Trade, Regulation and Firm-Level Productivity in the OECD

Sarra Ben Yahmed* Sean Dougherty†

March 2011‡

Abstract

This paper examines how trade and regulation affect firm-level productivity outcomes, acting through international and domestic channels to influence the intensity of competition. The analysis looks across a large number of OECD countries and, taking account of industry-level market structure, uses import penetration and *de jure* product market regulation measures as proxies for international and domestic competitive pressures. Firm-productivity is measured using an index based on production function estimates from the Levinshon and Petrin (2003) approach.

Heterogeneous effects of international competition and domestic product market regulation on firm-level productivity growth are observed, consistent with a neo-Schumpeterian view of trade and regulation. Close to the technology frontier, import competition has a strongly positive effect on firm-level productivity growth, with stringent domestic regulation reducing this effect substantially. However, far from the frontier, neither import competition nor its interaction with domestic regulation has a statistically significant effect on firm-level productivity.

Keywords: Firm productivity growth, behind-the-border regulatory barriers, product market regulation, import competition, international trade.

JEL Classification Numbers: F1, K2, L2, L5, O1

*GREQAM, Université de la Méditerranée, e-mail:*sarra.ben-yahmed@univmed.fr*

†OECD Economics Department and the Paris School of Economics (Centre d'Economie de la Sorbonne–Paris 1), e-mail: *sean.dougherty@oecd.org*

‡Early work-in-progress, not for citation. Useful feedback was received in seminars at DEFI (Aix-en-Provence), the OECD Economics Department, and the Paris School of Economics. The authors would also like to thank Philippe Aghion, Jens Arnold, Andrea Bassanini, Romain Duval, Lionel Fontagné, Giuseppe Nicoletti, Joaquim Oliveira-Martins and Cyrille Schwellnus for useful suggestions. This paper was written under the personal capacity of the authors and does not necessarily reflect the views of the OECD nor its member countries.

1 Introduction

Globalisation has dramatically reduced explicit barriers to international trade in OECD as well as non-OECD countries over recent decades. These barriers have fallen far enough in manufacturing that they likely no longer represent a major obstacle to goods exporting and importing (Bouët et al., 2008). Institutional limits on protection that prevent countries from raising tariffs even in times of economic crisis have so far proven effective in preventing a bout of defensive, or retaliatory, anti-trade measures, even in the context of the panic-inducing Great Recession that we have just experienced (Conway et al., 2010).

Nevertheless, behind-the-border regulation still remains stringent in many economies (OECD, 2011). This stringent regulation of product markets obstructs firm entry, operation, and exit, limiting competition and potentially harming productivity. In many European countries, regulation of labour markets is also stringent in the form of job protection, limiting the flexibility of firms to change the size of their workforce in response to shocks, further obstructing the competitive process.

However, the mechanisms that cause weak competition to hamper productivity are not fully understood. In their recent review of endogenous growth theory, Philippe Aghion (2009) argues that there is an U-shaped relationship between the degree of competition and productivity, where firms closer to the frontier face stronger incentives to innovate in order to overcome the potential threat of new entrants. Near the frontier, stringent regulation reduces neck-to-neck competition and innovation, harming firm productivity. In contrast, farther from the frontier, Schumpeter (Mark II)-type effects dominate and firms face discouragement, making innovation and productivity growth less likely.

New trade theory offers a somewhat different, though not necessarily incompatible, perspective. Various models, notably Marc Melitz's (2003), posit that heterogeneous firms and fixed trading costs yield entry and exit dynamics that reallocate market shares from low-productivity firms that trade domestically—or exit—to higher productivity firms that compete in international markets. Bernard et al. (2007) show how this process can help strengthen comparative advantage through creative destruction in these industries, though in neither case do the dynamics come about through *intra*-firm productivity dynamics. Melitz and Ottaviano "M-O" (2008) show that intra-firm productivity can be enhanced through increasing toughness of import competition, implying the potential for dynamic gains from policy reform.

This paper takes a differences-in-differences approach that uses the insights from the new trade literature to identify the empirical effects at the firm level of import competition and anti-competitive domestic regulation on productivity, also incorporating distance-to-frontier effects. In so doing, it develops new evidence in support of both sets of theories, suggesting that (i) trade models could be enriched by incorporating a distance-to-frontier and intra-firm productivity dimension, and (ii) distance-to-frontier ideas could be enriched by examining their interactions with trade.

Beyond these general insights, several important findings stand out:

- Stronger competition, in the form of higher import penetration, is associated with higher firm-level productivity growth close to the productivity frontier, an effect which remains robust even when estimated in lags, thought it varies when the smallest firms are over-sampled in the dataset. The main result is consistent with the predictions of the Aghion endogenous growth model as well as the M-O framework, though the latter would not have predicted a differential effect vis-à-vis the technology frontier.

- Close to the technology frontier, anti-competitive product market regulation substantially reduces the scope for TFP improvements, through an interaction with import competition; far from the frontier, the effect is not statistically significant. The expected effect of regulation via competition is consistent with Aghion again, as well as the M-O framework. However, the observation that the effect of product market regulation acts through an interaction with trade is important, as it implies that product market regulation damages productivity at least in part by reducing the competition-enhancing effect of import competition.

- The competition-impinging effect of product market regulation through import competition is robust to the inclusion of controls for the stringency of upstream regulation, a Herfindahl index that captures the market shares concentration across firms, as well as industry fixed effects that capture the invariant industry-specific characteristics such as the intensity of ICT use.

In order to examine these questions, a large-scale firm database (Amadeus) is examined that covers more than half of OECD member countries, which is then re-weighted to be representative of the actual size distribution of firms in the whole population, and matched with regulation and trade datasets. This firm

data is sufficient to allow for the measurement of robust productivity measures that take account of potential simultaneity biases. Unique OECD indexes of product market regulation are used to measure *de jure* regulatory settings, at the country level and across time. International trade data are matched with production data, to generate measures of import penetration at the detailed industry level.

Previous evidence on the effect of domestic regulation on productivity has examined various channels, though few have examined trade. A number of empirical studies, particularly those of the OECD (2003, 2006), have found distortionary effects of indicators of product and labour market regulation on overall productivity outcomes. For instance, Arnold et al. (2010) look at the effect of product market regulation at the firm level, through the ICT channel, and find supportive evidence of distance-to-frontier effects. At the industry level, Bourlès et al. (2010) look at the effect of upstream product market regulation on sector-level productivity, and they also find distance-to-frontier effects. Earlier evidence from Nicoletti and Scarpetta (2003) found gains from reform, though the distance-to-frontier effects were the reverse.

A broader set of empirical work has used rougher indicators of institutional and policy settings in examining the role of institutions more generally in mediating the role of trade in affecting overall growth and productivity outcomes. Cross-country studies include Dollar and Kraay (2003), Rodrick et al. (2004), Alcalá and Ciccone (2004), and Freund and Bolaky (2008), who have tried to disentangle the respective roles of institutions and trade for growth. On balance, the evidence appears to suggest that institutions have a more fundamental role, as they complement trade liberalisation, and strengthen the long term effects of trade on growth, by enhancing the role of comparative advantage. However, the types of policies and reforms that may drive productivity in this context are still not clear from this literature[1].

Research at the level of the firm seems more promising to reveal the underlying mechanics of how policies may work through trade to affect productivity and growth outcomes. Firm-level analysis has revealed a substantial role for product market regulation and employment protection legislation in affecting

[1]One promising approach from a related literature uses incomplete contract theory to examine the effect of overall institutional quality on the organization of trade. Studies following this approach include Acemoglu, Antràs and Helpman (2007), which finds an important role of contracting institutions leading to strengthened comparative advantage.

the margins of job creation and destruction, firm exit and entry, as well as reallocation of productivity across firms (e.g. Bartlesman et al., 2009). However, this work does not explicitly consider how international trade may drive and/or reinforce these margins[2].

