-\mu}{1-\mu}} \tau^{\frac{\alpha-1}{1-\mu}} x_S(i)^{\alpha} \tag{14}$$

As shown in the Appendix, the problem is simplified because the firms will optimally charge the same price in both markets: $p_N(i) = p_S(i)$.[17] Thus, $P_N = P_S = P$. We can define the aggregate price index more precisely:

$$P = \left(\int_{\underline{\theta}}^{\infty} M p(\theta)^{\frac{\alpha}{\alpha-1}} g(\theta) \, d\theta \right)^{\frac{\alpha-1}{\alpha}} \tag{15}$$

where we integrate over the productivities θ and M denotes the prevailing mass of firms.

To determine how to split any production level x between x_N and x_S the firms will maximize (14). The resulting sales in each market will be

$$\begin{aligned} x_N(\theta) &= \frac{\gamma}{(1-\gamma)(\tau)^{-\frac{1}{1-\mu}} + \gamma} x(\theta) \\ x_S(\theta) &= \frac{(1-\gamma)(\tau)^{-\frac{1}{1-\mu}}}{(1-\gamma)(\tau)^{-\frac{1}{1-\mu}} + \gamma} x(\theta) \end{aligned}$$

as expected, an increase in the tariff τ will increase the fraction x_N and decrease x_S.

[15] Recall that the South is *always* an importer of differentiated goods (and an exporter of intermediate and homogeneous goods).

[16] The aggregate prices P_S refer to the prices received by the producers not those payed by the consumers.

[17] This implies that the Southern consumers will pay $p^S(i) = \tau p^N(i)$.

The entrepreneur and the manager will play a game, analogous to the one described in the previous section, pinning down the production level of x and the total revenue collected by a firm (see the Appendix for the details).

$$x\left(\theta\right)=T\left(P\right)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}\,\theta^{\frac{1}{1-\alpha}}\left[\Lambda_k^l\right]^{\frac{1}{1-\alpha}} \tag{16}$$

$$R=T\left(P\right)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}\,\theta^{\frac{\alpha}{1-\alpha}}\left[\Lambda_k^l\right]^{\frac{\alpha}{1-\alpha}} \tag{17}$$

where $T\equiv\left(\left(1-\gamma\right)\left(\tau\right)^{\frac{-1}{1-\mu}}+\gamma\right)$ is a measure of the tariff τ and $\Lambda_k^l\equiv\alpha\left(\frac{\beta_k^l}{w^N}\right)^{\nu}\left(\frac{(1-\beta_k^l)}{w^l}\right)^{1-\nu}$ is a parameter specific to each organizational form.

The profit function corresponding to this scenario is

$$\pi_k^l(\theta,P,\nu,\tau)=\Psi_k^l T P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}\theta^{\frac{\alpha}{1-\alpha}}-f_k^l w^N \tag{18}$$

Equation (18) looks just like equation (9) with the extra term $\left(\left(1-\gamma\right)\left(\tau\right)^{\frac{-1}{1-\mu}}+\gamma\right)$. In fact, if there were no tariffs, $\tau^{\frac{-1}{1-\mu}}=1$, both equations would be identical. However, with tariffs actually imposed, $\tau^{\frac{-1}{1-\mu}}<1$, the profit line for *each* organizational form becomes flatter than that under free trade.

Given our assumptions, the sorting pattern of firms will not change. Firms with productivity levels below $\underline{\theta}$ will exit the market, firms above $\underline{\theta}$ but below θ_O^N will outsource in the North; and those between θ_O^N and θ_V^N integrate in the North. Finally, high productivity firms will get their inputs in the South, and among these, those with θ_i between θ_V^N and θ_O^S outsource, while those with the highest productivities ($\theta_i>\theta_O^S$) engage in FDI.

We can compute these cutoffs values.

$$\begin{aligned}
\pi_O^N=0\Rightarrow\underline{\theta}\left(P,\tau\right)&=\left[\frac{w^N f_O^N}{T\Psi_O^N}\frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}}\right]^{(1-\alpha)/\alpha}\\
\pi_O^N=\pi_V^N\Rightarrow\theta_O^N\left(P,\tau\right)&=\left[\frac{w^N(f_O^N-f_V^N)}{T(\Psi_O^N-\Psi_V^N)}\frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}}\right]^{(1-\alpha)/\alpha}\\
\pi_O^S=\pi_V^N\Rightarrow\theta_V^N\left(P,\tau\right)&=\left[\frac{w^N(f_V^N-f_O^S)}{T(\Psi_V^N-\Psi_O^S)}\frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}}\right]^{(1-\alpha)/\alpha}\\
\pi_O^S=\pi_V^S\Rightarrow\theta_O^S\left(P,\tau\right)&=\left[\frac{w^N(f_O^S-f_V^S)}{T(\Psi_O^S-\Psi_V^S)}\frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}}\right]^{(1-\alpha)/\alpha}
\end{aligned} \tag{19}$$

These four expressions for the cutoff values together with the free entry condition determine a system of five equations with five unknowns: $\underline{\theta}, \theta_O^N, \theta_V^N, \theta_O^S$ and P. Solving the system (assuming a particular distribution for θ) we are able to express each endogenous variable as a function the model's parameters alone.

The free entry condition may be written as

$$\begin{aligned} w^N f_E &= \int_{\underline{\theta}}^{\theta_O^N} \left[T\Psi_O^N P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \theta^{\frac{\alpha}{1-\alpha}} - f_O^N w^N \right] g(\theta)\, d\theta \\ &+ \int_{\theta_O^N}^{\theta_V^N} \left[T\Psi_V^N P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \theta^{\frac{\alpha}{1-\alpha}} - f_V^N w^N \right] g(\theta)\, d\theta \\ &+ \int_{\theta_V^N}^{\theta_O^S} \left[T\Psi_O^S P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \theta^{\frac{\alpha}{1-\alpha}} - f_O^S w^N \right] g(\theta)\, d\theta \\ &+ \int_{\theta_O^S}^{\infty} \left[T\Psi_V^S P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \theta^{\frac{\alpha}{1-\alpha}} - f_V^S w^N \right] g(\theta)\, d\theta \end{aligned}$$

4.1 Effects of τ on cutoffs, prices and quantities

If we differentiate this same expression we can learn how does the aggregate price index change when we move the tariff τ.

$$\begin{aligned} \frac{\partial LHS}{\partial P} dP + \frac{\partial LHS}{\partial \tau} d\tau &= \frac{\partial RHS}{\partial P} dP + \frac{\partial RHS}{\partial \tau} d\tau \\ &\Longrightarrow \\ \frac{dP}{d\tau} &= -\frac{\frac{\partial RHS}{\partial \tau} - \frac{\partial LHS}{\partial \tau}}{\frac{\partial LHS}{\partial P} - \frac{\partial RHS}{\partial P}} \end{aligned}$$

In the Appendix I show that

$$\frac{dP}{d\tau} = \frac{(1-\gamma)(1-\alpha)}{\alpha-\mu} \frac{P(\tau)^{\frac{-1}{1-\mu}-1}}{T} > 0 \tag{20}$$

Note that this implies that if the South imposes a tariff τ it will worsen its terms of trade: Meltzer's Paradox.

We can now compute the effect of τ on the cutoffs.

$$\begin{aligned}\frac{d\underline{\theta}}{d\tau} &= \frac{\partial\underline{\theta}}{\partial\tau}d\tau + \frac{\partial\underline{\theta}}{\partial P}\frac{dP}{d\tau} = \underline{\theta}\frac{\frac{(1-\alpha)}{\alpha}\frac{(1-\gamma)}{-(1-\mu)}(\tau)^{\frac{-1}{1-\mu}-1}}{T} + \underline{\theta}\frac{\frac{\alpha-\mu}{\alpha(1-\mu)}}{P}\frac{dP}{d\tau} \\ &= 0\end{aligned}$$

Hence, the cutoff $\underline{\theta}$ is not affected by τ. Since $\underline{\theta}$ and θ_O^N differ only on constant terms but not in the way they are affected by P and τ we know that $\frac{\partial\theta_O^N}{\partial\tau} = 0$. Thus, we conclude that the cutoff values are not affected by the tariff. The reason for this comes from the free entry condition.

First, note that we can express the profit function as $\pi = q(P,\tau) * \theta^{\frac{\alpha}{1-\alpha}} - const$ for some function q – so the intercept is fixed and the slope is determined by the interaction of P and τ. Second, looking once again at the free entry condition, we realize that the area below the profit functions *must* integrate to $w^N f_E$. Third, all profit functions depend on P and τ in the same way: a change in τ will affect the slope of all profit lines in the same way.

Thus, if a change in tariff τ were to change the cutoff $\underline{\theta}$ that would imply a change in the slope of the profit function π_O^N. However, if that profit function were to change, then all profit functions would see their slopes changed as well. This would, in turn, imply that the area below the profit lines will no longer integrate to $w^N f_E$ violating the free entry condition. Thus, all change in τ must be compensated by a change in P leaving the cutoffs and profits per firm unaffected – it's straightforward to check, comparing the expressions for π and $x(i)$, that the total quantity per firm will not change with τ either. However, the composition will: x_N will increase and x_S will decrease.

Effects on the prices charged by the firms. We know that firms will charge the same price in both markets $p_S = p_N = p$. After some algebra we find that

$$\begin{aligned}\frac{dp_S}{d\tau} &= (1-\gamma)^{1-\alpha}\left[\frac{\partial p_S}{\partial x_S}\frac{dx_S}{d\tau} + \frac{\partial p_S}{\partial P}\frac{dP}{d\tau} + \frac{\partial p_S}{\partial \tau}\right] \\ &= p_S\left[(\alpha-1)\,x_S^{-1}\frac{dx_S}{d\tau} + \frac{\alpha-\mu}{1-\mu}P^{-1}\frac{dP}{d\tau} + \frac{\alpha-1}{1-\mu}\tau^{-1}\right] \\ &= 0\end{aligned}$$

Therefore, the tariff τ will not affect the price charged by each individual firm.

