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Trade Liberalization, Mergers and Acquisitions, and Intra-Industry Reallocations

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Abstract

This paper presents a Melitz-type model of international trade in final goods and Grossman-Hart-Antràs input sourcing by heterogeneous firms. We show how firms self-select into different organizational forms in a continuum of industries with different characteristics. Next, we show how a liberalization of trade leads to short run increases in the number of firm mergers and acquisitions and potentially new gains from trade. Finally, we show how the relative prevalence of integrating firms is increasing in some industries while constant in all others.

Keywords: *international trade, firm heterogeneity, make-or-buy decision, export behavior, productivity gains, M&As*

JEL classification: D23, F12, F14, F15, and L2

1 Introduction

Empirical research by Bernard and Jensen (1999), Pavcnik (2002), and Trefler (2004) has shown that within-industry reallocations of market shares raise industry productivity after liberalization of trade. The seminal work of Melitz (2003) has spurred an enormous literature which formalizes these newly emphasized gains from trade. Melitz (2003) features the following transmission mechanism from trade liberalization to gains from trade based on resource reallocation and increases in aggregate productivity: trade liberalization increases the profitability of more productive firms which export. In the domestic factor market, this in turn raises labor demand and the real wage which, in the end, forces the least productive firms to exit. This differential impact of trade liberalization across heterogeneous firms, where more productive firms flourish and attract labor resources while the least productive firms are battered and lay off resources, implies an increase in aggregate industry productivity.

In this paper, we emphasize another, perhaps complementary, transmission mechanism from trade liberalization to resource reallocation and productivity gains. We put forward a Melitz (2003)-type model of international final good trade which gives a prominent role to the market for corporate control. In the aftermath of trade liberalization, we show how efficiency enhancing mergers and acquisitions (M&As) reallocate resources across firms which could contribute to increases in aggregate productivity.[1]

Our approach is inspired by recent empirical research by Breinlich (2008) who shows that the 1989 initial adoption of the Canada-United States Free Trade Agreement (CUSFTA) led to a liberalization of trade and a sizable increase in domestic Canadian M&A activity.[2] Breinlich (2008) also shows that M&As transferred resources from less to more productive firms. This is backed by the comprehensive evidence in Andrade et al. (2001) who show that more than two-thirds of all U.S. M&As since 1973 transferred resources from less to more efficient firms. This is interesting since ex-post firm-level adjustment through M&A activity is potentially beneficial for the overall economy. Instead of firm resources becoming temporarily idled when a firm dismantles and liquidates its parts in the factor markets, resources can perhaps be reallocated more efficiently through the market for corporate control where M&As take place.

In the following, we introduce the opportunity of one particular kind

[1]The reallocation of resources resulting from changes in ownership structures is a new potential source of gains from trade compared to Melitz (2003). However, due to free entry, reallocation through M&As interacts with other sources of reallocation (see Atkeson and Burstein, 2010), and thus, we do not claim that our model leads to larger total gains from trade than those seen in the Melitz (2003) model.

[2]Breinlich (2008) also finds that the impact of trade liberalization on domestic U.S. M&As was negligible. Like Breinlich (2008), we see this finding as a result of the notion that the 1989 shock, caused by trade liberalization, had a substantially heavier impact on the Canadian economy compared to its U.S. counterpart. In a comparison of relative 1989 GDPs, we note that Canada was outnumbered by a factor of ten.

of M&A activity, namely vertical integration of an intermediate-input supplier. In this respect, our model builds on a well-established strand of the international-trade literature which analyzes firm sourcing decisions in industry or general equilibrium. This literature comprises, among others, McLaren (2000) and Grossman and Helpman (2002) which use Transaction Cost Economics by Coase (1937) and Williamson (1975, 1985). A parallel literature has been created in the wake of the articles by Antràs (2003) and Antràs and Helpman (2004).[3] Like these latter papers (upon which we build our model), we utilize the Grossman-Hart-Moore Property Rights Theory of the Firm in a context of international trade. Despite the fact that we only allow for vertical integration in our analysis of M&A activity, we can show that domestic M&A activity increases in the short run after trade liberalization and that this increase induces intra-industry reallocations. Moreover, even though firms in our model may restructure after trade liberalization through M&A activity in the market for corporate control instead of using the conventional Melitz-type factor adjustments, we can show that our analysis of a particular range of industries, by and large, boils down to a modified version of the Melitz (2003) model.

Our paper is structured as follows. Section two introduces the basic setup. Section three emphasizes the timing of events in a five period game. The key organizational decision, which determines the ownership decision and export status, is presented in section four. Section five and six derive the firm sorting pattern in Figure 1. Section seven studies liberalization of trade. Section eight discusses M&A activity. Finally, section nine provides some concluding remarks and directions for future research.

2 Setup

We put forward a theoretical model of international final-good trade between two symmetrical countries. Our model is basically a variation of Antràs and Helpman (2004). In contrast to their model, however, we analyze trade in final goods between symmetrical countries. The preferences of the representative consumer are represented by the utility function:

$$U = \int_0^1 \varphi(j) \log Q(j)\,\mathrm{d}j,$$

[3] Surveys of this literature are found in Antràs (2005, 2011).

where

$$Q(j) = \left[\int_{i\in\omega_j} q_j(i)^\alpha \,\mathrm{d}i\right]^{1/\alpha}, \quad 0<\alpha<1,$$

denotes an industry j consumption index.[4] Each country contains a unit continuum of industries, i.e., $0 \leq j \leq 1$. The Cobb-Douglas expenditure shares, $\varphi(j)$, obey the condition, $\int_0^1 \varphi(j)\,\mathrm{d}j = 1$. The elasticity of substitution among varieties in the same industry is equal to $\sigma = 1/(1-\alpha)$. ω_j denotes the endogenous measure of available varieties, indexed by i, in industry j. As is well-known, variety demand is given by the demand function:

$$q_j(i) = A_j p_j(i)^{-\sigma}, \tag{1}$$

where the demand shifter, A_j, is taken as given by the particular supplier of variety i. In the general equilibrium, where wages are normalized to unity, we have that:

$$A_j = \frac{\varphi(j)L}{\int_{i\in\omega_j} p_j(i)^{1-\sigma}\,\mathrm{d}i},$$