There have been a series of country-specific firm-level case studies that have identified substantial roles for trade regulation specifically in affecting the firm entry/exit and reallocative margins, for Chile (Pavnick, 2002), Columbia (Fernandez, 2007), India (Topalova, 2004; Goldberg et al., 2010), and Indonesia (Amiti and Konings, 2007). This work suggests that examining the effects of entry/exit and foreign competition is central to understanding firm-level productivity, yet (again) they do not address behind-the-border regulation.

The paper proceeds as follows. The second section describes the data and sampling frame, the construction of productivity measures, and the import penetration and domestic regulation measures. The third section motivates the empirical approach, and examines the effects of import penetration and domestic regulation on firm-level productivity growth. The fourth section concludes.

2 Data and measurement

In order to investigate the questions raised above, firm-level data are used to compute productivity measures, sectoral trade data are used to measure foreign competition, and restrictive regulation is measured using the OECD's economy-wide indexes of product market regulation.

2.1 Firm-level data: Amadeus

Firm level data are used based on company reports included in the Amadeus database compiled by the Bureau van Dijk. This database covers European OECD countries over the time period 1995–2005. Countries covered are Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Ireland, Luxembourg, Nederland, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden and the United Kingdom. The data for Ireland and Greece are not used since the former have very few reporting firms, while the latter lack wage and materials data. While all the countries included are OECD

[2]Fewer studies that make use of firm data have looked at behind-the-border regulation head-on. One exception is Cuñat and Melitz (2010), who examine the role of labour market flexibility as a source of comparative advantage in volatile industries using detailed trade data with U.S. firm-level job turnover.

members, the former transition economies of Central and Eastern Europe are likely to have a wider dispersion of productivity across than the other countries as a result of their one-time structural transitions.

Data are cleaned for outliers using several approaches. First, firms with negative values for any variable entering the production function – operating revenue or value added, wages, capital stock, material inputs – or with depreciation higher than net capital stock are eliminated from the sample. Firms that report extreme year-to-year variation in ratios between production function variables and extreme reversals in one of these variables are not retained, either. Finally, outliers have been removed by eliminating the top and bottom one percent of the productivity distribution and subsequently re-estimating productivity without these extreme observations. The productivity estimation is described in more detail below.

Sectoral coverage includes all tradable goods and services, including mining, all of manufacturing (ISIC 15 to 37), electricity, utilities (ISIC 40, 51, 52), transport and communications (ISIC 60 to 64), business activities as R&D, advertising (ISIC 71 to 74) and recreational and cultural activities (ISIC 92). Consolidated accounts in the Amadeus dataset are dropped, which avoids problems of double-counting.

2.2 Sampling frame

The Amadeus data are broadly representative of the business sectors of OECD countries, since they include virtually all public companies, and is a fair representation of larger companies. However, smaller firms are underrepresented, since they typically do not report balance sheet information publicly. In addition, not all firms in the Amadeus data report information on all production function variables. The remaining sample used in this study includes only firms for which TFP estimates could be obtained.

In order to ensure that the sample of firms is as representative as possible of the population distribution of firms across size classes, sectors and countries, a re-sampling procedure was applied (see Schwellnus and Arnold, 2008). First, population weights for every size-sector-country strata were calculated from the OECD Structural Business Statistics database for the year 2000. Second, random draws with replacement from each size-sector-country strata in the TFP sample were taken until the weight of each strata corresponds to its population

weight.[3]

This method resulted in a sample that is representative of the population distribution along the dimensions employment size, sector and country. The sample size is then set to 139 065 firms (drawn from a set of 79 513 real firms) which results in 831 187 firm-year observations. While this method yields a more representative sample in the year 2000, it may also increase measurement error since smaller firms are over-sampled, and such firms have higher rates of entry and exit in the dataset. The resampled dataset may thus be less representative as the time period shifts away from the year 2000. Thus, both the non-resampled and the resampled data are considered to ensure robustness.

2.3 Estimation of Total Factor Productivity

Our productivity variable, total factor productivity (TFP), measures the firm-level efficiency in the use of all inputs. We calculate TFP as the residual from the estimation of a logarithmic Cobb-Douglas production function of the form:

$$lny_{isct} = \alpha_{sc} lnl_{isct} + \beta_{sc} lnk_{isct} + \epsilon_{isct} \tag{1}$$

where the subscripts i stand for the firm, t for time (year), c for country and s for sector. The dependent variable of the production function is a firm's value-added (y), with labour (l) and capital (k) as production factors. When value-added was not available, it was imputed as the residual between operating revenue and material inputs. Labour inputs are measured using the total wage bill, while net capital stocks were used to measure capital input. Nominal values are deflated using sector-specific price indexes, with the exception of capital stocks that have been deflated using deflators for gross fixed capital formation. The production function is estimated at the sector-country level sc, in order to avoid strong assumptions on the homogeneity of production technologies across sectors and OECD countries. The residuals ϵ_{isct} represent plant-specific efficiency in the year t.

The ideal measure of TFP would be in volume terms ("physical TFP"); however, given the data available, "revenue-based TFP" is used in most of studies, including this one. The pluses and minuses of using various measures are developed in Foster, Haltiwanger and Syverson (2008). In most business micro

[3]The re-sampling proceedure is restricted to firms with at least 20 employees since the coverage below this threshold is unstatisfactory.

data sets like Amadeus, establishment-level prices are unobserved. Thus, establishment output is measured as revenue divided by a common industry-level deflator. This method embodies within-industry price differences in output and productivity measures. Difficulties arise when prices reflect idiosyncratic demand shifts, demographic characteristics or market power variation rather than quality or production efficiency differences. Then high productivity businesses are actually highly profitable businesses and may not be particularly technologically efficient. For instance, a firm sheltered from competition because of some regulatory barriers can set high prices and look very efficient in these data even if it is in fact not the case. Since we cannot implement the Foster et al. (2008) treatment, firm fixed effects are used to control for time invariant characteristics that may determine firm-level prices.

Estimation of equation (1) by OLS may well lead to biased estimates as inputs in the production function are likely to be related to the residuals. Let us decompose the residuals as follows:

$$\epsilon_{isct} = \omega_{isct} + u_{isct} \tag{2}$$

Equation (2) decomposes firm efficiency into a part that is predictable by the firm ω_{isct} , though not observable in the data, and a part due to productivity shock that can be forecast nor by the firm nor by the econometrician.

Firms choose their input on the basis of their knowledge of their environment and own efficiency ω_{it}. Hence, if firms that anticipate high efficiency level hire more workers and invest more, OLS estimates will be biased upward. The endogeneity of input choices is well known in the literature. Consistent productivity estimates are obtained using semiparametric estimation techniques of Olley and Pakes (1996) or Levinshon and Petrin (2003). These methods correct for simultaneity biases. To carry out those estimations, we need data on investment for the former and intermediate inputs for the latter in order to proxy firm's private knowledge of its efficiency.

Our preferred TFP estimates is the one using Levinshon and Petrin (LP) method which uses information on materials to correct for the simultaneity bias. We do not chose the Olley and Pakes technique as it relies on investments to proxy for unobserved productivity while prior information on investments are not provided in Amadeus. Although we could create an investment measure using the perpetual inventory equation, we do not follow this path because of a high probability of measurement errors in capital depreciation (fixed assets

are measured as book values of capital stocks, which may diverge from a more economic concept of depreciation due to tax reporting incentives). Hence, we compute firm TFP by using intermediate inputs to capture variation in ω_{isct} that are correlated to firms' input choices.

$$\omega_{isct} = f(m_{isct}, k_{isct})$$

Introducing this function into (1), we now have :

$$lnY_{isct} = \alpha_{sc} lnl_{isct} + \beta_{sc} lnk_{isct} + f(m_{isct}, k_{isct}) + u_{isct} \tag{3}$$

The variation in inputs is now not related with the error term u_{isct} so that we have consistant estimates of the parameters. We compute firm's TFP by substracting its predicted value-added from its actual value-added. At this stage, firms' TFP value are not comparable across sectors and countries.