Mass of firms. Making use of the inverse demands and of our expression for x we can rewrite the aggregate prices in the following way:

$P = M^{-\frac{1-\alpha}{\alpha}}\left(\int\left(\theta^{\frac{1}{1-\alpha}}\left[\Lambda_k^l\right]^{\frac{1}{1-\alpha}}\right)^{\alpha} g(\theta)\,d\theta\right)^{-\frac{1-\alpha}{\alpha}}$; and then solve for

$$M = P^{\frac{-\alpha}{1-\alpha}}\left(\int\left(\theta^{\frac{1}{1-\alpha}}\left[\Lambda_k^l\right]^{\frac{1}{1-\alpha}}\right)^{\alpha} g(\theta)\,d\theta\right)^{-1}$$

Note that since the cutoffs do not change with τ and $\frac{\partial P}{\partial \tau} > 0$ it follows that $\frac{\partial M}{\partial \tau} < 0$ – so the increase in τ doesn't affect the cutoffs but reduces the mass of firms entering the market. This explains why both aggregate prices and quantities per firm increase in the North.

We summarize these results in the following proposition.

Proposition 1 *For any differentiable distribution $G(\cdot)$, the imposition of a tariff τ on the Southern imports of Northern final goods will:*

1. *Increase the aggregate prices P.*
2. *Not affect any of the cutoffs, nor the production or the price charged by each firm.*
3. *Increase the sales in the North and decrease them in the South.*
4. *Decrease the resulting mass M of firms.*

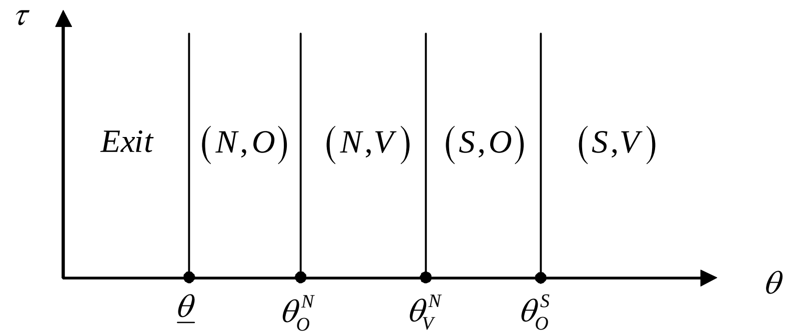

Figure 2: Organizational form cutoffs as a function of τ.

Trade flows. The value of the Southern imports of differentiated goods is given by

$$\begin{aligned} P_S X_S &= \left[\int M p_S(\theta)^{\frac{\alpha}{\alpha-1}} g(\theta)\, d\theta\right]^{\frac{\alpha-1}{\alpha}} \left[\int M x_S(\theta)^{\alpha} g(\theta)\, d\theta\right]^{\frac{1}{\alpha}} \\ &= M \left[\int p_S(\theta)^{\frac{\alpha}{\alpha-1}} g(\theta)\, d\theta\right]^{\frac{\alpha-1}{\alpha}} \left[\int x_S(\theta)^{\alpha} g(\theta)\, d\theta\right]^{\frac{1}{\alpha}} \end{aligned}$$

we know that M and x_S will decrease with τ. Additionally, $p_S = p_N = p$ will not change. Since the integration range does not change the following result is immediate:

Proposition 2 *The imposition of a tariff τ on the Southern imports of differentiated goods will have the following effects on the trade flows:*

1. *Southern imports of differentiated goods will decrease (in quantity and value).*

2. *To keep trade balanced, Southern exports of inputs and the homogeneous good will decrease (in quantity and value).*

4.2 Prevalence

Given these results, another question naturally arises: How does a tariff affect the fraction of firms that choose each organizational form? To answer this, I assume that $G(\theta)$ has a Pareto distribution. Thus,

$$G(\theta) = 1 - \left(\frac{b}{\theta}\right)^z, \qquad \theta \geq b \geq 0, \tag{21}$$

where z is the shape of the function and assumed to be large enough so that the variance is finite. Helpman et al. (2004) find some empirical support for the Pareto distribution. See also Antràs and Helpman (2004) for a similar analysis.

Define σ_k^l as the fraction of active firms that get their inputs at location l and have ownership structure k. Then, given equation (21) and the cutoffs values, we have:

$$\begin{array}{c} \sigma_O^N = 1 - \left[\frac{\Psi_O^N - \Psi_v^N}{f_O^N - f_V^N}\frac{f_O^N}{\Psi_O^N}\right]^{z(1-\alpha)/\alpha} \\ \sigma_V^N = \left(\frac{f_O^N}{\Psi_O^N}\right)^{z(1-\alpha)/\alpha}\left[\left(\frac{f_O^N - f_V^N}{\Psi_O^N - \Psi_v^N}\right)^{-z(1-\alpha)/\alpha} - \left(\frac{f_V^N - f_O^S}{\Psi_V^N - \Psi_O^S}\right)^{-z(1-\alpha)/\alpha}\right] \\ \sigma_O^S = \left(\frac{f_O^N}{\Psi_O^N}\right)^{z(1-\alpha)/\alpha}\left[\left(\frac{f_V^N - f_O^S}{\Psi_V^N - \Psi_O^S}\right)^{-z(1-\alpha)/\alpha} - \left(\frac{f_O^S - f_V^S}{\Psi_O^S - \Psi_V^S}\right)^{-z(1-\alpha)/\alpha}\right] \\ \sigma_V^S = \left[\frac{\Psi_O^S - \Psi_V^S}{f_O^S - f_V^S}\frac{f_O^N}{\Psi_O^N}\right]^{z(1-\alpha)/\alpha} \end{array} \tag{22}$$

Proposition 3 *If the productivities θ are Pareto distributed, the imposition of a tariff on imports of differentiated goods does not affect the relative distribution of the firms' organizational form. (See Figure 3).*

Proof. From (22) it follows that $\frac{\partial \sigma_k^l}{\partial \tau} = 0$, for $l = \{N, V\}$ and $k = \{O, V\}$. ■

Proposition 3 may at first seem counterintuitive. However, it is important to realize that in this model the cost of serving in each market is the same for all firms – i.e., in contrast to Melitz (2003), all firms export the same share of production regardless of their productivity. Since all firms are affected by τ in the same way, there are no changes in the relative production costs (North vs. South) and therefore there are no changes in σ_k^l.

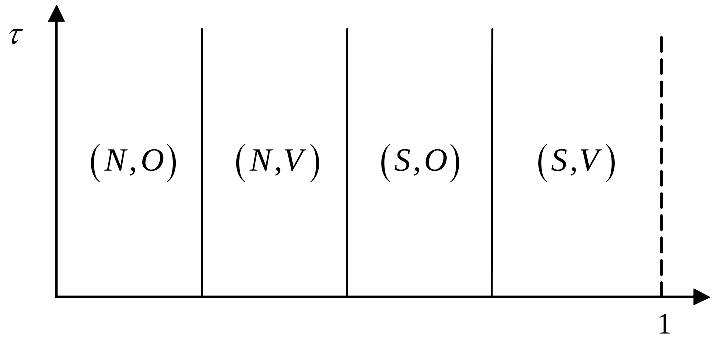

Figure 3: Organizational form shares as a function of τ.

5 Tariffs on intermediate goods

I consider next the case in which the South government does not impose any tariffs ($\tau = 1$) on the Southern imports of differentiated goods. Instead the North government imposes a tariff $\zeta \equiv 1 + t^N$ on the Southern exports of intermediate goods. This policy affects the relative cost of getting the inputs in the South *vis a vis* getting them in the North. The profit function must be modified accordingly, thus,

$$\pi_k^l(\theta, P, \nu) = \vartheta^{I(l=S)} \Psi_k^l P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \theta^{\frac{\alpha}{1-\alpha}} - f_k^l w^N \tag{23}$$

where $\vartheta \equiv \zeta^{\frac{-(1-\nu)\alpha}{(1-\alpha)}}$ and $I(l = S)$ is an indicator function, which takes value one if the inputs are produced in the South and zero otherwise. This implies that in the former case the profit function is multiplied by a factor less than one ($\zeta^{-(1-\nu)\alpha/(1-\alpha)} < 1$), while in the latter case it is multiplied by one ($\zeta^0 = 1$).

As a benchmark case I assume that there is no change in the firms' sorting pattern. Thus, a version of (13) holds. In particular,

$$\vartheta \Psi_V^S > \vartheta \Psi_O^S > \Psi_V^N > \Psi_O^N$$

This, in turn, requires that: $\left(\frac{w^N}{w}\right)^{1-\nu} > \frac{\phi\left(\beta_V^N, \nu\right)}{\vartheta \phi(\beta, \nu)}$.

The new cutoffs are now going to be

$$\begin{aligned}
\pi_O^N = 0 \Rightarrow \underline{\theta}\left(P\left(\zeta\right)\right) &= \left[\frac{w^N f_O^N}{\Psi_O^N}\frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}}\right]^{(1-\alpha)/\alpha} \\
\pi_O^N = \pi_V^N \Rightarrow \theta_O^N\left(P\left(\zeta\right)\right) &= \left[\frac{w^N (f_O^N - f_V^N)}{(\Psi_O^N - \Psi_V^N)}\frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}}\right]^{(1-\alpha)/\alpha} \\
\pi_O^S = \pi_V^N \Rightarrow \theta_V^N\left(P\left(\zeta\right),\zeta\right) &= \left[\frac{w^N (f_V^N - f_O^S)}{(\Psi_V^N - \vartheta\Psi_O^S)}\frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}}\right]^{(1-\alpha)/\alpha} \\
\pi_O^S = \pi_V^S \Rightarrow \theta_O^S\left(P\left(\zeta\right),\zeta\right) &= \left[\frac{w^N (f_O^S - f_V^S)}{\vartheta(\Psi_O^S - \Psi_V^S)}\frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}}\right]^{(1-\alpha)/\alpha}
\end{aligned} \tag{24}$$

Note that the first two cutoffs ($\underline{\theta}$ and θ_O^N) depend on ζ only indirectly via its effect on P. In contrast, the last two (θ_V^N and θ_O^S) depend on ζ both directly and indirectly.