where L measures country size. Following Melitz (2003), prospective final-good firms sink a fixed entry cost of f_e and draw an idiosyncratic productivity parameter, θ, from the known distribution, $G(\theta)$. Given a realization of θ, final-good firms choose their optimal organizational form in what we dub the organizational decision. The choice set includes the options of internalizing the necessary production of intermediate inputs or outsourcing this business function.[5] Furthermore, the organizational decision is also about possible exporting. As in Antràs and Helpman (2004), final-good production is given by:

$$q_j(i) = \theta(i)\left(\frac{h(i)}{\eta_j}\right)^{\eta_j}\left(\frac{m(i)}{1-\eta_j}\right)^{1-\eta_j} = \theta(i)\zeta(\eta_j)h(i)^{\eta_j}m(i)^{1-\eta_j}, \tag{2}$$

where $\eta_j \in (0,1)$ and $\zeta(\eta_j) = \eta_j^{-\eta_j}(1-\eta_j)^{-(1-\eta_j)}$. In equation (2), $h(i)$ and $m(i)$, respectively, denote relationship specific investments in headquarter

[4]We let the degree of substitutability between varieties in a given sector be constant across industries such that we can focus attention on inter-industry variation in other, more interesting, parameters.

[5]This is the make-or-buy decision known from Industrial Organization and the Theories of the Firm. We define outsourcing as the acquisition of a necessary intermediate input from an unaffiliated domestic business partner.

services and a manufacturing input. The economies' unit continuum of industries differ with respect to headquarter intensity, η_j.[6] In the following, we will index industries by their headquarter intensity, η, and we therefore drop the industry index, j. We will let $F(\eta)$ denote the share of industries with headquarter intensity less than or equal to η. For now, we focus attention to a given final-good variety, i, in a given industry, η, and therefore, we suppress these indices when we can.

To simplify matters, we assume complete asset specificity, meaning that the inputs, h and m, are completely tailored to the production of the particular final-good variety and absolutely useless elsewhere. The investments in headquarter services, h, are undertaken by the particular final-good producer of a particular final-good variety and the investments in m are undertaken by a particular domestic intermediate-good supplier with whom the final-good producer has matched and initiated a business relationship.[7] We dub final-good producers, H-firms, and intermediate-good suppliers, M-firms.

Key to our analysis is the so-called organizational decision of the H-firm, which determines an ownership structure and export status. The ownership structure, k, can either be (vertical) integration, V, or outsourcing, O, while the export status, x, can be either exporter, X, or non-exporter, D (domestic sales only). Denote by $\mathbb{1}_x$ an indicator function for exporting, i.e., $\mathbb{1}_X = 1$ and $\mathbb{1}_D = 0$. Exporting is subject to Samuelson iceberg costs, $\tau > 1$, such that τ units of final goods must be shipped in order for one salable unit to arrive on foreign shores. The choice of ownership structure will later affect the relative bargaining power of the H-firm, and hence, the investment incentives, of the H- and M-firms. This is the crux of the matter. The fixed costs of production, f_{kx}, depend on the organizational decision, $kx \in \{OD, VD, OX, VX\}$, in the following way:

$$f_{kx} = f_k + \mathbb{1}_x f_X, \tag{3}$$

where f_O and f_V are the fixed costs resulting from outsourcing and integration, respectively, and f_X is the fixed cost of exporting. We thus assume that exporting leads to a discrete increase in total fixed costs, at the size of f_X, and that this increase is invariant to the ownership decision, $k \in \{V, O\}$. Furthermore, we impose an assumption of managerial overload in integrated firms

[6] We denote $\frac{\partial q_j(i)}{\partial h_j(i)} \frac{h_j(i)}{q_j(i)} = \eta_j$ by the term "headquarter intensity".

[7] We will elaborate on this matching below.

that dominate possible economies of scope in management, i.e., $f_O < f_V$.[8]

Our assumptions of consumer love-of-variety, costly trade in final and intermediate goods, and country symmetry, imply that some final-good varieties will be traded. Trade in intermediate inputs is absent due to the presence of iceberg trade costs. Therefore, our model is a model of possible final-good trade and its consequences, and not a model of what has become known as offshoring (vertical MNE activity and foreign outsourcing).

We now turn to the details of the sequential game that H- and M-firms play together. In the organizational decision, H-firms apply backwards induction in the following sequence of events which, broadly speaking, resemble the events in Antràs and Helpman (2004, 2008) until Period Four.

3 The Timing of Events and Model Details

Period Zero

Prospective H-firms make a productivity draw from $G(\theta)$ after paying an entry cost, f_e. The mass of prospective entrants is determined by free entry.

Period One

The H-firm chooses the optimal organizational form, kx. Further, the particular H-firm under scrutiny receives the lump-sum participation fee, T, from the particular M-firm with whom the H-firm initiates the business relationship. Due to a perfectly elastic supply of M-firms, T is set such that the M-firm receives her outside option $\bar{U}$ which we will normalize to zero.[9] Like Antràs and Helpman (2004), we will assume that only the organizational decision, kx, and the participation fee, T, and *not* the subsequent production

[8]This assumption, which is shared with Antràs and Helpman (2004), is not trivial and it is debated in the literature. We will discuss and rationalize this assumption later.

[9]Note that we can rationalize this on the basis of a CRTS matching function.

of h and m, are contractible at this stage.[10,11]

Period Two

The H-firm and the M-firm simultaneously determine their optimal relationship specific investments, h and m, respectively. We assume that one unit of either input is produced from one unit of labor.