Following Pavcnik (2002) and Fernandez (2007), we construct a TFP index based on LP estimates of the production function. We are thus able to deal with some potential bias in the estimation procedure as well as with the comparability issue. The TFP index based on the LP estimates is constructed in two steps. First, for each 4-digit sector s, we compute the TFP of a reference plant as in (5); this hypothetical plant has mean output and input levels which are calculated over the whole period, for every industry-country cells. Second, we obtained plant i's productivity index at time t as in (4) by subtracting its predicted output from its actual one and then by taking the difference with the reference plant productivity. This index number methodology follows Aw, Chen and Roberts (2001) and Caves, Christensen and Tretheway (1981). The relative TFP measure obtained ensures comparability across industries and countries.

$$A_{isct} = Y_{isct} - \widehat{\alpha}_{sc} L_{isct} - \widehat{\beta}_{sc} K_{isct} - \widehat{A}_{refsc} \tag{4}$$

where

$$\widehat{A}_{refsct} = \overline{Y}_{sc} - \widehat{\alpha}_{sc} \overline{L}_{sc} - \widehat{\beta}_{sc} \overline{K}_{sc} \tag{5}$$

We then compute firm's TFP growth rate as the log difference : $lnA_{isct} - lnA_{isct-1}$. Summary statistics for firm's TFP growth are shown in table 1. It displays the standard variation, the mean, median, the 10th and 90th percentiles of firm's TFP growth for each country. It shows that there is a wide variation in ΔlnA_{isct} both within and across countries.

2.4 Trade openness

To capture the pro-competitive impact of trade we construct a proxy for foreign competition which is import penetration. Trade data come from Comtrade database. By combining it with detailed production data from OECD Structural Demographic Business Statistics (SDBS) database, we compute different openness measures at the 4-digit sectoral level. The trade data come from Comtrade database. By combining it with detailed production data from OECD SDBS database, we compute different openness measures at the 4-digit sectoral level.

Summary statistics for the import penetration measure across countries are shown in Table 2. This table displays the median, the 25th and 75th percentiles of import import penetration. It shows that there is a wide variation in import penetration both across countries and across time. Figure 1 illustrates the variation of import penetration for sample four-digit sectors and within sectors across country and time. We can see that there is considerable variation in openness across country and time even within narrowly defined sectors.

2.5 Regulation and market structure measures

The primary measure of regulation is the OECD product market regulation indicators of *de jure* anti-competitive regulations, focusing on the vintages which coincide with the coverage of the Amadeus data. These include the 1998 and 2003 updates, the settings for which are assumed to be unchanged for the intervening and immediately succeeding years. These indicators include both domestic as well as international barriers; only the domestic barriers are used here, specifically the sub-tree described as "barriers to entrepeneurship", which covers administrative burdens on startups, regulatory and administrative opacity and sectoral barriers to competition (see Wölfl et al., 2009).

A Herfindahl index of firm concentration at the four-digit level using the Amadeus firm database is used to control for the extent of *de facto* competition from domestic firms.

The OECD 'Regimpact' measure, which assesses the industry-specific knock-on effects of anti-competitive regulation in seven network sectors is used to control for the extent of upstream regulation (Conway et al., 2006).

Table 3 displays some summary statistics for those tree measures of domestic competition.

3 Empirical analysis of firm-level productivity

In order to investigate the questions raised above, firm-level data are used to compute productivity measures, sectoral trade data are used to measure foreign competition, and restrictive regulation is measured using the OECD's economy-wide indexes of product market regulation.

3.1 The effect of competition

Competition may stem from both foreign as well as domestic sources, which we take into account by differentiating the two. To account for competition from foreign firms, we use import penetration to the sector as a proxy. Import penetration varies across sectors, countries and time. Our methodology thus assumes that increased import shares are equivalent to an increase in competition within an industry and that this increase is exogenous to the productivity growth of an individual firm. Several studies document that increased imports amount to tougher competition: Katics and Petersen (1994) find that it is associated with reduced price-cost margins using industry-level data for the United States between 1976 and 1986. Recent empirical studies including Pavnick (2002), Fernandez (2007) and Kletzer (2002) use import shares as measures of competition from trade, with Kletzer discussing the assumptions necessary for this procedure to be valid. Finally, Chen et al. (2009) find that import penetration has a boosting effect on industrial average productivity, supporting the pro-competitive effect of trade predicted by the theoretical model of M-O (2008).

To measure domestic competition, different measures have been proposed in the literature, such as price-cost margins and concentration indexes. Both measures have substantial flaws. First, they do not allow disentangling the effect of foreign competition from the effect of domestic competition. Secondly, while both sources of competition are supposed to put a downward pressure on price-cost margins, it is not clear that higher concentration indexes indicate lower competitive forces. Indeed, pressures from abroad may lead to exit of domestic firms resulting in a small number of operating national firms, i.e. a more concentrated domestic sector. We control in some specifications for the concentration level of the industry as well as for the level of the *Regimpact* index. The latter measures the impact of regulation in services sectors on the industries using their services as inputs; it allows us to control for one cause of variation in price-cost margins that are embedded in our revenue-based measure

of firm's TFP. We believe that the two sub-indexes of product market regulation we use, namely barriers to entrepreneurship and burdens on startups, capture more accurately domestic competitive pressures as they are a direct measure of barriers to entry.

Aghion et al. (2005) exploit several policy reforms that influenced the competitive environment in Europe, namely the European Single Market Program and industry specific reforms imposed by the Monopolies and Mergers Commission. They claim that those experiments enable them to identify the causal impact of competition on innovation. The perspective of this paper is similar; it makes the most of a country specific index PMR that captures various product market reforms that took place in OECD countries between 1998 and 2008. The product market regulation index captures various policies with different treatment intensity across countries and time.

Our empirical analysis aims at highlighting the effect of foreign competition varies with the local stringency of product market regulation. Theoretical predictions on the interaction between trade and product market regulation are ambiguous though. On one hand, PMR and openness can go in the same direction and have an additive positive effect by increasing the productivity cut-off. In light of Melitz's (2003) model, we can interpret higher PMR as higher fixed costs which imply higher productivity levels. At the same time, foreign exposure reduces rents and demand stronger competitiveness to survive. Further, the pro-competitive effect of openness can be even higher in less-competitive sectors domestically as it creates new incentives to upgrade the production technology. On the other hand, rigidities can impede reallocation, innovation and firm adjustments. Higher PMR can be an obstacle to firms' entry and thus to competition. We contribute to the literature trying to answer this question by estimating productivity growth equations at the firm level where exposition to international markets and to domestic regulation both interact. We find that their effect can be non-linear and depends on the characteristics of heterogeneous firms, especially their distance to the global technological frontier.

3.2 Empirical specification: difference-in-differences

We relate TFP growth to domestic and foreign competition in the following way:

$$\Delta A_{eict} = \beta_0 + \beta_1 T_{ict} + \beta_2 T_{ict} \times PMR_{ct} + \beta_3 X_{eict} + \gamma_i + D_{ct} + \epsilon_{eict} \quad (6)$$

Productivity growth can vary across firms because of sectoral features that have nothing to do with competitive pressures. To avoid any spurious correlation due to industry characteristics, sector fixed effects γ_i are included. They capture time-invariant characteristics that shape the potential for technological upgrading. It is also very likely that TFP growth is influenced by other institutional determinants or policies that do not affect competition. Country-time fixed effects D_{ct} are added to deal with this type of correlation. The effects also address country macroeconomic shock common to all sectors. X_{eict} is a set of control variables that can vary across firms e and time t or across sectors i, country c and time t as the level of concentration or the impact of regulation in services sectors on the manufacturing sector under study. One type of such characteristics that we control for is the size of the firm.