To make sure that, at least initially, all four types of firms exist in equilibrium we need

$$\underline{\theta} < \theta_O^N, \theta_V^N < \theta_O^S \tag{25}$$

To guarantee that this ordering (25) holds we need the following conditions to be satisfied: $\frac{f_O^N}{\Psi_O^N} < \frac{f_O^N - f_V^N}{\Psi_O^N - \Psi_V^N} < \frac{f_V^N - f_O^S}{\Psi_V^N - \vartheta\Psi_O^S} < \frac{f_O^S - f_V^S}{\vartheta(\Psi_O^S - \Psi_V^S)}$.

Finally, the free entry condition may be written as

$$\begin{aligned}
w^N f_E &= \int_{\underline{\theta}}^{\theta_O^N} \left[\Psi_O^N P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \theta^{\frac{\alpha}{1-\alpha}} - f_O^N w^N\right] g\left(\theta\right) d\theta \\
&\quad + \int_{\theta_O^N}^{\theta_V^N} \left[\Psi_V^N P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \theta^{\frac{\alpha}{1-\alpha}} - f_V^N w^N\right] g\left(\theta\right) d\theta \\
&\quad + \int_{\theta_V^N}^{\theta_O^S} \left[\Psi_O^S \vartheta P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \theta^{\frac{\alpha}{1-\alpha}} - f_O^S w^N\right] g\left(\theta\right) d\theta \\
&\quad + \int_{\theta_O^S}^{\infty} \left[\Psi_V^S \vartheta P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \theta^{\frac{\alpha}{1-\alpha}} - f_V^S w^N\right] g\left(\theta\right) d\theta
\end{aligned}$$

5.1 Effects of ζ on cutoffs and prices

Just as in the previous section, we can use the cutoffs and the free entry condition to analyze the effects of the tariff ζ.. In the Appendix I show that the change in P due to a change is τ is positive: $\frac{dP}{d\zeta} > 0$. Therefore, the imposition of a tariff ζ on the Northern imports of Southern intermediate goods will increase the aggregate prices.

With this result we can compute the effect of the tariff ζ on the different cutoffs. The first two cutoffs depend on ζ only via P:

$$\begin{aligned}\frac{\partial \underline{\theta}}{\partial \zeta} &= \frac{d\underline{\theta}}{dP}\frac{dP}{d\zeta} \\ &= \underbrace{\left[\frac{w^N f_O^N}{\Psi_O^N}\right]^{(1-\alpha)/\alpha} \frac{-(\alpha-\mu)}{(1-\mu)\,\alpha} \frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)\alpha}+1}}}_{(-)} * \underbrace{\frac{dP}{d\zeta}}_{(+)} < 0\end{aligned}$$

$$\begin{aligned}\frac{\partial \theta_O^N}{\partial \zeta} &= \frac{d\theta_O^N}{dP}\frac{dP}{d\zeta} \\ &= \underbrace{\left[\frac{w^N (f_O^N - f_V^N)}{(\Psi_O^N - \Psi_V^N)}\right]^{(1-\alpha)/\alpha} \frac{-(\alpha-\mu)}{(1-\mu)\,\alpha} \frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)\alpha}+1}}}_{(-)} * \underbrace{\frac{dP}{d\zeta}}_{(+)} < 0\end{aligned}$$

The tariff ζ protects those firms working with Northern managers. It allows some low productivity firms to stay in the market due to the lower $\underline{\theta}$. It also provides incentives the most productive firms within the (N, O) group to vertically integrate (lower θ_O^N) since they are now relatively "more competitive" *vis a vis* firms sourcing in the South.

In contrast, the other two cutoffs depend on ζ directly and indirectly via P (again, the details are provided in the Appendix).

$$\begin{aligned}\frac{d\theta_V^N}{d\zeta} &= \frac{\partial \theta_V^N}{\partial \zeta} + \frac{\partial \theta_V^N}{\partial P}\frac{dP}{d\zeta} > 0 \\ \frac{d\theta_O^S}{d\zeta} &= \frac{\partial \theta_O^S}{\partial \zeta} + \frac{\partial \theta_O^S}{\partial P}\frac{dP}{d\zeta} > 0\end{aligned}$$

As expected, the tariff ζ "hurts" those firms working with Southern managers increasing the effective cost of their labor. The least productive firms within each type ((S, O) and (S, V)) will have to switch to a less productivity demanding organizational form ((N, O) and (S, O), respectively).

Proposition 4 *In the benchmark case, and for any $G(\cdot)$, a tariff ζ imposed on the Northern imports of Southern intermediate goods will have the following effects:*

1. *Aggregate prices P will increase.*

2. *Cutoffs $\underline{\theta}$ and θ_O^N will decrease.*

3. *Cutoffs θ_V^N and θ_O^S will increase.*

Effects on firms' prices and quantities. We already know that $x(i) = (P)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \theta_i^{\frac{1}{1-\alpha}} \zeta^{I(l=S)\frac{-(1-\nu)\alpha}{(1-\alpha)}} \left[\Lambda_k^l\right]^{\frac{1}{1-\alpha}}$. Then,

$$\begin{aligned}
\frac{dx(i)}{d\zeta} &= \frac{\partial x}{\partial \zeta} + \frac{\partial x}{\partial P}\frac{dP}{d\zeta} \\
&= x(i)(P)^{-1}\frac{1}{1-\alpha}\left\{-I(l=S)\frac{P}{\zeta}(1-\nu)\alpha + \frac{\alpha-\mu}{1-\mu}\frac{dP}{d\zeta}\right\} \\
&> 0 \Leftrightarrow l = N \\
&< 0 \Leftrightarrow l = S
\end{aligned}$$

Not surprisingly, firms working with Northern managers will increase their output while offshoring firms will decrease theirs.[18]

Remember that the demands were given by $p(i) = x(i)^{\alpha-1} P^{\frac{\alpha-\mu}{1-\mu}}$. Thus,

$$\begin{aligned}
\frac{dp(i)}{d\zeta} &= \frac{\partial p}{\partial x}\frac{dx}{d\zeta} + \frac{\partial p}{\partial P}\frac{dP}{d\zeta} \\
&= \frac{p}{x}(\alpha-1)\frac{dx}{d\zeta} + \frac{\alpha-\mu}{1-\mu}\frac{p}{P}\frac{dP}{d\zeta} \\
&= I(l=S)\frac{p}{\zeta}(1-\nu)\alpha
\end{aligned}$$

Offshoring firms will increase their prices while non-offshoring firms will not change them – they increase their sales due to a positive substitution effect.

[18] Firms in the margin of the cutoffs will have a discrete change if they switch their type because of the change in $\Lambda_k^l \equiv \left[\alpha\left(\frac{\beta_k^l}{w^N}\right)^{\nu}\left(\frac{(1-\beta_k^l)}{w^l}\right)^{1-\nu}\right]^{\frac{1}{1-\alpha}}$. For firms switching from (N,O) or (N,V) this term will be positive; while for those moving from (S,V) to (S,O) or from (S,O) to (N,V) it will be negative (since ν is "high"). Obviously, for those firms entering into the market after the tariff the change is positive.

Trade flows. The value of the Southern imports of differentiated goods is given by $I^S = (1-\gamma) PX$. The effect of the tariff ζ will be the following:[19]

$$\begin{aligned} \frac{dI^S}{d\zeta} &= (1-\gamma)\left[X\frac{dP}{d\zeta} + P\frac{dX}{d\zeta}\right] \\ &= -\frac{\mu}{1-\mu}(1-\gamma) X \frac{dP}{d\zeta} < 0 \end{aligned}$$

Proposition 5 *The imposition of a tariff ζ on the Northern imports of intermediate goods will have the following effects on the trade flows:*

1. *Southern imports of differentiated goods will decrease (in quantity and value).*

2. *To keep trade balanced, Southern exports of inputs and the homogeneous good will decrease (in quantity and value).*

5.2 Prevalence

Using the Pareto distribution (21) we can check how the fractions σ_k^l are affected by ζ.

$$\begin{aligned} \sigma_O^N &= 1 - \left[\frac{\Psi_O^N - \Psi_v^N}{f_O^N - f_V^N}\frac{f_O^N}{\Psi_O^N}\right]^{\frac{z(1-\alpha)}{\alpha}} \\ \sigma_V^N &= \left(\frac{f_O^N}{\Psi_O^N}\right)^{\frac{z(1-\alpha)}{\alpha}}\left[\left(\frac{f_O^N - f_V^N}{\Psi_O^N - \Psi_v^N}\right)^{-z(1-\alpha)/\alpha} - \left(\frac{f_V^N - f_O^S}{\Psi_V^N - \vartheta\Psi_O^S}\right)^{-z(1-\alpha)/\alpha}\right] \\ \sigma_O^S &= \left(\frac{f_O^N}{\Psi_O^N}\right)^{\frac{z(1-\alpha)}{\alpha}}\left[\left(\frac{f_V^N - f_O^S}{\Psi_V^N - \vartheta\Psi_O^S}\right)^{\frac{-z(1-\alpha)}{\alpha}} - \left(\frac{f_O^S - f_V^S}{\vartheta(\Psi_O^S - \Psi_V^S)}\right)^{\frac{-z(1-\alpha)}{\alpha}}\right] \\ \sigma_V^S &= \left[\vartheta\frac{\Psi_O^S - \Psi_V^S}{f_O^S - f_V^S}\frac{f_O^N}{\Psi_O^N}\right]^{\frac{z(1-\alpha)}{\alpha}} \end{aligned} \tag{26}$$

Proposition 6 *In the benchmark case, and if $G(\cdot)$ is Pareto, the imposition of a tariff on Southern exports of inputs, reduces the fractions of active firms outsourcing and integrating in the South, increases the fraction of those integrating in the North and has no effect on those outsourcing in the North. (See Figure 4).*

[19] It's easy to check that $\frac{dX}{d\zeta} = -\frac{dP}{d\zeta}\frac{X}{P}\frac{1}{1-\mu}$.

