

# Import Competition, Heterogeneous Preferences of Managers and Productivity\*

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## Abstract

Empirical evidence on the relationship between import competition and firm productivity is mixed. We re-investigate this question by focusing on heterogeneous preferences of managers. In our model, the manager can endogenously change productivity depending on her relative preferences over firm profits versus private benefits and effort cost. We predict that managers react to import competition only if they care about private benefits and cost. Furthermore, the direction of their response depends on the firm's initial productivity. Firms with low initial productivity *increase* productivity because their managers worry about bankruptcy. Firms with high initial productivity *decrease* productivity because the marginal benefit of exerting effort falls. We test the theoretical predictions using rich Spanish firm-level data, comparing family-managed to professionally-managed firms. The empirical results are strikingly consistent with theory; and driven by family management rather than ownership and by organizational improvements related to managerial effort.

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# 1 Introduction

The recent surge in China's exports has triggered the re-examination of an old unsettled, yet important, economic question: Does (import) competition spur innovation and thus productivity and growth, or does it discourage it? The empirical evidence of recent papers remains mixed. While some papers find positive effects of competition (e.g., Bloom et al., 2016; Gorodnichenko et al., 2010; Iacovone, 2012a), others find almost no, mixed, or even negative effects (Hashmi, 2013; Autor et al., 2016; Hombert and Matray, 2015; Gong and Xu, 2015; Brandt et al., 2012; Gilbert, 2006; Arora et al., 2015). Perhaps not surprisingly, there is also very little empirical evidence on the mechanism of how competition affects productivity (Holmes and Schmitz Jr, 2010).

Our paper aims to shed light on this issue by focusing on the person in the firm who ultimately makes decisions regarding innovation: the manager. Managers have been found to have heterogeneous utility functions (e.g., Pennings and Smidts, 2003; Pennings and Garcia, 2009; Bandiera et al., 2014b; Holtz-Eakin et al., 1993). In this paper we introduce heterogeneous preferences of managers to the trade literature, as they may explain why not all firms react to import competition in the same way, instead generating heterogeneous effects and therefore mixed empirical evidence across data sets and studies.<sup>1</sup>

In the theory part of our paper, we embed heterogeneous preferences of managers in a partial equilibrium, heterogeneous firm model (a la Melitz, 2003). Each firm receives an initial, random productivity draw, but managers can improve the initial productivity, and thus the profitability of the firm, by exerting effort, which entails private cost. Managers derive utility from firm profits, private benefits (which are lost when the firm goes bankrupt), and disutility from cost (due to effort). We examine the behavior of two types of managers who have different preferences for firm profits relative to private benefits and costs after an import competition shock.

Our model predicts a very distinct pattern of heterogeneous productivity responses that depend not only on the type of manager but also on the firm's initial, random productivity draw. First, managers who care most about *private benefits and cost* relative to firm profits react the strongest to an import competition shock. Their response, however, depends on the location of the firm on the initial productivity distribution. Firms in the left tail of the distribution have lower endogenous productivity and are closer to bankruptcy. When import competition increases, their managers *exert additional effort* because they do not want the firm to go bankrupt (and thus lose the private benefit).<sup>2</sup> On the other hand, firms in the right tail of the productivity distribution show *reduced productivity* after an import competition shock

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<sup>1</sup>The literature is just beginning to explore heterogeneous effects of foreign competition on innovation. For examples, see Hombert and Matray (2015) and Bena and Simintzi (2015).

<sup>2</sup>If the initial productivity draw is too low to justify the extra effort, managers choose to let the firm exit.

because the marginal benefit of exerting effort is reduced.

In the empirical part of our paper, we test these complex predictions on the example of family managers. Family managers represent a well-suited application for testing our theory because the literature has identified them as having different preferences compared to professional managers. For example, family managers receive various amenities from their firms, which lead to substantial, non-profit driven incentives (Demsetz and Lehn, 1985; Bertrand and Mullainathan, 2003; Bandiera et al., 2014a; Hurst and Pugsley, 2011). Family managers have also been found to spend less time managing the firm because they prefer more leisure and are often richer (e.g., Bandiera et al., 2011, 2014b). Other studies have also found family managers to be more entrenched and more likely to pursue personal goals (Morck et al., 1988; Kim and Lu, 2011). Taking all this evidence together, family managers correspond to those managers in our model who care relatively more about private benefits and costs compared to firm profits.

Besides being a suitable application of our theory, family firms are also an important economic phenomenon. First, they are widespread, even in developed countries. For example, 15% of the American Fortune Global 500 firms are family firms. In Europe, 40% of large, listed companies are controlled by families.<sup>3</sup> In developing countries family firms are even more dominant: Out of large (>\$1 billion) firms, 85% are family run in South-East Asia, 75% in Latin America, 67% in India and around 65% in the Middle East.<sup>4</sup> Even in countries such as China where many large firms are state-owned, this proportion is still 40%.

Second, family firms have been associated with lower productivity and worse management quality than non-family firms (Morck et al., 2000; Pérez-González, 2006; Villalonga and Amit, 2006; Bennedsen et al., 2007; Bloom and van Reenen, 2007). Economists have long been worried about the implications of their lower performance on welfare and aggregate growth. As an example, inherited family firms have been found to be one cause for slow economic growth in Canada, the “Canadian disease” (Morck et al., 2000).

Finally, despite their average lower performance, the presence of family firms is far from declining. On the contrary, family-owned businesses are expected to remain an important feature of the global economy for the foreseeable future.<sup>5</sup>

For all these reasons, understanding when family-managed firms improve their productivity has become a central topic in both academic research and policy debates. The evidence in this paper suggests that competition can incentivize unproductive family firms to improve productivity.

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<sup>3</sup>See <http://www.economist.com/news/leaders/21629376-there-are-important-lessons-be-learnt-surprising-resilience-family-firms-relative>.

<sup>4</sup>See <http://www.economist.com/news/business/21629385-companies-controlled-founding-families-remain-surprisingly-important-and-look-set-stay>.

<sup>5</sup>See <http://www.economist.com/news/special-report/21648171-far-declining-family-firms-will-remain-important-feature-global-capitalism>.

We use Spanish firm-level data between 1993 and 2007 to test the empirical predictions of our model, exploiting changes in import competition that are induced by exogenous changes in EU-wide tariffs. The Spanish economy in those two decades presents an ideal scenario for studying the effect of import competition on family firms. First, there were large shocks to import competition: Imports grew substantially between 1993 and 2007, driven both by increased European integration and an unprecedented increase in Chinese exports.<sup>6</sup> Second, Spain's import tariffs are determined at the EU level and therefore arguably exogenous to Spanish firms. Third, Spain has a large number of family firms: 40% of the observations in our sample are family (managed) firms. Fourth, the Spanish data set is unusually rich in that it allows us to differentiate between family management and family ownership, and this distinction is important for verifying the mechanism underlying our results. On top of this, the Spanish data set has a number of variables that allow us to avoid common problems in productivity estimation. For example, it provides firm specific input and output price changes that allow us to obtain a measure of total factor productivity that is not driven by changes in markups. It also provides data on different outcome variables (e.g., introduction of new machinery vs. introduction of new organizational methods) that allows us to test whether the suggested mechanism, managerial effort, is driving the results. Finally, we can distinguish firm exits from non-responses, which allows us to check whether positive productivity responses are generated purely by a selection effect.

Our empirical findings resemble the complex theoretical predictions closely: After a reduction in import tariffs, only family-managed (but not professionally-managed) firms respond with productivity changes. The family firms in the left tail of the initial distribution *increase their productivity*, whereas those in the right tail of the distribution *reduce it*. In contrast, we do not observe any significant changes in productivity for professionally-managed firms.

Our empirical specification is demanding and allows for firm fixed effects, firm-specific growth rates, year fixed effects, and controls for export tariffs faced by Spanish firms. Beyond this, we provide a battery of robustness checks for our findings, including: Non-parametric estimation by different quartiles (or terciles or quintiles) of the initial productivity distribution; checking for selection effects generated by exiting firms; propensity score matching techniques to correct for the endogenous selection into family firms; alternative productivity measures and tariff measures; excluding alternative responses that might show up as productivity responses in the data, such as changes in imported inputs, exporting behavior, or the introduction of more productive capital such as new machinery; or checking for endogenous switching between family firms and non-family firms. Our findings are robust to all these tests.

Finally, we are able to provide additional evidence that supports the mechanism suggested

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<sup>6</sup>In the latter respect, Spain had an experience similar to other developed countries, e.g., the US (Autor et al., 2013) and the UK (Bloom et al., 2016).

in the model, i.e., managerial preferences and effort choices. First, we show that the results are driven by family management rather than family ownership (and, therefore, not by mechanisms that operate through ownership, such as a differential tax treatment). Furthermore, we show that productivity improvements are generated by the introduction of new organizational methods rather than by investments like new machinery or increased R&D. This supports our theory because the re-organization of work processes is a typical managerial task, and less costly to the firm (in terms of dollars spent) than to the manager (in terms of effort) compared to alternative ways to improve productivity that involve investment.

Our paper is related to four strands of literature. First, our paper contributes to the literature on how trade liberalization affects firm productivity. There are many excellent studies on how trade liberalization facilitates resource reallocation between firms (Pavcnik, 2002; Trefler, 2004; Tybout, 2004) and affects firm-level R&D, innovation (Baldwin and Robert-Nicoud, 2008; Costantini and Melitz, 2008; Atkeson and Burstein, 2010; Teshima, 2008), and product scope and quality (Bas and Ledezma, 2010; Kugler and Verhoogen, 2012; Bas and Bombarda, 2013). A related literature studies how increased exporting opportunities incentivize firms to improve productivity (De Loecker, 2007, 2011; Lileeva and Trefler, 2010; Bustos, 2011). Only recently, the literature started to investigate how stiffer import competition affects firm productivity and innovations among surviving firms (e.g., Fernandes and Paunov, 2009; Brandt et al., 2012; Iacovone, 2012b; Mion and Zhu, 2013; Dhyne et al., 2014; Hombert and Matray, 2015; Autor et al., 2016; Bena and Simintzi, 2015; Bloom et al., 2016).<sup>7</sup> Breaking from the existing papers, we focus on the role of managers, especially family managers, in creating heterogeneous productivity responses. Given that most developing countries host a large number of family firms and have also often experienced dramatic trade liberalization episodes, paying attention to the impact of trade on family firms seems to be particularly important.

Second, the theoretical literature in industrial organization on competition and productivity usually arrives at a non-monotonic or ambiguous relationship (e.g., Schmidt, 1997; Aghion et al., 2005; Vives, 2008). There are a variety of models that predict a possible increase in innovation resulting from competition (e.g., Holmes et al., 2012; Bloom et al., 2013; Waugh et al., 2014). In particular, reduced X-inefficiency (Horn et al., 1995; Aghion et al., 1997, 1999; Schmidt, 1997; Raith, 2003) is one of the channels investigated.<sup>8</sup> Our model is in spirit most closely related to this type of argument. However, none of these models considers heterogeneous effects that depend on the preferences of managers.

Third, we contribute to the literature on family firms (Bandiera et al., 2011, 2014b; Bertrand

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<sup>7</sup>The historical lack of focus on import competition in the trade literature is likely driven by the prevalence of trade models with CES preferences, which generate constant markups and are therefore unaffected by import competition.

<sup>8</sup>Also note that in Holmes and Stevens (2014), large firms are more impacted by import competition because small firms focus on niches.

et al., 2008; Bloom and van Reenen, 2007; Burkart et al., 2003; Mullins and Schoar, 2016; Pérez-González, 2006; Villalonga and Amit, 2006; Bandiera et al., 2014a; Bennedsen et al., 2007; Morck et al., 2000) by highlighting how economic forces, specifically increased competition, can alleviate the low productivity problem of family firms over time - an issue that is also of great policy interest.<sup>9</sup>

Fourth, the literature in corporate finance studies how ownership concentration (e.g., in family firms) affects firm value (Jensen and Meckling, 1976; Morck et al., 1988; Faccio and Lang, 2002; Kim and Lu, 2011). The main finding is that concentrated ownership (above a certain threshold) reduces firm value due to an entrenchment effect and an amenity effect, i.e., it generates owner-managers that have enough power to be able to indulge their preferences for non-value-maximization. We also focus on managers with non-profit preferences, but breaking from this literature, we focus on the channel through which family-managed firms change productivity after an arguably exogenous shock: increased managerial effort and organizational innovation.<sup>10</sup>

The rest of the paper is organized as follows. Section 2 presents a model emphasizing how non-profit preferences of managers affect managerial effort, and thus firm productivity, after trade liberalization. Section 3 uses Spanish data to provide supportive evidence for the model's predictions. Section 4 concludes the paper.

## 2 Model

We present a static partial equilibrium model with heterogeneous firms, whose managers have the possibility to exert effort and increase the productivity of the firm. Managers have different preferences with respect to firm profits and private benefits and cost, and therefore react differently to a change in the competitiveness of the market.

### 2.1 Setup

As in Melitz (2003), firms draw a random initial productivity,  $\phi$ . The initial productivity draw is fixed throughout the model, and its cumulative density function (CDF) is assumed to be  $G(\phi)$ . Firm profits are positively related to the exogenous productivity draw.

Managers have to exert effort,  $\beta$ , in order to operate their firms, and this effort choice affects ex post firm productivity endogenously. The profit of the firm,  $\pi$ , taking into account the effort of the managers, is given by:

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<sup>9</sup>In this respect, our paper builds on Morck et al. (2000), who showed that increased product market competition as well as more open capital markets reduced the performance gap of heir-controlled firms in Canada.

<sup>10</sup>A related paper is Hau et al. (2016), who show that Chinese private firms with good management practices improved productivity after a minimum wage increase in China.

$$\pi = \eta\phi\beta - \left(f - a\beta + \frac{1}{2}\beta^2\right).$$

The first term,  $\eta$ , is an exogenous market competitiveness parameter that decreases when import competition increases.<sup>11</sup> Firm profits decrease when competitiveness increases.

Effort affects firm profits in two ways: First, it increases *realized productivity*,  $\phi\beta$ , of the firm. Since empirically we can only observe realized, but not initial, firm productivity, our comparative statics will always be derived with respect to the former. Second, exerting effort also reduces the fixed cost of production,  $f$ , with decreasing returns to effort:  $a\beta - \frac{1}{2}\beta^2$ .<sup>12</sup> The firm has to pay the resulting fixed cost,  $(f - a\beta + \frac{1}{2}\beta^2)$ , in order to survive and produce. The firm exits if profits are negative.

The manager derives utility from both firm profit and private benefits and costs. Private benefits,  $\bar{U}$ , include monetary (e.g., fixed salary) and non-monetary benefits the firm offers (e.g., amenity, leisure), which disappear when the manager has to leave the firm, for example, when the firm exits.<sup>13</sup> Private costs include the provision of effort (i.e., the disutility of working), e.g., by reducing the leisure of the manager.<sup>14</sup> Overall, the manager's utility is given by:

$$U = \begin{cases} \alpha_g \left[ \eta\phi\beta - \left(f - a\beta + \frac{1}{2}\beta^2\right) \right] + d_g(\bar{U} - \beta) & \text{if firm exists} \\ 0 & \text{if firm exits,} \end{cases}$$

where  $\alpha_g$  and  $d_g$  denote the importance of firm profits and private benefits and cost respectively for a manager of type  $g$ .<sup>15</sup> Note that weight  $\alpha_g$  measures how much the manager cares about maximizing the profits of the firm. This might be because the manager receives profit shares, but the formulation is more general and includes more than just monetary compensation.

The outside option of the manager is assumed to be zero if the firm goes bankrupt and she has to leave.

There are two types of managers with different preferences: *F*-type managers and *P*-type managers. Without loss of generality, we assume that *F* type managers care *relatively less* about firm profits and *relatively more* about private benefits than *P* type managers:

<sup>11</sup>One can also think of  $\eta(P, Y)$  as a function of the price level  $P$  and overall market size  $Y$  in a constant elasticity of substitution (CES) type framework. For example, in a standard Melitz (2003) model with CES preferences, we have  $\eta(P, Y) := YP^{\sigma-1}\lambda^{1-\sigma}\frac{1}{\sigma}$ , with  $\lambda$  denoting the constant markup and  $\sigma$  the elasticity of substitution.

<sup>12</sup>We include this negative quadratic term in the fixed cost to ensure that the realized fixed cost is non-negative (under some parameter assumptions, see Assumption 3 which we discuss later). Note that we can also allow for decreasing returns to managerial effort in the variable profits term.

<sup>13</sup>Note that the disappearance of private benefits when the firm exits can also be interpreted as the switching cost of finding another job, as in Schmidt (1997).

<sup>14</sup>Note that we can also allow for convex effort cost.

<sup>15</sup>In Appendix F, we show that the specific functional form of the private benefits does not matter for our theoretical results.

**Assumption 1.**

$$\frac{d_F}{\alpha_F} > \frac{d_P}{\alpha_P}$$

Several points are worth mentioning before proceeding. First, in Assumption 1, we do not take a stand on whether  $\alpha$  is larger or smaller for  $F$ -type managers. Similarly, we also do not take a stand on whether the private benefit,  $d_F \bar{U}$ , is bigger or smaller than  $d_P \bar{U}$ .<sup>16</sup> Our assumption on the difference between  $F$ - and  $P$ -type managers is about the *relative* importance of private benefits to profits only, not about the importance of either component.

Finally, we do not assume that  $F$ -type managers have on average worse initial productivity draws than  $P$ -type managers; the initial productivity distributions are the same. However, due to different effort choices made by different types of managers we get an endogenously different distribution of *realized* productivity, which we will discuss later.