Conditional on some controls, TFP growth is explained by both domestic and foreign competition in equation (6). Since we control for industry and country-time fixed effects, this specification identifies the effect of foreign competition through differential evolution of the import penetration across industries (industry-time variation). This approach allows us to capture the different effects that barriers to entry may have depending on sectors' degree of openness.

Models of endogenous growth, considering the existence of technological flows between firms across all countries, dwell on the role played by the pool of highly innovative firms in driving productivity growth of incumbent firms. Productivity growth of followers depends on the productivity growth of the world technological frontier. Adding productivity growth of the frontier firms (top 5 percent or 1 percent), we estimate:

$$\Delta A_{eict} = \beta_0 + \Delta A_{frontit} + \beta_1 T_{ict} + \beta_2 T_{ict} \times PMR_{ct} + \beta_3 X_{eict} + \gamma_i + D_{ct} + \epsilon_{eict} \quad (7)$$

3.3 Splitting the sample according to firm's distance to the frontier

We allow for a non-monotonic effect of competition according to the heterogeneity of firms. We consider their position on the productivity distribution specific

to their industry, the right tail of the distribution representing the productivity frontier. Is the positive escape-competition effect conditional on the distance of the firm to its industry frontier? The rationale behind this question is the following: the closer firms are to the frontier, the stronger the escape-competition effect tends to be, so that the pro-competitive of trade displays a boosting effect. On the other hand, for laggard firms, an increase of competition due to the entry of foreign firms on their market has a depressing effect as they are too far from the frontier to cope with it.

To capture the size of the technology gap among firms, we compute an industry-specific frontier by taking the average productivity of the top 1% or 5% firms across all countries: it is thus a global frontier which is consistent with our cross-country empirical strategy.

To evaluate the differential impact of foreign competition and product market regulation according to firm heterogeneity, we estimate equations (6) and (7) for two sub-samples: a sample of firms that are above the median level of TFP, in other words that are closer to the global TFP frontier and a sample of firms that have a TFP level below the median of their industry, i.e. that feature a larger technological gap.

3.4 The issue of reverse causality

Foreign competition is proxied by import penetration. It is possible that a bias exists because of reverse causality between productivity and trade orientation. Foreign firms are able to enter more heavily a market if domestic firms are not efficient, leaving the competitive advantage to trade partners. This implies a negative correlation between productivity and import shares. However, this relation should be weak in our specification as we regress firm level productivity on sectoral import shares. We also consider that the reverse causality issue is less acute when we look at TFP growth compare as productivity levels. Finally, this could bias us away from finding a productivity enhancing effect of import competition. In spite of it, our results indicate a positive relationship between productivity growth of the top firms and import penetration, which strengthen our confidence in such a finding.

3.5 Interpretation of results

The preliminary results of the productivity growth estimation equations are shown in Tables 4 and 5, while table 6 to 13 provide robustness checks. They

all use import penetration at the sectorial level (IP) to proxy foreign competition pressures. The first set of results, Tables 4 and 5, and Tables 6 and 7, show equation (6), using the Barriers to entrepreunership index (PMR) contemporaneously and with lags, both with the default dataset (Tables 4 and 5) and the resampled dataset (Tables 6 and 7). Overall the results, which split the sample by distance to frontier, are highly consistent with our theoretical hypotheses, and are robust across specifications, including those that account for potential reverse causality (lags) and potential sampling bias (resampled).

Changes in firm productivity are impacted by both the domestic institutional environment and the extent of openness to foreign markets. However, firms' responses to foreign competition are heterogeneous ; this is the case even within narrowly defined sectors. The evolution of firm TFP growth depends remarkably on its position in the distribution of firm efficiency. Firms that are technologically advanced benefit from competitive pressure of foreign firms' entry into their domestic markets. This "escape competition effect" is present only for the most competitive firms, while foreign competition has no significant impact on firms that are at the bottom of the efficiency distribution. Importantly, these results are robust when using lags, implying that the direction of causality is from trade to productivity.

The positive pro-competitive effect of trade on advanced firms has a different magnitude according to the extent of product market regulation in the country. Trade becomes more beneficial as market regulation becomes less stringent. The 'barriers to entrepreneurship' PMR index is used in the estimates shown in Tables 4, 5, 6 and 7, which reflects anti-competitive measures such as entry barriers and administrative burdens that inhibit competition across sectors. To more clearly delineate the effects of these measures, the entry barriers subindicator is used in Tables 8 and 9. These results yield coefficient estimates that are qualitatively very similar to the estimates with the barriers to entrepreneurship index shown for broader PMR.

Domestic competition may also vary within a country, across sectors. This may very well have an effect on incentives to upgrade one's technology. We use another regulatory index, Regimpact, to help control for pressures that may affect costs. Regimpact can control for the cost structure of intermediate inputs coming from upstream sectors. A higher regimpact index means service sectors have more market power and this may lead to an increase in the costs of intermediates for downstream sectors. Therefore it helps control for the ability of firms to enjoy profits. Here the firms that are closer to the frontier seem to

cope more easily with high regulation in upstream services sectors; it can be an incentive to improve one's production process in order to compensate for higher costs of intermediates (see the coincident estimates, Tables 4 and 6). On the other hand, it has a damping effect on laggard firms (see the lagged regressions, Tables 2 and 7).

The level of competition within a sector can also be proxied by the concentration level in this sector. In concentrated sectors, firms are not forced to reduce prices and can make positive profits more easily. Hence low productive firms can survive. Our analysis suggests that the concentration level has a different impact on more advanced vs. laggard firms, based on the raw dataset (Tables 4 and 5). While high concentration seems to allow less efficient firms to perform well, it is not a condition for high-productive firms whose TFP growth rates are not significantly affected by the concentration level. Such a concentration index is however an imperfect measure of competition as it doesn't capture the existence of entry threats. Moreover it focuses on a geographically limited definition of competition while European manufacturing sectors are open and some firms operate in international markets. Our favored measure of competition however, is the product market regulation index, as it can proxy unobservable entry threats as well as the existing flexibility that can be used to adjust to changes in market structure.

These results are robust to a number of alternative specifications, including the restriction of the sample to surviving firms only (see Tables 12 and 13), as well as the inclusion of the growth of the productivity frontier. While these changes in specification have a slight impact on the results, they remain roughly the same in magnitude and sign. Alternative specifications that include size dummies have no discernible effect on the results. Inclusion of the direct effect of product market regulation has a somewhat larger effect on the results, which was expected as we include country fixed effect and year fixed effect separately to estimate the impact of country-wide PMR. Yet, the results on our variables of principal interest, import penetration and its interaction with PMR remain qualitatively the same.

4 Bibliography

.

Acemoglu, D., P. Antràs and E. Helpman (2007), "Contracts and Technology Adoption", *American Economic Review*, Vol. 97, No. 3, pp. 916-943.

Aghion, P., R. Burgess, S. Redding and F. Zilibotti (2008), "The Unequal Effects of Liberalization: Evidence from Dismantling the License Raj in India", American Economic Review, Vol. 98, No. 4, pp. 1397-1412.

Aghion, P. and P. Howitt (2009), The Economics of Growth, MIT Press, Cambridge.

Aghion, P. , R. Blundell, R. Griffith, P. Howitt and S. Prantl (2009), "The Effects of Entry on Incumbent Innovation and Productivity", *The Review of Economics and Statistics*, Vol. 91, No. 1, pp. 20-32.

Alcalá, F. and A. Ciccone (2004), "Trade and Productivity", *Quarterly Journal of Economics*, Vol. 119, No. 2, pp. 613-646.

Amiti, M. and J. Konings (2007), "Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia", *American Economic Review*, Vol. 97, No. 5, pp. 1611-38.

Arnold, J., G. Nicoletti, S. Scarpetta (2010), "Much ado about something? Regulation, resource reallocation and productivity in a panel of EU countries", Presented at the Ifo / CESifo & OECD Conference on Regulation, January, www.oecd.org/dataoecd/20/37/44537865.pdf

Aw, B-Y, X-M Chen and M. Roberts (2001), "Firm-level Evidence on Productivity Differentials, Turnover, and Exports in Taiwanese Manufacturing", *Journal of Development Economics*, Vol. 66, No. 1, pp. 51-86.