Proof. Differentiating the σ_k^l found in expression (26) we get:

$$\frac{\partial \sigma_O^N}{\partial \zeta} = 0$$

$$\frac{\partial \sigma_V^N}{\partial \zeta} = \left(\frac{f_O^N}{\Psi_O^N}\right)^{\frac{z(1-\alpha)}{\alpha}} zK^{-2} \left(\frac{f_V^N - f_O^S}{\Psi_V^N - \vartheta \Psi_O^S}\right)^{\frac{z(1-\alpha)}{\alpha}-1} \Psi_O^S (1-\nu) \zeta^{\frac{-(1-\nu)\alpha}{(1-\alpha)}-1} > 0$$

$$\frac{\partial \sigma_V^S}{\partial \zeta} = -\left(\frac{\Psi_O^S - \Psi_v^S}{f_O^S - f_V^S} \frac{f_O^N}{\Psi_O^N}\right)^{\frac{z(1-\alpha)}{\alpha}} z(1-\nu)\zeta^{\frac{-(1-\nu)\alpha}{(1-\alpha)}-1} < 0$$

where $K \equiv \left[\left(\frac{f_O^N - f_V^N}{\Psi_O^N - \Psi_v^N}\right)^{z(1-\alpha)/\alpha} - \left(\frac{f_V^N - f_O^S}{\Psi_V^N - \vartheta \Psi_O^S}\right)^{z(1-\alpha)/\alpha}\right]$

Note that $\frac{\sigma_O^S}{\sigma_V^S} = \left(\frac{\Psi_V^N - \vartheta \Psi_O^S}{f_V^N - f_O^S} \frac{f_O^S - f_V^S}{\vartheta(\Psi_O^S - \Psi_V^S)}\right)^{\frac{z(1-\alpha)}{\alpha}} - 1$. So we have that

$$\frac{\partial}{\partial \zeta}\left(\frac{\sigma_O^S}{\sigma_V^S}\right) = \frac{z(1-\alpha)}{\alpha}\left(\frac{\Psi_V^N - \vartheta \Psi_O^S}{f_V^N - f_O^S} \frac{f_O^S - f_V^S}{\Xi(\Psi_O^S - \Psi_V^S)}\right)^{\frac{z(1-\alpha)}{\alpha}-1} \left(\frac{f_O^S - f_V^S}{\vartheta(\Psi_O^S - \Psi_V^S)}\right)\left(\frac{-\Psi_V^N}{\vartheta} \frac{1}{f_V^N - f_O^S}\right)\frac{\partial \vartheta}{\partial \zeta} < 0.$$

Given that $\frac{\partial \sigma_V^S}{\partial \zeta} < 0$, it must be that $\frac{\partial \sigma_O^S}{\partial \zeta} < 0$. ■

Remark 1 *In the South, the decrease will be greater among the outsourcing firms.*

This result is very intuitive. Since getting inputs in the South is now relatively more expensive some firms will look for Northern managers. The overall effect is clear: the fraction of firms sourcing in North (South) will increase (decrease). In this way, some firms with organizational form (S, O) switch to (N, V) and σ_V^N will increase. Also, as some firms switch from (S, V) into (S, O), σ_V^S will decrease. Thus, the fraction of firms choosing $\{S, O\}$ is affected by these two "in" and "out" movements. However, the outward movement is greater and so the overall effect on σ_O^S is negative. Conversely, a tariff reduction will increase the prevalence of outsourcing firms in both countries (relative to integrating firms) and the fraction of firms sourcing in the South.

5.3 Higher values of ζ

So far we have assumed that the tariff is such that all four types of firms exist in equilibrium – i.e., that the ordering of the cutoffs given by expression (25) is satisfied.

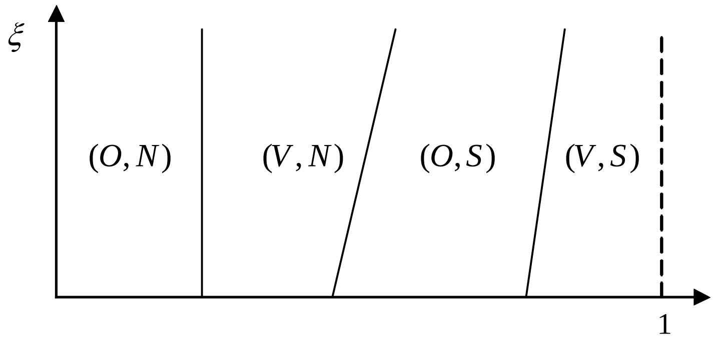

Figure 4: Organizational form shares as a function of tariffs on intermediate goods

However, as ζ increases this will no longer be satisfied. Let's look again at the conditions determining how the cutoffs are ranked. In the case of the first inequality, $\underline{\theta} < \theta_O^N \Leftrightarrow \frac{f_O^N}{\Psi_O^N} < \frac{f_V^N - f_O^N}{\Psi_V^N - \Psi_O^N}$, ζ makes no difference. However, in the other two cases it does:

$$\theta_O^N < \theta_V^N \Leftrightarrow \frac{f_V^N - f_O^N}{f_O^S - f_V^N} < \frac{\Psi_V^N - \Psi_O^N}{\vartheta \Psi_O^S - \Psi_V^N}$$

$$\theta_V^N < \theta_O^S \Leftrightarrow \frac{f_O^S - f_V^N}{f_V^S - f_O^S} < \frac{\Psi_O^S}{(\Psi_V^S - \Psi_O^S)} - \frac{\Psi_V^N}{\vartheta(\Psi_V^S - \Psi_O^S)}$$

In both cases, the last line has an inequality whose LHS is fixed while the RHS varies with ζ. In the first case, ζ increases the RHS making the inequality "easier" to hold – thus, $\theta_O^N < \theta_V^N$ will be preserved. However, in the second case, the RHS decreases with ζ making the inequality "harder" to hold. Hence, eventually the sign of the inequality will be reversed and $\theta_V^N > \theta_O^S$. Once this takes place no firm will organize as (S, O) and we will have new cutoff $\left(\theta_V^N\right)'$ originating from the intersection of π_V^N and π_V^S.

$$\pi_V^S = \pi_V^N \Rightarrow \theta_V^N \left(P\left(\zeta\right), \zeta\right)' = \left[\frac{w^N(f_V^N - f_V^S)}{(\Psi_V^N - \vartheta \Psi_V^S)} \frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}}\right]^{(1-\alpha)/\alpha}$$

From our previous analysis we know that this new cutoff $\theta_V^N\left(P\left(\zeta\right), \zeta\right)'$ will increase with ζ: $\frac{\partial\left(\theta_V^N\right)'}{\partial \zeta} > 0$.[20]

[20] However, under this scenario, the free entry condition will be modified since there are less types of firms. In consequence, the specific expression for $dP/d\zeta$ will also be different.

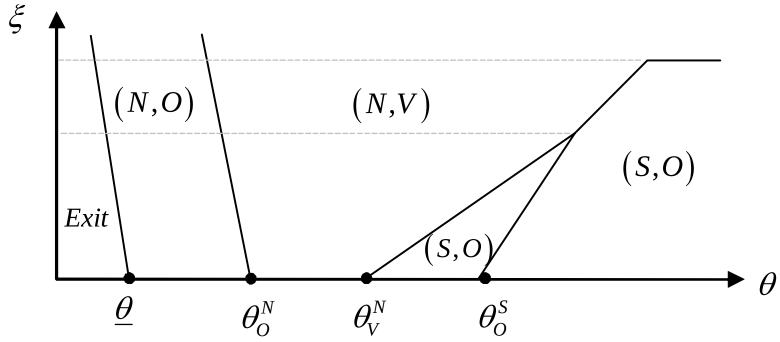

Figure 5: Organizational form cutoffs as a function of ζ.

Finally, as ζ continues to increase there will be a reversal in the ordering of the slopes of the profit functions. When ζ is such that

$$\Psi_O^N < \vartheta\Psi_O^S < \vartheta\Psi_V^S < \Psi_V^N$$

the profit line for (N,V) is going to have a grater intercept and slope than those of (S,O) and (S,V). Thus, no firm will look for a Southern manager – all firms will organize as (N,O) or (N,V).

To sum up, the magnitude of the tariff ζ will determine the outcome of the industry equilibrium as shown in Figure 5.[21] In an industry that would have all four types of firms under free trade, high values of ζ will allow only two kinds of firms, (N,O) and (N,V), no offshoring and, hence, no intra-firm international trade. As ζ starts decreasing some (S,V) firms will appear. Finally, for lower values of ζ there will be four different kinds of firms.

[21] The movements of the cutoffs with respect to ζ in general will not be linear.

6 Comment on τ and ζ

From the results obtained above we know that the effects of ζ on the shares of active firms choosing each form is quite different from the effects of τ. From Propositions 3 and 6 it follows that while the South government is incapable of changing the shares σ_k^l, the North government is able to affect the percentage of firms that get their inputs in each country. Alternatively, while the tariffs on final goods do not affect the distribution of firms, tariffs on intermediate goods do affect it. This second interpretation extends beyond this version of the model. Presumably, in a more generalized version where there are also Southern entrepreneurs, the only policies influencing the organizational form shares would be the tariffs on intermediate goods. That is, if both countries had available both kinds of policies, the tariffs on final goods would be irrelevant to institutional forms, while the interaction among the two input tariffs would determine the σ_k^l shares.

7 Conclusion

This paper studies the interaction between firms' organizational forms and tariffs. Following the theoretical framework developed by Antràs and Helpman (2004), I first show that a tariff imposed by the South on differentiated final goods imports has no effect on the cutoffs at which each type is chosen nor on the fraction of active firms operating in the South. Next, I show that a tariff imposed by the North on Southern intermediate good exports decreases the thresholds at which firms look for Northern managers and increases those at which firms decide to offshore. Additionally, this same tariff reduces the share of active firms looking for inputs in the South and increases the prevalence of vertical integration (relative to outsourcing) in *both* countries. Finally, I show how the actual structure of any industry depends on the tariff level.

