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**Entry on Export Markets and  
Firm-Level Performance  
Growth: Intra-Industrial  
Convergence or Divergence?**

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By **Florian Mayneris**, CORE

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#### Summary

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**Keywords:** Export Decision, Investment, Firm Heterogeneity

**JEL Classification:** D21, D24, F12

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# Entry on Export Markets and Firm-Level Performance Growth: Intra-Industrial Convergence or Divergence?

Florian Mayneris\*

January 4, 2010

## Abstract

This paper investigates theoretically and empirically the endogenous investment decision of firms conditioning on export decision. It shows that theoretically, whatever the form of preferences, firms that start exporting invest more and grow more than the others. However, it is shown that when preferences are CES, within each category of firms (domestic and switchers), initial productivity and investment are strategic complements, inducing intra-industrial divergence. On the contrary, when preferences are quadratic, initial productivity and investment are strategic substitutes: less productive firms invest more and grow more than the others, inducing intra-industrial convergence. Empirical results on French data support the predictions of the quadratic preferences model.

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It is now well established that exporting firms are more productive, bigger and pay higher wages than domestic ones. A large number of papers on different types of countries have corroborated this idea. We can cite, among others, Bernard and Jensen (1999) on US firms, Greenaway and Kneller (2008) on UK firms, Eaton, Kortum, and Kramarz (2008) on French firms or Clerides, Lach, and Tybout (1998) on Mexican and Colombian firms. A natural question then concerns the nature of causality between export participation and productivity: do better firms become exporters or does exporting improve firms' performance?

There are two stories in favor of the *selection* hypothesis. One can think that exporting is costly; in particular, there can exist fixed export costs, linked up with the research of distribution networks in the destination country or the adaptation of products to the tastes of

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foreign consumers for example. In a context of monopolistic competition *à la* Dixit-Stiglitz, more productive firms are the only ones to be able pay these fixed costs. This is the explanation proposed by Melitz (2003). On the other hand, as advanced by Melitz and Ottaviano (2008), increased competition in a model with quadratic preferences could also explain the self-selection of more productive firms on foreign markets: the existence of iceberg transport costs makes that firms have a “competitive” disadvantage with respect to domestic firms when they try to enter on foreign markets. Since it is optimal for firms to transfer transport costs entirely to foreign consumers, the firms with lower f.o.b prices, that is to say the more productive ones, are the only ones to export.

There are also two main reasons why firms could become more productive when entering on foreign markets. The first one is learning-by-exporting: as emphasized in Grossman and Helpman (1991), exporters may benefit from the technical expertise of their buyers. On the other hand, some papers focused more recently on the correlation between the decision to start exporting and the decision to invest in productivity or quality-enhancing activities. As noted by Lileeva and Trefler (2007), “it is hard to believe that there could be large productivity gains [from exporting] unless firms actively engaged in costly productivity-enhancing investments such as the adoption of advanced manufacturing technologies, the use of just-in-time production techniques, and product restructuring”. Indeed, the revenues generated by the access to foreign markets can be an incentive to spend money in improving production processes or the quality of products, while such investments may not be profitable for domestic firms because of smaller sales. A few models have been developed in this direction. Bustos (2008) introduces a dichotomous technology choice and Bas and Ledezma (2008) add a continuous investment in a Melitz-type model. Verhoogen (2008) also builds on Melitz (2003) to provide a model of quality choice at the firm-level. In all these models, entry on export markets can be associated with firm-level improved performance.

Empirically, many papers find supportive evidence for the selection effect. Bernard and Jensen (1999) find that US exporters are *ex ante* bigger and pay higher wages than domestic firms; US exporters also tend to be more productive even though results are less striking. Greenaway and Kneller (2008) and Clerides, Lach, and Tybout (1998) also conclude to such an *ex ante* export premium for UK, Mexican and Colombian firms. However, as stated by Costantini and Melitz (2007), it could be the case that firms, planning to enter on export markets, engage in productivity-enhancing activities before exporting. Hence, the positive correlation between *ex ante* productivity and export decision measured in the papers cited above could in fact be due to a causal impact of export decision on productivity.

The results obtained in papers that explicitly study the causal impact of exporting on productivity are rather mixed: Van Biesebroeck (2005) and De Loecker (2007) find a positive effect of trade liberalization on Ivorian and Slovenian firms respectively whereas Clerides, Lach, and Tybout (1998), Bernard and Jensen (1999) and Greenaway and Kneller (2008) find at most short-run effects. Here again, if firms anticipate their entry on export markets, some of these studies may miss part of the effect by looking at immediate post-entry productivity evolution. Moreover, all of these papers have in common to impose a homogeneous response of individual productivity to export participation. However, Lileeva and Trefler (2007) show that following the US-Canada free-trade agreement, low-productivity firms were, among Canadian new exporters, the only ones to experience productivity gains. Export participation generated within-industry convergence. On the contrary, Bustos (2008) argues that in Argentina, following the implementation of MERCOSUR, technology adoption and subsequent productivity gains were concentrated among middle-range productivity firms, that

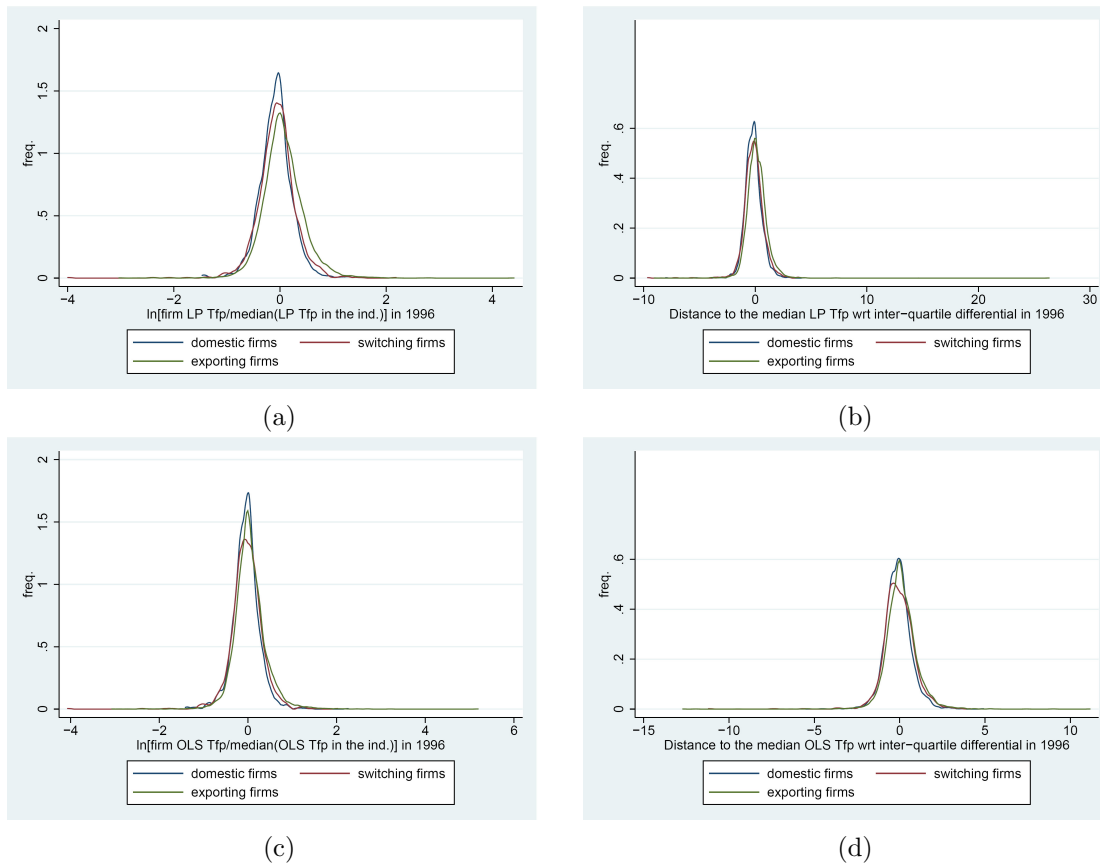


Figure 1: Productivity distribution and export status in 1996

is to say most productive new exporters. Entry on foreign markets generated in Argentina within-industry divergence.

In this paper, I shed new light on this recent debate about the heterogeneous impact of export participation on firms' performance. In the theoretical part, I introduce investment in the two main models of trade with heterogeneous firms. However, I do not endogenize the decision to start exporting: I do not have any prediction about the relative productivity of firms that start exporting (the *switchers*) with respect to domestic firms. This choice is motivated by the data. Indeed, for French firms, contrary to what selection models predict, the productivity distribution of switchers is not different from the productivity distribution of domestic firms.

As shown in figure , whatever the TFP index and the definition of relativeness, the productivity distribution of switchers is very close to the productivity distribution of domestic firms<sup>1</sup>. The productivity distribution of exporters is more clearly shifted on the right but the support of productivity distributions of domestic, switching and exporting firms are not disconnected as theory would suggest. These results do not mean that the predictions from models of selection on export markets are wrong; they rather suggest that the export status of a firm is determined by more complex mechanisms than a "simple" selection on initial productivity. This point has also been acknowledged by Eaton, Kortum, and Kramarz (2008) on French customs data and Armenter and Koren (2009) on US data.

<sup>1</sup>Two TFP indices are used, Levinsohn and Petrin (2003) and simple OLS, and two definitions of relativeness are distinguished, the difference to the median within 2-digit industries and the difference to the median with respect to the difference between the 3rd and the 1st quartiles in the industry; this latter definition allows to control for the way productivities are distributed around the median within each industry. A domestic firm does not export neither in 1996 nor in 2004, an exporting firm exports in both years and a switching firm exports in 2004 but not in 1996.