The manager's objective function is her utility function. If the firm exists, the manager's effort is determined by:

$$\begin{aligned} \max_{\beta} \quad & \alpha_g \left[ \eta \phi \beta - \left( f - a\beta + \frac{1}{2}\beta^2 \right) \right] + d_g(\bar{U} - \beta) \\ \text{s.t.} \quad & \eta \phi \beta - \left( f - a\beta + \frac{1}{2}\beta^2 \right) \geq 0. \end{aligned} \tag{2.1}$$

We call the inequality  $\eta \phi \beta - (f - a\beta + \frac{1}{2}\beta^2) \geq 0$  the *non-bankruptcy constraint*, i.e., profits are non-negative and the firm survives.

Without loss of generality, we normalize  $\alpha_P$  and  $\alpha_F$  to one. For further exposition, we further simplify the assumptions to  $d_P = 0$ , i.e.,  $P$ -type managers only care about firm profits and not at all about the private benefits.<sup>17</sup> With these additional assumptions, Assumption 1 simplifies to:

**Assumption 2.**

$$d_F > d_P = 0.$$

Finally we make the following assumption that ensures that the realized fixed cost after effort provision,  $f - a\beta + \frac{1}{2}\beta^2$ , is non-negative for all non-negative effort choices:

**Assumption 3.**

$$2f > a^2.$$

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<sup>16</sup>Note that we could also allow  $\bar{U}$  to differ across the two types of managers. In this case, we only need to add the assumption  $\min\{\bar{U}_F, \bar{U}_P\} > \sqrt{2f}$  for our results to go through. We discuss this assumption in Appendix G.

<sup>17</sup>In Appendix E, we show that the qualitative predictions of the model are unchanged if  $d_P$  is allowed to be bigger than zero.



## 2.2 Effort choice

Since the **P-type manager** does not care about private benefits, her objective function becomes:

$$\begin{aligned} \max_{\beta} \quad & \eta\phi\beta - \left(f - a\beta + \frac{1}{2}\beta^2\right) \\ \text{s.t.} \quad & \eta\phi\beta - \left(f - a\beta + \frac{1}{2}\beta^2\right) \geq 0, \end{aligned}$$

which yields the following solution for effort in the case in which firms earn non-negative profits, i.e., when the initial productivity draw is larger than the *exit cutoff*,  $\bar{\phi}_P$ :

$$\beta_P(\phi) = \eta\phi + a \quad \text{if } \phi \geq \bar{\phi}_P \equiv \frac{\sqrt{2f} - a}{\eta}. \quad (2.2)$$

The effort level given in equation (2.2) can be interpreted as the *first-best effort level*, i.e., the effort level that maximizes firm profits. This optimal effort is an increasing function of the initial productivity draw, as a bigger initial productivity draw increases the marginal benefit of exerting effort via increased variable profits.

If the initial productivity draw is smaller than *the exit cutoff*,  $\bar{\phi}_P$ , (which in the case of the *P-type manager* is also the *zero profit cutoff*), the manager would have negative utility with the optimal effort function (2.2), while her outside option is zero. So below the cutoff,  $\bar{\phi}_P$ , a *P-type firm*, i.e., the firm managed by a *P-type manager*, exits and the *P-type manager* exerts no effort. The effort choice of the *P-type manager* at the exit cutoff is:

$$\beta_P(\bar{\phi}_P) = \sqrt{2f} \quad (2.3)$$

Next, we analyze how the **F-type manager** chooses her effort. Since the *F-type manager* cares about both firm profits and private benefits, her objective function (if the firm exists) is given by:

$$\begin{aligned} \max_{\beta} \quad & \eta\phi\beta - \left(f - a\beta + \frac{1}{2}\beta^2\right) + d_F(\bar{U} - \beta) \\ \text{s.t.} \quad & \eta\phi\beta - \left(f - a\beta + \frac{1}{2}\beta^2\right) \geq 0 \end{aligned} \quad (2.4)$$

The optimal effort choice is

$$\beta_F(\phi) = \eta\phi + (a - d_F) \quad \text{if } \phi \geq \bar{\phi}_F \equiv \frac{(2f + d_F^2)^{\frac{1}{2}} - a}{\eta}. \quad (2.5)$$

We denote  $\bar{\phi}_F$  as the *zero profit cutoff* for *F-type firms* since firm profits are strictly positive if

the initial productivity draw is above this cutoff. The value of this cutoff can be obtained by setting the profits to zero given the optimal effort choice dictated by equation (2.5):

$$(\eta\bar{\phi}_F + a)\beta_F(\bar{\phi}_F) - \frac{1}{2}\beta_F(\bar{\phi}_F)^2 = f,$$

which leads to

$$\beta_F(\bar{\phi}_F) = (2f + d_F^2)^{\frac{1}{2}} - d_F \in (0, \sqrt{2f}).$$

Note that  $\bar{\phi}_F > \bar{\phi}_P$ , i.e., the zero profit cutoff is bigger for  $F$ -type firms than for  $P$ -type firms (note that for  $P$ -type firms, the exit cutoff and the zero profit cutoff are the same). Naturally, when profits are positive, the effort level of  $F$ -type manager also increases with the initial productivity draw, as they are complements. The effort level given in equation (2.5) can be interpreted as the *second-best level of effort*, since the manager is not maximizing firm profits in this case.

However, the  $F$ -type firm (i.e., the firm managed by an  $F$ -type manager) does not necessarily exit below the zero profit cutoff  $\bar{\phi}_F$ : For the  $F$ -type manager whose initial productivity draw is slightly smaller than  $\bar{\phi}_F$ , her firm would exit if she exerted effort at the level derived in equation (2.5). However, both the firm and the manager can achieve a Pareto improvement in this case if the manager increases her effort beyond the effort level defined in equation (2.5), since the initial productivity draw is not too low and the optimal effort level in (2.5) does not maximize firm profits. In equilibrium, it is optimal for the manager to exert effort at the level that makes her firm break even, which will be higher than the second-best effort level. Below the zero profit cutoff,  $\bar{\phi}_F$ , it is optimal for the  $F$ -type manager to exert just enough effort for the firm to survive. In this case the firm makes zero profits, but the  $F$ -type manager gets the private benefit,  $\bar{U}$ .<sup>18</sup> As long as  $d_F(\bar{U} - \beta) > 0$ , the  $F$ -type manager prefers to exert effort to make sure the firm survives. Specifically, the optimal effort for the  $F$ -type manager if  $\phi < \bar{\phi}_F$  is obtained by setting firm profits equal to zero:

$$\left[ (\eta\phi + a)\beta(\phi) - \frac{1}{2}\beta(\phi)^2 \right] = f,$$

which yields the solution:

$$\beta_F(\phi) = (\eta\phi + a) - \sqrt{(\eta\phi + a)^2 - 2f} \quad \text{if } \phi < \bar{\phi}_F \quad (2.6)$$

Finally, we have to take into account the  $F$ -type manager's participation constraint. The payoff of the manager must fall when  $\phi$  decreases, which is implied by the revealed pref-

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<sup>18</sup>The purpose of deviating from the optimal effort level in equation (2.5) is to ensure the survival of the firm and obtain the private benefit,  $\bar{U}$ . Thus, any further upward deviation from the effort level under which the firm breaks even is sub-optimal for the manager.

erences argument. Therefore, we only need to look at the  $F$ -type manager who is at the exit cutoff. We know that when  $\phi = \bar{\phi}_P$ ,  $\beta_F(\bar{\phi}_P) = (2f)^{\frac{1}{2}}$ , and the firm makes zero profits. Moreover, when  $\phi = \bar{\phi}_P$ , it is impossible to improve firm profits by adjusting the effort since the effort is already at the first-best level. Therefore, if  $\bar{U} \geq (2f)^{\frac{1}{2}}$ , the  $F$ -type manager prefers to stay in the firm when her productivity draw is above or equal to  $\bar{\phi}_P$  and quits the firm when the draw is below  $\bar{\phi}_P$ .<sup>19</sup> Throughout the paper, we assume that  $\bar{U} \geq (2f)^{\frac{1}{2}}$  and show that our theoretical results hold under milder assumptions in Appendix G.

In total, the  $F$ -type manager with  $\phi \in [\bar{\phi}_P, \bar{\phi}_F]$  stays in her firm and exerts effort according to equation (2.6). For the  $F$ -type manager with  $\phi < \bar{\phi}_P$ , there is no way to make the firm earn non-negative profits. Thus, these  $F$ -type managers quit their firms, and their firms exit the market as well. The following proposition summarizes the above results:

**Proposition 1** (Optimal effort choice). *Suppose Assumptions 2 and 3 hold. For  $F$ -type managers with productivity draws above  $\bar{\phi}_F (> \bar{\phi}_P)$ , the optimal effort choice is*

$$\beta_F(\phi) = \eta\phi + a - d_F.$$

When  $\phi \in [\bar{\phi}_P, \bar{\phi}_F]$ , the optimal effort is

$$\beta_F(\phi) = (\eta\phi + a) - \sqrt{(\eta\phi + a)^2 - 2f}.$$

For  $P$ -type managers with productivity draws above  $\bar{\phi}_P$ , the optimal effort choice is

$$\beta_P(\phi) = \eta\phi + a.$$

All managers and firms with an initial productivity draw lower than  $\bar{\phi}_P$  choose to exit.

The effort of the  $P$ -type manager increases in  $\phi$ . The effort of the  $F$ -type manager decreases first and increases afterwards with  $\phi$  (i.e., the relationship is “U”-shaped).

*Proof.* We have already shown how both manager types choose their optimal effort. The relationship between the initial productivity draw and the optimal effort choice holds because  $\beta'_P(\phi) > 0$ , and  $\beta'_F(\phi) > 0$  for  $\phi \geq \bar{\phi}_F$ , and  $\beta'_F(\phi) < 0$  for  $\phi \in [\bar{\phi}_P, \bar{\phi}_F]$ .  $\square$

Figure A.1 graphs the optimal effort choices of  $F$ -type and  $P$ -type managers, as well as realized productivity as a function of the initial productivity draw.

<sup>19</sup>Under the assumption that  $\bar{U} \geq (2f)^{\frac{1}{2}}$ , both types of managers with an initial productivity draw that is slightly below  $\bar{\phi}_P$  still want their firms to survive (and thus, to continue receiving private benefits). They therefore would consider covering the firm's negative profits using their own wealth outside the firm. We assume, however, that this is not possible. In practice, it is likely that a manager is either financially constrained (e.g., professional managers), or that her wealth mainly resides inside the firm (e.g., owner-managers), which makes such an action very unlikely.

The above proposition illustrates that there are two different ways in which  $F$ -type managers are incentivized to exert effort. On the one hand, when the initial productivity draw is high, they exert effort in order to increase the marginal profitability of the firm. For  $F$ -type managers of these firms, the initial productivity draw and the managerial effort are complements. For further exposition, we label these managers as the *unconstrained managers*. On the other hand, when the initial productivity draw is low (but not extremely low),  $F$ -type managers exert effort in order to make their firms break even and stay in the market. For  $F$ -type managers of those firms, the initial productivity draw and the managerial effort are substitutes, since a better productivity draw reduces the level of effort that is required to make the firm break even. We label these managers as the *constrained managers*.

The following proposition characterizes the optimal effort choice and its implications further:

**Proposition 2** (Cross-sectional predictions). *First, conditional on the initial productivity draw, non-exiting  $P$ -type firms have higher managerial effort and realized productivity. Second, non-exiting  $P$ -type firms have higher average realized productivity and managerial effort compared with non-exiting  $F$ -type firms. Third, the realized productivity of  $P$ -type firms,  $\beta_P(\phi)\phi$ , increases in  $\phi$ . Fourth, the realized productivity of  $F$ -type firms,  $\beta_F(\phi)\phi$ , increases in  $\phi$  for  $\phi \geq \bar{\phi}_F$ . Finally, the realized productivity of  $F$ -type firms,  $\beta_F(\phi)\phi$ , decreases first and increases afterwards in  $\phi$  when  $\phi \in [\bar{\phi}_P, \bar{\phi}_F]$ . In particular, when  $a^2$  approaches  $2f$ , the interval in which  $\beta_F(\phi)\phi$  decreases in  $\phi$ , shrinks to zero.*

*Proof.* See Appendix C. □

Proposition 2 has several implications.  $P$ -type managers always exert more effort than  $F$ -type managers. As a result, it is more difficult for  $F$ -type firms to survive than for  $P$ -type firms (conditional on the initial productivity draw). However, at the exit cutoff,  $F$ -type firms have the same level of realized productivity and managerial effort as  $P$ -type firms: When it comes to exiting the market,  $F$ -type managers are disciplined well and behave no worse than  $P$ -type managers. Figure A.1 illustrates this.

The cross-sectional second prediction about the (weighted and unweighted) *average* realized productivity of Proposition 2 can be tested. Note that this result is an implication of our theory and not an assumption, as both types of firms draw their initial productivity from the same distribution.

In what follows we consider the parameter range in which  $a^2$  is close to  $2f$ , which rules out the non-intuitive special case in which realized productivity decreases in the initial productivity draw. For a more detailed discussion on the difference in the productivity distribution of  $F$ -type firms and  $P$ -type firms, see Appendix D.

### 2.3 Impact of import competition on productivity

In this subsection we analyze how stiffer import competition affects the realized productivity of  $F$ -type firms and  $P$ -type firms differently. Specifically, we conduct a comparative statics exercise of a decrease in  $\eta$  (i.e., an increase in import competition) on managerial effort and firm productivity. We derive several predictions that we will test in the empirical section.

We begin by summarizing our predictions when import competition increases: The least productive surviving  $F$ -type firms *increase* their (log) productivity, whereas the most productive surviving  $F$ -type firms *reduce* their (log) productivity. The increase of log productivity for the least productive  $F$ -type firms is *larger* than the productivity increase of the least productive surviving  $P$ -type firm, and the decrease of log productivity for the most productive  $F$ -type is *also larger* than the productivity decrease for the most productive surviving  $P$ -type firm. So, all productivity changes due to import competition are more pronounced for  $F$ -type firms compared to  $P$ -type firms. The model does not generate a clear prediction about what happens to the *average* log productivity of  $F$ -type firms relative to  $P$ -type firms.

We use subscripts “*before*” and “*after*” to denote variables before and after a reduction in import tariffs. Note that we will focus on comparative statics with respect to relatively small tariff changes, which are defined in the following assumption.

**Assumption 4.**

$$\frac{\eta_{after}}{\eta_{before}} > \frac{(2f)^{\frac{1}{2}} - a}{(2f)^{\frac{1}{2}} - a + d_F},$$

where parameters  $\eta_{before}$  and  $\eta_{after} (< \eta_{before})$  denote the market competitiveness before and after the reduction in import tariffs.

A larger increase in import competition would generate an uninteresting case in which all constrained managers exit, and therefore the exit threat does not play a role for productivity improvements. Given that the exit rates are small in our empirical application, we think it is more interesting to focus on the other case here.<sup>20</sup>

The following propositions state formally how stiffer import competition affects  $F$ -type firms and  $P$ -type firms differently:

**Proposition 3** (Comparison across  $F$ -type firms with different initial productivity). *After import competition increases, the initially least productive surviving  $F$ -type firms increase productivity, whereas the initially most productive surviving  $F$ -type firms decrease productivity.*

*Proof.* See Appendix C. □

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<sup>20</sup>Note that empirically, the annual changes in import tariffs did not lead to extreme changes in market size or exit rates. While the changes were large over the course of the entire 20 years, the annual changes were not.

The least productive surviving *F*-type firms increase productivity, because stiffer import competition incentivizes their managers to exert more effort to ensure the survival of their firms (i.e., by just earning non-negative profits). Since increased competition makes survival tougher, these managers are disciplined by the market and have to exert more effort to ensure survival.

On the contrary, the most productive surviving *F*-type firms decrease productivity as the marginal return to effort falls when markets become more competitive, but they are not worried about survival.

The above proposition states that the disciplining effect of stiffer competition is present only when the firm is close to the exit cutoff *and* its manager cares about private benefits. This insight differentiates the result of our paper from existing papers in the literature that do not take firm heterogeneity and management type into account (e.g., Schmidt, 1997; Raith, 2003).

**Proposition 4** (Comparison between *F*-type and *P*-type firms). *When import competition increases, the increase in log productivity for the least productive F-type firm is larger than that for the least productive P-type firm, while the reduction in log productivity for the most productive F-type firm is also larger than that for the most productive P-type firm.*

*Proof.* See Appendix C. □

Our model predicts opposite patterns for the change in log productivity within the least productive (surviving) firms and within the most productive (surviving) firms. First, among the least productive surviving firms, *F*-type firms increase log productivity relative to *P*-type firms since the former firms and the latter firms increase and decrease productivity (and managerial effort) under stiffer import competition respectively. Second, both *F*-type firms and *P*-type firms decrease productivity (and managerial effort) after intensified import competition if their initial productivity is high. In addition, conditional on the initial productivity draw, they reduce productivity by the same degree. However, *F*-type firms have lower realized productivity than *P*-type firms, conditioning on the initial productivity draw. Therefore, the decrease in log realized productivity (i.e., the percentage decrease) is larger for *F*-type firms than for *P*-type firms, conditioning on the initial productivity draw (or initial productivity).<sup>21</sup> In short, our model predicts that the difference in the change of log productivity (between *F*-type firms and *P*-type firms) gets reversed when we move from the least productive (surviving) firms to the most productive (surviving) firms.

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<sup>21</sup>When we condition on the initial productivity, the decrease in log productivity is larger for *F*-type firms as well. The bigger the initial productivity draw, the larger the firm's productivity decrease since the initial productivity draw and the market size are complements (for the determination of the optimal effort). This is true for both unconstrained *F*-type firms and unconstrained *P*-type firms. As a result, *F*-type firms that have the same initial productivity (or log productivity) as *P*-type firms must receive a bigger initial productivity draw than *P*-type firms. Therefore, conditional on initial productivity (or log productivity), the most productive (surviving) *F*-type firms decrease log productivity by more than the most productive (surviving) *P*-type firms after import competition increases.