There are several natural extensions for this model. First, the model's predictions might be empirically tested to check the relative importance of tariffs on final goods *vis a vis* tariffs on intermediate goods.[22] Second, the model could be adjusted to consider the effects of tariffs under a more sophisticated production process. An example of such an extension could be to allow firms to produce the final good abroad and export it back from the foreign location. See Grossman, Helpman and Szeidl (2004 and 2006), Yeaple (2003) and Ekholm et al (2004) for three-country frameworks where firms behave in this way. Third, the model could also be extended to consider the optimal tariff policy that each government should follow.[23] Preliminary results, modeling the governments as national income maximizers, indicate that the South government should still follow some version of the standard rule – set the tariff equal to the inverse of the other country's export supply elasticity.[24] Finally, we could consider a world composed by one North country and many South countries. In a similar way to that followed by Blanchard (2005), each of the Southern countries would design an optimal tariff τ^i while the North could still have an import tariff ζ. Depending on whether discrimination is possible or not (i.e., allowing the North to impose different ζ^i) one might expect to find that the optimal τ's differ, both in value and in efficiency.

[22] To the best of my knowledge, Feenstra and Hanson (2005) is the only trade paper to empirically test outsourcing. Using Chinese export-processing data, they find evidence supporting the "property-rights approach to the firm.

[23] For some seminal papers on endogenous tariffs, see Meyer (1984) and Bhagwati (1987).

[24] This way of modeling the governments is similar to that found in Bagwell and Staiger (1999) and Blanchard (2004a) .

APPENDIX

A Derivations for sections 4 and 5

A.1 Firm's problem

Sales in each market. In order to decide how to split a given production level $x(i)$ between the Northern and Southern markets the firm will solve

$$\max \gamma^{1-\alpha} P_N^{\frac{\alpha-\mu}{1-\mu}} x_N(i)^{\alpha} + (1-\gamma)^{1-\alpha} P_S^{\frac{\alpha-\mu}{1-\mu}} \tau^{\frac{\alpha-1}{1-\mu}} (x(i) - x_N(i))^{\alpha} \tag{27}$$

The FOC is

$$\frac{\partial(\cdot)}{\partial x_N(i)} = \gamma^{1-\alpha} P_N^{\frac{\alpha-\mu}{1-\mu}} \alpha x_N(i)^{\alpha-1} - (1-\gamma)^{1-\alpha} P_S^{\frac{\alpha-\mu}{1-\mu}} \tau^{\frac{\alpha-1}{1-\mu}} \alpha (x(i) - x_N(i))^{\alpha-1} = 0$$

The resulting optimal quantities are:

$$\begin{aligned} x_N(i) &= \frac{\gamma (P_N)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}}{(1-\gamma)(P_S)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} (\tau)^{-\frac{1}{1-\mu}} + \gamma (P_N)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}} x(i) \\ x_S(i) &= \frac{(1-\gamma)(P_S)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} (\tau)^{-\frac{1}{1-\mu}}}{(1-\gamma)(P_S)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} (\tau)^{-\frac{1}{1-\mu}} + \gamma (P_N)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}} x(i) \end{aligned} \tag{28}$$

Output and revenue. Let's plug in these quantities into the revenue:

$$R = \left((1-\gamma)(P_S)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} (\tau)^{\frac{-1}{1-\mu}} + \gamma (P_N)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \right)^{1-\alpha} x^{\alpha}$$

Defining $\Upsilon = \left((1-\gamma)(P_S)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} (\tau)^{\frac{-1}{1-\mu}} + \gamma (P_N)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \right)^{1-\alpha}$ we can re-write the revenue as $R = \Upsilon x(i)^{\alpha}$.

The production of $x(i) = \theta_i \left(\frac{h}{\nu}\right)^{\nu} \left(\frac{m}{1-\nu}\right)^{1-\nu}$ requires cooperation among an entrepreneur and a manager. Since contracts are incomplete they will choose h and m non-cooperatively – each one will get a fraction (β_k^l or $\left(1-\beta_k^l\right)$) of the ex-post surplus.

The entrepreneur chooses h, taking m as given, in order to maximize:

$$\max_h \beta R - w^N h$$

In the same way, the manager chooses m, taking h as given:

$$\max_{m} \beta R - w^l m$$

The optimal decisions for the entrepreneur and the manager are the following:

$$\begin{aligned} h^* &= \frac{\beta_k^l \alpha \nu R}{w^N} \\ m^* &= \frac{\left(1-\beta_k^l\right) \alpha (1-\nu) R}{w^l} \end{aligned} \tag{29}$$

Consequently:

$$R = \left((1-\gamma) (P_S)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} (\tau)^{\frac{-1}{1-\mu}} + \gamma (P_N)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \right) \theta^{\frac{\alpha}{1-\alpha}} \left[\alpha \left(\frac{\beta_k^l}{w^N} \right)^{\nu} \left(\frac{\left(1-\beta_k^l\right)}{w^l} \right)^{1-\nu} \right]^{\frac{\alpha}{1-\alpha}} \tag{30}$$

Combining this last expression with $R = \Upsilon x^{\alpha}$ we can find out $x(i)$:

$$x(i) = \left((1-\gamma) (P_S)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} (\tau)^{\frac{-1}{1-\mu}} + \gamma (P_N)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \right) \theta^{\frac{1}{1-\alpha}} \left[\alpha \left(\frac{\beta_k^l}{w^N} \right)^{\nu} \left(\frac{\left(1-\beta_k^l\right)}{w^l} \right)^{1-\nu} \right]^{\frac{1}{1-\alpha}} \tag{31}$$

Profits. From the expression for the revenue we can compute the profits earned by a firm looking for a manager in location l and with capital structure k.

$$\begin{aligned} \pi_k^l &= R - f_k^l w^N - w^N h^* - w^l m^* \\ \pi_k^l &= \left[1 - \alpha \left(\beta \nu + (1-\beta)(1-\nu)\right)\right] R - f_k^l w^N \end{aligned}$$

Replacing by R:

$$\pi_k^l = \Psi_k^l \left((1-\gamma) (P_S)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} (\tau)^{\frac{-1}{1-\mu}} + \gamma (P_N)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \right) \theta^{\frac{\alpha}{1-\alpha}} - f_k^l w^N$$

A.2 Aggregate prices

Recall that the demands faced by firms in each market were

- $p_S(i) = (1-\gamma)^{1-\alpha}(x_S(i))^{(\alpha-1)} P_S^{\frac{\alpha-\mu}{1-\mu}} \tau^{\frac{\alpha-1}{1-\mu}}$

- $p_N(i) = \gamma^{1-\alpha}(x_N(i))^{(\alpha-1)} P_N^{\frac{\alpha-\mu}{1-\mu}}$

The aggregate prices were defined as follows:

- $P_S = \left(\int_{\underline{\theta}}^{\infty} Mp_S(\theta)^{\frac{\alpha}{\alpha-1}} g(\theta)\, d\theta\right)^{\frac{\alpha-1}{\alpha}}$

- $P_N = \left(\int_{\underline{\theta}}^{\infty} Mp_N(\theta)^{\frac{\alpha}{\alpha-1}} g(\theta)\, d\theta\right)^{\frac{\alpha-1}{\alpha}}$

It follows that:

$$\begin{aligned} P_S &= (1-\gamma)^{1-\mu}\tau^{-1}\left(\int M(x_S(\theta))^{\alpha} g(\theta)\, d\theta\right)^{-\frac{1-\mu}{\alpha}} \\ P_N &= \gamma^{1-\mu}\left(\int M(x_N(\theta))^{\alpha} g(\theta)\, d\theta\right)^{-\frac{1-\mu}{\alpha}} \end{aligned}$$

Plugging in the quantities x_S and x_N: and taking the ratio we find:

$$\frac{P_S}{P_N} = \frac{\left((1-\gamma)(P_S)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}(\tau)^{-\frac{1}{1-\mu}}\right)^{-(1-\mu)}}{\left(\gamma (P_N)^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}\right)^{-(1-\mu)}}\tau^{-1}\frac{(1-\gamma)^{1-\mu}}{\gamma^{1-\mu}}$$

Then:

$$P_S = P_N = P$$

Thus, we conclude that the aggregate prices in both countries are exactly the same. Consequently, we can re-write all the expressions derived in the previous subsection as functions of τ and P alone.

A.3 Effect of τ on P

First, let's rewrite the free entry condition

$$\begin{aligned} w^N f_E &= \Psi_O^N T P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \left[V\left(\theta_O^N\right) - V\left(\underline{\theta}\right)\right] - f_O^N w^N \left[G\left(\theta_O^N\right) - G\left(\underline{\theta}\right)\right] + \\ &\quad \Psi_V^N T P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \left[V\left(\theta_V^N\right) - V\left(\theta_O^N\right)\right] - f_V^N w^N \left[G\left(\theta_V^N\right) - G\left(\theta_O^N\right)\right] + \\ &\quad \Psi_O^S T P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \left[V\left(\theta_O^S\right) - V\left(\theta_V^N\right)\right] - f_O^S w^N \left[G\left(\theta_O^S\right) - G\left(\theta_V^N\right)\right] + \\ &\quad \Psi_V^S T P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \left[V\left(\infty\right) - V\left(\theta_O^S\right)\right] - f_V^S w^N \left[1 - G\left(\theta_O^S\right)\right] \end{aligned}$$

where $V(\theta) \equiv \int_0^\theta \theta^{\frac{\alpha}{1-\alpha}} g(\theta)\, d(\theta)$.