The optimal investment decision is thus calculated conditioning on the export decision of firms. I adopt a very partial equilibrium perspective. I focus on firms that stay in the industry for a given time-span and study the evolution of their relative performance according to their export decision. I do not deal with entry and exit of firms and their impact in terms of general equilibrium.

Doing so, I also contribute to the literature that seeks to understand better the differences between Melitz (2003) and Melitz and Ottaviano (2008) models, that are at first sight so similar. Indeed, I show that theoretically, export participation can induce both within-industry divergence or convergence according to the specification of consumers preferences. More precisely, whatever the form of preferences, switchers invest more and grow more than domestic firms. But in a Melitz (2003) framework, within each group of firms, more productive firms invest more and grow more, whereas the prediction is completely reversed with quadratic preferences. I argue that this is not due to different mechanisms at work in both models but to the functional form of profits. The functional form of preferences determines the way firm-level profits are related to productivity, which then impacts the relationship between initial productivity and investment: profits are multiplicative with respect to productivity when preferences are CES, and additive with respect to the inverse of productivity when preferences are quadratic.

In the empirical part, I show that, conditioning on initial productivity, French data tend to support the Melitz and Ottaviano (2008) framework: less productive new exporters have higher performance growth than initially more productive ones, and these different performances can, at least partly, be attributed to different incentives to invest.

Section 1 presents a brief review of the literature. The models are developed in section 2. Empirical results are displayed in section 3 and section 4 concludes.

## **1 Export participation and heterogeneous productivity gains: a brief review of the literature**

Melitz (2003) and Melitz and Ottaviano (2008) both introduce firms heterogeneity in models of international trade with increasing returns, but they assume CES preferences for the first one and quadratic preferences for the second one. Quadratic preferences were introduced by Ottaviano, Tabuchi, and Thisse (2002) in a model of economic geography *à la* Krugman (1991) in order to verify that the results obtained in New Economic Geography models with CES preferences were robust to alternative specifications. It appeared that it was the case, giving credit to the idea that the specification of preferences was more or less innocuous. At first sight, introducing firms heterogeneity does not change many things since, even if the mechanisms at work are not the same, Melitz (2003) and Melitz and Ottaviano (2008) yield very similar results about the selection of firms on export markets and the intra-industrial reallocations induced by trade liberalization. But the devil is in the detail and it seems that both models are in fact much more different than what was thought. Baldwin and Harrigan (2007) show for example that both models have very different predictions about the impact of importer size on zero-trade flows and on the f.o.b price of producers. In this chapter, I show that, conditioning on export decision, they also have very different predictions about the link between initial productivity and performance growth.

Melitz (2003) and Melitz and Ottaviano (2008) are silent about the impact of export participation on firm-level productivity. In both models, firms draw an initial productivity

that does not change over time. Trade liberalization has a positive effect on aggregate productivity at the industry level through firm selection (the least productivity firms are forced to exit) and intra-industry reallocations (exporters and more productive firms expand at the expense of domestic and less productive firms). But there are no within-firm productivity improvements. This is at odds with findings on several countries cited in the introduction. That is why recent papers have introduced in a Melitz-type model the possibility for firms to improve their productivity through investment.

Bustos (2008) assumes that firms produce with one production factor, labor. There is a fixed cost of production  $f$  and a constant marginal cost  $\frac{1}{\phi}$ . After observing their initial productivity, firms can choose a “high” technology and reduce their initial marginal cost by a factor  $\gamma$  greater than 1, but at a cost  $f\eta$ , with  $\eta$  greater than 1 too. Since preferences of consumers are CES, the revenues and profits of a firm are a multiplicative function of its initial productivity. It then appears clearly that more productive firms can better amortize the initial fixed investment cost. There is a productivity threshold  $\phi^*$  for technology adoption. All the firms with an initial productivity higher than  $\phi^*$  will choose the “high” technology. If the cost of “high” technology is sufficiently big with respect to the fixed export cost, the model predicts that more productive exporting firms will be the only ones to use the “high” technology. Trade liberalization, by increasing export revenues, lowers the technology adoption threshold  $\phi^*$ . Consequently, falling trade costs generate technology adoption among middle-range firms, that is to say more productive new exporters and less productive continuing exporters.

Bas and Ledezma (2008) introduce a continuous investment in a Melitz-type model. After observing their initial productivity  $\phi$ , firms can make an investment  $I(\phi)$  and attain a productivity level  $[I(\phi)]^\alpha \phi$ , with  $\alpha$  positive and smaller than 1. This last assumption implies that for a given firm, investment has decreasing marginal returns. In their model, firms choose their optimal investment by maximizing their domestic profits only. Here again, preferences of consumers are CES and the revenues and profits of firms are a multiplicative function of productivity. Consequently, more productive firms invest more and grow more than the others and trade liberalization tends to increase the incentive to invest.

In both models, more productive firms invest more than the others and have higher productivity gains. In that sense, we can say that initial productivity and investment are strategic complements. Investment magnifies initial heterogeneity of firms and creates divergence in terms of productivity between exporters and non exporters, but also, within each category, between more and less productive firms.

Verhoogen (2008) is related to this line of research. In this paper, the model is not about productivity-enhancing but about quality-enhancing investment. Preferences are CES and product quality and productivity are supposed to be complements. An increase in the incentive to export is associated to heterogeneous responses of firms: initially more productive firms increase their exports, produce a greater share of high quality goods and raise their wages with respect to initially less productive firms. Trade liberalization is here again a source of divergence within industries. Theoretical results are corroborated by the empirical analysis of Mexican firms dynamics after the peso devaluation of December 1994.

However, these conclusions cannot be generalized. Indeed, Lileeva and Treffer (2007) find completely opposite results on Canadian firms. They study the labour productivity evolution of Canadian plants following the implementation of the US-Canada Free Trade Agreement (FTA) in 1989. They find that among new exporters, low productivity plants experienced large gains while high productivity plants experienced no gains. They interpret these results as higher TFP gains for initially low productivity plants. Indeed, these plants

that experienced high labour productivity gains also invested more heavily in innovation and technology adoption than the others over the period and increased their relative share on the domestic market. To interpret these results, the authors propose a model of selection into investing and exporting. As in papers cited above, Lileeva and Treffer assume CES preferences for consumers and monopolistic competition. A firm is supposed to have the choice between two technologies. The investment cost is fixed. The difference with Bustos (2008) is that for a given level of initial productivity  $\phi_0$ , firms are heterogeneous in terms of productivity gains  $\phi_1 - \phi_0$  they can expect from investing in the “high” technology. The rest of the model is very similar to Melitz (2003) and Bustos (2008): firms must reach a certain productivity threshold in order to export, trade liberalization lowers this threshold and makes it profitable for some firms to invest and start exporting. But now, there are switchers all along the distribution of initial productivities and *mechanically*, less productive switchers experience higher productivity gains since they were further than the others from the export productivity threshold. This theoretical framework allows the authors to rationalize their empirical findings. However, heterogeneous response is not really endogenized here; it is rather exogenously assumed. Moreover, this heterogeneity in terms of productivity gains is not really motivated. Why, for a given initial productivity and for a given amount or type of investment, some firms should experience important productivity gains and some others not? However, an interesting point of their paper is that, contrary to the conclusions of papers previously analyzed in this section, export participation is shown to generate in the USA intra-industrial convergence among exporters in terms of productivity. This debate is interesting *per se* since it allows us to refine the analysis of the complex dynamics generated by international trade within industries. It is also relevant from a political economy point of view: indeed, whether export participation benefits to high or low productive firms will have different implications on the composition of groups of supporters and opponents to liberalization policies.

## 2 Models

In this section, I show that convergence effects can be theoretically obtained without resorting to a second source of heterogeneity. I find that introducing investment decision in Melitz (2003) and Melitz and Ottaviano (2008) generates very different results. Starting to export is associated with higher investment and consequently higher productivity growth, whatever the functional form of preferences. However, incentives to invest are shown to be heterogeneous among firms, the form of this heterogeneity changing according to the way we model the demand function of consumers. Within each group of firms (switching and domestic firms), more productive firms invest more and have higher productivity gains when preferences are CES. On the contrary, with quadratic preferences, less productive firms invest more and have higher productivity gains. Consequently, both models predict divergence in terms of productivity evolution between exporters and non exporters but within each group of firms, the first one predicts divergence whereas the second one predicts convergence. Since forces in both models are roughly the same and work in the same directions, it then appears that the choice of the functional form of preferences is not innocuous in terms of predictions/conclusions.

I consider there are two symmetric countries,  $H$  and  $F$  and I analyze, without loss of generality, the export and investment decisions of firms in country  $H$ .



## 2.1 Sequence of the game

I consider a game with two periods, 0 and 1. A firm draws an initial productivity  $\phi_0$  from a distribution  $G(\phi_0)$  in period 0 and then produces for the domestic market only. At that time, it also decides whether to start exporting or not in period 1. A firm that starts exporting is called a switcher. Given its initial productivity and its decision about starting to export, the firm makes a productivity enhancing investment  $I_0(\phi_0)$  in period 0 which will increase its productivity in period 1:

$$\phi_1 = [I_0(\phi_0)]^\alpha \phi_0 \quad (1)$$

with  $0 < \alpha < 1$ . I consequently assume that for a given initial productivity, marginal returns of investment are decreasing: while investing, one more unit of investment increases less and less initial productivity. The way I model the link between investment and productivity is the same as in Bas and Ledezma (2008).