Bartelsman, E., J. Haltiwanger and S. Scarpetta (2009), "Cross Country Differences in Productivity: The Role of Allocative Efficiency", NBER Working Papers, No. 15490, November.

Bernard, A., S. Redding, and P. Schott (2007), "Comparative Advantage and Heterogeneous Firms", *Review of Economic Studies*, Vol. 74, No. 1, pp. 31–66.

Bouët, A., Y. Decreux, L. Fontagné, S. Jean, D. Laborde (2008), "Assessing Applied Protection across the World", *Review of International Economics*, Vol. 16, No. 5, pp. 850–863.

Bourlès, R., G. Cette, J. Lopez, J. Mairesse, and G. Nicoletti (2010), "Do Product Market Regulations in Upstream Sectors Curb Productivity Growth? Panel Data Evidence for OECD Countries", *OECD Economics Department Working Papers*, No. 791, July.

Caves, D. W., L.R. Christensen and M.W. Tretheway (1980), "Flexible Cost Functions for Multiproduct Firms ", *Review of Economics and Statistics*, Vol. 62, No. 3, pp. 477-81.

Chen, N., J. Imbs, and A. Scott (2009), "The dynamics of trade and competition", *Journal of International Economics*, Vol. 77, No. 1, pp. 50-62.

Conway, P., D. de Rosa, G. Nicoletti and F. Steiner (2006), "Product Market Regulation and Productivity Convergence", *OECD Economic Studies*, Vol. 43, No. 2, pp. 39-76.

Conway, P., S. Dougherty and A. Radziwill (2010), "Long-term growth and policy challenges in the large emerging economies", *OECD Economics Department Working Papers*, No. 755, March.

Cuñat, A. and M. Melitz (2010), "A many-country, many-good model of labor market rigidities as a source of comparative advantage", *Journal of the European Economic Association*, Vol. 8, No. 2–3, pp. 434–41.

Dollar D. and A. Kraay (2003), "Institutions, trade, and growth", *Journal of Monetary Economics*, Vol. 50, No. 1, pp. 133-162.

Fernandez, A. (2007), "Trade policy, trade volumes and plant-level productivity in Colombian manufacturing industries", *Journal of International Economics*, Vol. 71, No. 1, pp. 52-71.

Foster, L., Haltiwanger, J. and C.J. Syverson (2008), "Market Selection, Reallocation, and Restructuring in the U.S. Retail Trade Sector in the 1990s", *The Review of Economics and Statistics*, Vol. 88, No. 4, pp. 748-758.

Freunda, C. and B. Bolakyb (2008), "Trade, regulations, and income", *Journal of Development Economics*, Vol. 87, No. 2, pp. 309-21.

Goldberg, P.K., A.K. Khandelwal, N. Pavcnik and P. Topalova (2010), "Imported Intermediate Inputs and Domestic Product Growth: Evidence from India", *The Quarterly Journal of Economics*, Vol. 125, No. 4, pp. 1727-67.

Katics, M. and B. Petersen (1994), "The Effect of Rising Import Competition on Market Power: A Panel Data Study of US Manufacturing", *The Journal of Industrial Economics*, Vol. 42, No. 3, pp. 277-286.

Kletzer, L. (2002), *Imports, Exports and Jobs: What Does Trade Mean for Employment and Job Loss?* W.E. Upjohn Institute for Employment Research, Kalamazoo, Michigan.

Levinsohn J. and A. Petrin (2003), "Estimating production functions using inputs to control for unobservables", *Review of Economic Studies*, Vol. 70, No. 2, pp. 317–341

Melitz, M. (2003), The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity, *Econometrica*, Vol. 71, No. 6, pp. 1695–1725.

Melitz, M. and G. Ottaviano (2008), Market Size, Trade, and Productivity, *Review of Economic Studies*, Vol. 75, pp. 295–316.

Nicoletti, G. and S. Scarpetta (2003), "Regulation, productivity and growth: OECD evidence", *Economic Policy*, Vol. 18, No. 36, pp. 9-72.

Nunn, N. (2007), "Relationship-Specificity, Incomplete Contracts, and the Pattern of Trade", *The Quarterly Journal of Economics*, Vol. 122, No. 2, pp. 569-600.

OECD (2003), *The Sources of Growth in OECD Countries*, OECD, Paris.

OECD (2006), *Employment Outlook – Boosting Jobs and Incomes*, OECD, Paris.

OECD (2011), *Economic Policy Reforms: Going for Growth*, OECD, Paris, www.goingforgrowth.org.

Olley, G.S. and A. Pakes (1996), "The Dynamics of Productivity in the Telecommunications Equipment Industry", *Econometrica*, Vol. 64, No. 6, pp. 1263-1297.

Pavcnik, N. (2002), "Trade Liberalization, Exit, and Productivity Improvement: Evidence from Chilean Plants", *Review of Economic Studies*, Vol. 69, No. 1, pp. 245-76.

Pelkmans, J. (2010), "Product Market Reforms in EU Countries: Are the methodology and evidence sufficiently robust?", *CEPS Working Documents*, No. 332, July.

Rodrick, D., A. Subramanian and F. Trebbi (2004), "Institutions Rule: The Primacy of Institutions over Geography and Integration in Economic Development", *Journal of Economic Growth*, Vol. 9, No. 2, pp. 271-303.

Schwellnus, C. and J. Arnold (2008), "Do Corporate Taxes Reduce Productivity and Investment at the Firm Level?: Cross-Country Evidence from the Amadeus Dataset", *OECD Economics Department Working Papers*, No. 641.

Topalova, P. (2004), "Trade Liberalization and Firm Productivity: The Case of India", *IMF Working Papers*, No. 04/28.

Wölfl, A., I. Wanner, T. Kozluk and G. Nicoletti (2009), "Ten Years of Product Market Reform in OECD Countries: Insights from a Revised PMR Indicator", *OECD Economics Department Working Papers*, No. 695.

Table 1: Summary statistics : Firms' TFP growth

Country	Standard deviation	10th percentile	mean	median	90th percentile
All	2.87	-1.24	-.01	.01	1.28
AUT	33.81	-.48	-2.84	0	.3
BEL	4.09	-1.76	0	0	1.79
CZE	1.78	-.84	.09	.01	1.03
DEU	10.83	-1.7	.41	0	2.5
DNK	6.72	-.72	.14	.01	1.17
ESP	2.01	-1.01	.01	0	1.04
FIN	2.1	-1.3	.04	.01	1.46
FRA	1.2	-.63	.06	.03	.76
GBR	4.17	-1.64	-.05	-.02	1.53
ITA	2.3	-1.55	.01	.01	1.56
NLD	3.51	-1.83	.14	0	2.54
NOR	2.01	-1.12	.06	.04	1.35
POL	4.32	-1.75	.47	.05	3.13
PRT	2.15	-1.02	.07	.01	1.36
SVK	1.69	-.72	.2	.02	1.14
SWE	6.43	-4.16	-.45	-.03	3.4

Source: Authors' calculations based on Amadeus database. TFP index based on LP estimates. Not resampled dataset.