Next, let's differentiate with respect to P.

$$\begin{aligned} \frac{\partial LHS}{\partial P} &= 0 \\ \frac{\partial RHS}{\partial P} &= \Psi_O^N T \{ \frac{\alpha-\mu}{(1-\mu)(1-\alpha)} P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}-1} \left[V\left(\theta_O^N\right) - V\left(\underline{\theta}\right)\right] + \\ &\quad P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \left[\theta_O^{N\frac{\alpha}{1-\alpha}} g\left(\theta_O^N\right) \frac{d\theta_O^N}{dP} - \underline{\theta}^{\frac{\alpha}{1-\alpha}} g\left(\underline{\theta}\right) \frac{d\underline{\theta}}{dP}\right] \} - f_O^N w^N \left[g\left(\theta_O^N\right) \frac{d\theta_O^N}{dP} - g\left(\underline{\theta}\right) \frac{d\underline{\theta}}{dP}\right] + \\ &\quad \Psi_V^N T \{ \frac{\alpha-\mu}{(1-\mu)(1-\alpha)} P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}-1} \left[V\left(\theta_V^N\right) - V\left(\theta_O^N\right)\right] + \\ &\quad P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \left[\theta_V^{N\frac{\alpha}{1-\alpha}} g\left(\theta_V^N\right) \frac{d\theta_V^N}{dP} - \theta_O^{N\frac{\alpha}{1-\alpha}} g\left(\theta_O^N\right) \frac{d\theta_O^N}{dP}\right] \} - f_V^N w^N \left[g\left(\theta_V^N\right) \frac{d\theta_V^N}{dP} - g\left(\theta_O^N\right) \frac{d\theta_O^N}{dP}\right] + \\ &\quad \Psi_O^S T \{ \frac{\alpha-\mu}{(1-\mu)(1-\alpha)} P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}-1} \left[V\left(\theta_O^S\right) - V\left(\theta_V^N\right)\right] + \\ &\quad P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \left[\theta_O^{S\frac{\alpha}{1-\alpha}} g\left(\theta_O^S\right) \frac{d\theta_O^S}{dP} - \theta_V^{N\frac{\alpha}{1-\alpha}} g\left(\theta_V^N\right) \frac{d\theta_V^N}{dP}\right] \} - f_O^S w^N \left[g\left(\theta_O^S\right) \frac{d\theta_O^S}{dP} - g\left(\theta_V^N\right) \frac{d\theta_V^N}{dP}\right] + \\ &\quad \Psi_V^S T \{ \frac{\alpha-\mu}{(1-\mu)(1-\alpha)} P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}-1} \left[V\left(\infty\right) - V\left(\theta_O^S\right)\right] + \\ &\quad P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \left[-\theta_O^{S\frac{\alpha}{1-\alpha}} g\left(\theta_O^S\right) \frac{d\theta_O^S}{dP}\right] \} - f_V^S w^N \left[-g\left(\theta_O^S\right) \frac{d\theta_O^S}{dP}\right] \end{aligned}$$

Look at the third line: we have $-\Psi_O^N T P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \underline{\theta}^{\frac{\alpha}{1-\alpha}} g\left(\underline{\theta}\right) \frac{d\underline{\theta}}{dP}$ and $f_O^N w^N g\left(\underline{\theta}\right) \frac{d\underline{\theta}}{dP}$. But from the definition of the cutoff we know that $\Psi_O^N T P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \underline{\theta}^{\frac{\alpha}{1-\alpha}} = f_O^N w^N$. Hence, these terms cancel out – analogously for the other cutoffs. So,

$$\frac{\partial RHS}{\partial P} = \left((1-\gamma)(\tau)^{\frac{-1}{1-\mu}}+\gamma\right)\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}-1}\{\Psi_O^N\left[V\left(\theta_O^N\right)-V\left(\underline{\theta}\right)\right]+ \Psi_V^N\left[V\left(\theta_V^N\right)-V\left(\theta_O^N\right)\right]+\Psi_O^S\left[V\left(\theta_O^S\right)-V\left(\theta_V^N\right)\right]+\Psi_V^S\left[V\left(\infty\right)-V\left(\theta_O^S\right)\right]\}$$

Similarly, with respect to τ

$$\frac{\partial LHS}{\partial \tau} = 0$$

$$\frac{\partial RHS}{\partial \tau} = P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}\frac{-(1-\gamma)}{1-\mu}(\tau)^{\frac{-1}{1-\mu}-1}\{\Psi_O^N\left[V\left(\theta_O^N\right)-V\left(\underline{\theta}\right)\right]+\Psi_O^S\left[V\left(\infty\right)-V\left(\theta_O^N\right)\right]+ \Psi_V^N\left[V\left(\theta_V^N\right)-V\left(\theta_O^N\right)\right]+\Psi_O^S\left[V\left(\theta_O^S\right)-V\left(\theta_V^N\right)\right]+\Psi_V^S\left[V\left(\infty\right)-V\left(\theta_O^S\right)\right]\}$$

Finally, the change in P due to a change is τ is

$$\frac{dP}{d\tau} = \frac{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}(1-\gamma)(\tau)^{\frac{-1}{1-\mu}-1}}{T\frac{\alpha-\mu}{(1-\alpha)}P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}-1}} = \frac{(1-\gamma)(1-\alpha)}{\alpha-\mu}\frac{P(\tau)^{\frac{-1}{1-\mu}-1}}{T}>0 \tag{32}$$

A.4 Effect of ζ on P

First, let's rewrite the free entry condition

$$w^N f_E = \Psi_O^N P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}\left[V\left(\theta_O^N\right)-V\left(\underline{\theta}\right)\right]-f_O^N w^N\left[G\left(\theta_O^N\right)-G\left(\underline{\theta}\right)\right]+ \Psi_V^N P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}\left[V\left(\theta_V^N\right)-V\left(\theta_O^N\right)\right]-f_V^N w^N\left[G\left(\theta_V^N\right)-G\left(\theta_O^N\right)\right]+ \Psi_O^S\zeta^{\frac{-(1-\nu)\alpha}{(1-\alpha)}}P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}\left[V\left(\theta_O^S\right)-V\left(\theta_V^N\right)\right]-f_O^S w^N\left[G\left(\theta_O^S\right)-G\left(\theta_V^N\right)\right]+ \Psi_O^S\zeta^{\frac{-(1-\nu)\alpha}{(1-\alpha)}}P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}\left[V\left(\infty\right)-V\left(\theta_O^S\right)\right]-f_V^S w^N\left[1-G\left(\theta_O^S\right)\right]$$

Proceeding exactly as in the previous subsection we find that

$$\frac{dP}{d\zeta}=\frac{(1-\mu)(1-\nu)\alpha}{\alpha-\mu}P\zeta^{\frac{-(1-\nu)\alpha}{(1-\alpha)}-1}\left\{\Psi_O^S\left[V\left(\theta_O^S\right)-V\left(\theta_V^N\right)\right]+\Psi_V^S\left[V\left(\infty\right)-V\left(\theta_O^S\right)\right]\right\}A>0$$

where $A^{-1} \equiv \Psi_O^N \left[V\left(\theta_O^N\right) - V\left(\underline{\theta}\right)\right] + \Psi_V^N \left[V\left(\theta_V^N\right) - V\left(\theta_O^N\right)\right] + \vartheta\left(\Psi_O^S \left[V\left(\theta_O^S\right) - V\left(\theta_V^N\right)\right] + \Psi_V^S \left[V\left(\infty\right) - V\left(\theta_O^S\right)\right]\right) > 0$ since $V\left(\cdot\right)$ is an increasing function.

A.5 Effect of ζ on the cutoffs

A.5.1 Case 1: θ_V^N

After some tedious algebra we find that:

$$\begin{aligned} \frac{d\theta_V^N}{d\zeta} &= \frac{\partial\theta_V^N}{\partial\zeta} + \frac{\partial\theta_V^N}{\partial P}\frac{dP}{d\zeta} \\ &= -\theta_V^N \left[\frac{(1-\nu)\zeta^{\frac{-(1-\nu)\alpha}{(1-\alpha)}-1}\Psi_O^S}{\left(\Psi_V^N - \vartheta\Psi_O^S\right)} + \frac{(\alpha-\mu)}{(1-\mu)\,\alpha}\frac{1}{P} * \frac{dP}{d\zeta}\right] \\ &= -\theta_V^N(1-\nu)\zeta^{\frac{-(1-\nu)\alpha}{(1-\alpha)}-1}Q > 0 \end{aligned}$$

where $Q \equiv \frac{\Psi_O^S\Psi_O^N\left[V\left(\theta_O^N\right)-V\left(\underline{\theta}\right)\right]+\Psi_O^S\Psi_V^N\left[V\left(\theta_V^N\right)-V\left(\theta_O^N\right)\right]+\Psi_V^N\Psi_O^S\left[V\left(\theta_O^S\right)-V\left(\theta_V^N\right)\right]+\Psi_V^N\Psi_V^S\left[V(\infty)-V\left(\theta_O^S\right)\right]}{\left(\Psi_V^N-\vartheta\Psi_O^S\right)\left\{\Psi_O^N\left[V\left(\theta_O^N\right)-V\left(\underline{\theta}\right)\right]+\Psi_V^N\left[V\left(\theta_V^N\right)-V\left(\theta_O^N\right)\right]+\vartheta\left(\Psi_O^S\left[V\left(\theta_O^S\right)-V\left(\theta_V^N\right)\right]+\Psi_V^S\left[V(\infty)-V\left(\theta_O^S\right)\right]\right)\right\}}$.
Note that since $V\left(\cdot\right)$ is increasing and $\left(\Psi_V^N - \vartheta\Psi_O^S\right) < 0$ it follows that $Q < 0$.