The cost of investment is supposed to be paid by the firm in period 1. I assume that investing consists in buying an imported investment good; the latter is freely traded and elastically supplied by a big country. The other countries are consequently price-taker for the investment good. Given these assumptions, I can ignore in the model the investment good market, since from the point of view of firms, the price of the investment good is fixed and equal to  $p_I$ .

I do not model the decision to start exporting; I consider it as given. In “traditional” trade models with heterogeneous firms, the decision to start exporting is based on expected profits on the export market, which are themselves a function of firm productivity. In reality, the success of entry on export market will also depend on several other non observed parameters, correlated or not with initial productivity: the adequacy between the characteristics of the good the firm produces and the tastes of foreign consumers, the knowledge the firm has of distribution networks in the destination country etc. The decision to start exporting is thus endogenous to many other determinants than productivity, which can explain why the supports of productivity distribution of domestic firms, switchers and exporters do not exhibit the disconnection that heterogeneous firms models predict (cf introduction). This endogeneity of the export decision is not a problem for my work. Indeed, I am interested in the differences in terms of performance growth between switching and domestic firms that can be explained by different incentives to invest. Whether the decision to start exporting is determined by initial productivity, networks of the entrepreneur abroad or a specific interest of the entrepreneur for foreign markets does not matter.

## 2.2 A CES preferences model

### 2.2.1 Production

I suppose that there is one production factor, labor. In each country, there is a continuum of firms indexed by their labor productivity level  $\phi$ , each firm producing a different variety of the same good. Firms compete under monopolistic competition.

$\frac{1}{\phi}$  is the per unit labor cost of production. Since I am not interested in the entry/exit dynamics of firms, I can ignore the fixed cost of production.

In any period  $t$ , the production cost function of a firm is given by the following expression:

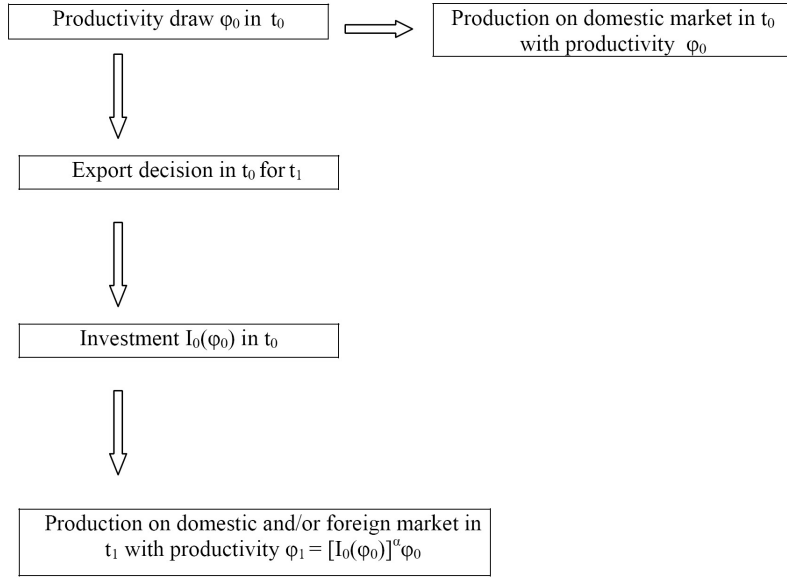


Figure 2: Sequence of the game

$$C[q(\phi_t)] = \frac{q(\phi_t)}{\phi_t} w \quad (2)$$

$t=0,1$ . Since domestic and foreign countries are symmetric, I can simplify the analysis by normalizing the wage level  $w$  to 1.

### 2.2.2 Preferences

There is a continuum of homogeneous consumers of mass 1. I assume that preferences of consumers are CES:

$$U = \left[ \int_{\omega \in \Omega_h} q_h(\omega)^{\frac{\sigma-1}{\sigma}} d\omega + \int_{\omega \in \Omega_f} q_f(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}} \quad (3)$$

where  $h, f$  denote home and foreign countries variables,  $\Omega_i$  is the set of consumed varieties from country  $i$ ,  $q_i(\omega)$  is the quantity of variety  $\omega$  from country  $i$  that is consumed at the optimum and  $\sigma$  is the elasticity of substitution between varieties (greater than 1). I denote  $Q$  the basket of consumed goods.

The representative consumer optimizes the consumption level of each variety under the following budget constraint:

$$R = \left[ \int_{\omega \in \Omega_h} p_h(\omega) q_h(\omega) d\omega + \int_{\omega \in \Omega_f} p_f(\omega) q_f(\omega) d\omega \right] \quad (4)$$

where  $R$  is the total expenditure of consumer.

Consumer utility is maximized for:

$$q_i(\omega) = RP^{\sigma-1}p_i^{-\sigma}(\omega) \quad (5)$$

where  $p_i(\omega)$  is the price of variety  $\omega$  from country  $i$ ,  $R$  is the total amount of sales  $PQ$  and  $P$  is the aggregate price index in the economy:

$$P = \left[ \int_{\omega \in \Omega_h} p_h(\omega)^{1-\sigma} d\omega + \int_{\omega \in \Omega_f} p_f(\omega)^{1-\sigma} d\omega \right]^{\frac{1}{1-\sigma}} \quad (6)$$

The demand of consumers for variety  $\omega$  increases when the price of this variety with respect to the aggregate price in the economy  $\left(\frac{p(\omega)}{P}\right)^\sigma$  decreases.

### 2.2.3 Domestic firms

We assume that information is perfect. Firms perfectly know in period 0 what will be their environment in period 1; given their decision about starting to export and their initial productivity draw, they consequently choose their investment level in period 0 in order to maximize their profit in period 1. The game we described in subsection 2.1 is thus solved through backward induction.

We focus here on firms that have chosen in period 0 not to export in period 1. The profit function of a domestic firm in period 1 is:

$$\pi_d(\phi_1) = \left( p_d(\phi_1) - \frac{1}{\phi_1} \right) q_d(\phi_1) - p_I I_d(\phi_0) \quad (7)$$

Given the demand function calculated in subsection 2.2.2, profit maximization with respect to  $p_d(\phi_1)$  and  $q_d(\phi_1)$  implies that:

$$p_d(\phi_1) = \left( \frac{\sigma}{\sigma-1} \right) \frac{1}{\phi_1} \quad (8)$$

$$q_d(\phi_1) = \left( \frac{\sigma-1}{\sigma} \right)^\sigma RP^{\sigma-1} \phi_1^\sigma \quad (9)$$

I use these optimal values to calculate total sales and profit of domestic firms at the equilibrium:

$$r_d(\phi_1) = \left( \frac{\sigma-1}{\sigma} \right)^{\sigma-1} RP^{\sigma-1} \phi_1^{\sigma-1} \quad (10)$$

$$\pi_d(\phi_1) = \frac{r_d(\phi_1)}{\sigma} - p_I I_d(\phi_0) = \frac{RP^{\sigma-1}}{\sigma} \left( \frac{\sigma-1}{\sigma} \right)^{\sigma-1} \phi_1^{\sigma-1} - p_I I_d(\phi_0) \quad (11)$$

Given the link between initial productivity and post-investment efficiency defined in equation 1, firm-level optimal price and output can be written as follows:

$$p_d(\phi_1) = [I_d(\phi_0)]^{-\alpha} p_d(\phi_0) \quad (12)$$

$$q_d(\phi_1) = [I_d(\phi_0)]^{\alpha\sigma} q_d(\phi_0) \quad (13)$$

$p_d(\phi_1)$  and  $q_d(\phi_1)$  are functions of  $p(\phi_0)$  and  $q(\phi_0)$ . We can note that for a given initial productivity level, the higher the amount of investment, the lower the price and the higher the output relatively to their levels before investment. I use these expressions to calculate total sales and profits of domestic investing firm and I obtain:

$$r_d(\phi_1) = [I_d(\phi_0)]^{\alpha(\sigma-1)} r(\phi_0) \quad (14)$$

$$\pi_d(\phi_1) = [I_d(\phi_0)]^{\alpha(\sigma-1)} \frac{r_d(\phi_0)}{\sigma} - p_I I_d(\phi_0) \quad (15)$$

Equations 14 and 15 show that investing increases the level of sales but decreases firm-level profit by the cost investment. I can then calculate the level of investment that maximizes domestic profit and I find, after solving first-order condition:

$$I_d(\phi_0) = \left[ \frac{\alpha Q P^\sigma}{p_I} \left( \frac{\sigma-1}{\sigma} \right)^\sigma \phi_0^{\sigma-1} \right]^{\frac{1}{1-\alpha(\sigma-1)}} \quad (16)$$

where I suppose that  $0 < \frac{1}{1-\alpha(\sigma-1)}$  i.e.  $\frac{1}{\sigma-1} > \alpha$ , in order to ensure non explosive investments for the least productive firms.