**Proposition 5** (Average productivity). *When import competition increases, the average log productivity of F-type firms can either increase or decrease, and it can either increase or decrease relative to P-type firms.*

*Proof.* See Appendix C. □

Among F-type firms (and P-type firms in the general case of our model), there are firms that decrease productivity and firms that increase productivity under stiffer import competition. Overall, it is not clear how the average productivity of F-type firms changes when import tariffs are reduced.

Another empirical prediction that immediately follows is that when import competition increases, the exit rate is the same for F-type firms as for P-type firms, as F-type managers and P-type managers share the same exit cutoff.

Summarizing the predictions, Figures A.2 and A.3 show changes in managerial effort and log realized productivity after a reduction in import tariffs as functions of the initial productivity draw and the initial productivity. The second graph of Figure A.3 shows the prediction most relevant for our empirical tests, as it is related to the initial productivity. We will derive the empirical counterpart of this graph below.

### 3 Empirical analysis

In this section, we test the complex pattern of productivity responses that the theory predicts on the example of family managers.

Family managers represent a well-suited application of our theory because the literature has identified them as having different preferences compared to professional managers. First, family managers receive various amenities from their firms, which lead to substantial non-profit driven incentives (Demsetz and Lehn, 1985; Bertrand and Mullainathan, 2003; Bandiera et al., 2014a; Hurst and Pugsley, 2011). Examples of these amenities are the use of firm resources for personal purposes, the opportunity to use the firm to address family issues (e.g., finding a prestigious job for a low-ability offspring), or empire building.

Second, in their study of manager diaries, Bandiera et al. (2011) and Bandiera et al. (2014b) found that, in contrast to professional managers, family managers care more about leisure and non-monetary private benefits that the firm offers and less about money. They explain that this is consistent with a wealth effect, i.e., family managers are wealthier (e.g., because they own the firm or they have inherited wealth) and therefore care more about leisure. This assumption is also consistent with the century-old “Carnegie Conjecture,” which states that a large amount of inheritance dampens people’s incentive to work (e.g., Holtz-Eakin et al., 1993).

Third, family managers have also been found to be more entrenched, i.e., they have higher effective control and are therefore less likely to be forced towards value maximization by market discipline or corporate control. They are instead more likely to pursue private benefits and goals (Morck et al., 1988; Kim and Lu, 2011).

Consistent with this literature, we interpret family managers as corresponding to the *F*-type managers in our model who care relatively more about private benefits and costs compared to firm profits, and professional managers as *P*-type managers.

### 3.1 Data description

We use panel data from a Spanish survey of manufacturing firms (ESEE; Encuesta Sobre Estrategias Empresariales) that is collected by the Fundación SEPI, a foundation affiliated with the Spanish Ministry of Finance and Public Administration.<sup>22</sup> The survey is designed to cover a representative sample of Spanish Manufacturing firms and includes around 1,800 firms per year. Participation of firms with more than 200 employees is required, while firms with more than 10 but less than 200 employees are sampled via a stratified sampling approach. SEPI makes a great effort to replace non-responding and exiting firms to ensure the continuing representativeness of the sample, leading to a total number of around 4,000 observed firms between 1993 and 2007. We focus on data before 2007 in order to avoid confounding issues that were brought about by the financial crisis.

The most distinctive feature of this data set is that it provides very rich information on several dimensions that are important for our empirical analysis.

**Family firms.** First of all, we can distinguish between family-managed and professionally-managed firms because the survey includes a variable that gives the number of “owners and working relatives who hold managing positions.” We classify firms as family-managed firms (or family firms, in short) if this number is bigger than or equal to one in the first year of our sample, 1993. We use the first year of the sample for this definition in order to avoid a potentially endogenous definition of management type that responds to changed competition (but we do check whether endogenous management explains our results).

**Productivity.** We need detailed data on capital stock, output, employment and intermediate inputs to estimate total factor productivity (TFP) at the firm level. In many firm-level data sets, capital stock is not available and must be reconstructed using investment data (often using only average depreciation rates). The problem of missing initial capital stock is only negligible if data over a long period of time is available and initial capital stock is depreciated for much of the observed sample period. Fortunately, the Spanish data set provides both gross and net capital stock together with firm-level depreciation and investment, which allows for a precise construction of the capital stock at any point in time.

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<sup>22</sup>For more information, see <http://www.fundacionsepi.es/esee/sp/spresentacion.asp>



Estimation of total factor productivity by OLS may suffer from several problems: Employment and capital choices are endogenous and TFP cannot be easily distinguished from markup changes (Beveren, 2012). To deal with the endogeneity problem, we estimate TFP using the Levinsohn-Petrin method, which uses intermediate inputs to control for unobserved expected productivity changes. This is preferable to the Olley-Pakes method, which uses investment as control, because investment is often reported as zero. The monotonicity condition, which is key for the Olley-Pakes method, is more likely to be satisfied for intermediate inputs, as firms usually report positive use of intermediate goods.

Beveren (2012) points out that policy evaluation is usually robust to the TFP estimation method with one exception: It is necessary to control for input and output prices (De Loecker, 2011). Luckily, the Spanish firm-level survey provides a remedy to this omitted price bias, as it also reports input and output prices. Firms are asked by how much % the sales price of its products and the purchasing price of its intermediate inputs and services has changed compared to the previous year. The price changes are a weighted average across final products and markets (for output prices) and a weighted average across intermediate inputs, energy consumption, and purchased services (for input prices). We use these price changes to deflate output and intermediate inputs at the firm level (instead of industry-wide deflators).

We use TFP estimated by Levinsohn-Petrin in the described way for our main results. Our empirical results, however, are also robust to using simpler productivity measures, such as TFP estimation without price adjustment, labor productivity, and productivity backed out from a simple OLS regression with firm and year fixed effects.

**Entry and exit.** One concern is that we might falsely pick up a positive effect of competition on productivity because firms that are hit very hard by a negative productivity shock exit the sample. Without correcting for this selection effect, the productivity effect might be overestimated. Unfortunately in many data sets it is not possible to distinguish exiting from non-responding firms. The Spanish data set however provides this information, as it follows up on non-responding firms to determine their status. Exiting firms include closed firms, firms in liquidation, and firms that are taken over by other firms, and we can check for differential exit rates across family-managed and professionally-managed firms. Note that exit rates are quite small in the sample (2.4% on average), so they do not turn out to be a big confounding issue.

**Other productivity related outcomes.** Besides TFP, we can also check for other productivity related outcomes, e.g., by using dummies for whether new machinery or new organizational methods were used in process innovation, whether product innovation was undertaken, as well as R&D spending and number of patents.

**Trade related outcomes.** We can also check whether increased import competition is associated with changed importing and exporting behavior by the firm by looking at firm-level imports, exports, and a dummy that indicates whether the firm has adopted imported

technology.

**Family management vs. family ownership.** Our main regressions use information on family members involved in management as regressor. As a robustness check, however, we can use a variable indicating whether the firm is controlled by a family group as an indicator for family ownership and thereby distinguish between family-owned and family-managed, and family-owned but professionally-managed firms. This variable, however, is available only after 2006, so we only use it in robustness checks.<sup>23</sup>

**Tariff data.** This paper exploits variation in industry-specific import tariffs over time. We use tariffs that the EU imposes on imports from the rest of the world (“import tariffs”) to construct our main regressor. All tariff data used in the analysis is from TRAINS (provided by UNCTAD); accessed via the WITS software provided by the World Bank.<sup>24</sup> We use the weighted average of the import tariff in each product category (ISIC Rev. 3; 244 product categories) and aggregate them to the NACECLIO industries that the Spanish data uses (20 NACECLIO categories<sup>25</sup>) by using trade shares in 1993 (to avoid endogeneity of the weights). Our results are robust to using trade shares from the previous year to calculate the industry-level tariffs, or just using tariffs imposed on China (which experienced the largest decreases in our sample period). For robustness checks, we calculate average tariffs that other countries impose on imports from the EU (“export tariffs”) as an indicator for export opportunities with the same methodology.

The resulting import tariffs are shown in Figure A.4. Tariffs fell over time, especially during the 1990’s. A large heterogeneity of tariffs across industries is also visible. Beverages, food/tobacco, meat related products, and textiles all started with the highest tariffs. While tariffs dropped for food and drink related industries, tariffs on textiles fell very little. Tariffs for leather/fur/footwear and vehicles also changed little and remain on the higher end.

### 3.2 Descriptive statistics

**Family firms.** Family firms are prevalent in Spain: 41% of our observations are family firms, as can be seen in Table B.1. Consistent with the literature, family firms are on average smaller (both in terms of sales and employment), have lower productivity, and spend less on R&D.

While our main empirical analysis focuses on what happens to productivity after a shock to import competition, note that the data is also consistent with the cross-sectional

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<sup>23</sup> Assuming family ownership is persistent, we use the maximum of the years 2006 to 2010 to indicate a family-owned firm.

<sup>24</sup><http://wits.worldbank.org/wits/>

<sup>25</sup>The 20 industries are: Meat related products; food and tobacco; beverage; textiles and clothing; leather, fur, and footwear; timber; paper; printing and publishing; chemicals; plastic and rubber products; nonmetal mineral products; basic metal products; fabricated metal products; industrial and agricultural equipment; office machinery, data processing, precision instruments and similar; electric materials and accessories; vehicles and accessories; other transportation materials; furniture; miscellaneous.

predictions of the model. For example, Proposition 2 predicts that family-managed firms have lower average productivity than professionally-managed firms, which is what we see in Table B.1 and what many papers in the literature on family firms also find. Our model can explain this difference in average productivity endogenously, even with the same initial productivity distribution. But we can explain more than just average differences: Figure A.5 shows that the distribution of family firms consists of more small firms than the distribution of non-family firms. Moreover, it shows that there are disproportionately more extremely unproductive firms among family firms. This is consistent with a more refined prediction about the cross-sectional differences in the productivity distribution that we derive in Proposition 6 in Appendix D. Finally, in the Online Appendix, we even show that our model can explain the differences in the first four moments of the log productivity distribution between family and non-family firms: mean, variance, skewness and kurtosis.

The share of family firms ranges from 19% to 68% across different industries. In the Online Appendix, we show that differences in family firm shares are uncorrelated with import tariff reductions.

Family management is relatively persistent: 74% of family-managed firms in 1993 are still family-managed in 2007. In robustness checks, we make sure that changes in management type are not responsible for the observed productivity responses. In the Online Appendix, we also show that the probability of switching from family to professional management is uncorrelated with the tariff reduction that we use as a measure for import competition and a firm's initial productivity.

**Trade and tariffs.** Trade grew substantially over the time period we use in this paper, 1993 to 2007.<sup>26</sup> Figure A.6 shows that Spain's imports from the rest of the world grew from 60 billion EUR in 1993 to 265 billion EUR in 2007, with a slowdown in the early 2000's. Spain's exports also grew, but at a slower rate, especially after 2000. Spain incurred a trade deficit from its goods trade in every single year over the observed time period. The trade deficit increased from around 2% of GDP to a staggering 10% of GDP at the end of the sample period.

China's rise as one of the world's main exporters is also visible in the Spanish data: Spain's imports from China soared over this period, while exports to China grew at a much slower rate. China's share in Spain's imports increased from 2% in 1993 to 6% in 2007. This increase was most prevalent in industries like leather/fur/footwear, textiles/clothing, and nonmetal mineral products.

Researchers have attributed the increased trade with EU countries to the increased European integration that came with the introduction of the euro, the European Single Market, and the European Monetary Union (e.g., Berger and Nitsch, 2008; Bergin and Lin, 2012; Brouwer et al., 2008). Another important trade liberalization episode that occurred during the sample

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<sup>26</sup>Trade data is from COMTRADE (provided by UNSD) and is accessed via the WITS software provided by the World Bank.

period was China's accession to the WTO in 2001, which was accompanied by a fall of tariff and non-tariff barriers between China and the European Union, among others, and led to increased trade with China (e.g., Bloom et al., 2016; Autor et al., 2013). While our main analysis uses average import tariffs across all countries in the world as regressor, in robustness checks, we just use variation in import tariffs against China, which have the largest variation over time in the data.

### 3.3 Empirical strategy

Our theory predicts that after import competition increases, family firms with initially low productivity should increase productivity, whereas family firms with initially high productivity should lower their productivity. Both changes should be larger in magnitude than the changes made by non-family firms with the same initial productivity (see Predictions 3 and 4, as summarized in Figure A.3).

**Separate regressions.** In order to test these predictions, we start by running a specification that allows for import competition to have a heterogeneous effect on productivity depending on the initial productivity of the firm, and we run it separately for family firms and non-family firms:

$$\Delta TFP_{ist} = \beta_1 \Delta IMP_{st} + \beta_2 (TFP93_i \cdot \Delta IMP_{st}) + \text{yearFE} + \text{firmFE} + \eta_{it}, \quad (3.1)$$

where  $i$  denotes firm,  $s$  denotes industry, and  $t$  denotes year.

We use the *negative* (for easier interpretation) of the industry- and year-specific EU import tariff, denoted as  $IMP_{st}$ , as our exogenous variation for import competition. This means when  $IMP_{st}$  increases, import competition increases due to a reduction in import tariffs. In general, it is not always clear whether tariff changes can be interpreted as exogenous to firms and industries, as large companies often try to influence policy makers to negotiate favorable tariffs. However, in the Spanish case, tariffs are negotiated at the European level, and it is less likely that Spanish firms are able to influence European decision making. Furthermore, many tariff changes are part of a larger political process (e.g., the EU enlargement, or China's WTO accession), and therefore likely out of the control of specific Spanish firms.<sup>27</sup>

The main empirical measure for productivity,  $TFP_{ist}$ , is obtained via Levinsohn-Petrin estimation as described above. Since 1993 is the initial year of our sample period,  $TFP93_i$  is used to proxy for the initial productivity of the firm.

Our specification allows for year fixed effects to absorb macroeconomic shocks. Since the model is in first differences, any time-invariant firm or industry characteristics are absorbed,

<sup>27</sup>Note that in the Online Appendix, we also show that the industry level tariff reductions are uncorrelated with the share of family firms in various industries.

as firm fixed effects in levels drop out in the first differences specification. In addition, we make the empirical specification even more demanding by adding firm level fixed effects to the estimation equation in first differences, allowing for firm specific time trends. Historically, import tariffs have fallen, while productivity has increased at the industry level. These correlated trends should not be interpreted as causal evidence of a response of productivity to import competition, so we only interpret deviations from the trend as causal evidence for our mechanism.<sup>28</sup>

Finally, all standard errors are clustered at the industry level, in the spirit of Bertrand et al. (2004).<sup>29</sup>

**Non-parametric regressions.** The response of firm productivity to decreased import tariffs might be highly non-linear with respect to a firm's initial productivity. In order to check this, we also implement non-parametric versions of the above regressions for both types of firms:

$$\Delta TFP_{ist} = \beta_1 \Delta IMP_{st} + \sum_p \beta_p (Perc93_{pi} \cdot \Delta IMP_{st}) + \text{yearFE} + \text{firmFE} + \eta_{it}, \quad (3.2)$$

where  $Perc93_{pi}$  are dummy variables for firm  $i$ 's position in different percentiles  $p$  of the initial productivity distribution. We experiment with different percentiles, using halves, terciles, quartiles and quintiles. If the response were indeed highly non-linear, the non-parametric estimation would yield qualitatively different results compared to the regressions imposing linearity.

**Pooled regressions.** Our next main specification is a pooled regression of family and non-family firms with triple interaction terms that allow for differential effects of import competition depending on a firm's management type (family vs. non-family) and the initial productivity. The resulting regression equation is:

$$\begin{aligned} \Delta TFP_{ist} = & \beta_1 \Delta IMP_{st} + \beta_2 (\Delta IMP_{st} \cdot TFP93_i) + \beta_3 (\Delta IMP_{st} \cdot FAM93_i) \\ & + \beta_4 (\Delta IMP_{st} \cdot TFP93_i \cdot FAM93_i) + \text{yearFE} + \text{firmFE} + \eta_{ist}, \end{aligned} \quad (3.3)$$

Note that this is a fully saturated model, as the remaining interaction terms are soaked up by the firm fixed effects. This regression is very similar to the regressions run separately for family and non-family firms, and it allows us to show a large number of robustness checks in

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<sup>28</sup>Autor et al. (2016) have also pointed out this problem and add industry fixed effects to their specification in growth rates to address this problem. Note, however, that our results do not depend on firm fixed effects, as shown in the Online Appendix.

<sup>29</sup>We can also cluster at the firm level, but prefer to show the more conservative standard errors derived from clustering at the industry level.

an easy and space-saving way.

**Robustness checks.** In order to analyze the robustness of our results, we conduct a number of alternative specifications using our pooled regression as our basis.

First, since most trade liberalization episodes are bilateral and increase trade in both directions (even within narrowly defined industries), increased import competition often coincides with increased export opportunities. Our estimates might therefore suffer from omitted variable bias and be picking up productivity changes caused by exporting rather than competition (e.g., as in Lileeva and Trefler, 2010; Bustos, 2011, even though they do not differentiate between family and non-family firms). In a robustness check, we control for the full interactions with tariffs other countries impose on trade originating from the EU,  $EXP_{st}$ . We aggregate this measure the same way that we aggregate import tariffs to the industry-year level and again use the negative tariff as measure for export opportunities.