Period Three

Generalized Nash bargaining over total final-good revenue which is generated in the subsequent Period Four. The H-firm reaps the fraction $\beta_k \in (0,1)$ of the revenue while the M-firm reaps the complementary fraction. We note that bargaining theoretically may break down in Period Three. In equilibrium, however, this will never happen due to positive appropriable quasi-rents (revenue minus the two outside options) in the business relationship. Under outsourcing, complete asset specificity guarantees outside options of zero to both parties. Hence, under outsourcing, the Period Four revenue, equal to the quasi-rents, is shared according to the fundamental relative bargaining power of H-firms which is $\beta \in (0,1)$. Thus, $\beta_O = \beta$. Things are different under (vertical) integration. Following Property Rights Theory of the Firm by, among others, Grossman and Hart (1986) and Hart (1995), we equate an ownership structure, k, with ownership of, and the residual rights to, assets. Under integration, the H-firm possesses residual control rights of assets and can selectively fire the M-firm and seize the earlier input production. If bargaining breaks down, or the M-firm is fired, in Period Three, then the H-firm can market $\delta \in (0,1)$ of final-good output in Period Four. This generates

[10] Since the seminal paper by Coase (1937) on Transaction Costs Economics, it has been known that firm boundaries are indeterminate in a world of complete contracts. Because we want to determine firm boundaries, we resort to an assumption of incomplete contracting where investments are observable to the transacting parties but not verifiable to third parties ex post (after input investments have been made). Luckily this scenario is empirically appealing as contracts do not specify each part's obligations in every conceivable eventuality, cf. the long discussion in Hart (1995). On the other hand, it is assumed that the business partners are able to contract on the organizational decision which is more likely than input quality to be verifiable by a third party. This contract makes it impossible for the H-firm to just run away with the transfer, T.

[11] The model by Antràs and Helpman (2004) does not include the possibility of exporting. We assume that parties can contract on exporting status as exports usually leave a paper trail. This trail is e.g. created from dealings with customs and shipping agencies.

a revenue of $\delta^\alpha R$ where R is the revenue from marketing the whole output. The outside option of the M-firm is again non-existing. All this lead to the following share of revenue which accrues to the H-firm:

$$\beta_V = \delta^\alpha + \beta(1-\delta^\alpha) = \beta + \delta^\alpha(1-\beta) > \beta = \beta_O.$$

The inequality $\beta_V > \beta_O$, and the implied input-investment incentives are key to our analysis.

Period Four

Final goods are produced on the basis of the intermediate inputs and sold domestically and possibly abroad. Furthermore, final-good production is distributed optimally across the two markets. The H-firm faces the following problem of finding the optimal, revenue maximizing, market allocation:[12]

$$\begin{aligned} R(h,m,x) = \max_{X_H,\, X_F} & \; A^{1/\sigma}\left[X_H^\alpha + \mathbb{1}_x \left(X_F/\tau\right)^\alpha\right] \\ st. & \;\; X_H + X_F \leq \theta\zeta h^\eta m^{(1-\eta)}, \end{aligned}$$

where it is understood that h and m are predetermined in the prior Period Two. The optimal market allocation entails a revenue of:

$$R(h,m,x) = A^{1/\sigma}\theta^\alpha h^{\alpha\eta} m^{\alpha(1-\eta)} \zeta^\alpha (1+\tau^{1-\sigma})^{\mathbb{1}_x(1-\alpha)}\,. \tag{4}$$

Note that the expression $(1+\tau^{1-\sigma})^{(1-\alpha)} > 1$ kicks in under exporting. Now, we turn to the center stage Period One organizational decision.

4 The Organizational Decision

By backward induction, the optimal Period One organizational decision solves the program:

$$\max_{k\in\{V,O\},\, x\in\{D,X\}} R(h_{kx}, m_{kx}, x) - h_{kx} - m_{kx} - f_{kx} \tag{5}$$

subject to the constraints:

$$\begin{aligned} h_{kx} &= \arg\max_h \{\beta_k R(h, m_{kx}, x) - h\}, \\ m_{kx} &= \arg\max_m \{(1-\beta_k) R(h_{kx}, m, x) - m\}, \end{aligned}$$

[12] This problem is of course trivial when exporting does not occur because input production costs are sunk in Period Four.

where it is understood that the revenue function $R(h, m, x)$ is given by equation (4). Note that the H-firm simply maximizes the joint profits in the business relationship by choosing the right organizational form in the set $\{OD, VD, OX, VX\}$ while taking into account that input investments are individually optimal given the organizational decision.[13] By combining the equilibrium input investments from the Period Two subgame with the revenue in equation (4) and noting the presence of fixed costs, we get the following profit function:

$$\pi_{kx}(\Theta, \eta) = A_\eta \Theta \psi_k(\eta)(1 + \tau^{1-\sigma})^{\mathbb{1}_x} - f_{kx}, \tag{6}$$

where $\Theta = \theta^{\alpha/(1-\alpha)}$ and

$$\psi_k(\eta) = \frac{1 - \alpha[\beta_k \eta + (1-\beta_k)(1-\eta)]}{[\frac{1}{\alpha}\beta_k^{-\eta}(1-\beta_k)^{-(1-\eta)}]^{\alpha/(1-\alpha)}}, \quad k \in \{V, O\},$$

denotes the efficiency of variable production achieved under ownership structure k.

Due to the higher fixed costs of integration, integration will only be observed in industries where it provides more efficient variable production than outsourcing. Lemma 1 identifies these industries.

Lemma 1 $\exists \eta_1 \in (0, 1)$: *$\psi_O(\eta_1) = \psi_V(\eta_1)$. Furthermore, $\eta > \eta_1 \Leftrightarrow \psi_V(\eta) > \psi_O(\eta)$ and $\eta < \eta_1 \Leftrightarrow \psi_V(\eta) < \psi_O(\eta)$.*

Proof. See Antràs and Helpman (2008). ■

Lemma 1 implies that for sufficiently high headquarter intensities, we see that variable production under integration is relatively more efficient. The reason is that variable production efficiency necessitates that residual rights of asset use are granted to the H-firm, such that the underinvestment by the H-firm becomes less severe. This insight follows from e.g. Grossman and Hart (1986) and Hart (1995). Due to the higher fixed costs of integration, firms

[13]It is straight forward to show that the input investments inherent in the program (5) are sub-optimally low. The reason is the incomplete contracts. Note that the investing parties, because of the Period Three Nash bargaining, do not reap the full marginal gains from investing, which are equal to $\frac{\partial R(h,m,x)}{\partial l}$, $l = \{h, m\}$, but do reap the full marginal costs.

trade efficiency in variable production off with fixed costs, in the industries $\eta \in (\eta_1, 1)$.[14]

In industries where $\eta > \eta_1$, the interaction between exporting and integration in the profit function (6), implies that the gains of exporting are higher under integration and the gains of integration are higher under exporting. This complementarity between the ownership decision and the export status will prove important in the analysis below.