Let's focus now on the determinants of investment for domestic firms. Not surprisingly, the higher  $p_I$ , the lower the level of investment: investment is a decreasing function of its price. Ignoring general equilibrium effects, investment also increases with  $Q$ , the size of the market. On the other hand, all else equal, the level of investment is an increasing function of  $P$ .  $P$  is an index of the competitive pressure in the industry; indeed, the more numerous and/or the more productive are the firms in the industry, the lower is  $P$  (cf Melitz (2003)). In this model, firms set their price following a constant markup rule. They adjust to tougher competition through quantities and not through prices. Tougher competition reduces the quantity of good a firm can sell (see expression 5) and also reduces the profits a firm can make. It consequently negatively affects its optimal investment choice. As emphasized in Aghion and Howitt (2005), this is a "particularly unappealing feature of the basic Schumpeterian model" which predicts that "product market competition is unambiguously detrimental to growth because it reduces the monopoly rents that reward successful innovators". Finally, all else equal, more productive domestic firms invest more and grow more than the others: investment magnifies initial heterogeneity of firms. Indeed, given the multiplicative form of profits with respect to productivity, the more productive is a firm, the more revenues one unit of investment generates. Since each unit of investment has the same price  $p_I$  whatever the productivity of the firm, more productive firms can better amortize the cost of investment.

#### 2.2.4 Exporting firms

I now study the investment decision of firms that decide in period 0 to start exporting in period 1. I follow once again a backward induction analysis. There exist per-unit iceberg trade costs equal to  $(\tau - 1)$ . Since I do not try to obtain predictions about the entry/exit of firms on the export market, I can ignore the fixed export cost. Home and foreign markets are perfectly segmented so that firms can make their decisions for each market separately.

In period 1, at the optimum on the export market, firms set the following price and sell the following quantity:

$$p_x(\phi_1) = \tau [I_x(\phi_0)]^{-\alpha} p_d(\phi_0) \quad (17)$$

$$q_x(\phi_1) = \tau^{-\sigma} [I_x(\phi_0)]^{\alpha\sigma} q_d(\phi_0) \quad (18)$$

Using these optimal price and output levels, I can then calculate the sales and the profit realized by an exporting firm on the foreign market:

$$r_x(\phi_1) = \tau^{1-\sigma} [I_x(\phi_0)]^{\alpha(\sigma-1)} r_d(\phi_0) \quad (19)$$

$$\pi_x(\phi_1) = \tau^{1-\sigma} [I_x(\phi_0)]^{\alpha(\sigma-1)} \frac{r_d(\phi_0)}{\sigma} - p_I I_x(\phi_0) \quad (20)$$

As usual in monopolistic competition models with DSK demand functions, variable trade costs are completely transferred to foreign consumers through higher output prices. Higher variable trade costs increase the output price charged by producers and decrease the sales and the profit they realize on the foreign market.

Since home and foreign markets are segmented, it is straightforward to see that an exporting firm will produce more and make more profit than a domestic one: activities on foreign markets will just come in addition of domestic ones. Contrary to Bas and Ledezma (2008), I endogenize the level of investment with respect to export status. Consequently, an exporting firm will make its investment decision on the basis of its total activity, by maximizing the following profit function:

$$\pi_{Total} = \pi_d(\phi_1) + \pi_x(\phi_1) = (1 + \tau^{1-\sigma}) [I_x(\phi_0)]^{\alpha(\sigma-1)} \frac{r_d(\phi_0)}{\sigma} - p_I I_x(\phi_0) \quad (21)$$

The first-order condition with respect to investment level imposes that an exporting firm will follow the investment rule:

$$I_x(\phi_0) = (1 + \tau^{1-\sigma})^{\frac{1}{1-\alpha(\sigma-1)}} I_d(\phi_0) \quad (22)$$

Since it can sell more, an exporting firm amortizes more easily its investment and will, all else equal, invest more and grow more than a domestic one. It will do it in a proportionate way, increasing its investment level by a factor  $(1 + \tau^{1-\sigma})^{\frac{1}{1-\alpha(\sigma-1)}}$ . All else equal, the higher the trade costs, the lower the investment differential between exporting and domestic firms.

The analysis conducted on the determinants of investment at the end of section 2.2.3 is still valid here. We can also note that a variation in  $\tau$  has an ambiguous effect on the investment of exporting firms: on the one hand, an increase in  $\tau$  reduces the sales of firms on export markets and consequently the incentive for firms to invest; this can be seen as *revenue* effect. On the other hand, it has the opposite effect through an increase in  $P$ , i.e a reduction of the competitive pressure (*competition* effect). The net effect of a variation of trade costs on investment and firm-level growth depends on the relative magnitude of both effects<sup>2</sup>.

### 2.2.5 Within industry divergence

In the end, adding investment in a Melitz-type model generates within-industry divergence at two levels:

- exporting firms invest more and consequently grow more than domestic firms,
- within both categories of firms, more productive firms invest more and grow more than the others.

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<sup>2</sup>The assumptions made in these kinds of models usually generate a positive net effect.

Export activities and investment magnify together the initial heterogeneity of firms. This is interesting from the point of view of the industrial dynamics induced by international trade. It is also interesting from the point of view of the political economy of trade liberalization: indeed, as usual, exporting firms will tend to be more favorable to trade liberalization than domestic firms but moreover, if these results are verified, among exporting firms, more productive ones should be more supportive than the others.

## 2.3 A quadratic preferences model

Assumptions about the production function of firms are the same as in section 2.2.1 but the specification of consumers' preferences changes.

### 2.3.1 Quadratic preferences

I assume now that consumers' preferences are quadratic, as in Ottaviano, Tabuchi, and Thisse (2002). In that case:

$$U = q_0 + \alpha \left( \int_{\omega \in \Omega_h} q_h(\omega) d\omega + \int_{\omega \in \Omega_f} q_f(\omega) d\omega \right) - \frac{1}{2} \gamma \left( \int_{\omega \in \Omega_h} q_h(\omega)^2 d\omega + \int_{\omega \in \Omega_f} q_f(\omega)^2 d\omega \right) - \frac{1}{2} \eta \left( \left( \int_{\omega \in \Omega_h} q_h(\omega) d\omega \right)^2 + \left( \int_{\omega \in \Omega_f} q_f(\omega) d\omega \right)^2 \right)$$

where  $q_0$  and  $q_i(\omega)$  are the consumption levels of the homogenous good used as numeraire and of different varieties of the differentiated good.  $\alpha$ ,  $\gamma$  and  $\eta$  are all positive.  $\alpha$  and  $\eta$  denote the degree of substitution between the numeraire and the differentiated good: the higher is  $\alpha$  and the lower is  $\eta$ , the less substitutable are the homogeneous and the differentiated goods. On the other hand,  $\gamma$  is an index of substitutability of the different varieties of the differentiated good: the lower is  $\gamma$ , the more substitutable are the different varieties.

As in subsection 2.2.2, after solving the maximization program of consumers, it comes that the demand of a given variety  $\omega$  is:

$$q_i(\omega) = \frac{\alpha L}{\eta N + \gamma} - \frac{L}{\gamma} p_i(\omega) + \frac{\eta N}{\eta N + \gamma} \frac{L}{\gamma} \bar{p} \quad (23)$$

where  $L$  is the size of population,  $N$  is the number of firms and  $\bar{p}$  is the average price at the equilibrium in the industry.

Given the expression 23, the demand for variety  $\omega$  produced in country  $i$  is positive if and only if:

$$p_i(\omega) \leq \frac{1}{\eta N + \gamma} (\gamma \alpha + \eta N \bar{p}) \equiv p_{max} \quad (24)$$

While in the case of CES preferences, the demand for a given variety is always positive, the hypothesis of quadratic preferences and consequently of variable price elasticity implies an upper bound for the price a firm can set. Indeed, for a given  $\bar{p}$ , the price elasticity of demand,  $\epsilon_i(\omega) = \left[ \frac{p_{max}}{p_i(\omega)} - 1 \right]^{-1}$  increases with  $p_i(\omega)$  and becomes infinite when  $p_i(\omega)$  tends to  $p_{max}$ .

### 2.3.2 Domestic firms

We focus here on firms that have chosen in period 0 not to export in period 1. We solve again the maximization problem of the firm with respect to investment through backward induction.

The profit function of a domestic firm in period 1 is:

$$\pi_d(\phi_1) = \left( p_d(\phi_1) - \frac{1}{\phi_1} \right) q_d(\phi_1) - p_I I_d(\phi_0) \quad (25)$$

Given the demand function calculated in subsection 2.3.1, profit maximization with respect to  $p_d(\phi_1)$  and  $q_d(\phi_1)$  implies that:

$$p_d(\phi_1) = \frac{1}{2} \left( p_{max} + \frac{1}{\phi_1} \right) \quad (26)$$

$$q_d(\phi_1) = \frac{L}{2\gamma} \left( p_{max} - \frac{1}{\phi_1} \right) \quad (27)$$

I use these optimal values to calculate total sales and profit of domestic firms at the equilibrium:

$$r_d(\phi_1) = \frac{L}{4\gamma} \left( p_{max}^2 - \frac{1}{\phi_1^2} \right) \quad (28)$$

$$\pi_d(\phi_1) = \frac{L}{4\gamma} \left( p_{max} - \frac{1}{\phi_1} \right)^2 - p_I I_d(\phi_0) \quad (29)$$

Low productivity firms charge higher prices, produce less and make less profit. Contrary to the CES model, the markup differs across firms:

$$\mu(\phi_1) = p_d(\phi_1) - \frac{1}{\phi_1} = \frac{1}{2} \left( p_{max} - \frac{1}{\phi_1} \right) \quad (30)$$

For a given degree of competition in the industry ( $p_{max}$  fixed), less productive firms charge lower markups, and for a given productivity, firms decrease their markup when competition increases (i.e  $p_{max}$  decreases).