Second, we use alternative measures for tariffs and productivity to re-estimate equation (3.3). With respect to alternative tariff measures, we take one of two approaches. In the first approach, we aggregate product\*country-level tariffs to the Spanish industries using one-year, lagged trade shares rather than trade shares from the initial year. Alternately, we simply use tariffs against China, which changed the most over our time period compared to tariffs against other countries due to China's WTO accession. Furthermore, we use different productivity measures as the outcome variable. For example, we omit the correction for input and output prices in obtaining the Levinsohn-Petrin productivity estimate, we just use the residuals from a simple OLS regression with firm and year fixed effects, or we use simple labor productivity.

Third, we use propensity score matching (PSM) techniques (nearest neighbor matching and inverse propensity score re-weighting) to correct for the possibly endogenous selection of firms into family firms and non-family firms. The potential concern is that family firms and non-family firms differ in various observable characteristics that might drive the productivity changes we observe. Therefore, although we use a time-invariant dummy for family management (and ownership), the estimates might still be biased if we do not deal with endogenous selection. In both methods, we use firm's initial TFP, sales, employment, and export status as observables to control for selection, but the results are robust to using only a subset of these observables. As a result of the matching, family firms and non-family firms are distributed more equally across initial TFP in our regressions when we use PSM, as shown in Figure A.7 for the example of nearest neighbor matching (we match to the 5 nearest neighbors).

Fourth, there is the worry that the productivity improvements are only due to a selection effect, i.e., firms with the smallest productivity increases or even decreases go bankrupt and exit, so we observe productivity increases only because the most successful firms survive. In order to understand whether this is an issue, we first check for differential exit rates between family and non-family firms. We then use an exit dummy (which becomes 1 in the year the firm exits) as a dependent variable in the regression to see whether there are different exit

probabilities between family and non-family firms and between firms with different initial productivity levels that arise due to increased import competition.

Fifth, we want to make sure that productivity improvements are not only driven by firms that replace their family managers by professional managers. We do this by estimating a regression that excludes firms that permanently switch from family management to professional management.

Finally, there is the possibility that a reduction in import tariffs also makes it easier to import inputs, and that this shows up in the TFP estimation (e.g., Amiti and Konings, 2007). Note at first that this is unlikely because our TFP estimation procedure corrects for changing input prices by applying firm-specific deflators to input prices. Furthermore, the productivity enhancement effect due to better access to imported inputs (i.e., more varieties as documented in Goldberg et al., 2010) is usually found in firms from developing countries (e.g., India, Mexico, Indonesia and China), and Spain is a developed economy. However, we can also use firm-level imports, or even firm-level imports of technology, as the dependent variable to verify that there is no differential access to imported inputs between family and non-family firms that is driven by a reduction in import tariffs. In a similar spirit, if import tariffs are correlated with tariffs that induce exporting, an increased tendency to export might be showing up in the TFP estimation. Again, we do not think this is very likely, as we also use firm-level deflators for outputs in our TFP estimation. Beyond this, we also use firm-level exports as a dependent variable to check whether there are any differential changes (between family and non-family firms) giving rise to confounding explanations.

**Mechanism.** In additional regressions, we try to pin down the mechanism driving our result, i.e., that managerial effort or management quality is responsible for the productivity changes rather than improvements in physical technologies, product innovation, or R&D investment. We do this by checking a few additional outcome variables. For example, we test whether firms adopt new machinery (consistent with improvement in physical technology) or whether they adopt new organizational methods (consistent with changes in management quality) in their production processes when they update their productivity as a result of increased import competition. Other than process innovation, we also check whether R&D activities, patents, or product innovation respond in the same way as process innovation. Furthermore, we can test whether family ownership rather than family management explains our result. If our mechanism, in line with Bandiera et al. (2014a,b), is true, family management is driving the results, and our results should only be only found for family-owned and -managed firms and not for family-owned but professionally-managed firms.

### 3.4 Empirical results

We start by dividing the sample into family-managed and professionally-managed firms and estimate the effect on these two samples separately using equation (3.1). Results are given in Table B.2. Column (1) shows that there is a positive, but insignificant effect of import competition on the average productivity of family firms. Column (4) shows a similarly positive, but insignificant result for non-family firms. Interestingly, when we allow for the effect of import competition to differ by initial productivity (as suggested by our theory), we find significant productivity responses. Column (2) shows that family firms with an initially low productivity respond to import competition by increasing their productivity. This response fades out and turns negative, however, as the initial productivity of the firm becomes larger. In contrast, there is no effect for non-family firms, as shown in column (5), which is precisely what the theory predicts. In columns (3) and (6) we add industry\*year fixed effects as an even more demanding specification. In this specification, we can no longer identify the main effect on import competition, but it is reassuring to know that the effects on the interaction terms remain of similar magnitude and significance.

Overall, the separate regressions are strikingly consistent with the theoretical predictions: Only family firms react to import competition with productivity changes, with increases for initially low and decreases for initially high productivity firms. Among non-family firms, there is no significant productivity change for any type of firm.

Regression equation (3.1) imposes a linear relationship between initial productivity and productivity changes after an import competition shock. The estimation might disguise a non-linear or non-monotonic relationship in the data. In order to see whether this is the case, we implement a non-parametric version of the regression equation by estimating equation (3.2), which allows for different productivity responses per initial productivity percentile. Table B.3 shows the results, again separately for family and non-family firms. In columns (1) and (5), we estimate the effect differently for the lower and upper half of firms in the initial productivity distribution, and we repeat the estimates for terciles, quartiles, and quintiles in columns (2) to (4) and (6) to (80).

The empirical pattern is consistent: None of the coefficients in the regressions for non-family firms have significant effects, whereas, it is clearly visible that, in response to import competition, the percentiles with the lowest initial productivity increase productivity significantly, and the percentiles with the highest initial productivity reduce it significantly. In between, the effect decreases monotonically. Furthermore, the results suggests that the effect is indeed linear for family firms. Figure A.8 shows the effects graphically for the case of quartiles.

In Table B.4 we move to the pooled estimation given in regression equation (3.3) that estimates the effects jointly for family and non-family firms in a triple differences framework.



We add the interaction terms step by step. In column (1) we estimate the average effect of increased import competition on productivity changes: On average, increased competition led to productivity increases, consistent with some other papers in the literature (e.g., Bloom et al., 2016), but the average effect is not significant. In column (2), it appears that the productivity increases might be more prevalent in firms with initially low productivity, and in column (3) it appears that non-family firms are increasing productivity by more, but none of the effects is significant.<sup>30</sup>

The full picture is again revealed only when looking at column (4) with all the interaction terms: Import competition causes productivity increases, but only for family firms with an initially low productivity level, because  $\beta_3 > 0$  and statistically significant. Family firms with higher initial productivity levels increase their productivity less (or even decrease their productivity), because  $\beta_4 < 0$  and statistically significant. In column (5) we allow for industry\*year fixed effects to absorb any industry-year specific heterogeneity that might be correlated with import competition. Taking this step leaves us unable to identify the main effect of import competition, but it is reassuring to see that all the interaction terms remain almost unchanged.

Table B.4 does not show the heterogeneous effects across the observed initial productivity distribution. Strictly speaking, then, we cannot say yet whether the firms in the left tail of the initial distribution increase and the firms in the right tail of the distribution decrease productivity, which would be in line with the theoretical prediction. In order to link the empirical result of column (4) more clearly to the theoretical predictions, we plot the predicted change in productivity due to import competition over the full range of observed values of the initial TFP distribution in Figure A.9. The effect on family firms is depicted by the solid black line and the effect on non-family firms is given by the gray line (the dashed lines give the 95% confidence intervals). Figure A.9 bears a striking resemblance to the theoretical prediction in Figure A.3: For the lowest initial values of TFP in our sample, the effect of import competition on productivity is *positive* for family firms, in line with Proposition 3. This is reversed for family firms at the high end of the initial productivity spectrum: For those firms, import competition leads to a *decrease* in productivity, again in line with Proposition 3. This is in stark contrast to non-family firms, which do not respond to import competition at all. This confirms Proposition 4: The magnitude of the change in productivity is larger for family firms than non-family firms on both tails of the productivity distribution.

The magnitude of the effect is sizable. An increase in the import tariff by 1 percentage point leads to a TFP increase of 3.3% for the firms in the sample with the lowest initial productivity and to a TFP decrease of 3.8% for the firms in the sample with the highest initial productivity.

<sup>30</sup>It is worthwhile noting that the average effect on productivity, as estimated in column (3) of Table B.4, is insignificant for both family and non-family firms. This is consistent with Proposition 5, which predicts an indeterminate average effect.

Over the sample period, the import tariff changed on average by 1/3 of a percentage point, which would be associated with TFP changes ranging from 0.8% to -0.9%. A large import tariff change (95th percentile), however, would be associated with larger TFP changes between 3.6% and -4.2%.<sup>31</sup>

**Robustness checks.** In Table B.5, we conduct our first set of robustness checks. First, since most trade liberalization episodes are bilateral and increase trade in both directions (even within narrowly defined industries), increased import competition often coincides with increased export opportunities. Our estimates might therefore suffer from omitted variable bias and be picking up productivity changes caused by exporting rather than competition. In column (2) we add therefore all the interactions with tariffs other countries impose on trade originating from the EU (“export tariffs”) as controls, but our results are robust to this inclusion. In column (3) we add industry-specific year effects as we did in column (5) of Table B.4, and again the results are robust to this inclusion.

In columns (4) and (5) we check whether our findings are robust to different ways of aggregating the tariffs. In column (4) we use the one-year, lagged import share of each product within an industry instead of the 1993 share to aggregate product level tariffs up to the industry level. In column (5) we use only tariffs on Chinese imports, as those were the most important tariff changes in the sample period. The magnitudes of the coefficients change slightly, but the main findings are robust across the alternative tariff specifications.

In columns (6) to (8) we check whether our findings are robust to alternative measures of productivity. In column (6) we omit the price adjustment in our TFP estimate, i.e., we use Levinsohn-Petrin revenue based productivity, *Lev Pet R*, instead of quantity based productivity. The effects are almost unchanged, which shows that quantity based productivity increases are driving the results, rather than markup changes. In column (7) we use TFP estimates that are residuals from a simple fixed effects (firm and year fixed effects) regression instead of the Levinsohn-Petrin procedure. Finally, in column (8) we use labor productivity instead of TFP as dependent variable. In line with other papers in the literature (e.g., Beveren, 2012), our estimates are not sensitive to the exact productivity estimation method.<sup>32</sup>

Next we report estimation results using propensity score matching (PSM) techniques to correct for the endogenous selection into family firms and non-family firms. Table B.6 shows results for nearest neighbor matching, and Table B.7 shows results for the more efficient

<sup>31</sup>Note that the average import tariff fell by 4 percentage points over the entire sample period, between 1993 and 2007.

<sup>32</sup>We also tested whether there are responses to lagged changes in import tariffs by including both contemporaneous and lagged difference in import tariffs (and their interaction terms); the results are available in the Online Appendix. Our results suggest that the response is immediate and that firms do not respond to changes that are in the past. Although firms respond immediately, the response is permanent and is not reversed in the following period. Specifically, the sum of the coefficients in front of the interaction terms between the family dummy and contemporaneous and lagged difference in import tariffs is 9.905\*\*\* (3.552). Moreover, the sum of the coefficients on the two triple interaction terms is -0.771\*\*\* (0.264). Thus, the effect is still present in the longer run.

inverse propensity score re-weighting method. In both tables we can see that the estimated coefficients for family-managed firms are not only qualitatively, but also quantitatively similar to the results reported in Table B.4. This shows that even after we tease out observable differences between family and non-family firms due to possibly endogenous selection, the differential impact of decreased import tariffs on firm productivity is still there.

There is the worry that the productivity improvements that we observe are only driven by a selection effect, i.e., firms with the smallest productivity increases or even decreases go bankrupt and exit, so we observe productivity increases only because the most successful firms survive. This is likely to be the case for firms with low initial productivity, who struggle with survival. However, our results are not driven by selection effects. First of all, it is reassuring to see that the annual exit rates for family firms and non-family firms are not statistically different, as Figure A.10 shows. We report regression results that relate exits to import competition in Table B.8. As the second column indicates, the reduction in import tariffs does not generate a differential impact on the exit rate between family and non-family firms, or between firms with initially low or high probability. Therefore, we can exclude the explanation that there are differential probabilities of exiting (after import tariffs go down), which could potentially drive our results.

Column (3) of Table B.8 checks whether the observed productivity improvements are driven by firms that replaced their family managers by professional managers, so we exclude firms that are initially family firms, but then permanently switch to professional management. It is reassuring to see that the results are not driven by those switchers, even though we lose 26% of our observations. If anything, our findings seem to become stronger in magnitude. Overall, switches between family and non-family firms cannot be used to explain our empirical findings.<sup>33</sup>

Finally, we look at our robustness checks related to exports and imports. There is the possibility that a reduction in import tariffs also makes it easier to import inputs, and that this shows up in the TFP estimation (e.g., Amiti and Konings, 2007). In a similar spirit, if import tariffs are correlated with tariffs that induce exporting, an increased tendency to export might be showing up in the TFP estimation. In Table B.9, we run regression equation (3.3) by treating the change in log imports, log imported technologies and log exports as the dependent variable. We want to investigate whether Spanish family firms had behaved differently in terms of importing or exporting after tariffs went down. Since the coefficients  $\beta_3$  and  $\beta_4$  are not significant in the regressions of the above trade-related variables, alternative explanations involving imported inputs or a change in exporting are not consistent with the empirical evidence.

**Mechanism.** In order to provide evidence for our proposed mechanism - changes in

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<sup>33</sup>In the Online Appendix, we also show that import competition neither influences the number of family managers nor the probability of being a family-managed firm, for firms with either initial low or high productivity.

productivity due to changes in managerial efforts -, we found a proxy in the data that is associated with changes in management practices. This is a dummy variable and records whether the firm adopts new organizational methods in the production process (i.e., a component of process innovation). We use this variable as an alternative dependent variable to check whether changes in productivity are consistent with changes in management practices. As an alternative, we also check whether firms use new machinery in production after import competition increases, which would be consistent with technological changes (but not consistent with changes in management practices). Table B.10 shows supportive evidence that changes in management practices are driving the TFP results: According to column (3) the least productive family firms, which according to our main analysis are the ones increasing TFP, are also implementing new organizational methods after competition increases. In line with the TFP result, this effect falls as a family firm's initial productivity increases, and there is no observed change for non-family firms. Moreover, this pattern does not hold for changes in physical technologies in the form of new machinery, as column (2) shows. This provides direct support for our proposed theoretical channel involving managerial effort highlighted in Section 2.

Our finding here is consistent with Schmitz Jr (2005), who studied increased competition in the U.S. iron ore industry and found that productivity improvements are brought about by new management practices. In this case this included giving workers more competencies and reorganizing work schedules in order to reduce redundancies in production processes.<sup>34</sup>

We also investigate how firm-level R&D activities and product innovation responded to reductions in import tariffs, and the estimation results are reported in Table B.11. Since relatively few firms do R&D in our data set (a common finding in many countries), we investigate the change in the extensive margin of doing R&D first. Column (2) shows no significant effects, suggesting that the change in the probability of doing R&D does not differ significantly between family and non-family firms. When we focus on the intensive margin (i.e., by only looking at firms with non-zero R&D), a pattern opposite to our productivity results appears, as shown by column (3). In short, changes in R&D activities do not seem to be driving our productivity changes, as opposed to the previously reported changes in management practices. In addition, columns (4) and (5) show that changes in the number of patents and in the probability of doing product innovation also do not differ significantly between family and non-family firms after a decrease in import tariffs. These findings confirm our previous argument that changes in physical technologies are *not* responsible for the productivity improvements we observe, rather, it is process innovation driven by managerial changes in organizational methods.<sup>35</sup>

<sup>34</sup>In the Online Appendix, we also explore whether different types of employment (e.g., full time, part time and temporary employment) changed differently in family and non-family firms depending on their initial productivity after import tariffs went down. We found no significant effects in either of those variables.

<sup>35</sup>Note that both our model and empirical exercise focus on short run changes in productivity and the managerial

Finally, family management is obviously correlated with family ownership, and family-owned firms might have different incentives compared to non-family-owned businesses for undertaking innovation (e.g., due to differential tax incentives). The mechanism we propose in this paper, however, is tied to the characteristics of the firm manager, not the owner, so we want to make sure we are not picking up the effects of ownership rather than management. If our proposed mechanism is true, TFP changes should only be observed for family-managed firms, but not for family-owned and professionally-managed firms. In Table B.12, we conduct this test by restricting the sample to family-owned firms. Now  $\beta_1$  and  $\beta_2$  yield the effect for family-owned, but professionally-managed firms (as the dummy for family manager is zero), and  $\beta_3$  and  $\beta_4$  yield the result for family-managed firms *relative* to family-owned and professionally-managed firms. Table B.12 conducts the main specification in column (1), and then also the same robustness checks as in Tables B.4 and B.5.<sup>36</sup> These results are strikingly consistent with our proposed mechanism, as productivity improvements are only observed in family-managed, but not professionally-managed family firms. This finding shows that increases in productivity are driven by differences in manager characteristics, such as their preferences, rather than differences in firm characteristics, such ownership. Overall, the empirical findings above are consistent with our model's predictions and also supportive of the mechanism we suggest.

## 4 Conclusion

In this paper, we propose a model featuring heterogeneity in managers' preferences and explore how increased import competition affects the productivity of firms with different managers differently. We show that the response of managerial effort and firm productivity to increased import competition is heterogeneous across firms and differs between firms with different types of managers. In particular, we find that only managers who care about private benefits respond to import competition, and the response is larger the more they care. Furthermore, the direction of the productivity change depends on the firm's initial position on the productivity distribution. The initially least productive surviving firms, whose managers care about their private benefits, improve productivity after increased import competition, whereas the initially most productive firms decrease productivity after an import competition shock.