5 Indifference Conditions

We now deduct the Period One sorting of firms into different organizational forms in different industries. The H-firm will choose to exit (and earn zero profits) or to produce under one of the organizational forms, $kx \in \{OD, OX, VD, VX\}$, and earn profits given by (6). To obtain the sorting of firms, we need a number of indifference conditions. Let $\Theta_{kD}(\eta)$ denote the value of $\Theta(= \theta^{\alpha/(1-\alpha)})$ at which $\pi_{kD} = 0$, $k \in \{O, V\}$. Further, let $\Theta_{OD}^{VD}(\eta)$ denote the value at which $\pi_{OD} = \pi_{VD}$. Obviously, $\Theta_{OD}^{VD}(\eta)$ can only be solved for in the industries $\eta \in (\eta_1, 1)$. In a closed economy, these would be the three relevant indifference conditions.

In the open economy, firms may export, and thus, additional indifference conditions are needed.[15] The first two gives indifference between exporting and not, conditional on an ownership decision, i.e., let $\Theta_{kD}^{kX}(\eta)$ denote the value of Θ for which $\pi_{kD} = \pi_{kX}$, $k \in \{O, V\}$. Next, let $\Theta_{OX}^{VX}(\eta)$ denote the productivity value at which firms are indifferent between integration and outsourcing conditional on exporting, i.e., $\pi_{OX} = \pi_{VX}$. Finally, let $\Theta_{OD}^{VX}(\eta)$ denote the value for which $\pi_{OD} = \pi_{VX}$. Expressions for these indifference values of Θ can be seen in Appendix A.

In order to illustrate the sorting of firms, it is expedient to get rid of the A_η's in the indifference values of Θ. This is done by dividing (scaling) all indifference values by $\Theta_{OD}(\eta)$. We thus introduce $\tilde{\Theta}(\eta) \equiv \Theta/\Theta_{OD}(\eta)$. This

[14]If the fixed cost of production was invariant to ownership structures, all firms would choose integration (outsourcing) in the industries $\eta > \eta_1$ ($\eta < \eta_1$).

[15]In addition to the conditions described you could consider $\pi_{VD} = \pi_{OX}$ and $\pi_{kX} = 0$ with $k \in \{O, V\}$. However, these will prove redundant.

leads to the following expressions:

$$\tilde{\Theta}_{VD}(\eta) = \frac{\Theta_{VD}(\eta)}{\Theta_{OD}(\eta)} = \frac{f_V}{\xi(\eta) f_O}, \tag{7}$$

$$\tilde{\Theta}_{OD}^{VD}(\eta) = \frac{\Theta_{OD}^{VD}(\eta)}{\Theta_{OD}(\eta)} = \frac{f_V - f_O}{f_O[\xi(\eta) - 1]}, \tag{8}$$

$$\tilde{\Theta}_{OD}^{OX}(\eta) = \frac{\Theta_{OD}^{OX}(\eta)}{\Theta_{OD}(\eta)} = \frac{\tau^{\sigma-1} f_X}{f_O}, \tag{9}$$

$$\tilde{\Theta}_{VD}^{VX}(\eta) = \frac{\Theta_{VD}^{VX}(\eta)}{\Theta_{OD}(\eta)} = \frac{\tau^{\sigma-1} f_X}{\xi(\eta) f_O}, \tag{10}$$

$$\tilde{\Theta}_{OX}^{VX}(\eta) = \frac{\Theta_{OX}^{VX}(\eta)}{\Theta_{OD}(\eta)} = \frac{\Theta_{OD}^{VD}(\eta)}{\Theta_{OD}(\eta)}(1 + \tau^{1-\sigma})^{-1}, \text{ and} \tag{11}$$

$$\tilde{\Theta}_{OD}^{VX}(\eta) = \frac{\Theta_{OD}^{VX}(\eta)}{\Theta_{OD}(\eta)} = \frac{f_X + f_V - f_O}{f_O[(1 + \tau^{1-\sigma})\xi(\eta) - 1]}, \tag{12}$$

where $\xi(\eta) = \psi_V(\eta)/\psi_O(\eta)$. It follows readily from Lemma 1 that $\xi(\eta_1) = 1$. This scaling is convenient since it will provide a straight forward derivation of the prevalence of integration. For the below illustration of firms' sorting pattern, the following lemma will be useful.

Lemma 2 *$\xi(\eta)$ is positive and strictly increasing in η for $\eta \in (0, 1)$.*

Proof. See Antràs and Helpman (2008). ■

6 The Sorting Pattern of Firms

To illustrate the sorting of firms into different organizational forms conditional on their productivity and the headquarter intensity of the industry in which they operate, we draw the above scaled indifference conditions, (7)–(12), in the $(\eta, \tilde{\Theta})$-plane. We introduce three additional assumptions. As is standard in the heterogeneous-firms trade literature, we assume that not all firms export in a given industry. This is ensured by the restriction $\tau^{\sigma-1} f_X > f_V$. Secondly, the least productive firms, in all industries, choose not to produce.[16] Thirdly, we will assume that, for a sufficiently high η,

[16] This imposes an upper bound on the entry cost which we will not elaborate on here.

all active firms will choose to integrate.[17] This is ensured by the restriction $f_V < \xi(1) f_O$. Lemma 1 and 2, along with our assumptions, lead to Figure 1.