Given the link between initial productivity and post-investment efficiency defined in equation 1, firm-level optimal price and output can be written as follows:

$$p_d(\phi_1) = \frac{1}{2} \left( p_{max} + \frac{1}{[I_d(\phi_0)]^\alpha \phi_0} \right) \quad (31)$$

$$q_d(\phi_1) = \frac{L}{2\gamma} \left( p_{max} - \frac{1}{[I_d(\phi_0)]^\alpha \phi_0} \right) \quad (32)$$

I use these expressions to calculate total sales and profits of domestic investing firms and I obtain:

$$r_d(\phi_1) = \frac{L}{4\gamma} \left( p_{max}^2 - \frac{1}{[I_d(\phi_0)]^{2\alpha} \phi_0^2} \right) \quad (33)$$

$$\pi_d(\phi_1) = \frac{L}{4\gamma} \left( p_{max} - \frac{1}{[I_d(\phi_0)]^\alpha \phi_0} \right)^2 - p_I I_d(\phi_0) \quad (34)$$

I can then calculate the level of investment that maximizes domestic profit. Solving the maximization problem is less straightforward than with CES preferences. I can however show that  $\phi_0$  and  $I_d(\phi_0)$  are related by the following relationship (see Appendix A):

$$\frac{1}{\phi_0} = \frac{[I_d(\phi_0)]^\alpha p_{max}}{2} \left[ 1 - \left( 1 - \frac{8\gamma p_I I_d(\phi_0)}{\alpha L p_{max}^2} \right)^{\frac{1}{2}} \right] \quad (35)$$

The analysis of the determinants of investment is less direct than in the the previous model but still remains tractable. Investment is a decreasing function of its price; indeed, for a given initial productivity  $\frac{1}{\phi_0}$ , an increase in  $p_I$  must be associated with a decrease in  $I_d(\phi_0)$  for relation 35 keeping verified. Symmetrically, all else equal (ignoring in particular competition and price effects), investment is an increasing function of the market size  $L$ . Results are so far exactly the same as in the previous model. The analysis differs when considering the impact of competition. Indeed,  $p_{max}$  (which is the “homologue” of  $P$  in the previous model) has two opposite effects on investment:

- on the one hand, as in a CES framework, a decrease in  $p_{max}$  tends to reduce, all else equal, the revenues of a firm and its incentives to invest. This is the effect generated in the second block of expression 35  $\left( \left[ 1 - \left( 1 - \frac{8\gamma p_I I_d(\phi_0)}{\alpha L p_{max}^2} \right)^{\frac{1}{2}} \right] \right)$ .
- on the other hand, tougher competition tends to encourage firms to invest in order to better face the competitive pressure. This is emphasized in the first block of expression 35  $\left( \frac{[I_d(\phi_0)]^\alpha p_{max}}{2} \right)$ .

Hence, besides the classical Schumpeterian negative effect of competition on investment described in section 2.2.3, we also have, when preferences are quadratic, a positive *pro-competitive effect*. It points at the stimulating impact of competition on investment: when competition is tougher, firms are incentivised to invest more in order to restaure their mark-ups and quantities. However, I show in Appendix A.3 that the global effect of competition on investment is, in a Melitz-Ottaviano framework, negative and consequently not very different from what it is in a Melitz-type approach.

Finally, relation 35 exhibits a negative relationship between  $\phi_0$  and  $I_d(\phi_0)$ : less productive firms invest more and have higher productivity gains than the others. Note that this last results is not driven by the partial equilibrium analysis. Of course,  $p_{max}$  is endogenous; it depends on the number of competitors and their average productivity, and consequently on the dynamics of entry/exit in the industry. However, the level of  $p_{max}$  is the same for all firms, that consider it as given. Ignoring these general equilibrium effects consequently does not affect the prediction of the model about the link between initial productivity and the level of investment.

This prediction is in complete opposition to what we found with CES preferences. Since the forces at play in both models work in the same directions, it seems that these opposite predictions are due to different functional forms of the profit functions. When preferences are CES, profit is a multiplicative function of  $\phi$ . Given the relationship between initial productivity, investment and productivity gains assumed in equation 1, one unit of investment generates more additional profit for initially more productive firms. On the contrary, with quadratic preferences, profit is an additive function of the inverse of initial productivity,



which is sufficient to reverse predictions about the relationship between initial productivity and investment.

These results show that even if models with CES preferences are very tractable, some of their results are directly induced by the choice of the functional form. This latter is not as innocuous as it can seem.

### 2.3.3 Exporting firms

At period 0, some firms may also decide to start exporting in period 1. They choose their level of investment by maximizing the following profit function:

$$\pi_{Total} = \pi_d(\phi_1) + \pi_x(\phi_1) = \frac{L}{4\gamma} \left[ \left( p_{max} - \frac{1}{[I_x(\phi_0)]^\alpha \phi_0} \right)^2 + \left( p_{max} - \frac{\tau}{[I_x(\phi_0)]^\alpha \phi_0} \right)^2 \right] \quad (36)$$

As shown in Appendix A.2, optimal investment for exporting firms is given by the following expression:

$$\frac{1}{\phi_0} = \frac{1 + \tau}{1 + \tau^2} \frac{[I_x(\phi_0)]^\alpha p_{max}}{2} \left[ 1 - \left( 1 - \frac{1 + \tau^2}{(1 + \tau)^2} \frac{8\gamma p_I I_x(\phi_0)}{\alpha L p_{max}^2} \right)^{\frac{1}{2}} \right] \quad (37)$$

When comparing equations 35 and 37, it appears clearly that for a given initial productivity, a firm that decides to start exporting will, all else equal, invest more and grow more than a domestic firm. Indeed, as it can sell more, an exporting firm can better amortize its investment. A variation in trade costs impacts firm-level investment through three different channels:

- a *revenue effect*: all else equal, a decrease in  $\tau$  improves the accessibility of foreign market. Potential revenues of the firm are bigger and this increases the incentive to invest. In equation 37, this channel appears through the variable  $\frac{(1+\tau)^2}{1+\tau^2} L$ , which is equal to  $2L$  when markets are perfectly integrated and to  $L$  when trade costs are infinite.
- a *competition effect*: a decrease in  $\tau$  will tend to increase competition and to decrease  $p_{max}$ . As stated in subsection 2.3.2 it will in the end discourage investment.
- a *penalty effect*: ignoring investment, the profit of exporting firms on export market is equal to  $\frac{L}{4\gamma} \left( p_{max} - \frac{\tau}{\phi} \right)^2$ . Trade costs impact profits on export markets as a *penalty* on firm-level productivity: when countries are symmetric, the profit of a firm with productivity  $\phi$  on export market is equal to the profit of a firm with productivity  $\frac{\phi}{\tau}$  on the domestic market. A decrease in  $\tau$  reduces the *penalty* and thus disincentives firms to invest. This is summarized by the multiplier  $\frac{1+\tau}{1+\tau^2}$  in equation 37. Indeed, this latter is equal to 1 when markets are perfectly integrated (no penalty), and tends to 0 when  $\tau$  becomes infinite (which means that firms should make an “infinite” investment in order to export when penalty is infinite).

The effect of a variation in trade costs on firm-level investment depends on the relative strength of these three effects.

### 2.3.4 Within industry convergence

In the end, adding investment in a Melitz-Ottaviano type model generates within-industry divergence and convergence:

- as in the model with CES preferences, exporting firms invest more and consequently grow more than domestic firms,
- contrary to the model with CES preferences, within both categories of firms, less productive firms invest more and grow more than the others.

Export activities and investment are strategic complements but investment and initial productivity are strategic substitutes. This last result is clearly at odds with the predictions of the previous model. It suggests a catch-up effect of export participation. This seems to be corroborated by the results of Lileeva and Trefler (2007) on Canadian firms. I now show that it also holds for French firms.

## 3 Empirical results

In this section, I investigate empirically the existence of heterogeneity in the response of firm-level performance growth to export participation (productivity, value added, employment growth...); I verify that this heterogeneity can be explained by different incentives to invest. I try to test directly some results or implications of the theoretical part in order to discriminate between the two models I have developed.

### 3.1 Testable results

Three main results or implications of the theoretical part can be tested. One of them is common to both models and the two others allow to discriminate between CES and quadratic preferences.

**Result 1:** *Whatever the form of preferences, switching firms invest more than domestic firms.*

In both models presented in the previous section, new exporters invest more than domestic firms due to higher sales. I will test this result by introducing a dummy identifying switching firms in the estimation of an investment function.

**Result 2a:** *With CES preferences, within each category of firms (switching and domestic firms), investment is an increasing function of firm-level initial productivity.*

**Result 2b:** *With quadratic preferences, within each category of firms (switching and domestic firms), investment is a decreasing function of firm-level initial productivity.*

To test this, I will introduce initial TFP as a determinant of investment. A positive and significant coefficient would validate the Melitz-type framework whereas a negative and significant coefficient would be in line with the Melitz-Ottaviano hypothesis of quadratic preferences.

**Result 3a:** *With CES preferences, switchers grow more than domestic firms. Moreover, more productive switching firms grow more than the others due to higher incentives to invest.*

**Result 3b:** *With quadratic preferences, switchers grow more than domestic firms. Moreover, less productive switching firms grow more than the others due to higher incentives to invest.*

Both models predict that switching firms grow more than the others because of higher incentives to invest. To test this result, I will estimate the determinants of performance growth at the firm-level: the coefficient on the dummy identifying switchers will (in)validate the existence of a switcher premium. If the explanation in terms of incentives to invest is right, I expect the exporter premium to vanish (or at least to be significantly reduced) when controlling for investment. The presence of heterogeneity in switchers performance growth will be investigated by adding an interaction term  $\text{Switcher} \times \text{TFP}$  as a determinant of performance growth, and alternatively by estimating the switcher premium for each quartile of initial productivity separately. Again, if the explanation in terms of heterogeneous incentives to invest is right, switcher premium heterogeneity should vanish or be reduced when controlling for investment.