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effort, and outcome variables like R&D or patenting are more relevant to long run outcomes. Therefore, we would not have expected those channels to be responsible for productivity improvements that firms make when they want to escape bankruptcy in the short run.

<sup>36</sup>The sample size is reduced because our indicator of family ownership is only available after 2006. Assuming that family ownership is relatively stable over time, we use this measure for years after 2006 in the analysis. However, because there are many firms that exist in 2006 did not exist in 1993, the sample size is substantially smaller than in other tables.

In the empirical part of our paper, we test these rich predictions by using family managers as an application of the theory. Family managers are well-suited for the application of our theory because the literature has identified them as having different preferences compared to professional managers: Family managers care more about private benefits and costs compared to professional managers. Using rich, firm-level data from Spain and changes in EU imposed import tariffs between 1993 and 2007, we find that the data is strikingly supportive of the theory: Family-managed firms with initially low productivity show significant productivity increases after a reduction of import tariffs, and this effect falls with the initial productivity of the family-managed firm. This is in contrast to non-family firms, whose productivity is barely affected by import competition. We show that our findings are driven by family management rather than family ownership and by improvements in organizational methods related to managerial effort rather than improvements in physical technologies.

Nevertheless, much remains to be explored. Given the increasing availability of panel data on management practices, using management survey data (e.g., the World Management Survey as in Bloom and van Reenen, 2007) can provide more direct evidence on how increased import competition affects firm productivity through affecting management quality. From the theoretical point of view, incorporating the partial equilibrium model presented in this paper into a general equilibrium trade model could help us understand how the difference in managers' preferences affects gains in aggregate productivity and welfare after trade liberalization.

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# Appendix

## A Figures

Figure A.1: Effort and realized productivity across firms

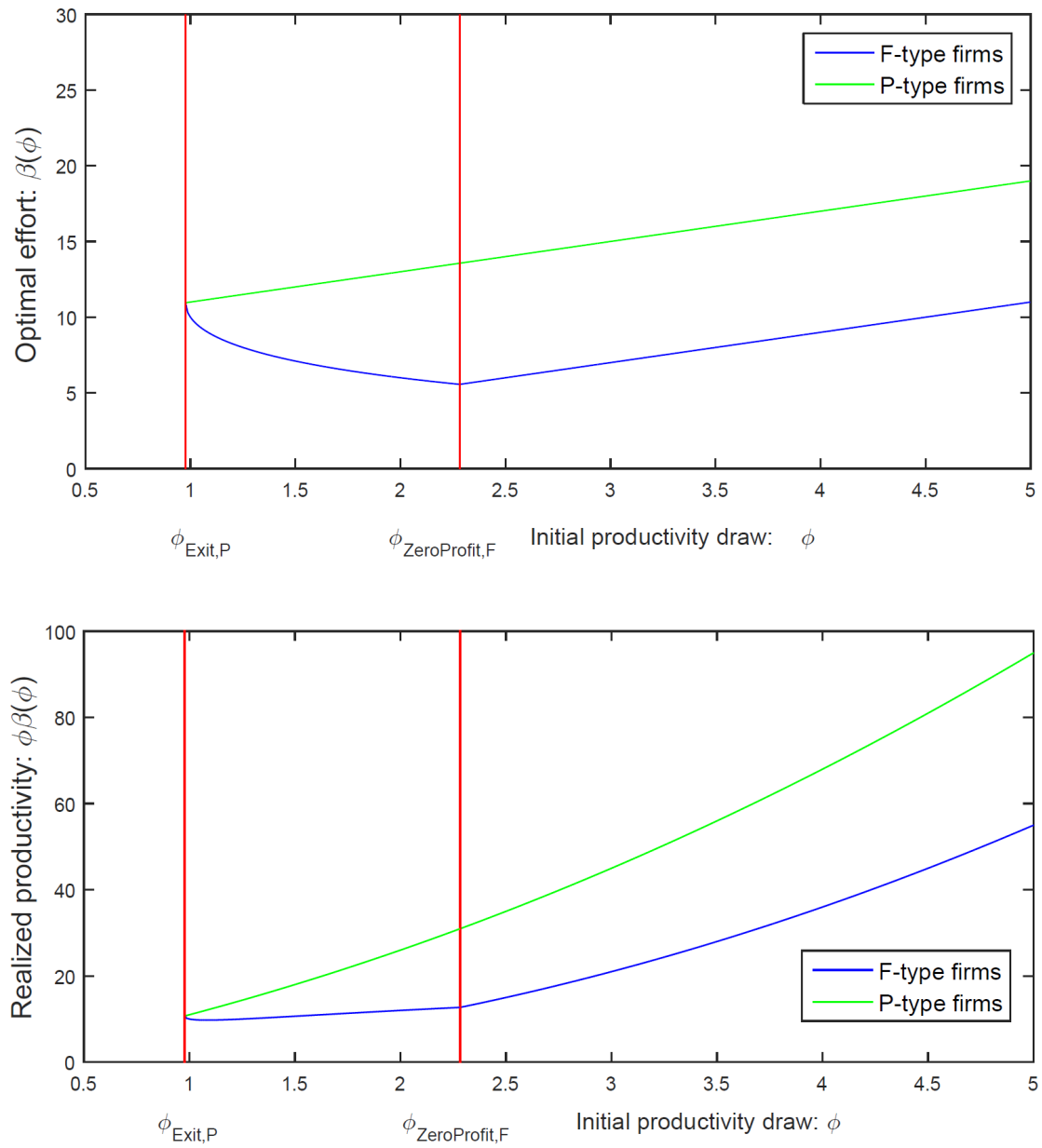


Figure A.2: Effect of increased import competition on effort and realized productivity

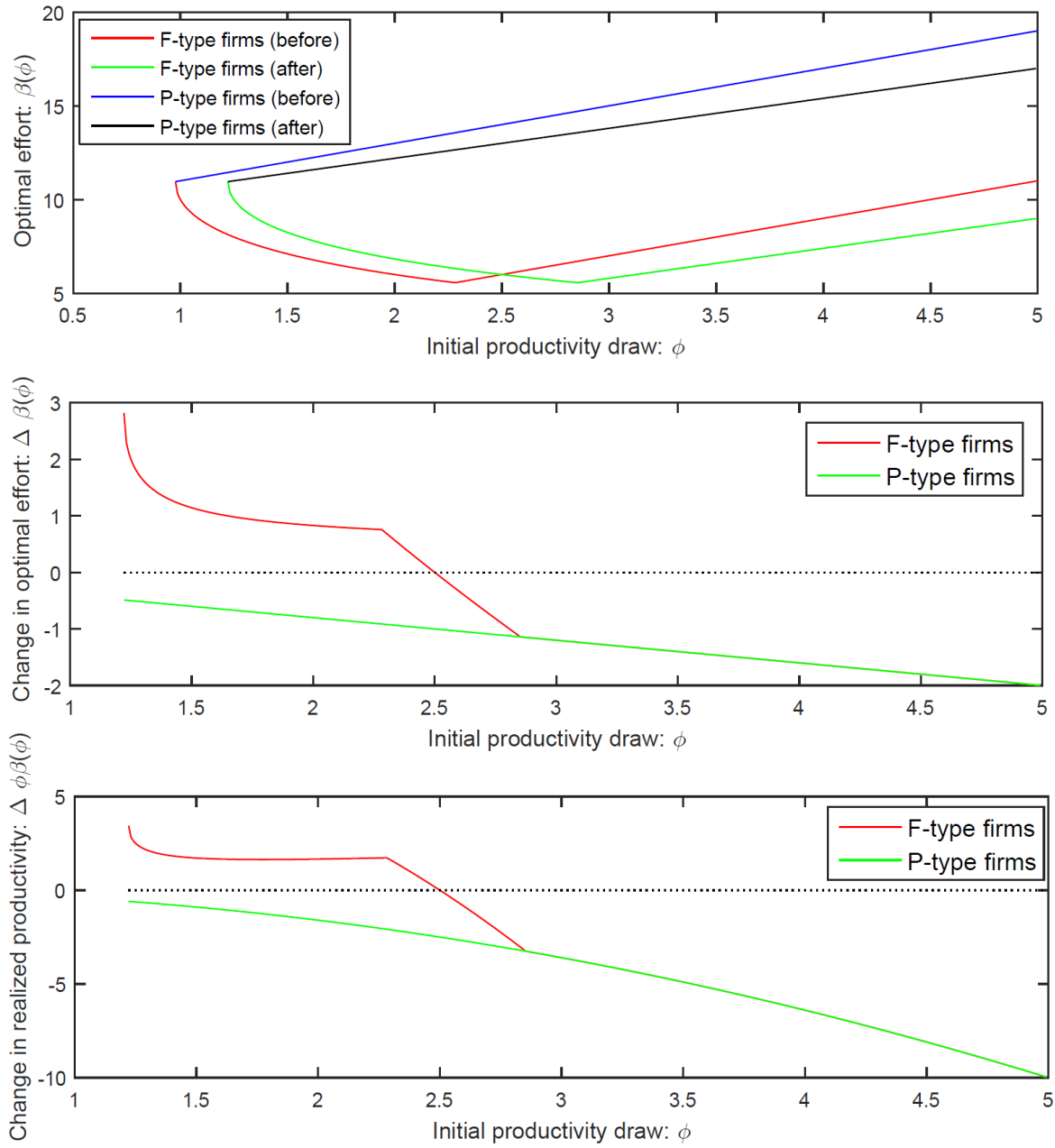


Figure A.3: Effect of increased import competition on log realized productivity

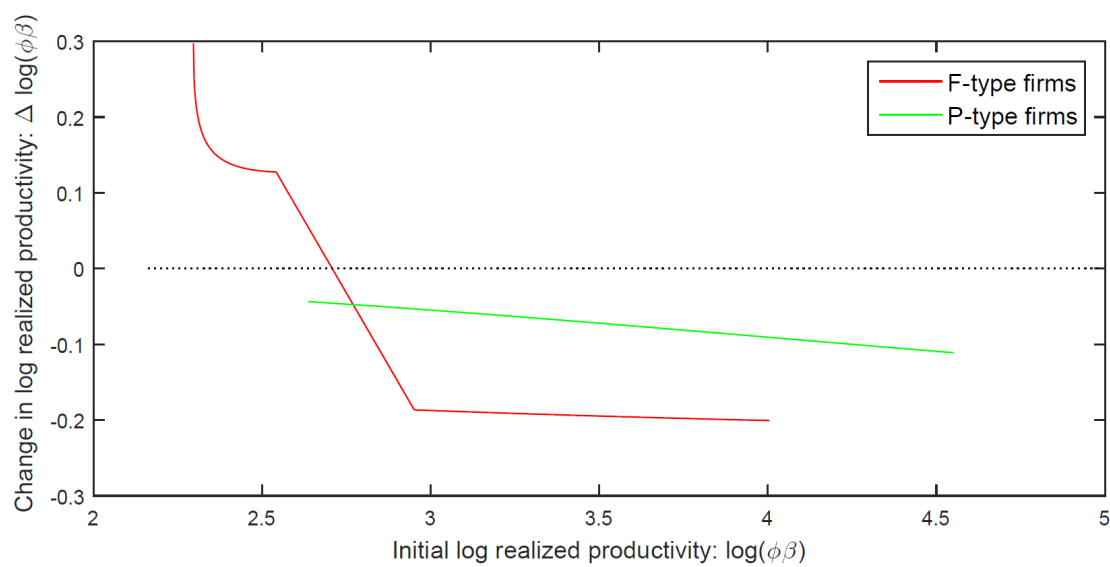
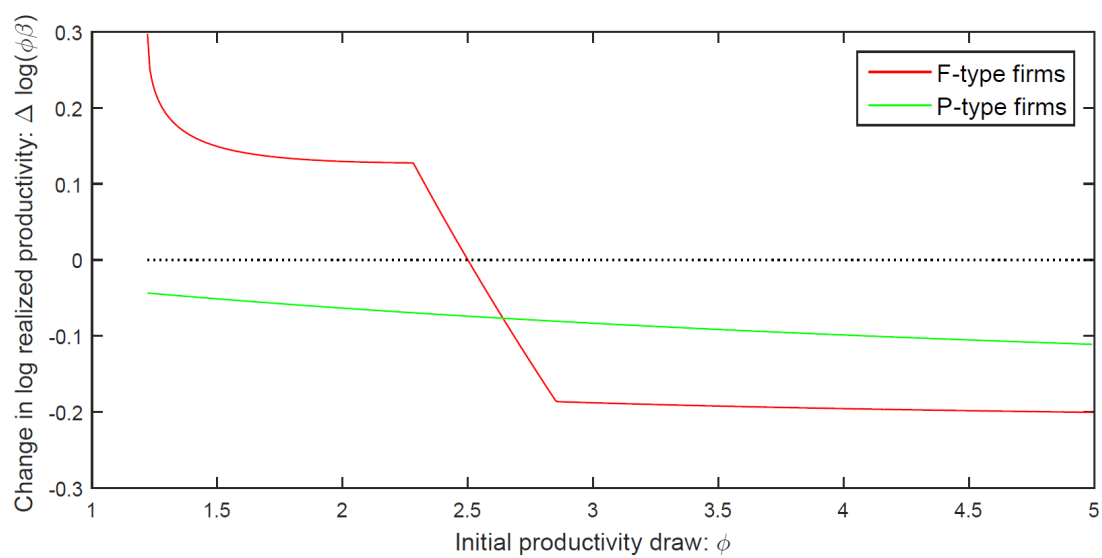
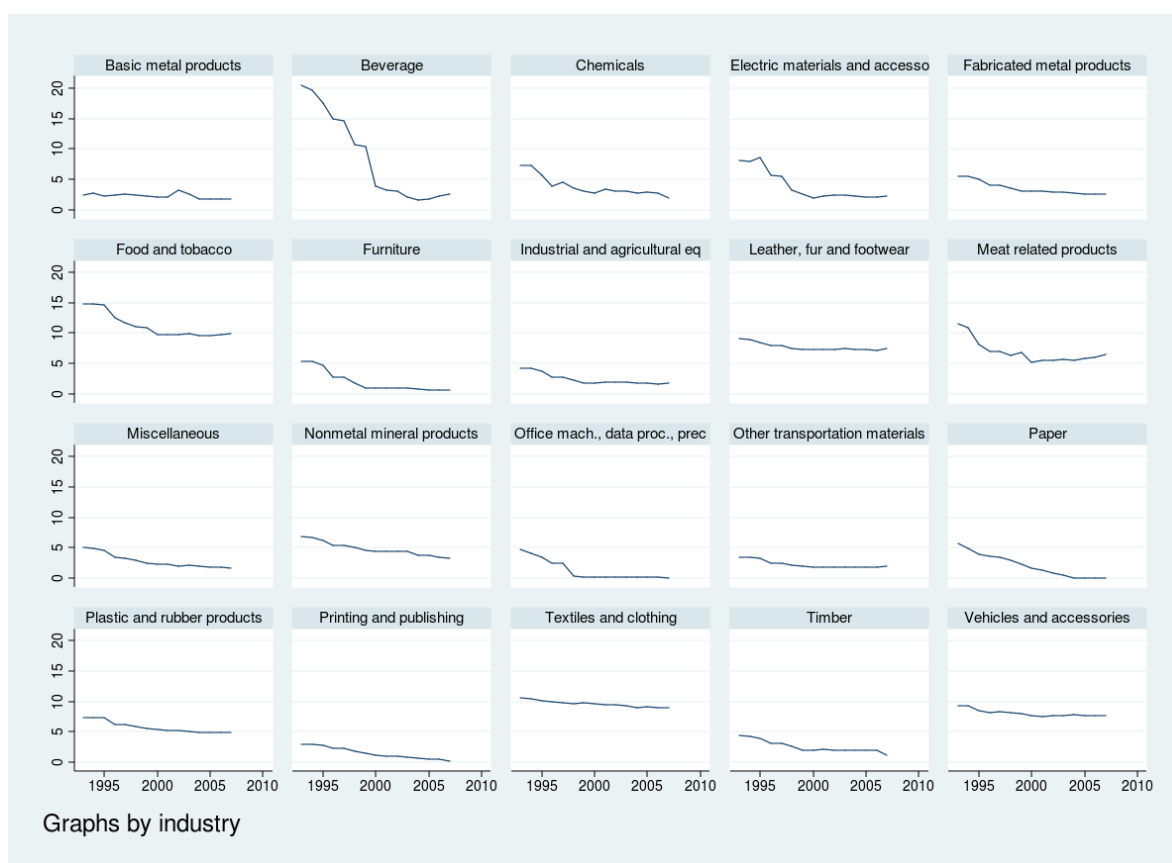


Figure A.4: EU import tariffs over time



Source: TRAINS database (provided by UNCTAD), accessed by World Integrated Trade Solution (WITS), [wits.worldbank.org](https://wits.worldbank.org)