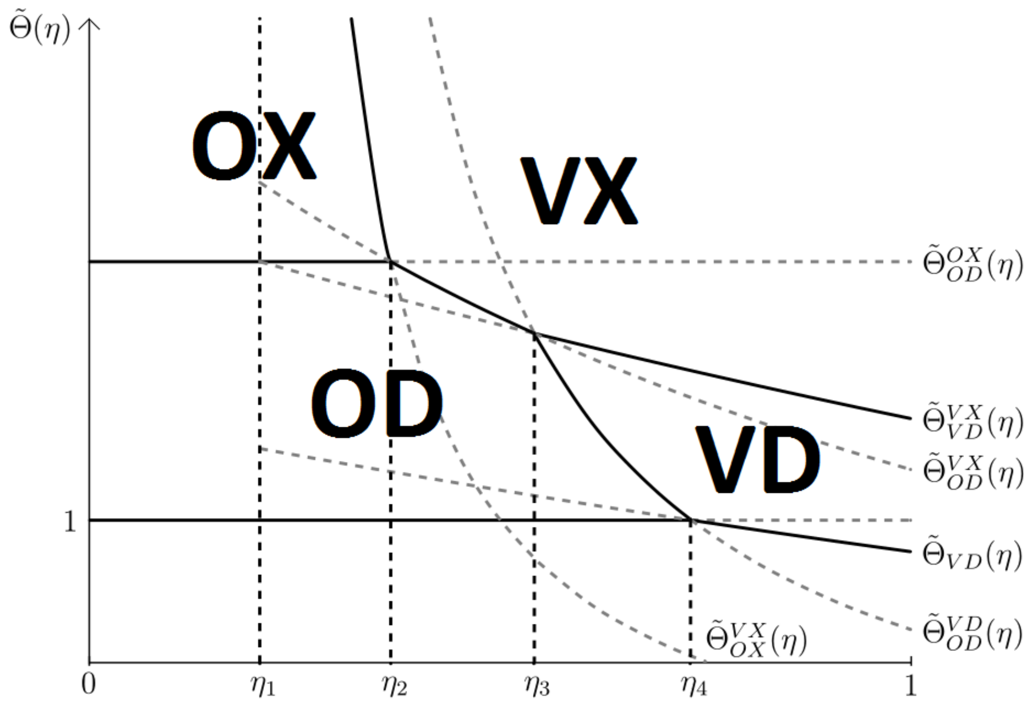

Figure 1: Sorting of firms in different industries.

To understand the sorting of firms in Figure 1, consider first the relatively low headquarter intensive industries, $\eta \in (0, \eta_1)$. In these industries, variable production is more efficient under outsourcing compared to integration, and thus, no firms will incur the higher fixed costs of integration. In these industries, the least productive active firms outsource and serve only the domestic market, while the most productive firms also export. In relatively high headquarter intensive industries, $\eta \in (\eta_1, 1)$, integration provides more efficient variable production than does outsourcing, cf. Lemma 1. By Lemma 2, the gain in relative efficiency of variable production, from integration, depends positively on η, and therefore the sorting of firms differs across these

[17]This is done to capture a wide variety of industry structures and thereby provide a more general analysis. Note that we have not restricted the distribution of industries $F(\eta)$.

industries.

In the industries $\eta \in (\eta_1, \eta_2)$, integration is only slightly more efficient than outsourcing when it comes to variable production. Thus, only very productive firms will choose to pay the higher fixed cost of integration. Further, firms need to be more productive to undertake integration than to export. The fact that the marginal integrating firm exports, promotes the decision to integration due to the complementarity mentioned above.

In the industries $\eta \in (\eta_2, \eta_3)$, firms either outsource and serve only the domestic market or choose to integrate and export. Here, integration is favored to an extent where firms find integration and exporting almost equally profitable. This is illustrated by an interval of productivities where firms would integrate if they were exporting and would export if they were integrating. However, at the same time neither exporting nor integration pay off when considered in isolation.[18] For the most productive of these firms, the complementarity between integration and exporting implies that they undertake both activities. Firms undertake integration exactly because they choose to export and vice versa.

In the industries $\eta \in (\eta_3, \eta_4)$, the efficiency of variable production under integration has become quite more efficient compared to that under outsourcing. In effect, integration is now attractive to the point where the relevant cutoff for integration, $\tilde{\Theta}_{OD}^{VD}$, is lower than the relevant cutoff for exporting, $\tilde{\Theta}_{VD}^{VX}$. I.e., the least productive active firms outsource, the most productive firms integrate and export, and firms with intermediate productivities integrate but do not export. The marginal exporter therefore integrates. The complementarity between exporting and integration implies that exporting is more prevalent than it would be if the marginal exporter was outsourcing. The relatively high prevalence of integration thus promotes exporting.

In the most headquarter intensive industries where $\eta \in (\eta_4, 1)$, all active firms integrate. The least productive active firms do not export while the most productive do. Again, we note that exporting is promoted by the prevalence of integration.

[18]It can be seen in Figure 1 that for $\eta \in (\eta_2, \eta_3)$ some firms have productivities below $\tilde{\Theta}_{OD}^{OX}$ and $\tilde{\Theta}_{OD}^{VD}$ and at the same time above $\tilde{\Theta}_{VD}^{VX}$ and $\tilde{\Theta}_{OX}^{VX}$.

7 Trade Liberalization

We consider a decrease in the iceberg trade costs, τ. In the present section, we investigate the effects on the prevalence of integrating firms in different industries. In Section 8, we turn to a discussion of the role that M&A activity plays in this context.

7.1 The Prevalence of Integration

By the prevalence of integration we mean the share (fraction) of active firms in a given industry that chooses the ownership structure $k = V$. We will denote the prevalence of integration, in industry η, by $\lambda(\eta)$ and we offer the following proposition.

Proposition 1 $\lambda(\eta) = 0$ *for* $\eta < \eta_1$ *and* $\lambda(\eta) = 1$ *for* $\eta > \eta_4$*. Furthermore,* η_1 *and* η_4 *are independent of* τ*.*

Proof. The first part follows trivially from the facts that no firms integrate in the industries $\eta \in (0, \eta_1)$ and all firms integrate in the industries $\eta \in (\eta_4, 1)$. Moreover, η_1 and η_4 are implicitly given by, respectively, $\xi(\eta_1) = 1$ and $\xi(\eta_4) = f_V/f_O$. Therefore, they do not depend on τ. ■

With Proposition 1 in our hands, we only need to determine the effect of trade liberalization on the prevalence of integration in the non-changing interval of industries, (η_1, η_4).[19] For this purpose, we will assume that productivities, θ, in all industries, are Pareto distributed, i.e.,

$$G(\theta) = 1 - \left(\frac{\theta^*}{\theta}\right)^{\kappa}, \tag{13}$$

where θ^* is a positive scale parameter and κ ($> \sigma - 1$) is the shape parameter.[20] This assumption leads to Proposition 2.

[19]In the industries $\eta \in (0, \eta_1)$ and $\eta \in (\eta_4, 1)$, our model basically boils down to the Melitz model since only one ownership structure exists.