Table 2: Summary statistics : Import Penetration, variation across years and countries

	1996			2005		
Country	25th percentile	median	75th percentile	25th percentile	median	75th percentile
AUT	22.41	46.55	86.88	43.9	76.7	101.25
BEL	35.84	73.45	124.64	42.28	91.14	156.5
CZE	24.26	56.47	74.02	27.25	60.78	102.17
DNK	34.69	63.82	94.83	46.71	80.46	113.24
ESP	14.57	30.18	53.94	18.11	45.55	69.46
FIN	16.06	47.99	73.35	20.13	49.74	83.37
FRA	17.71	36.06	55.46	23.05	46.09	69.26
GBR	19.53	40.9	60.65	25.21	56.12	82.46
GRC	15.57	39.43	73.54	30.7	60.48	84.92
IRL	41.85	68.66	100.25	29.98	68.92	102.54
ITA	12.27	23.08	41.18	14.12	31.37	54.79
LUX	.	.	.	62.83	101.08	123.32
NLD	41.75	84.7	139.45	39.89	82.83	172.19
NOR	35.6	64.83	86.33	29.48	66.02	92.8
POL	15.08	38.77	59.02	16.07	54.58	75.78
PRT	13.64	42.01	72.56	25.05	51.17	81.84
SWE	22.19	51.67	85.34	29.49	54.74	99.98

Source: Authors' calculations based on Comtrade and OECD SDBS databases.

Table 3: Summary statistics : Market Structure and Domestic Regulation

		Herfindahl Index			
Country	Standard deviation	10th percentile	mean	median	90th percentile
All	.08	0	.05	.02	.12
AUT	.25	.05	.33	.26	.61
BEL	.12	.01	.09	.04	.23
CZE	.11	.01	.09	.06	.22
DEU	.2	.04	.22	.16	.45
DNK	.11	.02	.11	.08	.21
ESP	.07	0	.03	.01	.07
FIN	.13	.02	.11	.06	.25
FRA	.07	0	.04	.02	.1
GBR	.09	.01	.08	.04	.18
ITA	.06	0	.03	.01	.08
NLD	.21	.05	.23	.15	.53
NOR	.09	0	.05	.03	.09
POL	.13	.02	.1	.05	.25
PRT	.21	.06	.22	.15	.51
SVK	.16	.05	.18	.13	.4
SWE	.09	.01	.07	.03	.17

		Index of Barriers to entrepreneurship			
Country	Standard deviation	10th percentile	mean	median	90th percentile
All	.6	1.45	2.23	2.39	3.05
AUT	.24	1.71	1.91	1.71	2.19
BEL	.22	1.88	2.16	2.33	2.33
CZE	.08	2.09	2.13	2.09	2.27
DEU	.24	1.83	2.05	1.83	2.31
DNK	.17	1.42	1.52	1.42	1.82
ESP	.35	1.63	2.17	2.39	2.39
FIN	.49	1.42	2.01	2.41	2.41
FRA	.62	1.79	2.55	3.05	3.05
GBR	.23	.95	1.29	1.45	1.45
ITA	.54	1.58	2.38	2.74	2.74
NLD	.13	1.78	1.93	2.05	2.05
NOR	.21	1.33	1.45	1.33	1.83
POL	.28	3.15	3.42	3.15	3.72
PRT	.25	1.57	2.02	2.16	2.16
SVK	0	1.51	1.51	1.51	1.51
SWE	.48	1.15	1.69	2.11	2.11

		Regimpact Index			
Country	Standard deviation	10th percentile	mean	median	90th percentile
All	.04	.02	.07	.06	.14
AUT	.05	.03	.08	.08	.13
BEL	.04	.05	.09	.08	.16
CZE	.04	.05	.1	.09	.17
DEU	.03	.02	.05	.05	.1
DNK	.01	.02	.03	.03	.05
ESP	.05	.03	.07	.07	.15
FIN	.04	.03	.06	.05	.13
FRA	.04	.02	.06	.05	.12
GBR	.03	.01	.04	.02	.09
ITA	.04	.04	.08	.07	.15
NLD	.04	.01	.05	.04	.1
NOR	.02	.03	.04	.03	.07
POL	.06	.08	.15	.15	.25
PRT	.05	.03	.1	.09	.17
SVK	.	.	.	.	.
SWE	.03	.02	.04	.03	.07

Source: Herfindahl, authors' calculations based on Amadeus database.
Barriers to entrepreneurship and Regimpact are from the OECD PMR databases.

Table 4: The impact of import penetration and PMR on firms' TFP growth, contemporaneous effect
Not resampled data set

PMR variable	Barriers to entrepreneurship								
	(1) All firms	(2) Close to the frontier	(3) Far from the frontier	(4) All firms	(5) Close to the frontier	(6) Far from the frontier	(7) All firms	(8) Close to the frontier	(9) Far from the frontier
IP	0.212**	0.460***	-0.080	0.201**	0.373**	-0.028	0.209**	0.453***	-0.105
	(0.094)	(0.153)	(0.070)	(0.090)	(0.175)	(0.060)	(0.104)	(0.153)	(0.082)
IP×PMR	-0.112**	-0.247***	0.040	-0.124**	-0.238***	0.077**	-0.107**	-0.202**	0.041
	(0.048)	(0.082)	(0.036)	(0.053)	(0.081)	(0.037)	(0.048)	(0.081)	(0.035)
Herf				-0.167	0.040	0.453***			
				(0.261)	(0.269)	(0.104)			
IP×Herf				0.067	0.155	-0.218***			
				(0.057)	(0.159)	(0.068)			
Regimpact							1.690	3.444***	-0.793
							(1.106)	(1.243)	(0.518)
IP×Regimpact							-0.169	-1.642	0.587
							(0.607)	(1.089)	(0.661)
Constant	-0.070	-0.658	-0.461***	-0.026	-0.654	-0.567***	-0.112	-0.782*	-0.446***
	(0.311)	(0.465)	(0.103)	(0.322)	(0.476)	(0.115)	(0.314)	(0.458)	(0.094)
Observations	417,449	237,399	160,666	417,449	237,399	160,666	414,789	235,980	159,560
R-squared	0.027	0.064	0.035	0.027	0.064	0.036	0.027	0.064	0.036
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered standard errors by country and sector. *** p<0.01, ** p<0.05, * p<0.1
Not resampled dataset.

Table 5: The impact of import penetration and PMR on firms' TFP growth, lagged effect
Not resampled data set

PMR variable	Barriers to entrepreneurship								
	(1) All firms	(2) Close to the frontier	(3) Far from the frontier	(4) All firms	(5) Close to the frontier	(6) Far from the frontier	(7) All firms	(8) Close to the frontier	(9) Far from the frontier
IP_{t-1}	0.155	0.411*	-0.088	0.078	0.194	0.054	0.151	0.462**	-0.086
	(0.149)	(0.219)	(0.104)	(0.178)	(0.250)	(0.103)	(0.151)	(0.223)	(0.101)
$IP \times PMR_{t-1}$	-0.069	-0.217**	0.050	-0.069	-0.190*	0.053	-0.068	-0.186*	0.048
	(0.070)	(0.101)	(0.049)	(0.069)	(0.103)	(0.045)	(0.077)	(0.102)	(0.047)
$Herf_{t-1}$				-0.326	-0.603*	0.477***			
				(0.279)	(0.344)	(0.101)			
$IP \times Herf_{t-1}$				0.129	0.864***	-0.235**			
				(0.112)	(0.330)	(0.094)			
$Regimpact_{t-1}$							0.266	1.280	-1.362**
							(0.978)	(1.128)	(0.533)
$IP \times Regimpact_{t-1}$							0.023	-1.622	0.055
							(0.881)	(1.342)	(0.559)
Constant	-0.105	-0.761	-0.506***	-0.017	-0.639	-0.612***	-0.111	-0.827*	-0.492***
	(0.353)	(0.474)	(0.137)	(0.376)	(0.458)	(0.148)	(0.352)	(0.474)	(0.110)
Observations	411,590	234,346	159,288	411,590	234,346	159,288	409,031	232,947	158,255
R-squared	0.027	0.066	0.035	0.027	0.066	0.036	0.028	0.066	0.036
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered standard errors by country and sector. *** p<0.01, ** p<0.05, * p<0.1
Not resampled dataset.