Figure A.5: Log sales distribution of Spanish manufacturing firms, 1994

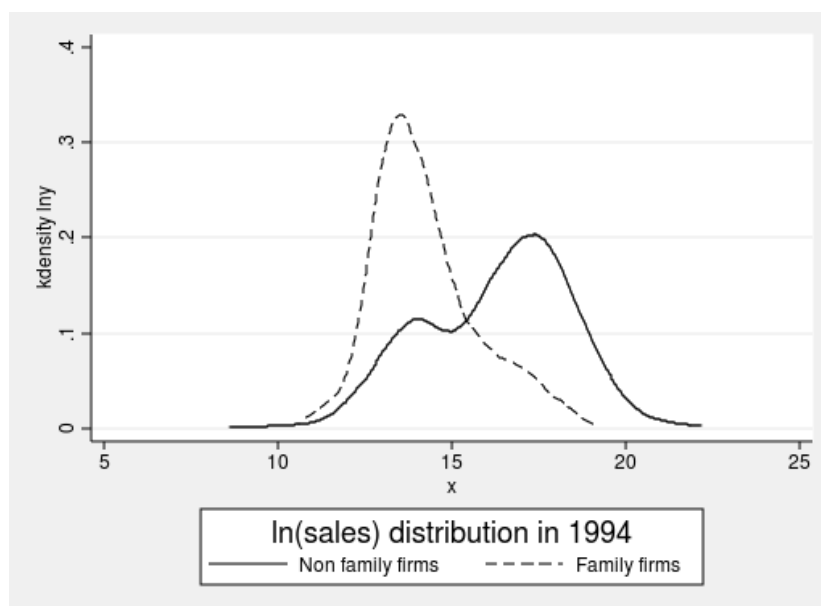
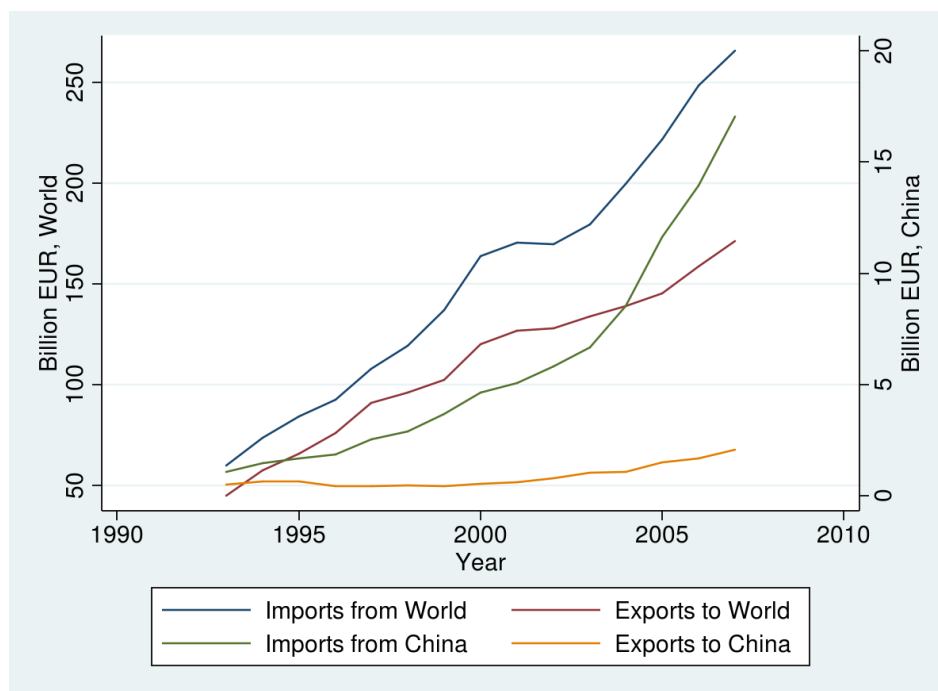


Figure A.6: Spanish trade



Source: United Nations COMTRADE database, accessed by World Integrated Trade Solution (WITS), [wits.worldbank.org](http://wits.worldbank.org)

Figure A.7: TFP distribution after nearest neighbor matching

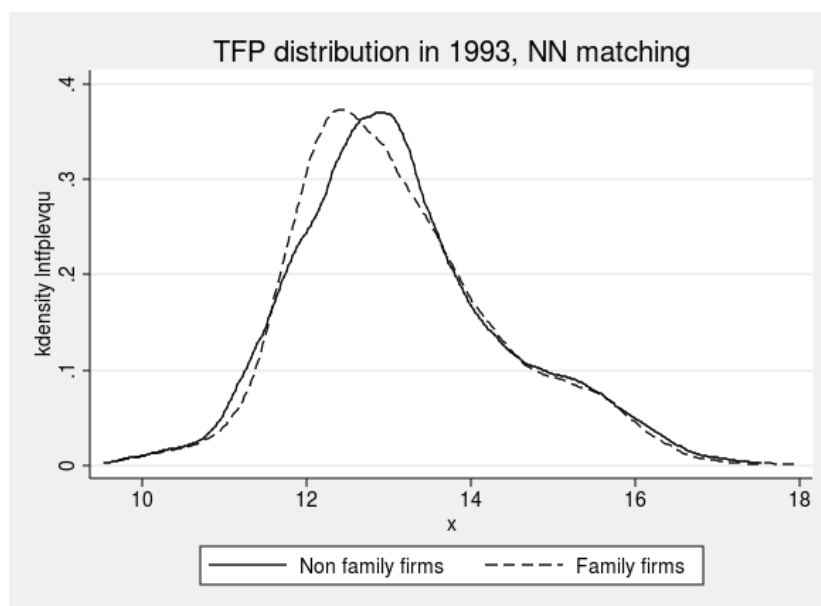


Figure A.8: Effect of import competition: Non-parametric estimation

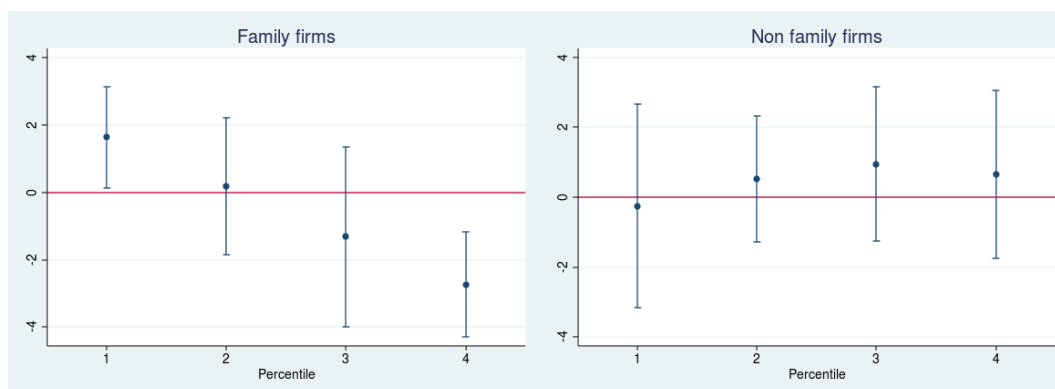


Figure A.9: Effect of import competition - graph

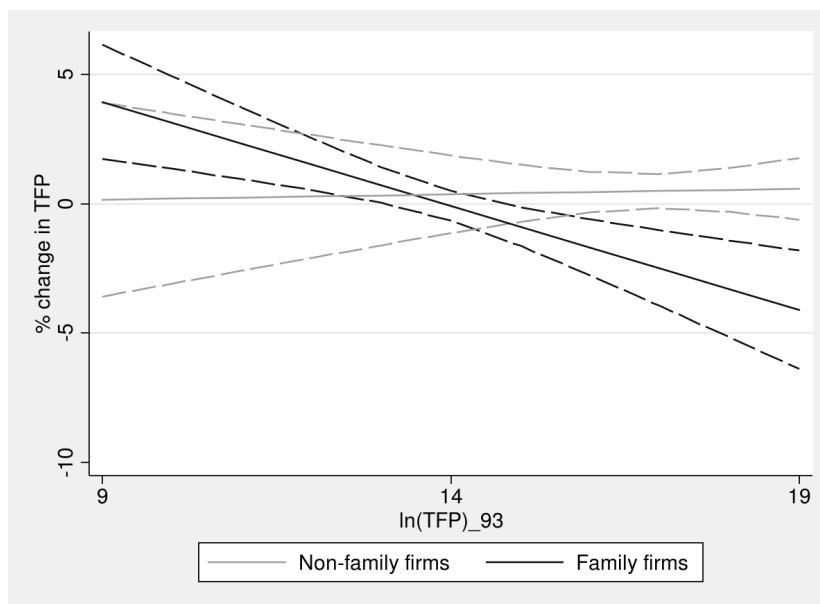


Figure A.10: Exit rate of family firms and non-family firms



## B Tables

Table B.1: Descriptive statistics of Spanish manufacturing firms

	Family firms	Non-family firms	Difference
N (firm-year)	10,092 (41%)	14,651 (59%)	
Sales, million EUR	10.05 (0.30)	100.79 (3.24)	90.74***
Employment	70.21 (1.43)	388.05 (8.02)	317.84***
ln(TFP)	13.51 (0.01)	14.94 (0.01)	1.43***
R&D expenses, thousand EUR	96.79 (7.06)	1424.29 (97.83)	1327.5***

Table B.2: Effect of import competition - separate regressions

	(1) Family firms	(2) Family firms	(3) Family firms	(4) Non-family firms	(5) Non-family firms	(6) Non-family firms
Dep var:	$\Delta TFP_{ist}$	$\Delta TFP_{ist}$	$\Delta TFP_{ist}$	$\Delta TFP_{ist}$	$\Delta TFP_{ist}$	$\Delta TFP_{ist}$
$\Delta IMP_{st}$	0.128 (0.340)	11.397*** (3.742)		0.342 (0.738)	-0.200 (4.968)	
$\Delta IMP_{st} \cdot TFP93_i$		-0.816*** (0.265)	-0.719** (0.311)		0.036 (0.289)	0.102 (0.314)
Observations	6,078	6,078	6,078	7,800	7,800	7,800
Number of firmid	612	612	612	812	812	812
Firm FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes		yes	yes	
Ind*Year FE			yes			yes

Notes: \* p<0.05, \*\* p<0.01, \*\*\* p<0.001. Standard errors in parentheses are clustered by NACECLIO industries.

Table B.3: Effect of import competition - non-parametric regressions

Dep var: $\Delta TFP_{ist}$ Sample:	(1) Family firms	(2) Family firms	(3) Family firms	(4) Family firms	(5) Non-family firms	(6) Non-family firms	(7) Non-family firms	(8) Non-family firms
$\Delta IMP_{st}$	1.676** (0.728)	1.678** (0.791)	1.628** (0.766)	1.469* (0.804)	0.030 (1.308)	0.181 (1.350)	-0.250 (1.489)	0.449 (1.363)
$\Delta IMP_{st} \cdot Perc2$	-2.297** (0.895)	-0.912 (0.922)	0.171 (1.035)	0.668 (1.408)	0.496 (0.993)	0.444 (0.837)	0.518 (0.919)	-1.367 (0.946)
$\Delta IMP_{st} \cdot Perc3$		-2.521*** (0.907)	-1.314 (1.358)	0.265 (1.032)		0.011 (1.077)	0.952 (1.130)	0.803 (1.038)
$\Delta IMP_{st} \cdot Perc4$			-2.731*** (0.798)	-1.861 (1.587)			0.647 (1.224)	0.061 (0.912)
$\Delta IMP_{st} \cdot Perc5$				-2.921*** (1.022)				-0.302 (1.234)
Observations	6,078	6,078	6,078	6,078	7,800	7,800	7,800	7,800
Number of firmid	612	612	612	612	812	812	812	812
Nr of percentiles	2	3	4	5	2	3	4	5
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes	yes

Notes: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ . Standard errors in parentheses are clustered by NACECLIO industries.

Table B.4: Effect of import competition - pooled regression

	(1)	(2)	(3)	(4)	(5)
	$\Delta TFP_{ist}$	$\Delta TFP_{ist}$	$\Delta TFP_{ist}$	$\Delta TFP_{ist}$	$\Delta TFP_{ist}$
$\Delta IMP_{st}$	0.292 (0.461)	3.119 (2.638)	0.369 (0.652)	-0.213 (4.818)	
$\Delta IMP_{st} \cdot TFP93_i$		-0.193 (0.164)		0.042 (0.284)	0.158 (0.283)
$\Delta IMP_{st} \cdot FAM93_i$			-0.208 (0.671)	11.401*** (4.378)	10.532*** (3.681)
$\Delta IMP_{st} \cdot TFP93_i \cdot FAM93_i$				-0.846*** (0.271)	-0.775*** (0.223)
Observations	13,878	13,878	13,878	13,878	13,878
Number of firmid	1,424	1,424	1,424	1,424	1,424
Firm FE	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	
Ind*Year FE					yes

Notes: \* p<0.05, \*\* p<0.01, \*\*\* p<0.001. Standard errors in parentheses are clustered by NACECLIO industries.

Table B.5: Robustness checks - pooled regression

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep var: $\Delta TFP_{ist}$	Baseline	Export controls		Alt. tariff measures		Alt. TFP measures		
Method:	Lev Pet Q	Lev Pet Q	Lev Pet Q	Lev Pet Q	Lev Pet Q	Lev Pet R	FE	Lab prod
$\Delta IMP_{st}$	-0.213 (4.818)	-0.447 (4.783)		1.204 (4.276)	-3.564 (2.797)	-1.167 (3.878)	1.186 (7.140)	-7.754 (7.239)
$\Delta IMP_{st} \cdot TFP93_i$	0.042 (0.284)	0.055 (0.282)	0.165 (0.282)	-0.056 (0.253)	0.221 (0.170)	0.201 (0.432)	-0.023 (0.551)	0.624 (0.468)
$\Delta IMP_{st} \cdot FAM93_i$	11.401*** (4.378)	10.849** (4.429)	9.980*** (3.825)	10.365*** (3.640)	9.163** (4.411)	9.995*** (3.147)	10.765* (5.627)	15.847** (6.329)
$\Delta IMP_{st} \cdot TFP93_i \cdot FAM93_i$	-0.846*** (0.271)	-0.807*** (0.276)	-0.735*** (0.234)	-0.775*** (0.225)	-0.640** (0.297)	-1.305*** (0.420)	-1.000** (0.440)	-1.162*** (0.410)
$\Delta EXP_{st}$		-0.750 (0.831)						
$\Delta EXP_{st} \cdot TFP93_i$		0.046 (0.056)	0.026 (0.055)					
$\Delta EXP_{st} \cdot FAM93_i$		-1.115** (0.518)	-1.204** (0.568)					
$\Delta EXP_{st} \cdot TFP93_i \cdot FAM93_i$		0.078** (0.038)	0.086** (0.042)					
Observations	13,878	13,878	13,878	13,878	13,878	13,896	14,120	12,617
Number of firmid	1,424	1,424	1,424	1,424	1,424	1,427	1,446	1,352
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes		yes	yes	yes	yes	yes
Ind*Year FE			yes					
Tariffs	1993 weights	1993 weights	1993 weights	t-1 weights	only China tariffs	1993 weights	1993 weights	1993 weights

Notes: \* p<0.05, \*\* p<0.01, \*\*\* p<0.001. Standard errors in parentheses are clustered by NACECLIO industries.

Table B.6: Pooled regression - nearest neighbor matching (5 nearest neighbors)

Dep var: $\Delta TFP_{ist}$	(1)	(2)	(3)	(4)	(5)
$\Delta IMP_{st}$	-0.792 (0.703)	-1.243 (1.062)	3.701 (4.678)	-3.383 (6.103)	
$\Delta IMP_{st} \cdot TFP93_i$			-0.328 (0.307)	0.162 (0.394)	0.529 (0.408)
$\Delta IMP_{st} \cdot FAM93_i$		0.968 (1.019)		13.534*** (4.723)	14.299*** (4.339)
$\Delta IMP_{st} \cdot TFP93_i \cdot FAM93_i$				-0.922*** (0.307)	-0.998*** (0.285)
Observations	11,607	11,607	11,607	11,607	11,607
Number of firmid	1,195	1,195	1,195	1,195	1,195
Firm FE	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	
Ind*Year FE					yes

Notes: \* p<0.05, \*\* p<0.01, \*\*\* p<0.001. Standard errors in parentheses are clustered by NACECLIO industries.

Table B.7: Pooled regression - inverse propensity score re-weighting

Dep var: $\Delta TFP_{ist}$	(1)	(2)	(3)	(4)	(5)
$\Delta IMP_{st}$	-0.070 (0.626)	-0.058 (1.054)	5.170 (4.523)	-0.645 (5.890)	
$\Delta IMP_{st} \cdot TFP93_i$			-0.382 (0.300)	0.048 (0.374)	0.330 (0.402)
$\Delta IMP_{st} \cdot FAM93_i$		-0.025 (1.024)		11.248** (4.478)	11.352** (4.655)
$\Delta IMP_{st} \cdot TFP93_i \cdot FAM93_i$				-0.827*** (0.280)	-0.838*** (0.293)
Observations	13,846	13,846	13,846	13,846	13,846
Number of firmid	1,421	1,421	1,421	1,421	1,421
Firm FE	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	
Ind*Year FE					yes

Notes: \* p<0.05, \*\* p<0.01, \*\*\* p<0.001. Standard errors in parentheses are clustered by NACECLIO industries.

Table B.8: Endogenous exits or change in management

	(1)	(2)	(3)
	$\Delta TFP_{ist}$	$\Delta Exit$	$\Delta TFP_{ist}$
$\Delta IMP_{st}$	-0.213 (4.818)	-0.070 (0.536)	-0.312 (4.913)
$\Delta IMP_{st} \cdot TFP93_i$	0.042 (0.284)	0.005 (0.040)	0.043 (0.288)
$\Delta IMP_{st} \cdot FAM93_i$	11.401*** (4.378)	-0.064 (0.535)	15.908** (6.804)
$\Delta IMP_{st} \cdot TFP93_i \cdot FAM93_i$	-0.846*** (0.271)	0.005 (0.040)	-1.204** (0.496)
Observations	13,878	13,231	10,915
Number of firmid	1,424	1,347	1,131
Firm FE	yes	yes	yes
Year FE	yes	yes	yes
Sample			excl fam firm switchers

Notes: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ . Standard errors in parentheses are clustered by NACECLIO industries.