[20]We assume for expositional simplicity that all industries share the same distribution of productivities. The results below do not depend on this assumption, i.e., we could allow for inter-industry variation in θ^* and κ.

Proposition 2 *In the industries $\eta \in (\eta_1, \eta_4)$, the prevalence of integration, $\lambda(\eta)$, is non-decreasing when τ is reduced. Furthermore, $\lambda(\eta)$ is strictly increasing in the industries $\eta \in (\eta_1, \eta_3)$. $\lambda(\eta)$ is constant in the industries $\eta \in (\eta_3, \eta_4)$.*

Proof. By the properties of the Pareto distribution, we have that for $\eta \in (\eta_1, \eta_4)$:

$$\lambda(\eta) = \left(\min\left\{\tilde{\Theta}_{OD}^{VD}(\eta), \max\left\{\tilde{\Theta}_{OX}^{VX}(\eta), \tilde{\Theta}_{OD}^{VX}(\eta)\right\}\right\}\right)^{-\kappa/(\sigma-1)}. \quad (14)$$

By equation (8), $\tilde{\Theta}_{OD}^{VD}(\eta)$ is independent of τ. By the equations (11) and (12), $\tilde{\Theta}_{OX}^{VX}(\eta)$ and $\tilde{\Theta}_{OD}^{VX}(\eta)$ are strictly decreasing when τ is reduced. It follows that the prevalence in (14) is non-decreasing when τ is reduced. Moreover, since

$$\tilde{\Theta}_{OD}^{VD}(\eta) > \max\left\{\tilde{\Theta}_{OX}^{VX}(\eta), \tilde{\Theta}_{OD}^{VX}(\eta)\right\} \text{ for } \eta \in (\eta_1, \eta_3), \quad (15)$$

it also follows that the prevalence in (14) is strictly increasing when τ is reduced in industries where $\eta \in (\eta_1, \eta_3)$. ■

To gain intuition for the results in Proposition 2, we illustrate firms' adjustments to trade liberalization in a figure akin to Figure 1. This leads us to Figure 2.

By Proposition 1, the prevalence of integration can only react to trade liberalization in the industries $\eta \in (\eta_1, \eta_4)$. Splitting up this interval, we have that in the industries $\eta \in (\eta_1, \eta_2)$, $\eta \in (\eta_2, \eta_3)$, and $\eta \in (\eta_3, \eta_4)$, the scaled cutoffs for integration are given by, $\tilde{\Theta}_{OX}^{VX}(\eta)$, $\tilde{\Theta}_{OD}^{VX}(\eta)$, and $\tilde{\Theta}_{OD}^{VD}(\eta)$, respectively. Further, due to the convenient scaling, the prevalence of integration is uniquely determined by, and is decreasing in, the relevant scaled cutoff, in the industries $\eta \in (\eta_1, \eta_4)$. This means that the reaction of the prevalence of integration is directly visible from the reaction of the relevant scaled cutoff in Figure 2.

As depicted in Figure 2, the trade liberalization has affected four of the cutoffs between different organizational forms.[21] Obviously, the cutoffs for exporting conditional on either ownership structure, $\tilde{\Theta}_{OD}^{OX}(\eta)$ and $\tilde{\Theta}_{VD}^{VX}(\eta)$, shift down. What is more important for the prevalence of integration is

[21] Our scaling implies that only the indifference conditions, which are affected directly by a decrease in τ, react. I.e., the scaling removes general equilibrium effects (through A_η) which, with Pareto distributed productivities, are irrelevant for determining prevalence.

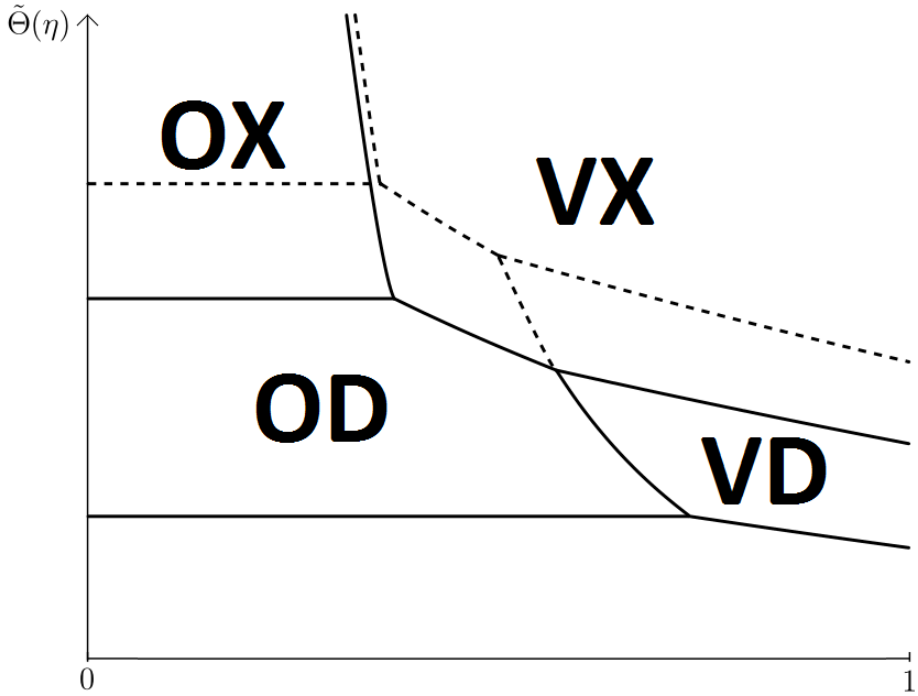

Figure 2: Effect of a reduction in τ.

that the scaled cutoff $\tilde{\Theta}^{VX}_{OX}(\eta)$ decreases when τ decreases. This is because the decrease in τ increases the value of integration for exporters, due to the above mentioned complementarity. In industries where the marginal integrator exports, the promotion of exports, by the decrease in τ, promotes integration. Thus, the prevalence of integration increases for $\eta \in (\eta_1, \eta_2)$. In Figure 2, this is illustrated by a drop in the scaled cutoff $\tilde{\Theta}^{VX}_{OX}(\eta)$.