A.5.2 Case 2: θ_O^S

$$\begin{aligned} \frac{d\theta_O^S}{d\zeta} &= \frac{\partial\theta_O^S}{\partial\zeta} + \frac{\partial\theta_O^S}{\partial P}\frac{dP}{d\zeta} \\ &= \theta_O^S\left(1-\nu\right)\zeta^{-1} + \theta_O^S\frac{-\left(\alpha-\mu\right)}{\left(1-\mu\right)\alpha}P^{-1} * \frac{dP}{d\zeta} \\ &= \theta_O^S(1-\nu)\zeta^{-1}\left\{\Psi_O^N\left[V\left(\theta_O^N\right) - V\left(\underline{\theta}\right)\right] + \Psi_V^N\left[V\left(\theta_V^N\right) - V\left(\theta_O^N\right)\right]\right\}A > 0 \end{aligned}$$

B Alternative parameter values

B.1 Input Intensive Sectors (Low ν)

In this appendix I assume that ν is relatively low, i.e., sectors relatively input intensive. Entrepreneurs will (*ceteris paribus*) choose an organizational form such that their share is as close as possible to β^*.[25]

Note that under these circumstances $\Psi_O^l > \Psi_O^l$ for $l = N, S$. Hence, π_O^l has a higher intercept and is steeper that π_O^l. It follows that these sectors will never choose to integrate. Rather, they will outsource in either North or South. Intuitively, low ν implies that the intermediate inputs are relatively more important than the headquarter services. Hence, in order to assure the appropriate provision of $m_j(i)$, the entrepreneurs find optimal to give better incentives to the managers. In this particular setting, the better incentives are implemented as a higher surplus share for the managers: $(1-\beta) = (1-\beta_O^l) > (1-\beta_V^l)$, $l \in \{N, S\}$.

I also assume that $\frac{w^N}{w^S} < \left(\frac{f_O^S}{f_O^N}\right)^{\frac{(1-\alpha)}{\alpha(1-\nu)}}$ otherwise, all firms would choose (S, O).

B.1.1 Tariffs on final goods

If this is the case we only have two cutoffs to look at:

$$\underline{\theta}(P,\tau) = \left[\frac{w^N f_O^N}{\Psi_O^N}\frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}\left((1-\gamma)(\tau)^{\frac{-1}{1-\mu}}+\gamma\right)}\right]^{(1-\alpha)/\alpha}$$

$$\theta_O^N(P,\tau) = \left[\frac{w^N(f_O^N-f_O^S)}{(\Psi_O^N-\Psi_O^S)}\frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}\left((1-\gamma)(\tau)^{\frac{-1}{1-\mu}}+\gamma\right)}\right]^{(1-\alpha)/\alpha}$$

[25] Recall that for low ν we have

$$\text{Low } \nu \text{ (close to 0)} \quad \beta^*(\nu) < \beta_O^N = \beta_O^S = \beta < \beta_V^S \leq \beta_V^N \quad \Rightarrow \quad \frac{\partial}{\partial\beta}\pi(\cdot) < 0$$

The free entry condition may be written as

$$w^N f_E = \int_{\underline{\theta}}^{\theta_O^N} \left[\Psi_O^N \left((1-\gamma)(\tau)^{\frac{-1}{1-\mu}} + \gamma\right) P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \theta^{\frac{\alpha}{1-\alpha}} - f_O^N w^N\right] g(\theta)\, d\theta + \\ + \int_{\theta_O^N}^{\infty} \left[\Psi_O^S \left((1-\gamma)(\tau)^{\frac{-1}{1-\mu}} + \gamma\right) P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \theta^{\frac{\alpha}{1-\alpha}} - f_O^S w^N\right] g(\theta)\, d\theta \tag{33}$$

Proceeding as in the previous Appendix we find that the change in P due to a change is τ is

$$\frac{dP}{d\tau} = \frac{(1-\gamma)(1-\alpha)}{\alpha-\mu} \frac{P(\tau)^{\frac{-1}{1-\mu}-1}}{\left((1-\gamma)(\tau)^{\frac{-1}{1-\mu}} + \gamma\right)} > 0 \tag{34}$$

Let's see what happens to the cutoffs when τ is increased:

$$\begin{aligned}
\frac{d\underline{\theta}}{d\tau} &= \frac{\partial\underline{\theta}}{\partial\tau} d\tau + \frac{\partial\underline{\theta}}{\partial P}\frac{dP}{d\tau} \\
&= \left[\frac{w^N f_O^N}{\Psi_O^N} \frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}\left((1-\gamma)(\tau)^{\frac{-1}{1-\mu}} + \gamma\right)}\right]^{(1-\alpha)/\alpha} \left[-\frac{\frac{(1-\alpha)}{\alpha}\frac{(1-\gamma)}{(1-\mu)}(\tau)^{\frac{-1}{1-\mu}-1}}{\left((1-\gamma)(\tau)^{\frac{-1}{1-\mu}} + \gamma\right)} + \frac{\frac{\alpha-\mu}{\alpha(1-\mu)}}{P}\frac{dP}{d\tau}\right] \\
&= \left[\frac{w^N f_O^N}{\Psi_O^N} \frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}\left((1-\gamma)(\tau)^{\frac{-1}{1-\mu}} + \gamma\right)}\right]^{(1-\alpha)/\alpha} * \\
&\quad \left[-\frac{\frac{(1-\alpha)}{\alpha}\frac{(1-\gamma)}{(1-\mu)}(\tau)^{\frac{-1}{1-\mu}-1}}{\left((1-\gamma)(\tau)^{\frac{-1}{1-\mu}} + \gamma\right)} + \frac{\frac{\alpha-\mu}{\alpha(1-\mu)}}{P}\frac{(1-\gamma)(1-\alpha)}{\alpha-\mu}\frac{P(\tau)^{\frac{-1}{1-\mu}-1}}{\left((1-\gamma)(\tau)^{\frac{-1}{1-\mu}} + \gamma\right)}\right] \\
&= 0
\end{aligned}$$

Hence, the cutoff $\underline{\theta}$ is not affected by τ. Since $\underline{\theta}$ and θ_O^N differ only on constant terms but not in the way they are affected by P and τ we know that $\frac{\partial\theta_O^N}{\partial\tau} = 0$. Thus, just as in the benchmark case, we conclude that the cutoff values are not affected by the tariff.

Similarly, the fraction of firms that will choose each of these two forms are

$$\sigma_O^S = \left[\frac{f_O^N}{f_O^N - f_O^S}\frac{(\Psi_O^N - \Psi_O^S)}{\Psi_O^N}\right]^{z(1-\alpha)/\alpha} ; \qquad \sigma_O^N = 1 - \sigma_O^S.$$

It is easy to check that the tariff has no effect on the shares: $\frac{\partial\sigma_O^S}{\partial\tau} = \frac{\partial\sigma_O^N}{\partial\tau} = 0$.

B.1.2 Tariffs on intermediate goods

As before, we only have two cutoffs to look at:

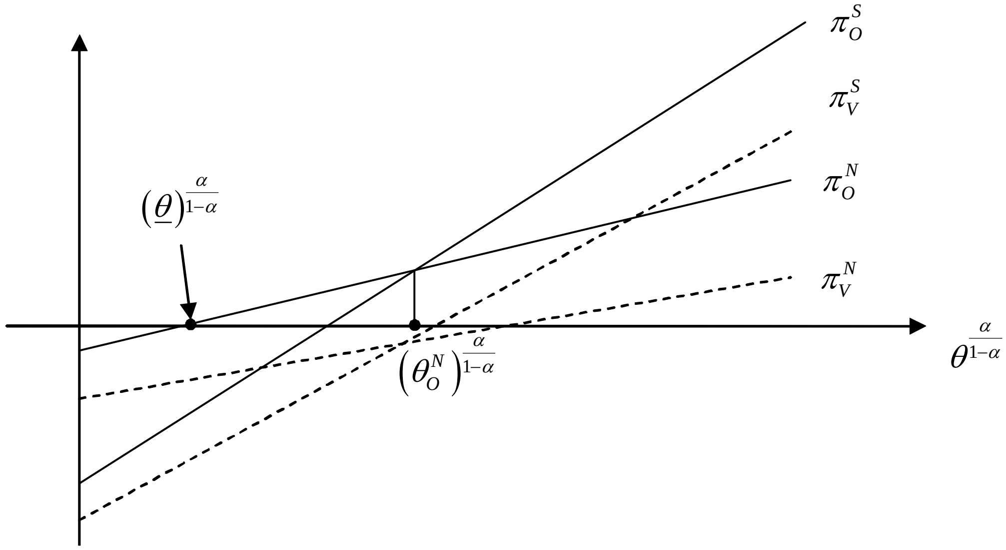

Figure 6: Low ν - Profit lines when $\frac{f_O^S}{f_O^N} > \left(\frac{w^N}{w^S}\right)^{\alpha(1-\nu)/(1-\alpha)}$

$\underline{\theta}(P(\zeta)) = \left[\frac{w^N f_O^N}{\Psi_O^N} \frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}}\right]^{(1-\alpha)/\alpha}$

$\theta_O^N(P(\zeta), \zeta) = \left[\frac{w^N(f_O^N - f_O^S)}{(\Psi_O^N - \vartheta\Psi_O^S)} \frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}}\right]^{(1-\alpha)/\alpha}$

The free entry condition may be written as

$$w^N f_E = \int_{\underline{\theta}}^{\theta_O^N} \left[\Psi_O^N P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \theta^{\frac{\alpha}{1-\alpha}} - f_O^N w^N\right] g(\theta)\, d\theta + + \int_{\theta_O^N}^{\infty} \left[\vartheta \Psi_O^S P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}} \theta^{\frac{\alpha}{1-\alpha}} - f_O^S w^N\right] g(\theta)\, d\theta \tag{35}$$

The change in P due to a change is ζ is

$$\frac{dP}{d\zeta} = \frac{(1-\mu)(1-\nu)\alpha}{(\alpha-\mu)} \frac{\Psi_O^S P \zeta^{\frac{-(1-\nu)\alpha}{(1-\alpha)}-1}\left[V(\infty) - V(\theta_O^N)\right]}{\left\{\Psi_O^N\left[V(\theta_O^N) - V(\underline{\theta})\right] + \Psi_O^S \vartheta\left[V(\infty) - V(\theta_O^N)\right]\right\}} > 0 \tag{36}$$