Table 6: The impact of import penetration and PMR on firms' TFP growth, contemporaneous effect
Resampled data set

PMR variable	Barriers to entrepreneurship								
	(1) All firms	(2) Close to the frontier	(3) Far from the frontier	(4) All firms	(5) Close to the frontier	(6) Far from the frontier	(7) All firms	(8) Close to the frontier	(9) Far from the frontier
IP	-0.020	0.365**	-0.052	-0.005	0.368**	-0.034	-0.043	0.328*	-0.116
	(0.204)	(0.181)	(0.088)	(0.207)	(0.185)	(0.089)	(0.229)	(0.180)	(0.108)
IP×PMR	0.007	-0.198**	0.022	0.002	-0.199**	0.028	0.011	-0.173*	0.040
	(0.105)	(0.096)	(0.043)	(0.105)	(0.097)	(0.045)	(0.108)	(0.093)	(0.047)
Herf				0.371	0.249	0.209*			
				(0.252)	(0.262)	(0.110)			
IP×Herf				-0.010	0.000	-0.068			
				(0.043)	(0.070)	(0.061)			
Regimpact							-0.046	3.925***	-1.183*
							(2.007)	(1.399)	(0.656)
IP×Regimpact							0.324	-0.175	0.693
							(0.647)	(0.868)	(0.495)
Constant	-0.179*	-3.913**	0.096***	-0.295**	-4.003**	0.042	-0.177	-4.034**	0.134***
	(0.100)	(1.734)	(0.028)	(0.150)	(1.763)	(0.042)	(0.116)	(1.725)	(0.036)
Observations	348,007	197,499	129,409	348,007	197,499	129,409	345,580	196,281	128,357
R-squared	0.037	0.037	0.031	0.037	0.037	0.031	0.037	0.037	0.031
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered standard errors by country sector. *** p<0.01, ** p<0.05, * p<0.1
Resampled dataset.

Table 7: The impact of import penetration and PMR on firms' TFP growth, lagged effect.
Resampled data set

PMR variable	Barriers to entrepreneurship								
	(1) All firms	(2) Close to the frontier	(3) Far from the frontier	(4) All firms	(5) Close to the frontier	(6) Far from the frontier	(7) All firms firms	(8) Close to the frontier	(9) Far from the frontier
IP_{t-1}	0.422**	0.700***	0.206	0.400*	0.648**	0.275	0.430**	0.696***	0.214
	(0.209)	(0.244)	(0.169)	(0.228)	(0.263)	(0.171)	(0.208)	(0.250)	(0.165)
$IP \times PMR_{t-1}$	-0.193*	-0.339***	-0.096	-0.193*	-0.331***	-0.097	-0.210**	-0.347***	-0.113
	(0.099)	(0.115)	(0.080)	(0.099)	(0.116)	(0.080)	(0.100)	(0.118)	(0.083)
$Herf_{t-1}$				-0.024	-0.268	0.171			
				(0.288)	(0.303)	(0.119)			
$IP \times Herf_{t-1}$				0.051	0.230	-0.155			
				(0.208)	(0.270)	(0.121)			
$Regimpact_{t-1}$							-2.567	-0.705	-2.684**
							(1.566)	(1.111)	(1.041)
$IP \times Regimpact_{t-1}$							0.713	0.281	0.833
							(1.066)	(1.256)	(0.721)
Constant	-0.250***	-4.214***	-0.037*	-0.241**	-4.130***	-0.087**	-0.167*	-4.188***	0.055
	(0.062)	(1.599)	(0.023)	(0.115)	(1.599)	(0.041)	(0.086)	(1.600)	(0.043)
Observations	338,137	192,631	125,563	338,137	192,631	125,563	335,895	191,445	124,651
R-squared	0.039	0.038	0.034	0.039	0.038	0.034	0.039	0.038	0.035
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered standard errors by country sector. *** p<0.01, ** p<0.05, * p<0.1
Resampled dataset.

Table 8: The impact of import penetration and PMR on firms' TFP growth, contemporaneous effect
Not resampled data set

PMR variable	Burdens on startups								
	(1) All firms	(2) Close to the frontier	(3) Far from the frontier	(4) All firms	(5) Close to the frontier	(6) Far from the frontier	(7) All firms	(8) Close to the frontier	(9) Far from the frontier
IP	0.071	0.180**	-0.039*	0.169**	0.113	0.070	0.049	0.225***	-0.038
	(0.049)	(0.073)	(0.023)	(0.071)	(0.111)	(0.071)	(0.048)	(0.081)	(0.026)
IP×PMR	-0.052*	-0.112**	0.032*	-0.073***	-0.106**	0.012	-0.063**	-0.095**	0.032
	(0.029)	(0.044)	(0.019)	(0.028)	(0.044)	(0.025)	(0.030)	(0.045)	(0.024)
Herf				-0.159	-0.030	0.425***			
				(0.263)	(0.273)	(0.101)			
IP×Herf				-0.134	0.127	-0.144*			
				(0.084)	(0.157)	(0.078)			
Regimpact							1.463	3.549***	-0.624
							(1.109)	(1.245)	(0.543)
IP×Regimpact							0.910	-1.568	-0.021
							(0.843)	(1.116)	(0.825)
Constant	-0.045	-0.619	-0.481***	-0.054	-0.705	-0.554***	-0.067	-0.751	-0.473***
	(0.309)	(0.470)	(0.109)	(0.329)	(0.467)	(0.094)	(0.313)	(0.463)	(0.098)
Observations	417,449	237,399	160,666	414,789	235,980	159,560	414,789	235,980	159,560
R-squared	0.027	0.064	0.035	0.027	0.064	0.036	0.027	0.064	0.036
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered standard errors by country and sector. *** p<0.01, ** p<0.05, * p<0.1
Not resampled dataset.

Table 9: The impact of import penetration and PMR on firms' TFP growth, lagged effect
Not resampled data set

PMR variable	Burdens on startups								
	(1) All firms	(2) Close to the frontier	(3) Far from the frontier	(4) All firms	(5) Close to the frontier	(6) Far from the frontier	(7) All firms firms	(8) Close to the frontier	(9) Far from the frontier
IP_{t-1}	0.085***	0.167*	-0.020	0.102	0.013	0.137*	0.066**	0.246*	-0.015
	(0.031)	(0.099)	(0.027)	(0.104)	(0.142)	(0.080)	(0.030)	(0.132)	(0.027)
$IP \times PMR_{t-1}$	-0.066**	-0.110**	0.034	-0.072**	-0.099**	0.012	-0.080**	-0.099**	0.043
	(0.026)	(0.044)	(0.024)	(0.031)	(0.046)	(0.026)	(0.033)	(0.044)	(0.029)
$Herf_{t-1}$				-0.301	-0.608*	0.466***			
				(0.278)	(0.344)	(0.099)			
$IP \times Herf_{t-1}$				-0.013	0.736**	-0.212**			
				(0.129)	(0.321)	(0.101)			
$Regimpact_{t-1}$							-0.010	1.269	-1.206**
							(0.988)	(1.146)	(0.558)
$IP \times egimpact_{t-1}$							0.964	-1.399	-0.414
							(1.005)	(1.334)	(0.706)
Constant	-0.062	-0.721	-0.526***	0.007	-0.601	-0.615***	-0.048	-0.788*	-0.522***
	(0.351)	(0.478)	(0.141)	(0.376)	(0.458)	(0.143)	(0.351)	(0.478)	(0.117)
Observations	411,590	234,346	159,288	411,590	234,346	159,288	409,031	232,947	158,255
R-squared	0.027	0.066	0.035	0.027	0.066	0.036	0.028	0.066	0.036
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered standard errors by country and sector. *** p<0.01, ** p<0.05, * p<0.1
Not resampled dataset.