The fourth scaled cutoff, affected by a decrease in τ, is $\tilde{\Theta}^{VX}_{OD}(\eta)$ which decreases. Thus, in industries where the marginal integrator is also the marginal exporter, the now more attractive exporting opportunity naturally promotes integration. In effect, the prevalence of integration rises in these industries. This is illustrated by a decrease in the scaled cutoff $\tilde{\Theta}^{VX}_{OD}(\eta)$ in Figure 2.

The overall impression from Figure 2 is that the effect of trade liberalization on the prevalence of integration is positive in some industries and zero in the rest.[22] This is exactly the combined insight of Proposition 1 and 2.

[22]This is contrary to the findings of McLaren (2000). However, we are not aware of empirical evidence in conflict with our findings.

Corollary 1 *It follows from Proposition 1 and 2 that the prevalence of integration, $\lambda(\eta)$, is non-decreasing in all industries, $\eta \in (0,1)$, when τ is reduced. Moreover, $\lambda(\eta)$ is strictly increasing in the industries $\eta \in (\eta_1, \eta_3)$.*

8 Mergers and Acquisitions

In order to analyze an economy's post trade-liberalization adjustment through M&As, we now turn to a discussion of the masses of integrating firms in the various industries.

Lemma 3 *The unscaled productivity cutoffs $\Theta_{OX}^{VX}(\eta)$ and $\Theta_{OD}^{VX}(\eta)$ are both strictly decreasing when trade is liberalized. On the other hand, the unscaled productivity cutoff $\Theta_{OD}^{VD}(\eta)$ is strictly increasing, when trade is liberalized. Furthermore, in the industries $\eta \in (\eta_1, \eta_3)$, we see increases in the masses of firms which integrate. In the industries $\eta \in (\eta_3, \eta_4)$, we see decreases in the masses of firms which integrate.*

Proof. See Appendix B. ∎

We use Lemma 3 as a stepping stone to an analysis of post trade liberalization M&As. However, the static nature of our model hinders meaningful talk about M&As. As a remedy to this problem, we introduce dynamics. We follow Melitz (2003) and assume that economies last forever. In all periods, all active firms face the same constant probability, γ, of idiosyncratic death shocks that force affected firms to exit. Moreover, we change the cost structure of integration slightly. Assume now, on the one hand, that the per-period fixed cost of integration is $f_V' = f_O$. On the other hand, there are now a positive one-time *sunk* cost of integration (but not of outsourcing). We will denote this by $s_V > 0$. Note that firms are indifferent between paying the sunk cost, s_V, and paying the equivalent amortized cost of γs_V every period until the idiosyncratic death shock strikes. Let us assume that $\gamma s_V = f_V - f_O$. Thus, with amortization of the sunk cost, the new per-period cost of integration, $f_O + \gamma s_V$, is equal to the fixed cost of integration in the previous analysis, f_V. Formally,

$$f_O + \gamma s_V = f_V > f_O.$$

Given these assumptions, the results of the comparative static analysis in Section 7 still apply for steady state.

Why these changes in cost structure? Well, as noted by Helpman (2010), the fixed costs of integration are not necessarily larger than the fixed costs of outsourcing, i.e., $f_O \geq f_V$ may hold. On a related note, Defever and Toubal (2010) report that a survey of French multinationals shows that the fixed costs of outsourcing exceed the fixed costs of integration. When it comes to the ranking of per-period fixed costs, we believe that the jury is still out. The assumption, $f'_V = f_O$, is intended to level the playing field. In addition, we assume that establishing an integrated firm requires one-time costs that cannot be recouped by subsequent outsourcing. In effect, we assume that the property rights that result in improved bargaining power, $\beta_V > \beta_O$, are costly to establish. However, once established, the integrated firm does not feature higher fixed costs than an outsourcing firm.

At long last, we are equipped for an informal discussion of post trade liberalization M&A activity. Lemma 3 clears the way. We set off with a discussion of the industries where $\eta \in (\eta_1, \eta_3)$. According to Lemma 3, we have two interrelated findings for these industries. One, as a consequence of trade liberalization, we observe decreases in the relevant unscaled cutoff productivities between outsourcing and integration. For the industries $\eta \in (\eta_1, \eta_2)$ and $\eta \in (\eta_2, \eta_3)$, these cutoffs are given by $\Theta_{OX}^{VX}(\eta)$ and $\Theta_{OD}^{VX}(\eta)$, respectively. Two, the masses of firms which integrate increase. These two findings necessitate firm level adjustments through M&As. Some firms, which used to outsource, now merge with, or acquire, their input suppliers. In effect, the trade liberalization spurs a wave of M&A activity which appears to be consistent with Breinlich (2008). As these M&As reallocate resources across firms, they are a potential source of productivity gains.

A contrary development occurs in the industries where $\eta \in (\eta_3, \eta_4)$. In these industries, the masses of firms, which integrate, decrease in the long run. The intuition for this result is based upon the observation that the relevant cutoff between outsourcing and integration, in these industries, is given by $\Theta_{OD}^{VD}(\eta)$, since the marginal integrating firm opts not to export. As in Melitz (2003), firms that solely serve their domestic market experience losses in their revenues. This is indicated by the post trade liberalization increase in $\Theta_{OD}(\eta)$. These losses in domestically generated revenue mean that fewer firms find it profitable to sink the one-time sunk costs of integration. Mathematically, this is seen by observing that $\Theta_{OD}^{VD}(\eta)$ is strictly increasing when τ decreases. However, even though domestic firms are in fact battered by increased competition, none of the active integrating firms "downsize" to outsourcing in their adjustment processes. In the short run, bygones are bygones, and the higher costs of integration, s_V, are sunk. This implies that no active firms, whatsoever, change ownership structure from integration to outsourcing. The short run adjustments to new long run industry structures are created by the death shocks, which force firms to exit, and the altered tradeoff that new entrants face between outsourcing and integration. Note that even though the mass of integrating firms decrease in these industries, the prevalence of integration is constant in the long run, cf. Proposition 2.

9 Future Analysis

Having provided results on the intra-industry prevalence of integration and the mass of integrating firms, we would like to investigate how the economy-wide prevalence of integration reacts to trade liberalization. This will be influenced by possible changes in the mass of active firms in different industries relative to the total mass of firms in the economy.