### 3.2 The data

I use French annual business surveys<sup>3</sup> data (ABS), provided by the French ministry of Industry. The data set covers all the firms with more than 20 employees, or some smaller firms with sales higher than 5 millions euros over the 1996-2004 period. It comprises all balance-sheet data (production, value added, employment, capital, exports, aggregate wages, investment etc.) and information about firm location, firm industry classification and firm structure (number of plants, etc.).

I conserve in the sample firms from continental France (that is to say overseas départements and Corsica excluded) and from manufacturing industries that are present in the ABS each year of the period 1996-2004.

### 3.3 Empirical strategy

The empirical strategy is based on a simple comparison of switchers and non-switchers investment and performance growth over the period under study. The definition of what a switcher is is not trivial. Indeed, firms declare in the ABS their annual exports. However, some firms declare very small sales on foreign markets, either in terms of value or in terms of share of their total sales. Moreover, some firms alternate regularly null and positive export flows, without any persistence in export activities. Consequently, to be sure that the switchers I identify are firms that engage significantly in export activities, I consider that a firm exports when its annual total exports are bigger than 50 000 euros<sup>4</sup>. Moreover, a firm is said to have become an exporter over the period if it did not export from 1996 to 1998, and if it exported in 2004 or in 2002 and 2003 successively. A firm is considered as a domestic firm if it did not export from 1996 and 1998 and if it exported at most once at the end of the period, in 2002 or in 2003. All other observations are dropped. Note that results are robust to alternative definitions of thresholds and constraints in terms of persistence<sup>5</sup>

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<sup>3</sup>Called in French “Enquêtes annuelles d’entreprises”.

<sup>4</sup>This amounts to consider as zeros 12.6% of positive export flows in the sample.

<sup>5</sup>I also tried to define exporters imposing a threshold in terms of share of exports in total sales (equal to the first quartile of positive observations, 3%), and to remove the constraints in terms of persistence to define switchers, a switching firm being defined as a firm that exports in 2004 but not in 1996.

I adopt a two-steps empirical strategy. I first estimate an investment function over the period 1996-2004, keeping the empirical specification as close as possible to the theory. In the models, firms take into account expected profits in period 1 to choose their optimal investment in period 0, expected sales being determined by their initial productivity draw and their level of investment. This is a problem for the empirical analysis for two reasons: first, we cannot explain firm-level investment between 1996 and 2004 by sales in 2004 for clear reverse causality issues. Moreover, theoretically, initial productivity fully determines potential sales and profits of a firm, and consequently firm-level investment: strictly speaking, firm-level initial productivity should consequently be the unique firm-level determinant of investment. This is not verified in the data: for a given size in terms of sales or employment, we observe firms with very different productivity levels.

Consequently, I decide to estimate the following investment function:

$$\text{inv}_{ij1996-2004} = \alpha \text{sales}_{i1996} + \beta \text{tfp}_{i1996} + \gamma \text{switcher}_i + d_j + \epsilon_i \quad (38)$$

where  $\text{inv}_{ij1996-2004}$  is the average annual investment of firm  $i$  from sector  $j$  between 1996 and 2004. The measure of investment I use is off contribution and net of land investment. It has two main limitations: first, the information is missing for some firms and some years so that total investment is not computed on the same number of years for all firms. This is why I use the average annual investment over the period rather than total investment. Moreover, we cannot distinguish between different types of investment (technology adoption, machines purchases, R&D...). My measure of investment is thus potentially noisy.

Variable  $\text{sales}_{i1996}$  represents total sales of firm  $i$  in 1996,  $\text{tfp}_{i1996}$  the TFP level of firm  $i$  in 1996<sup>6</sup> and  $\text{switcher}_i$  is a dummy that identifies firms that start exporting during the period. Theory tells us that investment also depends on the size of the market and on competitive pressure: this is controlled for by sectoral fixed effects  $d_j$  defined at the 3-digit industry level.  $\gamma$  is the parameter thanks to which I can test Result 1 exposed in subsection 3.1 while  $\beta$  allows to discriminate between Results 2a and 2b.

I then test Results 3a and 3b by estimating the determinants of performance growth rate (TFP, sales, value added and employment) at the firm-level. The dependent variable is  $\Delta y_{ij1996-2004}$ , the growth rate between 1996 and 2004 of variable  $y$  for firm  $i$  operating in sector  $j$ ; I estimate the following equation:

$$\Delta y_{ij1996-2004} = \alpha y_{i1996} + \beta \text{tfp}_{i1996} + \gamma \text{switcher}_i + d_j + \epsilon_i \quad (39)$$

I control for the level of  $y$  and for firm-level TFP at the beginning of the period. I also control for a 3-digit industry fixed effect  $d_j$  to purge firm-level performance growth from industry-level business cycles. The variable of interest is  $\text{switch}_i$ . I consequently measure the impact of export participation on performance growth by comparing switchers and non-switchers with similar initial sales and TFP within narrowly defined industrial sectors. I investigate potential heterogeneity of the effect by adding an interaction term  $\text{switcher}_i \times \text{tfp}_i$  or, alternatively, by running the regression for different quartiles of initial TFP level.

Contrary to some other papers on the topic, I do not instrument the decision to start exporting. Indeed, I am not interested in some “learning-by-exporting” effects. Exporting is

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<sup>6</sup>I estimate production functions at the 2-digit industry level following Levinsohn and Petrin (2003) method. value added is regressed on capital and labor. value added is deflated by an annual branch price index and capital by a price index common to all industrial sectors. The elasticities I find are credible and range from 0.1 to 0.3 for capital and from 0.6 to 0.9 for labour.

endogenous to many other things, in particular to investment decisions as emphasized in the theoretical part, and this is what I want to capture.

In order to test the explanation in terms of investment, I then investigate if the inclusion of investment in preceding regressions reduces significantly the switcher premium and the estimated heterogeneity.

### 3.4 Results

#### 3.4.1 Results on investment

I first estimate firm-level determinants of investment. There are 2168 domestic firms and 739 switchers in the sample. All regressions contain 3-digit industry fixed effects and standard-errors are clustered at the industry level. Column (1) of table 1 shows that, as predicted by theory, within a given industry, bigger firms in terms of sales invest more. This is coherent with the idea, common to both models, that bigger firms can better amortize investment. Column (2) also shows that, as emphasized in the theoretical part, switching exporters invest significantly more than domestic firms, probably due to better business opportunities: firms that start exporting can sell more and have thus more incentives to invest. Result 1 is validated. Finally, it appears in column (3) that conditioning on the initial size of a firm and its export status over the period (switcher or not), the more productive is a firm at the beginning of the period, the less it tends to invest annually. Result 2b is consequently verified: this tends to validate the Melitz-Ottaviano hypothesis of quadratic preferences against CES preferences in Melitz-type models of trade.

Table 1: Investment determinants 1996/2004

Model :	Dependent Variable: ln Annual average investment $_{i1996-2004}$		
	(1)	(2)	(3)
Ln sales $_{i1996}$	0.913 <sup>a</sup> (0.035)	0.893 <sup>a</sup> (0.036)	1.014 <sup>a</sup> (0.040)
Switcher $_i$		0.253 <sup>a</sup> (0.063)	0.243 <sup>a</sup> (0.058)
Ln LP Tfp $_{i1996}$			-0.557 <sup>a</sup> (0.137)
N	2907	2907	2907
R <sup>2</sup>	0.322	0.331	0.35

Note: Standard errors in parentheses <sup>a</sup>, <sup>b</sup> and <sup>c</sup> respectively denoting significance at the 1%, 5% and 10% levels. 3-digit industry fixed effects are introduced in all regressions. Standard errors are corrected to take into account correlation at the 3-digit industry level.

#### 3.4.2 Results on performance growth

Table 2 presents the results about the heterogeneous impact of starting to export on firm-level performance growth between 1996 and 2004 (Levinsohn-Petrin TFP, value added, total sales and employment). For all indices except TFP growth, it appears in column (2) that switchers experienced on average higher performance growth than domestic firms, conditioning on initial performance level and initial TFP. The average switcher premium ranges from around 10% for value added and employment growth to almost 17% for total sales growth. Further

investigation shows that performance gains generated by the entry on foreign markets are heterogeneous: initially low productive new exporters experience larger gains than the others. Indeed, the interaction term  $\text{Switcher} \times \text{Ln LP Tfp}_{i1996}$  is always negative (even though not always significant), and depending on the performance index, only the first quartile, the first two quartiles or the first three quartiles of firms in terms of initial Tfp experience significant performance gains when starting to export with respect to domestic firms. The switcher premium is never significant for firms in the last quartile of initial productivity. This suggests catch-up effects linked up with entry on foreign markets<sup>7</sup>. These results on French firms are in line with those obtained by Lileeva and Trefler (2007) on Canadian firms. They are also coherent with findings in Konings and Vandenbussche (2008): indeed, they show that domestic European firms that receive antidumping protection have higher productivity growth than non-protected domestic firms, and that the effect is larger for initially low productive firms. Higher incentives to invest are one of the explanations advanced to understand such a productivity growth differential. Konings and Vandenbussche (2008) results are symmetric to my results on French new exporters.