So the change in the cutoffs due to a change in the tariff ζ is given by

$$\frac{\partial\underline{\theta}}{\partial\zeta} = \frac{d\underline{\theta}}{dP}\frac{dP}{d\zeta}$$

$$= -\underline{\theta}(1-\nu)\left[\frac{\Psi_O^S \zeta^{\frac{-(1-\nu)\alpha}{(1-\alpha)}-1}\left[V(\infty) - V(\theta_O^N)\right]}{\left\{\Psi_O^N\left[V(\theta_O^N) - V(\underline{\theta})\right] + \Psi_O^S \zeta^{\frac{-(1-\nu)\alpha}{(1-\alpha)}}\left[V(\infty) - V(\theta_O^N)\right]\right\}}\right] < 0$$

Hence, the lowest cutoff will decrease as the tariff ζ increases. Conversely, as the Northern country reduces its tariff the cutoff $\underline{\theta}$ will increase.

$$\begin{aligned}\frac{d\theta_O^N}{d\zeta} &= \frac{\partial\theta_O^N}{\partial\zeta} + \frac{\partial\theta_O^N}{\partial P}\frac{dP}{d\zeta} \\ &= \frac{\theta_O^N(1-\nu)\zeta^{\frac{-(1-\nu)\alpha}{(1-\alpha)}-1}\Psi_O^S\Psi_O^N\left[V(\infty)-V(\underline{\theta})\right]}{\left(\zeta^{\frac{-(1-\nu)\alpha}{(1-\alpha)}}\Psi_O^S-\Psi_O^N\right)\left\{\Psi_O^N\left[V\left(\theta_O^N\right)-V(\underline{\theta})\right]+\Psi_O^S\zeta^{\frac{-(1-\nu)\alpha}{(1-\alpha)}}\left[V(\infty)-V\left(\theta_O^N\right)\right]\right\}} > 0\end{aligned}$$

We conclude that the cutoff θ_O^N will increase with the tariff ζ.

B.2 Headquarters Intensive Sectors (High ν)

In this section I study the equilibria arising when inequality (12) is not satisfied. That is, when the wage differential is relatively small: $\left(\frac{w^N}{w}\right)^{1-\nu} < \phi(\beta_V^N,\nu)/\phi(\beta,\nu)$. Consequently, π_V^N is steeper than π_O^S, so the order given by expression (13) does not hold any longer and is replaced by either one among two alternatives. In other words, Southern wages are not as a attractive as in the benchmark case. Hence, the number of firms choosing South will presumably decrease.

B.2.1 Tariffs on final goods[26]

First, it could be that $\Psi_V^S(\nu) > \Psi_V^N(\nu) > \Psi_O^S(\nu) > \Psi_O^N(\nu)$, in which case (S,O) is never chosen in equilibrium. Thus, in equilibrium, there can be at the most three firm types : (N,O), (N,V) and (S,V).

The corresponding threshold values and organizational form shares are $\underline{\theta} = \left[\frac{w^N f_O^N}{\Psi_O^N T}\frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}}\right]^{(1-\alpha)/\alpha}$, $\theta_O^N = \left[\frac{w^N(f_O^N-f_V^N)}{(\Psi_O^N-\Psi_V^N)T}\frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}}\right]^{(1-\alpha)/\alpha}$, $\theta_V^N = \left[\frac{w^N(f_V^N-f_V^S)}{(\Psi_V^N-\Psi_V^S)T}\frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}}\right]^{(1-\alpha)/\alpha}$;

[26] The case of the tariff on inputs was already covered in the main body of the paper.

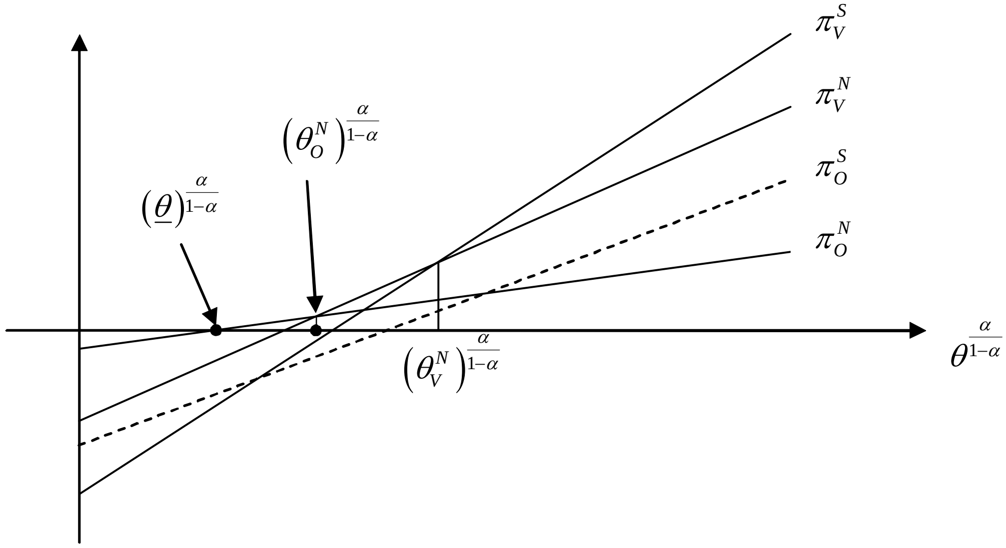

Figure 7: Profit lines if $\Psi_V^S > \Psi_V^N > \Psi_O^S$

$$\sigma_O^N = 1 - \left[\frac{f_O^N}{f_O^N - f_V^N}\frac{(\Psi_O^N - \Psi_V^N)}{\Psi_O^N}\right]^{\frac{z(1-\alpha)}{\alpha}}, \qquad \sigma_V^N = \left(\frac{f_O^N}{\Psi_O^N}\right)^{\frac{z(1-\alpha)}{\alpha}}\left[\left(\frac{f_O^N - f_V^N}{\Psi_O^N - \Psi_V^N}\right)^{\frac{z(1-\alpha)}{\alpha}} - \left(\frac{f_V^N - f_V^S}{\Psi_V^N - \Psi_V^S}\right)^{\frac{z(1-\alpha)}{\alpha}}\right]^{-1},$$

$$\sigma_V^S = \left[\frac{f_O^N}{f_V^N - f_V^S}\frac{(\Psi_V^N - \Psi_V^S)}{\Psi_O^N}\right]^{\frac{z(1-\alpha)}{\alpha}}.$$

It is easy to check that the imposition of the tariff has no effect on the proportion of active firms: $\frac{\partial \sigma_k^l}{\partial \tau} = 0$ for $(l, k) \in \{(N, O), (N, V), (S, V)\}$.

Second, it could be that $\Psi_V^N(\nu) > \Psi_V^S(\nu) > \Psi_O^S(\nu) > \Psi_O^N(\nu)$. If so, (N, V) is preferred to (S, O) and (S, V). Thus, at the most there are two types of firms in equilibrium: (N, O) and (N, V). This is an extreme case because there is no international trade in intermediate goods. Intuitively, the wage differential is so small that the lower Northern fixed costs outweigh the lower Southern wages for *every* productivity level.

The cutoff values and firm type shares are given by

$$\underline{\theta} = \left[\frac{w^N f_O^N}{\Psi_O^N T}\frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}}\right]^{(1-\alpha)/\alpha}, \qquad \theta_O^N = \left[\frac{w^N(f_O^N - f_V^N)}{(\Psi_O^N - \Psi_V^N)T}\frac{1}{P^{\frac{\alpha-\mu}{(1-\mu)(1-\alpha)}}}\right]^{(1-\alpha)/\alpha}; \qquad \sigma_O^N = 1 - \sigma_V^N, \qquad \sigma_V^N = \left[\frac{f_O^N}{f_O^N - f_V^N}\frac{(\Psi_O^N - \Psi_V^N)}{\Psi_O^N}\right]^{\frac{z(1-\alpha)}{\alpha}}.$$

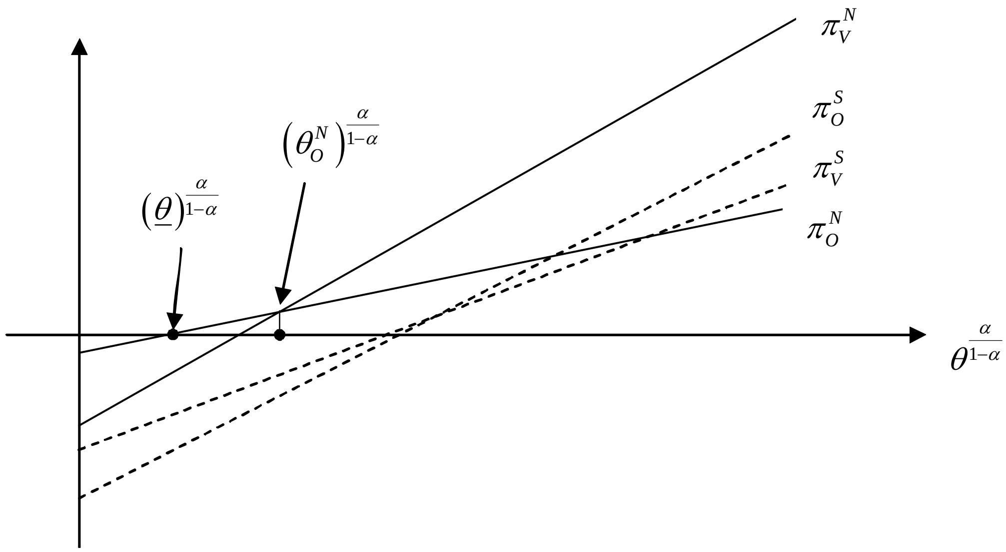

Figure 8: Profit lines if $\Psi_V^S < \Psi_V^N$

Clearly, the tariff does not affect the shares: $\frac{\partial \sigma_k^N}{\partial \tau} = 0$.

In both cases, the effect of τ on P and the cutoffs is analogous to the cases already described.

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