Table B.9: Importing and exporting

	(1)	(2)	(3)	(4)
	$\Delta TFP_{ist}$	$\Delta \ln(exp)_{it}$	$\Delta \ln(imp)_{it}$	$\Delta \ln(imp_{tech})_{it}$
$\Delta IMP_{st}$	-0.213 (4.818)	-27.073 (16.481)	-36.203 (39.268)	3.110 (2.448)
$\Delta IMP_{st} \cdot TFP93_i$	0.042 (0.284)	1.808* (1.057)	2.179 (2.434)	-0.194 (0.196)
$\Delta IMP_{st} \cdot FAM93_i$	11.401*** (4.378)	50.123 (45.036)	58.455 (35.745)	-7.058 (7.589)
$\Delta IMP_{st} \cdot TFP93_i \cdot FAM93_i$	-0.846*** (0.271)	-3.242 (3.077)	-3.516 (2.420)	0.480 (0.597)
Observations	13,878	7,796	7,633	12,565
Number of firmid	1,424	904	906	1,349
Firm FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes

Notes: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ . Standard errors in parentheses are clustered by NACECLIO industries.



Table B.10: Mechanism: Effort-related changes, not changes in (physical) machines

	(1)	(2)	(3)
	<i>Process innovation</i>		
	$\Delta TFP_{ist}$	New machinery dummy	New organizational methods dummy
$\Delta IMP_{st}$	-0.213 (4.818)	-0.506 (8.244)	2.957 (4.344)
$\Delta IMP_{st} \cdot TFP93_i$	0.042 (0.284)	-0.029 (0.576)	-0.211 (0.314)
$\Delta IMP_{st} \cdot FAM93_i$	11.401*** (4.378)	-10.424 (10.917)	16.191** (7.337)
$\Delta IMP_{st} \cdot TFP93_i \cdot FAM93_i$	-0.846*** (0.271)	0.706 (0.786)	-1.224** (0.570)
Observations	13,878	13,596	13,596
Number of firmid	1,424	1,446	1,446
Firm FE	yes	yes	yes
Year FE	yes	yes	yes

Notes: \* p<0.05, \*\* p<0.01, \*\*\* p<0.001. Standard errors in parentheses are clustered by NACECLIO industries.

Table B.11: Mechanism: R&amp;D, patents, and product innovation

	(1)	(2)	(3)	(4)	(5)
	$\Delta TFP_{ist}$	Change in R&D Dummy	<i>R&amp;D and Patents</i> Change in log R&D expenses	Change in the number of patents	<i>Product Innovation</i> Change in product innovation dummy
$\Delta IMP_{st}$	-0.213 (4.818)	-3.025 (3.629)	93.864*** (33.964)	65.330*** (22.187)	-12.368** (6.235)
$\Delta IMP_{st} \cdot TFP93_i$	0.042 (0.284)	0.176 (0.259)	-5.659*** (2.183)	-3.997** (1.557)	0.802** (0.396)
$\Delta IMP_{st} \cdot FAM93_i$	11.401*** (4.378)	7.949 (6.716)	-122.758*** (46.234)	198.896 (189.340)	-7.811 (12.599)
$\Delta IMP_{st} \cdot TFP93_i \cdot FAM93_i$	-0.846*** (0.271)	-0.559 (0.462)	7.784** (3.043)	-15.720 (14.574)	0.775 (0.915)
Observations	13,878	13,972	4,725	14088	23,413
Number of firmid	1,424	1,436	600	1,438	1,693
Firm FE	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes

Notes: \* p<0.05, \*\* p<0.01, \*\*\* p<0.001. Standard errors in parentheses are clustered by NACECLIO industries.

Table B.12: Mechanism: Family management, not family ownership

Dep var: $\Delta TFP_{ist}$ , Method:	(1)	(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Baseline		Export controls		Alt. tariff measures		Alt. TFP measures		Lev Pet Q		Lev Pet R		FE		
	Lev	Pet Q	Lev	Pet Q	Lev	Pet Q	Lev	Pet Q	Lev	Pet Q	Lev	Pet Q	Lev	Pet R	FE
$\Delta IMP_{st}$	-13.518 (13.962)			-14.765 (13.894)				-12.394 (12.705)		-18.811** (7.828)			-12.785 (8.309)		-21.186 (15.203)
$\Delta IMP_{st} \cdot TFP93_i$	0.787 (0.923)	0.858 (0.919)		0.870 (0.918)	0.937 (0.918)			0.740 (0.843)	1.199** (0.534)			1.439 (1.019)		1.621 (1.233)	
$\Delta IMP_{st} \cdot FAM93_i$	26.046* (14.373)	24.033* (12.734)		26.336* (14.277)	24.126* (12.611)			24.675** (12.207)	18.945* (10.779)			21.212*** (6.822)		37.433** (14.980)	
$\Delta IMP_{st} \cdot TFP93_i \cdot FAM93_i$	-1.689* (0.962)	-1.555* (0.859)		-1.707* (0.956)	-1.560* (0.851)			-1.635** (0.818)	-1.281* (0.750)			-2.492*** (0.846)		-3.004** (1.231)	
Observations	4,286	4,286		4,286	4,286			4,286	4,286			4,300		4,324	
Number of firmid	314	314		314	314			314	314			315		315	
Firm FE	yes			yes	yes			yes	yes			yes		yes	
Year FE	yes			yes				yes	yes			yes		yes	
Ind*Year FE		yes			yes										
Export controls				yes	yes										
Tariffs	1993	1993		1993	1993			t-1	only China			1993		1993	
	weights	weights		weights	weights			weights	tariffs			weights		weights	

Notes: \* p<0.05, \*\* p<0.01, \*\*\* p<0.001. Standard errors in parentheses are clustered by NACECLIO industries.

## C Proofs

First of all, since the managerial effort is the only endogenous part of productivity, we only need to show how the managerial effort changes when import tariffs fall (i.e.,  $\eta$  decreases).

### C.1 Proof for Proposition 2

Part one and two are true, since  $\beta_P(\phi; \eta) > \beta_F(\phi; \eta)$  for any  $\phi > \bar{\phi}_P$  and  $\beta_P(\phi; \eta) = \beta_F(\phi; \eta)$  when  $\phi = \bar{\phi}_P$ . Part three is true, since  $\beta_P(\phi; \eta)$  increases in  $\phi$ . Part four is true, since  $\beta_F(\phi; \eta)$  increases in  $\phi$  for  $\phi \geq \bar{\phi}_F$ . For the final part of this proposition, we need to show that  $T(\phi) \equiv \phi[(\eta\phi + a) - \sqrt{(\eta\phi + a)^2 - 2f}]$  decreases first and increases afterwards in  $\phi$  for  $\phi \in [\bar{\phi}_P, \bar{\phi}_F]$ . Differentiation shows that

$$\frac{d[\log(T(\phi))]}{d\phi} = \frac{1}{\phi} + \frac{\beta'_F(\phi)}{\beta_F(\phi)} = \frac{1}{\phi} - \frac{\eta}{\sqrt{(\eta\phi + a)^2 - 2f}}.$$

Therefore,  $dT(\phi)/d\phi > 0$  if and only if

$$\sqrt{(\eta\phi + a)^2 - 2f} > \eta\phi$$

or

$$T_1(\phi) \equiv \sqrt{(\eta\phi + a)^2 - 2f} - \eta\phi > 0.$$

Since  $T_1(\phi)$  increases in  $\phi$ , we have  $dT(\phi)/d\phi < 0$  if and only if

$$\phi_0 > \phi \geq \bar{\phi}_P,$$

where  $\phi_0 \equiv \frac{2f-a^2}{2\eta a}$  and  $dT(\phi)/d\phi \geq 0$  if and only if

$$\bar{\phi}_F \geq \phi \geq \phi_0.$$

Note that  $\phi_0$  approaches  $\bar{\phi}_P$  when  $a^2$  approaches  $2f$ . As a result, the interval in which  $\beta_F(\phi)\phi$  decreases in  $\phi$  shrinks to zero when  $a^2$  approaches  $2f$ .

### C.2 Proof for Proposition 3

For the least productive (surviving)  $F$ -type firms, we have two cases to consider. If  $\frac{\eta_{after}}{\eta_{before}} > \frac{(2f)^{\frac{1}{2}} - a}{(2f + d_F^2)^{\frac{1}{2}} - a}$ , then  $\bar{\phi}_F(\eta_{before}) > \bar{\phi}_P(\eta_{after})$ . For  $\phi \in [\bar{\phi}_F(\eta_{before}), \bar{\phi}_P(\eta_{after})]$ , the effort choice of  $F$ -type manager is dictated by equation (2.6) both before and after the reduction in import

tariffs (i.e., the constrained manager), and

$$\frac{d\beta_F(\phi; \eta)}{d\eta} = \phi \left[ 1 - \frac{C(\phi, \eta)}{\sqrt{C^2(\phi, \eta) - 2f}} \right] < 0,$$

where  $C(\phi, \eta) \equiv \eta\phi + a$ . Therefore, the least productive surviving  $F$ -type firms improve productivity. Next, if  $\frac{(2f)^{\frac{1}{2}} - a}{(2f + d_F^2)^{\frac{1}{2}} - a} \geq \frac{\eta_{after}}{\eta_{before}} > \frac{(2f)^{\frac{1}{2}} - a}{(2f)^{\frac{1}{2}} + d_F - a}$ , we have  $\bar{\phi}_F(\eta_{before}) \leq \bar{\phi}_P(\eta_{after})$ . For an  $F$ -type firm with the productivity draw of  $\bar{\phi}_P(\eta_{after})$ , its manager's effort level is  $\sqrt{2f}$  after the reduction in import tariffs. Before the reduction, the manager's effort level is

$$\beta_F(\bar{\phi}_P(\eta_{after}), \eta_{before}) = [(2f)^{\frac{1}{2}} - a] \frac{\eta_{before}}{\eta_{after}} + a - d_F < \sqrt{2f} = \beta_F(\bar{\phi}_P(\eta_{after}), \eta_{after}),$$

which is implied by Assumption 4. Since the change in the managerial effort and realized productivity is continuous in  $\phi$ , it must be true that the least productive surviving  $F$ -type firms improve productivity in both cases.

For the most productive (surviving)  $F$ -type firms, equation (2.5) indicates that  $\bar{\phi}_{F,before} < \bar{\phi}_{F,after}$ . When the initial productivity draw is above  $\bar{\phi}_{F,after}$  (i.e., the most productive surviving  $F$ -type firms),  $F$ -type managers are unconstrained both before and after the reduction in import tariffs. Therefore, their effort is determined by equation (2.5). Since  $\frac{d\beta_F(\phi; \eta)}{d\eta} = \phi > 0$  for these  $F$ -type managers, their effort and their firms' productivity go down when import competition increases.

#### C.4 Proof for Proposition 4

First, conditional on the initial productivity (or log productivity), the least productive (surviving)  $F$ -type firms increase log productivity relative to the least productive (surviving)  $P$ -type firms, since the former firms and the latter firms increase and decrease productivity (and managerial effort) under stiffer import competition respectively.

Second, both  $F$ -type firms and  $P$ -type firms decrease productivity (and managerial effort) when their initial productivity draw is above  $\bar{\phi}_{F,after}$ . For  $\phi > \bar{\phi}_{F,after}$ , if a  $F$ -type firm has the same productivity (or log productivity) as a  $P$ -type firm, it must be the case that  $\phi_1 > \phi_2 > \bar{\phi}_{F,after}$ , where  $\phi_1$  and  $\phi_2$  are the  $F$ -type firm's and the  $P$ -type firm's initial productivity draws respectively. This is because  $F$ -type firms always have lower realized productivity, conditioning on the initial productivity draw. For a  $P$ -type firm:

$$\begin{aligned}
& \log(\beta_P(\phi_2)\phi_2)_{after} - \log(\beta_P(\phi_2)\phi_2)_{before} \\
&= \log(\beta_P(\phi_2; \eta_{after})) - \log(\beta_P(\phi_2; \eta_{before})) = \log \left[ \frac{\eta_{after}\phi_2 + a}{\eta_{before}\phi_2 + a} \right] < 0.
\end{aligned}$$

For a  $F$ -type firm:

$$\begin{aligned}
& \log(\beta_F(\phi_1)\phi_1)_{after} - \log(\beta_F(\phi_1)\phi_1)_{before} = \log(\beta_F(\phi_1; \eta_{after})) - \log(\beta_F(\phi_1; \eta_{before})) \\
&= \log \left[ \frac{\eta_{after}\phi_1 + a - d_F}{\eta_{before}\phi_1 + a - d_F} \right] < \log \left[ \frac{\eta_{after}\phi_1 + a}{\eta_{before}\phi_1 + a} \right] < \log \left[ \frac{\eta_{after}\phi_2 + a}{\eta_{before}\phi_2 + a} \right],
\end{aligned}$$

since  $\phi_1 > \phi_2$  and  $\eta_{after} < \eta_{before}$ . Therefore, conditional on the initial productivity (or the initial productivity draw), the most productive (surviving)  $F$ -type firms decrease log productivity more than the most productive (surviving)  $P$ -type firms.

### C.5 Proof for Proposition 5

The change in average productivity (or log productivity) is ambiguous for  $F$ -type firms, since some of them increase productivity while the others decrease productivity. In the model presented in the main text, all  $P$ -type firms decrease productivity when import competition increases, since  $\frac{d\beta_P(\phi; \eta)}{d\eta} = \phi > 0$ . However, in Appendix E, in which  $P$ -type managers also care about the private benefits, the least productive  $P$ -type firms increase productivity when import competition increases. In short, the change in average productivity of  $P$ -type firms is indeterminate in the general case as well. Finally, since the least productive  $F$ -type firms (and the most productive  $F$ -type firms) increase (and decrease) log productivity relative to the least productive  $P$ -type firms (and the most productive  $P$ -type firms), we do not know how the average log productivity of  $F$ -type firms changes compared with  $P$ -type firms.

## D Discussion of productivity distributions

Other than Proposition 2, the model generates an even more refined prediction for the productivity distribution of  $F$ -type firms and  $P$ -type firms:

**Proposition 6.** *The distribution of realized productivity of  $F$ -type firms has a thicker tail of firms with extremely low productivity (compared with the distribution of  $P$ -type firms) since there are more constrained firms among  $F$ -type firms.*

*Proof.* When  $\bar{\phi}_F \geq \phi \geq \bar{\phi}_P$ ,  $\beta_F(\phi)\phi$  increases slower than (or even decreases in)  $\phi$  since  $\beta_F(\phi)$  decreases with  $\phi$  when  $\phi$  falls into this range. When  $\phi \geq \bar{\phi}_F$ ,  $\beta_F(\phi)\phi$  increases faster than  $\phi$ , since  $\beta_F(\phi)$  increases with  $\phi$  when  $\phi$  falls into this range. For  $P$ -type firms,  $\beta_P(\phi)\phi$  always increases faster than  $\phi$ . Therefore, the distribution of realized productivity of  $F$ -type firms has a thicker tail of firms with extremely low productivity compared with  $P$ -type firms.  $\square$

The above additional prediction can be used to rationalize the major finding in Hsieh and Klenow (2009) if we treat  $F$ -type firms and  $P$ -type firms as family firms and non-family firms respectively. As the managerial effort decreases with the initial productivity draw when managers are constrained, realized productivity increases slower with the initial draw when firms have the low initial productivity draws. As a result, realized productivity barely varies among firms with constrained managers, and these firms are the least productive ones among active firms. Since there are more such firms among family firms, the distribution of realized productivity (and firm size) for family firms has not only a smaller mean, but also a thicker left tail of extremely unproductive firms. One key finding from Hsieh and Klenow (2009) is that, compared with the US, the productivity distribution of firms in India and China has not only a smaller mean, but also a thicker left tail of extremely unproductive firms. Since there are probably more family firms in developing countries, our model can be used to explain this finding.

The change in average productivity (or log productivity) is ambiguous for  $F$ -type firms (and for  $P$ -type firms), since some of them increase productivity while the others decrease productivity.

## E Private benefits for $P$ -type managers

In this subsection, we consider the case in which both  $F$ -type managers and  $P$ -type managers care about private benefits, although  $P$ -type managers care less about these benefits. We show that our qualitative results are unchanged in this alternative setup. First, the derivation of the optimal effort and realized productivity is the same for  $P$ -type managers as for  $F$ -type managers except that  $P$ -type managers put a smaller weight on the private benefits in their objective function. We define the exit cutoff  $\bar{\phi}_{exit}$  (i.e., the cutoff on  $\phi$  below which both  $F$ -type managers and  $P$ -type managers choose to exit from the firm) and the zero profit cutoffs  $\bar{\phi}_g$  (i.e., the cutoff on  $\phi$  above which the firm run by either  $F$ -type managers or  $P$ -type managers earns positive profits) as follows:

$$\bar{\phi}_{exit} = \frac{(2f)^{\frac{1}{2}} - a}{\eta}$$

and

$$\bar{\phi}_g = \frac{(2f + d_g^2)^{\frac{1}{2}} - a}{\eta} \quad \text{with } g \in \{F, P\}.$$

Note that since  $\bar{\phi}_{exit} = \bar{\phi}_P$  in the main text, we do not define the exit cutoff separately in the main text. In order to shorten our proofs in this section, we divide the effort choice function of the manager into two categories:  $\beta_{g,1}(\phi)$  for constrained managers and  $\beta_{g,2}(\phi)$  for unconstrained managers where  $g \in \{F, P\}$ .