We replicate in Table 3 the results of Table 2, controlling for firm-level average annual investment over the period. Doing so, for all indices of performance growth and whatever the sample (all firms or specific quartiles), the coefficient on the amount of investment is always positive and significant and even if the switcher premium does not completely disappear, its level decreases clearly and its significance is greatly reduced.

Result 3b seems to be validated. Switchers have higher performance growth than domestic firms and this switcher premium is bigger for initially low productivity firms. Switchers that are initially highly productive (firms in the last quartile of initial productivity) do not experience significant higher individual performance than domestic firms with identical initial size and productivity. Controlling for investment greatly reduces the size and the significance of the estimated switcher premium. Differences in export behaviour consequently partly explain the heterogeneous performance growth differential between switchers and domestic firms. The predictions of Melitz-Ottaviano model with continuous investment are again validated against the predictions of the Melitz model.

Even if reduced, switcher premium often remains positive and significant. Three explanations can be advanced:

- Remaining premium is a “true” learning-by-exporting” effect,
- Switching firms were not exploiting at the beginning of the period their entire supply capacity, and they could consequently increase their sales, value added and employment without resorting to capacity-enhancing investment,
- The measure of investment I use does not allow to identify the different types of investments a firm realizes. The models were about productivity-enhancing investment but firms can also make quality-enhancing investment or investment in “radical innovations”, with less clear consequences on productivity, sales, value added and employment. The remaining switcher premium could thus be due to the fact that my measure of investment is noisy.

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<sup>7</sup>In unreported results, I obtain similar conclusions on labor productivity.

Table 2: Starting to export and firm-level performance growth 1996/2004

Model :	Dependent Variable: $\Delta \ln LP Tfp_{i1996-2004}$						
	(1) All	(2) All	(3) All	(4) 1st quart.	(5) 2nd quart.	(6) 3rd quart.	(7) 4th quart.
Ln LP Tfp <sub>i1996</sub>	-0.352 <sup>a</sup> (0.050)	-0.353 <sup>a</sup> (0.050)	-0.318 <sup>a</sup> (0.040)	-0.696 <sup>a</sup> (0.098)	-0.533 <sup>b</sup> (0.243)	-0.339 <sup>b</sup> (0.132)	-0.162 <sup>a</sup> (0.047)
Switcher <sub>i</sub>		0.026 (0.022)	0.454 <sup>c</sup> (0.266)	0.085 <sup>a</sup> (0.030)	0.021 (0.026)	-0.007 (0.030)	-0.005 (0.039)
Switcher <sub>i</sub> × Ln LP Tfp <sub>i1996</sub>			-0.122 (0.077)				
N	2899	2899	2899	724	726	724	725
R <sup>2</sup>	0.119	0.12	0.125	0.212	0.02	0.008	0.019
	Dependent Variable: $\Delta \ln Value\ added_{i1996-2004}$						
Ln value added <sub>i1996</sub>	-0.118 <sup>a</sup> (0.022)	-0.124 <sup>a</sup> (0.022)	-0.129 <sup>a</sup> (0.022)	-0.192 <sup>a</sup> (0.062)	-0.179 <sup>a</sup> (0.042)	-0.130 <sup>a</sup> (0.044)	-0.115 <sup>a</sup> (0.031)
Ln LP Tfp <sub>i1996</sub>	-0.078 (0.063)	-0.076 (0.062)	-0.019 (0.053)	-0.462 <sup>a</sup> (0.107)	-0.306 (0.388)	0.184 (0.270)	0.090 (0.073)
Switcher		0.098 <sup>a</sup> (0.035)	0.731 <sup>b</sup> (0.321)	0.167 <sup>a</sup> (0.052)	0.110 <sup>a</sup> (0.042)	0.079 (0.055)	-0.005 (0.066)
Switcher <sub>i</sub> × Ln LP Tfp <sub>i1996</sub>			-0.180 <sup>c</sup> (0.092)				
N	2907	2907	2907	726	728	726	727
R <sup>2</sup>	0.037	0.045	0.05	0.133	0.047	0.02	0.021
	Dependent Variable: $\Delta \ln Total\ sales_{i1996-2004}$						
Ln Total sales <sub>i1996</sub>	-0.066 <sup>a</sup> (0.015)	-0.081 <sup>a</sup> (0.016)	-0.084 <sup>a</sup> (0.017)	-0.169 <sup>a</sup> (0.039)	-0.092 <sup>a</sup> (0.033)	-0.058 <sup>c</sup> (0.032)	-0.049 <sup>c</sup> (0.029)
Ln LP Tfp <sub>i1996</sub>	-0.021 (0.033)	-0.014 (0.033)	0.030 (0.039)	-0.079 (0.073)	-0.108 (0.317)	-0.012 (0.276)	-0.010 (0.076)
Switcher <sub>i</sub>		0.167 <sup>a</sup> (0.032)	0.668 <sup>b</sup> (0.263)	0.235 <sup>a</sup> (0.077)	0.185 <sup>a</sup> (0.049)	0.181 <sup>a</sup> (0.044)	0.041 (0.057)
Switcher <sub>i</sub> × Ln LP Tfp <sub>i1996</sub>			-0.143 <sup>b</sup> (0.071)				
N	2907	2907	2907	726	728	726	727
R <sup>2</sup>	0.012	0.036	0.04	0.08	0.037	0.033	0.009
	Dependent Variable: $\Delta \ln Employment_{i1996-2004}$						
Ln employment <sub>i1996</sub>	-0.147 <sup>a</sup> (0.016)	-0.150 <sup>a</sup> (0.016)	-0.152 <sup>a</sup> (0.015)	-0.197 <sup>a</sup> (0.039)	-0.20 <sup>a</sup> (0.031)	-0.149 <sup>a</sup> (0.033)	-0.142 <sup>a</sup> (0.027)
Ln LP Tfp <sub>i1996</sub>	0.139 <sup>a</sup> (0.031)	0.136 <sup>a</sup> (0.031)	0.158 <sup>a</sup> (0.030)	-0.014 (0.080)	0.023 (0.266)	0.442 <sup>c</sup> (0.250)	0.127 <sup>b</sup> (0.054)
Switcher <sub>i</sub>		0.082 <sup>a</sup> (0.021)	0.348 <sup>c</sup> (0.187)	0.093 <sup>a</sup> (0.033)	0.097 <sup>a</sup> (0.033)	0.103 <sup>a</sup> (0.036)	-0.001 (0.053)
Switcher <sub>i</sub> × Ln LP Tfp <sub>i1996</sub>			-0.076 (0.054)				
N	2907	2907	2907	726	728	726	727
R <sup>2</sup>	0.056	0.065	0.067	0.079	0.081	0.052	0.073

Note: Standard errors in parentheses <sup>a</sup>, <sup>b</sup> and <sup>c</sup> respectively denoting significance at the 1%, 5% and 10% levels. 3-digit industry fixed effects in all regressions. Standard errors are corrected to take into account correlation at the 3-digit industry level.

Table 3: Starting to export, investment and firm-level performance growth 1996/2004