Further, and more importantly, we are looking into the reallocations stemming from the M&A activity discussed above. The trade liberalization, through decreases in τ, has both a direct mechanical effect on aggregate industry productivity and an indirect effect through intra-industry reallocation, cf. Atkeson and Burstein (2010). These reallocations will depend on changes in ownership structures as well as changes in export behavior (extensive and intensive margins). Firms integrating as a result of the trade liberalization will sink the cost of integration and expand production and to that end attract additional resources. Whether the resulting reallocations tend to increase or decrease aggregate industry productivity is unclear, and this depends on the extent to which the resources are taken from the relatively less productive firms.

Finally, we will investigate the case where export status is non-contractible. This may complicate the strategic interaction between the H-firm and the M-firm. These three ideas will guide our future analysis. Thank you for reading our paper.

Appendix A Indifference values of Θ

The (unscaled) indifference values of Θ defined in the paper are given by

$$\Theta_{OD} = \frac{f_O}{A_\eta \psi_O(\eta)},$$
$$\Theta_{VD} = \frac{f_V}{A_\eta \psi_V(\eta)},$$
$$\Theta_{OD}^{VD} = \frac{f_V - f_O}{A_\eta[\psi_V(\eta) - \psi_O(\eta)]},$$
$$\Theta_{OD}^{OX} = \frac{\tau^{\sigma-1} f_X}{A_\eta \psi_O(\eta)},$$
$$\Theta_{VD}^{VX} = \frac{\tau^{\sigma-1} f_X}{A_\eta \psi_V(\eta)},$$
$$\Theta_{OX}^{VX} = \frac{f_V - f_O}{A_\eta[\psi_V(\eta) - \psi_O(\eta)](1 + \tau^{1-\sigma})},$$
$$\Theta_{OD}^{VX} = \frac{f_X + f_V - f_O}{A_\eta[(1 + \tau^{1-\sigma})\psi_V(\eta) - \psi_O(\eta)]}.$$

Appendix B Proof of Lemma 3

To prove Lemma 3 we first need to show that the unscaled cutoffs Θ_{OX}^{VX} and Θ_{OD}^{VX} decrease, while the unscaled cutoff Θ_{OD}^{VD} increase, when τ decrease. We solve for these three by using the free-entry condition, $E[\pi] = f_e$. After some tedious algebra we obtain that

$$\Theta_{OX}^{VX} = \Theta^* \left[\frac{\sigma - 1}{\kappa - (\sigma - 1)} \frac{f_O}{f_e} \frac{1 + \tau^{-\kappa} \left(\frac{f_x}{f_O}\right)^{1-\frac{\kappa}{\sigma-1}} + (1+\tau^{1-\sigma})^{\frac{\kappa}{\sigma-1}} [\xi(\eta) - 1]^{\frac{\kappa}{\sigma-1}} \left(\frac{f_V - f_O}{f_O}\right)^{1-\frac{\kappa}{\sigma-1}}}{(1+\tau^{1-\sigma})^{\frac{\kappa}{\sigma-1}} [\xi(\eta) - 1]^{\frac{\kappa}{\sigma-1}} \left(\frac{f_V - f_O}{f_O}\right)^{-\frac{\kappa}{\sigma-1}}} \right]^{\frac{1}{\kappa}},$$

$$\Theta_{OD}^{VX} = \Theta^* \left[\frac{\sigma - 1}{\kappa - (\sigma - 1)} \frac{f_O}{f_e} \frac{1 + [\xi(\eta)(1+\tau^{1-\sigma}) - 1]^{\frac{\kappa}{\sigma-1}} \left(\frac{f_X + f_V - f_O}{f_O}\right)^{1-\frac{\kappa}{\sigma-1}}}{[\xi(\eta)(1+\tau^{1-\sigma}) - 1]^{\frac{\kappa}{\sigma-1}} \left(\frac{f_X + f_V - f_O}{f_O}\right)^{-\frac{\kappa}{\sigma-1}}} \right]^{\frac{1}{\kappa}}, \text{ and}$$

$$\Theta_{OD}^{VD} = \Theta^* \left[\frac{\sigma - 1}{\kappa - (\sigma - 1)} \frac{f_O}{f_e} \frac{1 + \xi(\eta)^{\frac{\kappa}{\sigma-1}} \tau^{-\kappa} \left(\frac{f_x}{f_O}\right)^{1-\frac{\kappa}{\sigma-1}} + [\xi(\eta) - 1]^{\frac{\kappa}{\sigma-1}} \left(\frac{f_V - f_O}{f_O}\right)^{1-\frac{\kappa}{\sigma-1}}}{[\xi(\eta) - 1]^{\frac{\kappa}{\sigma-1}} \left(\frac{f_V - f_O}{f_O}\right)^{-\frac{\kappa}{\sigma-1}}} \right]^{\frac{1}{\kappa}}.$$

It is readily seen that Θ_{OD}^{VX} and Θ_{OD}^{VD} are decreasing and increasing, respectively, when τ decreases. Now, differentiating Θ_{OX}^{VX} with respect to $\tau^{1-\sigma}$, we obtain,

$$\frac{\mathrm{d}\Theta_{OX}^{VX}}{\mathrm{d}\tau^{1-\sigma}} = K(\tau) \left[\left(\frac{\tau^{\sigma-1} f_X}{f_O} \right)^{1-\frac{\kappa}{\sigma-1}} - 1 \right],$$

where $K(\tau)$ is positive and a function of τ. Thus, due to the assumptions, $\tau^{\sigma-1} f_X > f_V$ and $f_V > f_O$, it follows that Θ_{OX}^{VX} is decreasing when τ decreases.

To prove the second part of Lemma 3, we need to know the mass of integrators in an industry, η. This is given by the mass of firms which draw a productivity, M_η^e, times the fraction who draws a productivity above the (unscaled) cutoff for integration. By equating the total expenditure on industry η varieties, $\phi_\eta L$, with the average revenue of a firm, we have that,

$$M_\eta^e = \frac{\sigma - 1}{\kappa} \frac{\phi_\eta L}{\sigma f_e}.$$

As M_η^e is independent of τ, the change in the mass of integrating firms is determined by the change in the cutoff for integration. When the (unscaled) cutoff falls the mass of integrating firms rises and vice versa. The second claim of the lemma follows from the above results on the unscaled cutoffs.

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