Table 10: The impact of import penetration and PMR on firms' TFP growth, with frontier's TFP growth, contemp. effect
Not resampled data set

PMR variable	Barriers to entrepreneurship								
	(1) All firms	(2) Close to the frontier	(3) Far from the frontier	(4) All firms	(5) Close to the frontier	(6) Far from the frontier	(7) All firms	(8) Close to the frontier	(9) Far from the frontier
ΔA_{front}	0.003***	0.003**	0.001*	0.003***	0.003**	0.001*	0.003**	0.003**	0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
IP	0.172**	0.350**	-0.082	0.162*	0.253	-0.029	0.169*	0.344**	-0.107
	(0.088)	(0.139)	(0.071)	(0.086)	(0.158)	(0.060)	(0.098)	(0.141)	(0.082)
IP×PMR	-0.092**	-0.189**	0.041	-0.101**	-0.177**	0.078**	-0.086*	-0.147*	0.042
	(0.045)	(0.074)	(0.036)	(0.050)	(0.074)	(0.037)	(0.045)	(0.076)	(0.035)
Herf				0.156	0.314	0.459***			
				(0.190)	(0.240)	(0.105)			
IP×Herf				0.057	0.164	-0.219***			
				(0.055)	(0.155)	(0.068)			
Regimpact							1.589	3.116***	-0.926*
							(0.995)	(1.117)	(0.522)
IP×Regimpact							-0.199	-1.545	0.590
							(0.563)	(1.004)	(0.664)
Constant	-0.611***	-1.070	-0.500***	-0.636***	-1.126	-0.597***	-0.652***	-1.187	-0.485***
	(0.191)	(0.797)	(0.142)	(0.206)	(0.828)	(0.160)	(0.187)	(0.791)	(0.131)
Observations	415,187	235,333	160,583	415,187	235,333	160,583	412,527	233,914	159,477
R-squared	0.032	0.051	0.035	0.032	0.051	0.036	0.033	0.052	0.036
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered standard errors by country and sector. *** p<0.01, ** p<0.05, * p<0.1
Not resampled dataset.

Table 11: The impact of import penetration and PMR on firms' TFP growth, with frontier's TFP growth, lagged effect
Not resampled data set

PMR variable	Barriers to entrepreneurship								
	(1) All firms	(2) Close to the frontier	(3) Far from the frontier	(4) All firms	(5) Close to the frontier	(6) Far from the frontier	(7) All firms	(8) Close to the frontier	(9) Far from the frontier
ΔA_{front}	0.003***	0.003**	0.001**	0.003***	0.003**	0.001**	0.003**	0.004**	0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
IP_{t-1}	0.116	0.246	-0.094	0.037	0.038	0.048	0.111	0.280	-0.091
	(0.138)	(0.184)	(0.104)	(0.166)	(0.214)	(0.103)	(0.141)	(0.181)	(0.101)
$IP \times PMR_{t-1}$	-0.052	-0.146*	0.052	-0.048	-0.116	0.056	-0.049	-0.124	0.050
	(0.064)	(0.085)	(0.049)	(0.064)	(0.087)	(0.045)	(0.072)	(0.092)	(0.047)
$Herf_{t-1}$				-0.062	-0.221	0.487***			
				(0.197)	(0.256)	(0.101)			
$IP \times Herf_{t-1}$				0.118	0.715**	-0.237**			
				(0.104)	(0.279)	(0.095)			
$Regimpact_{t-1}$							0.488	1.272	-1.392***
							(0.798)	(0.918)	(0.529)
$IP \times Regimpact_{t-1}$							-0.051	-1.080	0.054
							(0.852)	(1.208)	(0.561)
Constant	-0.630***	-1.067	-0.506***	-0.601***	-1.026	-0.614***	-0.644***	-1.128	-0.488***
	(0.189)	(0.797)	(0.145)	(0.194)	(0.800)	(0.157)	(0.188)	(0.794)	(0.119)
Observations	409,603	232,527	159,217	409,603	232,527	159,217	407,044	231,128	158,184
R-squared	0.033	0.053	0.035	0.033	0.053	0.036	0.033	0.053	0.036
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered standard errors by country and sector. *** p<0.01, ** p<0.05, * p<0.1
Not resampled dataset.

Table 12: The impact of import penetration and PMR on surviving firms' TFP growth, contemporaneous effect
Not resampled, balanced data set.

PMR variable	Barriers to entrepreneurship								
	(1) All firms	(2) Close to the frontier	(3) Far from the frontier	(4) All firms	(5) Close to the frontier	(6) Far from the frontier	(7) All firms	(8) Close to the frontier	(9) Far from the frontier
IP	0.212**	0.432**	-0.025	0.198*	0.387**	0.030	0.188*	0.406**	-0.042
	(0.106)	(0.169)	(0.075)	(0.101)	(0.179)	(0.069)	(0.111)	(0.171)	(0.095)
IP×PMR	-0.114**	-0.234***	0.014	-0.119**	-0.229**	0.041	-0.103*	-0.190**	0.017
	(0.056)	(0.090)	(0.038)	(0.057)	(0.090)	(0.041)	(0.056)	(0.094)	(0.039)
Herf				-0.020	0.316	0.458***			
				(0.268)	(0.278)	(0.120)			
IP×Herf				0.048	0.081	-0.200**			
				(0.065)	(0.129)	(0.078)			
Regimpact							2.522**	3.654***	0.036
							(0.990)	(1.079)	(0.657)
IP×Regimpact							0.085	-1.231	0.284
							(0.685)	(1.140)	(0.831)
Constant	-0.688*	-0.976	-0.486***	-0.677*	-1.026	-0.591***	-0.769**	-1.123	-0.486***
	(0.380)	(0.908)	(0.058)	(0.382)	(0.918)	(0.066)	(0.377)	(0.910)	(0.061)
Observations	230,279	127,303	92,246	230,279	127,303	92,246	229,068	126,645	91,755
R-squared	0.043	0.068	0.030	0.043	0.068	0.031	0.043	0.068	0.032
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by country and sector. *** p<0.01, ** p<0.05, * p<0.1
Not resampled dataset, only firms operating during the whole period (surviving firms).

Table 13: The impact of import penetration and PMR on surviving firms' TFP growth, lagged effect
Not resampled, balanced data set

PMR variable	Barriers to entrepreneurship								
	(1) All firms	(2) Close to the frontier	(3) Far from the frontier	(4) All firms	(5) Close to the frontier	(6) Far from the frontier	(7) All firms firms	(8) Close to the frontier	(9) Far from the frontier
IP_{t-1}	0.262	0.313	0.001	0.249	0.005	0.133	0.250	0.320	0.004
	(0.177)	(0.231)	(0.123)	(0.210)	(0.275)	(0.121)	(0.171)	(0.227)	(0.121)
$IP \times PMR_{t-1}$	-0.115	-0.176	0.010	-0.115	-0.130	0.013	-0.127	-0.164	0.013
	(0.081)	(0.110)	(0.058)	(0.081)	(0.112)	(0.054)	(0.091)	(0.118)	(0.056)
$Herf_{t-1}$				-0.172	-0.287	0.475***			
				(0.295)	(0.348)	(0.122)			
$IP \times Herf_{t-1}$				0.029	0.870**	-0.230**			
				(0.139)	(0.362)	(0.100)			
$Regimpact_{t-1}$							0.857	1.021	-1.031
							(0.996)	(1.139)	(0.714)
$IP \times Regimpact_{t-1}$							1.041	-0.481	-0.309
							(1.562)	(1.374)	(1.157)
Constant	-1.166***	-1.842*	-0.643***	-1.129***	-1.781*	-0.751***	-1.190***	-1.888*	-0.619***
	(0.336)	(1.064)	(0.104)	(0.333)	(1.066)	(0.112)	(0.337)	(1.065)	(0.091)
Observations	215,998	119,594	86,811	215,998	119,594	86,811	214,838	118,952	86,352
R-squared	0.046	0.073	0.031	0.046	0.073	0.031	0.046	0.073	0.032
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by country and sector. *** p<0.01, ** p<0.05, * p<0.1
Not resampled dataset, only firms operating during the whole period (surviving firms).

Figure 1. Import penetration: min/max and median by sector