**Proposition 7.** *Suppose Assumptions 1 and 3 hold. For  $F$ -type firms with productivity draws above  $\bar{\phi}_F$ , the optimal effort choice is*

$$\beta_F(\phi) = \beta_{F,2}(\phi) \equiv \eta\phi + a - d_F.$$

When  $\phi \in \{\bar{\phi}_{exit}, \bar{\phi}_F\}$ , the optimal effort is

$$\beta_F(\phi) = \beta_{F,1}(\phi) \equiv (\eta\phi + a) - \sqrt{(\eta\phi + a)^2 - 2f}.$$

For  $P$ -type firms with productivity draws above  $\bar{\phi}_P$ , the optimal effort choice is

$$\beta_P(\phi) = \beta_{P,2}(\phi) \equiv \eta\phi + a - d_P.$$

When  $\phi \in \{\bar{\phi}_{exit}, \bar{\phi}_P\}$ , the optimal effort is

$$\beta_P(\phi) = \beta_{P,1}(\phi) \equiv (\eta\phi + a) - \sqrt{(\eta\phi + a)^2 - 2f}.$$

For firms with productivity draws below  $\bar{\phi}_{exit}$ , managers (and firm owners) choose to exit. For  $F$ -

type firms (and  $P$ -type firms), realized productivity decreases in  $\phi$  when  $\phi < \min\{\frac{2f-a^2}{2\eta a}, \bar{\phi}_F\}$  (and  $\phi < \min\{\frac{2f-a^2}{2\eta a}, \bar{\phi}_P\}$ ) and increases in  $\phi$  afterwards.

*Proof.* We have proved this proposition for  $F$ -type managers in the main text. Since  $P$ -type managers care about both firm profit and the private benefits now, the derivation for them follows exactly the same logic as for  $F$ -type managers.  $\square$

For the three empirical predictions stated in the main text, Propositions 3 and 5 can be proved using the same approaches as in Appendix C. Now, we prove Proposition 4.

### E.1 Proof for Proposition 4

First of all, the proof for the comparison between the most productive  $F$ -type firms and the most productive  $P$ -type firms (i.e., firms with  $\phi > \bar{\phi}_{F,after}(> \bar{\phi}_{P,after})$ ) is the same as in Appendix C, as they are unconstrained managers in the current setup as well. For the least productive surviving managers, we want to show that  $F$ -type firms with the productivity draw of  $\bar{\phi}_{exit,after}$  increase log productivity more than  $P$ -type firms with the productivity draw of  $\bar{\phi}_{exit,after}$ . There are three cases to consider in total:

- Case one:  $\bar{\phi}_{exit,after} \leq \bar{\phi}_{P,before}$ :

$$\begin{aligned} \beta_{P,after}(\bar{\phi}_{exit,after}) - \beta_{P,before}(\bar{\phi}_{exit,after}) &= \beta_{P,1}(\bar{\phi}_{exit,after}, \eta_{after}) - \beta_{P,1}(\bar{\phi}_{exit,after}, \eta_{before}) \\ &= \beta_{F,1}(\bar{\phi}_{exit,after}, \eta_{after}) - \beta_{F,1}(\bar{\phi}_{exit,after}, \eta_{before}) = \beta_{F,after}(\bar{\phi}_{exit,after}) - \beta_{F,before}(\bar{\phi}_{exit,after}). \end{aligned}$$

- Case two:  $\bar{\phi}_{F,before} \geq \bar{\phi}_{exit,after} > \bar{\phi}_{P,before}$ :

$$\begin{aligned} \beta_{P,after}(\bar{\phi}_{exit,after}) - \beta_{P,before}(\bar{\phi}_{exit,after}) &= \beta_{P,1}(\bar{\phi}_{exit,after}, \eta_{after}) - \beta_{P,2}(\bar{\phi}_{exit,after}, \eta_{before}). \\ \beta_{F,after}(\bar{\phi}_{exit,after}) - \beta_{F,before}(\bar{\phi}_{exit,after}) &= \beta_{F,1}(\bar{\phi}_{exit,after}, \eta_{after}) - \beta_{F,1}(\bar{\phi}_{exit,after}, \eta_{before}). \end{aligned}$$

We know

$$\beta_{F,1}(\bar{\phi}_{exit,after}, \eta_{after}) = \beta_{P,1}(\bar{\phi}_{exit,after}, \eta_{after})$$

and

$$\beta_{F,1}(\bar{\phi}_{exit,after}, \eta_{before}) = \beta_{P,1}(\bar{\phi}_{exit,after}, \eta_{before}) < \beta_{P,2}(\bar{\phi}_{exit,after}, \eta_{before})$$

Thus, we must have

$$\beta_{P,after}(\bar{\phi}_{exit,after}) - \beta_{P,before}(\bar{\phi}_{exit,after}) < \beta_{F,after}(\bar{\phi}_{exit,after}) - \beta_{F,before}(\bar{\phi}_{exit,after}).$$



- Case three:  $\bar{\phi}_{exit,after} > \bar{\phi}_{F,before}$ :

$$\beta_{P,after}(\bar{\phi}_{exit,after}) - \beta_{P,before}(\bar{\phi}_{exit,after}) = \beta_{P,1}(\bar{\phi}_{exit,after}, \eta_{after}) - \beta_{P,2}(\bar{\phi}_{exit,after}, \eta_{before}).$$

$$\beta_{F,after}(\bar{\phi}_{exit,after}) - \beta_{F,before}(\bar{\phi}_{exit,after}) = \beta_{F,1}(\bar{\phi}_{exit,after}, \eta_{after}) - \beta_{F,2}(\bar{\phi}_{exit,after}, \eta_{before}).$$

We know

$$\beta_{F,1}(\bar{\phi}_{exit,after}, \eta_{after}) = \beta_{P,1}(\bar{\phi}_{exit,after}, \eta_{after})$$

and

$$\beta_{F,2}(\bar{\phi}_{exit,after}, \eta_{before}) < \beta_{P,2}(\bar{\phi}_{exit,after}, \eta_{before}).$$

Thus, we must have

$$\beta_{P,after}(\bar{\phi}_{exit,after}) - \beta_{P,before}(\bar{\phi}_{exit,after}) < \beta_{F,after}(\bar{\phi}_{exit,after}) - \beta_{F,before}(\bar{\phi}_{exit,after}).$$

In total, we have

$$\beta_{P,after}(\bar{\phi}_{exit,after}) - \beta_{P,before}(\bar{\phi}_{exit,after}) \leq \beta_{F,after}(\bar{\phi}_{exit,after}) - \beta_{F,before}(\bar{\phi}_{exit,after})$$

for all possible cases. Therefore, the least productive  $F$ -type firms increase productivity more than the least productive  $P$ -type firms, when import tariffs go down. Since  $F$ -type firms have (weakly) lower realized productivity, it is also true that the least productive (surviving)  $F$ -type firms increase log productivity (i.e., productivity in percentage terms) more than the least productive (surviving)  $P$ -type firms, when import tariffs go down.

Figures H.1 and H.2 show how the effort choice and log realized productivity change after a reduction in import tariffs.

## F Functional form of the private benefits

In this subsection, we show that our theoretical results continue to hold when the cost function of exerting effort is convex (as opposed to a linear function in the main text). Specifically, we consider that the effort cost takes the following form of  $\frac{\beta^2}{2}$ . The objective function of the manager now becomes

$$U = \begin{cases} \alpha_g \left[ \eta \phi \beta - (f - a\beta + \frac{1}{2}\beta^2) \right] - \frac{d_g}{2} \beta^2 & \text{if firm exists} \\ 0 & \text{if firm exits,} \end{cases}$$

where  $d_g > 0$  for  $g \in \{F, P\}$ . First, we still normalize  $\alpha_g = 1$ . As a result, the solution for the optimal effort is

$$\beta_g(\phi) = \frac{\eta\phi + a}{1 + d_g}, \quad (\text{F.1})$$

where  $d_g$  is assumed to be bigger than one (i.e., managers care also about private benefits and cost), if the zero profit condition does not bind. Next, the zero profit cutoff is calculated as

$$\bar{\phi}_g = \frac{\sqrt{\frac{f(1+d_g)^2}{\frac{1}{2}+d_g}} - a}{\eta} \text{ with } g \in \{F, P\}.$$

Note that the first-best level of effort (i.e., the one maximizing firm profits) is

$$\beta_{FB}(\phi) = \eta\phi + a. \quad (\text{F.2})$$

Third, we still assume that the outside option for the manager is small enough such that the manager with the initial draw of  $\bar{\phi}_{exit} \equiv \frac{(2f)^{\frac{1}{2}} - A}{\eta}$  strictly prefers working as a manager. Finally, similar to Assumption 4, we still assume that the increase in market competitiveness is not too big across two adjacent years. Based on these assumptions, we show that our theoretical results derived in the main text continue to hold. Similar to Section E, we divide the effort choice function of the manager into two categories as well:  $\beta_{g,1}(\phi)$  for constrained managers and  $\beta_{g,2}(\phi)$  for unconstrained managers where  $g \in \{F, P\}$ .

**Proposition 8.** *Suppose Assumptions 2 and 3 hold. For F-type firms with productivity draws above  $\bar{\phi}_F(> \bar{\phi}_{exit})$ , the optimal effort choice is*

$$\beta_F(\phi) = \beta_{F,2}(\phi) \equiv \frac{\eta\phi + a}{1 + d_F}.$$

When  $\phi \in [\bar{\phi}_{exit}, \bar{\phi}_F]$ , the optimal effort is

$$\beta_F(\phi) = \beta_{F,1}(\phi) \equiv (\eta\phi + a) - \sqrt{(\eta\phi + a)^2 - 2f}.$$

For P-type firms with productivity draws above  $\bar{\phi}_P(> \bar{\phi}_{exit})$ , the optimal effort choice is

$$\beta_P(\phi) = \beta_{P,2}(\phi) \equiv \frac{\eta\phi + a}{1 + d_P}.$$

When  $\phi \in [\bar{\phi}_{exit}, \bar{\phi}_P]$ , the optimal effort is

$$\beta_P(\phi) = \beta_{P,1}(\phi) \equiv (\eta\phi + a) - \sqrt{(\eta\phi + a)^2 - 2f}.$$

For managers and firms with the initial draws below  $\bar{\phi}_{exit}$ , both of them choose to exit. For both F-type

managers and  $P$ -type managers, the managerial effort decreases first and increases afterwards with  $\phi$  (i.e., it is “U”-shaped).

*Proof.* The proof is the same as the proof for Proposition 1.  $\square$

**Proposition 9.** *Conditional on the initial productivity draw,  $P$ -type firms have higher managerial effort and realized productivity:*

$$\beta_F(\phi) < \beta_P(\phi); \quad \phi\beta_F(\phi) < \phi\beta_P(\phi).$$

*Second,  $P$ -type firms have higher average realized productivity and managerial effort compared with  $F$ -type firms in equilibrium. Third,  $\beta_{g2}(\phi)\phi$  increases in  $\phi$  for  $\phi \geq \bar{\phi}_g$  where  $g \in \{F, P\}$ . Finally,  $\beta_{g1}(\phi)\phi$  decreases first and increases afterwards in  $\phi$  where  $g \in \{F, P\}$ . In particular, when  $a^2$  approaches  $2f$ , the interval in which  $\beta_{g1}(\phi)\phi$  decreases in  $\phi$  shrinks to zero.*

*Proof.* The proof is the same as the proof for Proposition 2.  $\square$

**Proposition 10.** *After import competition increases, the least productive surviving  $F$ -type firms improve log productivity, and the most productive surviving  $F$ -type firms decrease log productivity.*

*Proof.* The proof is the same as the proof for Proposition 3.  $\square$

**Proposition 11.** *After import competition increases, the increase in log productivity is larger for the least productive  $F$ -type firms than for the least productive  $P$ -type firms, and the reduction in log productivity is also larger for the most productive  $F$ -type firms than for the most productive  $P$ -type firms.*

*Proof.* For the least productive surviving firms, the proof follows from Appendix E. For firms with the productivity draw above  $\bar{\phi}_{F,after}$  (i.e., the most productive surviving firms), the change in log realized productivity is

$$\log(\beta_{after}(\phi)\phi) - \log(\beta_{before}(\phi)\phi) = \log \left[ \frac{\eta_{after}\phi + a}{\eta_{before}\phi + a} \right].$$

If an  $F$ -type firm and an  $P$ -type firm have the same initial (log) productivity, the  $F$ -type one must have a bigger  $\phi$ . This directly implies that the decrease in log productivity is bigger for the  $F$ -type firm than for the  $P$ -type firm.  $\square$

**Proposition 12.** *After import competition increases, average productivity of  $F$ -type firms can either increase or decrease. The change in average productivity of  $P$ -type firms is also indeterminate in the general case where  $P$ -type managers care about the private benefits as well.*

*Proof.* The change in average productivity (or log productivity) is ambiguous for  $F$ -type firms (and for  $P$ -type firms), since some of them increase productivity while the others decrease productivity.  $\square$

Finally, note that after import competition increases, the exit rate is same for  $F$ -type firms as for  $P$ -type firms, as the exit cutoff is the same for  $F$ -type firms as for  $P$ -type firms.

## G Discussion of the assumption on private benefits

In this subsection, we argue that our theoretical results do not crucially depend on the assumption about  $\bar{U}$ . We assume that  $d_F > d_P > 0$  and make the following assumption to ensure that there are both constrained and unconstrained managers at least among  $F$ -type managers in equilibrium:

$$\bar{U} \geq (2f + d_F^2)^{\frac{1}{2}} - d_F.$$

We argue that as long as the above inequality is satisfied, all our results go through. First, since we still have both constrained and unconstrained managers at least among  $F$ -type managers, the previous results on the optimal managerial effort and realized productivity are unchanged. Second, after import tariffs go down, the least productive surviving  $F$ -type firms improve productivity since the constrained managers still have to exert more effort in order to make their firms exactly break even. Third, after import tariffs go down, the most productive surviving  $F$ -type firms decrease productivity since the marginal returns to effort decreases for unconstrained  $F$ -type managers. The ambiguous results on the change of average productivity still holds, as long as there are two types of managers (i.e., the constrained ones and the unconstrained ones) in equilibrium. Finally, (conditional on the initial productivity) results on the comparison between  $F$ -type firms and  $P$ -type firms are unchanged, since the value of  $\bar{U}$  only affects results related to the extensive margin. In total, our theoretical results do not hinge on the assumption of  $\bar{U}$  stated in the main text of the paper.

## H Figures for Appendix

Figure H.1: Effect of increased import competition on effort and realized productivity

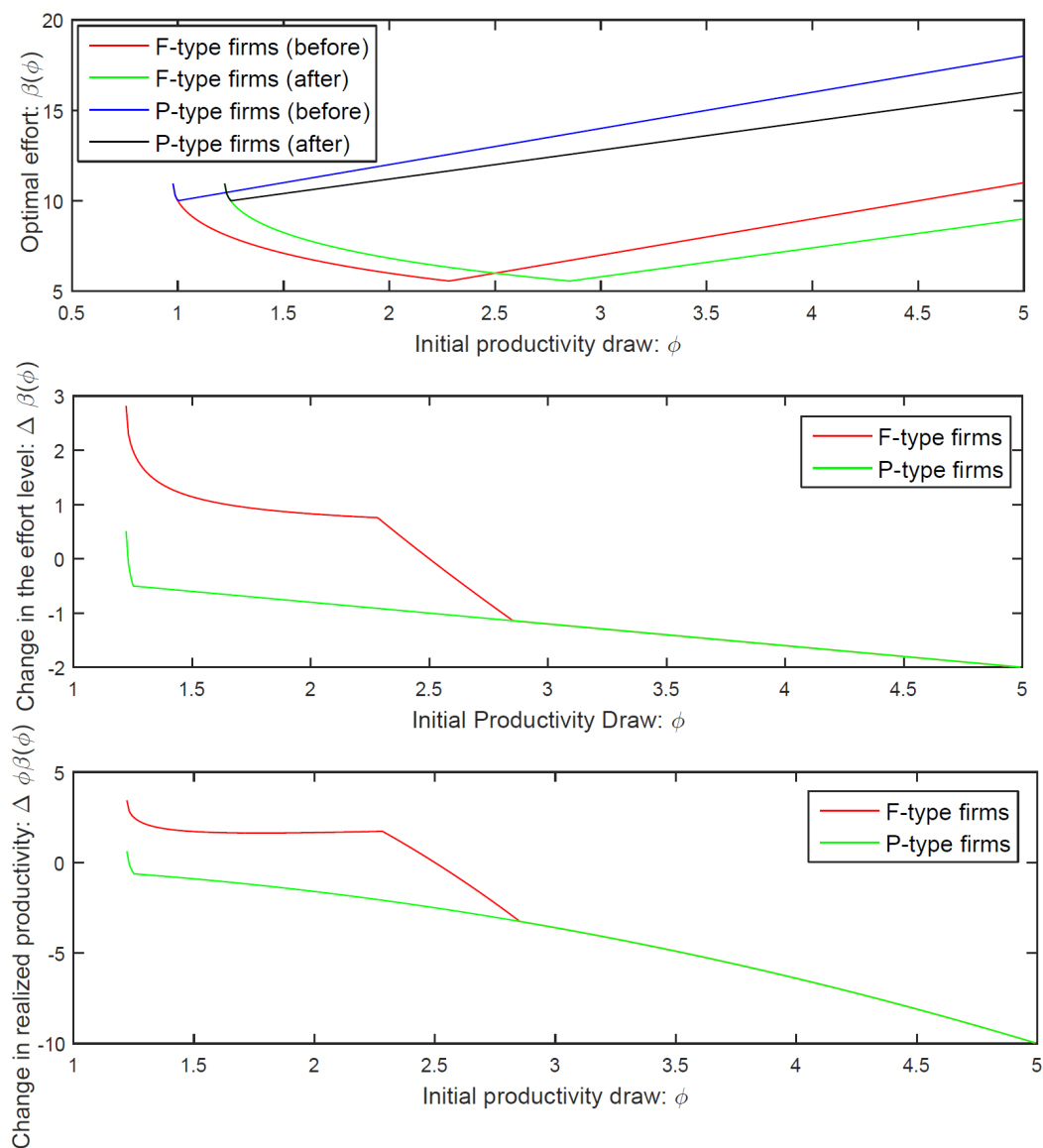


Figure H.2: Effect of increased import competition on log realized productivity