Model :	Dependent Variable: $\Delta \ln \text{TFP}_{i1996-2004}$					
	(1) All	(2) All	(3) 1st quart.	(4) 2nd quart.	(5) 3rd quart.	(6) 4th quart.
Ln LP Tfp <sub>i1996</sub>	-0.365 <sup>a</sup> (0.050)	-0.331 <sup>a</sup> (0.041)	-0.701 <sup>a</sup> (0.094)	-0.531 <sup>b</sup> (0.242)	-0.40 <sup>a</sup> (0.131)	-0.167 <sup>a</sup> (0.050)
Switcher <sub>i</sub>	0.017 (0.023)	0.424 (0.274)	0.066 <sup>b</sup> (0.033)	0.019 (0.026)	-0.022 (0.031)	-0.008 (0.040)
Ln average annual investment <sub>i1996-2004</sub>	0.022 <sup>a</sup> (0.007)	0.021 <sup>a</sup> (0.007)	0.039 <sup>b</sup> (0.017)	0.004 (0.015)	0.035 <sup>a</sup> (0.013)	0.016 <sup>c</sup> (0.010)
Switcher × Ln LP Tfp <sub>i1996</sub>		-0.116 (0.080)				
N	2899	2899	724	726	724	725
R <sup>2</sup>	0.125	0.13	0.223	0.02	0.024	0.023
	Dependent Variable: $\Delta \ln \text{Value added}_{i1996-2004}$					
Ln value added <sub>i1996</sub>	-0.329 <sup>a</sup> (0.029)	-0.333 <sup>a</sup> (0.028)	-0.452 <sup>a</sup> (0.052)	-0.312 <sup>a</sup> (0.056)	-0.456 <sup>a</sup> (0.050)	-0.274 <sup>a</sup> (0.044)
Ln LP Tfp <sub>i1996</sub>	0.072 (0.052)	0.127 <sup>b</sup> (0.051)	-0.276 <sup>a</sup> (0.080)	-0.140 (0.350)	0.207 (0.234)	0.243 <sup>a</sup> (0.047)
Switcher	0.040 (0.033)	0.649 <sup>c</sup> (0.342)	0.081 <sup>b</sup> (0.038)	0.068 <sup>c</sup> (0.039)	0.007 (0.046)	-0.036 (0.069)
Ln average annual investment <sub>i1996-2004</sub>	0.175 <sup>a</sup> (0.021)	0.175 <sup>a</sup> (0.021)	0.247 <sup>a</sup> (0.031)	0.120 <sup>a</sup> (0.042)	0.260 <sup>a</sup> (0.026)	0.141 <sup>a</sup> (0.023)
Switcher × Ln LP Tfp <sub>i1996</sub>		-0.173 <sup>c</sup> (0.099)				
N	2907	2907	726	728	726	727
R <sup>2</sup>	0.162	0.167	0.301	0.131	0.217	0.102
	Dependent Variable: $\Delta \ln \text{Total sales}_{i1996-2004}$					
Ln Total sales <sub>i1996</sub>	-0.260 <sup>a</sup> (0.022)	-0.262 <sup>a</sup> (0.022)	-0.372 <sup>a</sup> (0.050)	-0.240 <sup>a</sup> (0.044)	-0.312 <sup>a</sup> (0.038)	-0.194 <sup>a</sup> (0.038)
Ln LP Tfp <sub>i1996</sub>	0.084 <sup>b</sup> (0.033)	0.125 <sup>a</sup> (0.043)	-0.044 (0.079)	0.078 (0.281)	-0.034 (0.256)	0.114 <sup>c</sup> (0.059)
Switcher <sub>i</sub>	0.124 <sup>a</sup> (0.029)	0.594 <sup>b</sup> (0.268)	0.163 <sup>a</sup> (0.062)	0.152 <sup>a</sup> (0.042)	0.120 <sup>a</sup> (0.037)	0.026 (0.060)
Ln average annual investment <sub>i1996-2004</sub>	0.176 <sup>a</sup> (0.021)	0.176 <sup>a</sup> (0.021)	0.244 <sup>a</sup> (0.031)	0.139 <sup>a</sup> (0.045)	0.243 <sup>a</sup> (0.028)	0.137 <sup>a</sup> (0.025)
Switcher × Ln LP Tfp <sub>i1996</sub>		-0.134 <sup>c</sup> (0.076)				
N	2907	2907	726	728	726	727
R <sup>2</sup>	0.163	0.166	0.235	0.126	0.219	0.114
	Dependent Variable: $\Delta \ln \text{Employment}_{i1996-2004}$					
Ln employment <sub>i1996</sub>	-0.258 <sup>a</sup> (0.018)	-0.260 <sup>a</sup> (0.017)	-0.330 <sup>a</sup> (0.030)	-0.271 <sup>a</sup> (0.035)	-0.336 <sup>a</sup> (0.033)	-0.224 <sup>a</sup> (0.030)
Ln LP Tfp <sub>i1996</sub>	0.106 <sup>a</sup> (0.023)	0.127 <sup>a</sup> (0.028)	-0.038 (0.079)	0.062 (0.237)	0.223 (0.216)	0.130 <sup>a</sup> (0.040)
Switcher <sub>i</sub>	0.035 <sup>c</sup> (0.019)	0.280 (0.182)	0.032 (0.026)	0.062 <sup>b</sup> (0.031)	0.045 <sup>c</sup> (0.027)	-0.029 (0.055)
Ln average annual investment <sub>i1996-2004</sub>	0.122 <sup>a</sup> (0.014)	0.122 <sup>a</sup> (0.014)	0.152 <sup>a</sup> (0.020)	0.087 <sup>a</sup> (0.027)	0.180 <sup>a</sup> (0.020)	0.103 <sup>a</sup> (0.018)
Switcher <sub>i</sub> × Ln LP Tfp <sub>i1996</sub>		-0.070 (0.053)				
N	2907	2907	726	728	726	727
R <sup>2</sup>	0.18	0.181	0.22	0.156	0.219	0.166

Note: Standard errors in parentheses <sup>a</sup>, <sup>b</sup> and <sup>c</sup> respectively denoting significance at the 1%, 5% and 10% levels. 3-digit industry fixed effects in all regressions. Standard errors are corrected to take into account correlation at the 3-digit industry level.



## 4 Conclusion

In this paper, I shed new light on the debate about the relationship between productivity and starting to export. I introduce investment in theoretical frameworks *à la* Melitz and Melitz-Ottaviano and I show that they yield very different predictions: in both models, new exporters invest more and grow more than domestic firms, but in the first one, initial productivity and investment are complements whereas they are substitutes in the second one. Even if quadratic preferences generate a *pro-competitive* effect that is not at work in models with CES preferences, economic forces play in the same direction in both models. Predictions are thus different because of the functional form of profit with respect to initial productivity, which is multiplicative in the CES model and additive with respect to the inverse of initial productivity in the other one. Empirical results on French firm-level data tend to support the predictions of the quadratic preferences model: new exporters grow more, in terms of productivity, total value added, sales and employment than domestic firms, and this differential is stronger for initially low productive firms. Controlling for investment tends to reduce the heterogeneous impact of starting to export.

My results need further investigation: I should theoretically test further the role of the functional form of profit by introducing investment in a model with preferences *à la* Behrens and Murata (2007). I should also test if the predictions I have with quadratic preferences could not be obtained in a CES framework when returns to investment are strongly decreasing with initial productivity. From an empirical point of view, I should collect better data on investment in order to test more directly theoretical predictions.

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## A Investment and quadratic preferences

### A.1 Domestic firms

When we calculate first-order condition of profit function 34 with respect to  $I_d(\phi_0)$ , we find:

$$\frac{\delta\pi_d(\phi_1)}{\delta I_d(\phi_0)} = \frac{\alpha L}{2\gamma\phi_0 I_d(\phi_0)^{\alpha+1}} \left[ p_{max} - \frac{1}{[I_d(\phi_0)]^\alpha \phi_0} \right] - p_I = 0 \quad (40)$$

We search for the roots of a polynomial in  $I_d(\phi_0)$  of degree  $(2\alpha + 1)$ . We do not know how to solve such an equation. However, taking the problem symmetrically, we can note that equation 40 is a polynomial in  $\phi_0$  of degree 2. There are at most two real solutions. When they exist, they have the following form:

$$\frac{1}{\phi_0} = \frac{[I_d(\phi_0)]^\alpha p_{max}}{2} \left[ 1 + \left( 1 - \frac{8\gamma p_I I_d(\phi_0)}{\alpha L p_{max}^2} \right)^{\frac{1}{2}} \right] \quad (41)$$

$$\frac{1}{\phi_0} = \frac{[I_d(\phi_0)]^\alpha p_{max}}{2} \left[ 1 - \left( 1 - \frac{8\gamma p_I I_d(\phi_0)}{\alpha L p_{max}^2} \right)^{\frac{1}{2}} \right] \quad (42)$$

The solution will be the profit maximizing one if equation 40 is verified and  $\frac{\delta^2\pi_d(\phi_1)}{\delta^2 I_d[\phi_0]}(I_d[\phi_0]) < 0$ . We can show that:

$$\frac{\delta^2\pi_d(\phi_1)}{\delta^2 I_d[\phi_0]}(I_d(\phi_0)) = \frac{\alpha L}{2\gamma\phi_0 I_d(\phi_0)^{\alpha+2}} \left[ \frac{(2\alpha + 1)}{[I_d(\phi_0)]^\alpha \phi_0} - (\alpha + 1)p_{max} \right] \quad (43)$$

The second derivative is equal to zero for  $I_d(\phi_0) = \left[ \frac{(2\alpha+1)}{(\alpha+1)\phi_0 p_{max}} \right]^{\frac{1}{\alpha}}$ , positive for smaller values of  $I_d(\phi_0)$  and negative for higher values. Thus,  $I_d(\phi_0) = \left[ \frac{(2\alpha+1)}{(\alpha+1)\phi_0 p_{max}} \right]^{\frac{1}{\alpha}}$  is the maximum of the first derivative. When  $I_d(\phi_0)$  tends to 0, the first derivative tends to  $-\infty$  and when  $I_d(\phi_0)$  tends to  $+\infty$ , the first derivative tends to  $-p_I$ . When its maximum is positive, there are consequently two values for which the first derivative is null, and the one corresponding to the optimal investment will necessarily be, for a given  $\phi$  the higher one, that is to say the one corresponding to equation 42.

### A.2 Exporting firms

When we calculate first-order condition of profit function 36 with respect to  $I_x(\phi_0)$ , we find:

$$\frac{\delta\pi_{Total}(\phi_1)}{\delta I_x(\phi_0)} = \frac{\alpha L}{2\gamma\phi_0 [I_x(\phi_0)]^{\alpha+1}} \left[ (1 + \tau)p_{max} - \frac{(1 + \tau^2)}{[I_x(\phi_0)]^\alpha \phi_0} \right] - p_I = 0 \quad (44)$$

Following the same method as in Appendix A.1, we can show that:

$$\frac{1}{\phi_0} = \frac{1 + \tau}{1 + \tau^2} \frac{[I_x(\phi_0)]^\alpha p_{max}}{2} \left[ 1 - \left( 1 - \frac{1 + \tau^2}{(1 + \tau)^2} \frac{8\gamma p_I I_x(\phi_0)}{\alpha L p_{max}^2} \right)^{\frac{1}{2}} \right] \quad (45)$$

### A.3 Investment and competition

We calculate the first derivative of equation 35 with respect to  $p_{max}$  and we find:

$$\frac{\delta(1/\phi_0)}{\delta p_{max}} = \frac{I_d(\phi_0)^\alpha}{2} \left[ 1 - p_{max} \left( p_{max}^2 - \frac{8\gamma p I_d(\phi_0)}{\alpha L} \right)^{-\frac{1}{2}} \right] \quad (46)$$

When defined, this expression is clearly negative: all else equal, an increase in  $p_{max}$  tends to reduce  $\frac{1}{\phi_0}$ . Since initial productivity and investment are negatively correlated, this means that for a given initial productivity, a reduction in competitive pressure increases investment. The net effect of competition on investment is thus negative.

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