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ABSTRACT

Does Anti-Competitive Regulation Matter for Productivity? Evidence from European Firms*

Using firm-level data for a sample of European countries, we focus on the effects that product-market regulations have on firm-level TFP growth. We proxy regulatory burdens using the OECD indicators of sectoral non-manufacturing regulations. These allow accounting for both the direct effects of sectoral regulation on within-sector performance and the indirect effects of sectoral regulation on firms in other sectors through intersectoral input-output linkages. Our econometric specification of TFP is based on a “neo-Schumpeterian” empirical specification in which productivity improvements depend on growth at the global technological frontier and a catch up term. We assume that regulation can affect productivity growth both directly and by slowing down the rate of catch up. We find that product market regulations that curb competitive pressures tend to reduce the productivity performance of firms. The negative effect is particularly strong on firms characterised by an above-average productivity growth. Domestic regulations that affect all regulated firms in the same way seem to be more important than border regulations in this context.

JEL Classification: D24, L11, L51

Keywords: total factor productivity, firm-level data, product market regulation

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1. Introduction

In almost all industrialised economies, governments intervene in product markets through regulatory policies, particularly in services industries. Regulation in product markets is generally motivated by market failures, including monopoly conditions, externalities and asymmetric information. However, if poorly designed, product market regulations may also affect the degree of competition between firms by raising barriers to entry, placing restrictions on product choices or firm operations, or granting protection to incumbent special interest groups. Such anti-competitive effects of regulations can, in turn, limit firms' incentives to maximise efficiency and innovate. While some countries have managed to address public interest concerns in non-manufacturing sectors without much harm to competitive forces, other countries –particularly in continental Europe- have reduced the dynamism of some of these industries through excessively strict regulation. In this paper we relate anti-competitive regulatory policies and firm-level productivity growth in downstream sectors in 10 European countries, focusing on ways in which ill-designed regulations can harm productivity and not on the potential benefits of appropriate regulations.

2. Measuring regulation, inter-industry linkages and firm productivity

Indicators of product market regulations

Our measure of regulation is a comprehensive set of policy indicators assembled at the OECD on the basis of extensive surveys of national regulatory practices in services industries across sectors, countries and time. These industry-specific product market regulation (PMR) indicators cover two broad groups of services sectors: network industries, including energy (electricity and gas), transport (air, rail and road transport) and communication (post and telecommunications); and retail trade and professional services. They quantify anti-competitive restrictions in regulatory domains such as State control, barriers to entry, involvement in business operations, and, in some cases, vertical integration and market structure.²

The effects of policy-induced rigidities in non-manufacturing industries are not limited to these sectors themselves, but can also generate trickle-down effects into other sectors by raising the costs or lowering the quality of intermediate inputs, particularly in the case of services inputs where import competition is limited.³ Hence we pre-multiply the sector-specific regulation indicators for services industries by a matrix of input-output coefficients for 39 sectors, on the basis of the 2000 input-output tables for the United States. Using data from the United States –which are not part of our estimation sample- avoids the possible endogeneity of national input-output coefficients to national market characteristics such as the degree of competition.⁴ This results in an indicator matrix that we call regulation impact indicators, calculated as:

² See Conway and Nicoletti (2006) and Woelfl et. al. (2009) for a complete description of the OECD PMR indicators, which are also available on line at www.oecd.org/eco/pmr.

³ Bourles et al. (2010) present a theoretical model of how productivity may be affected by the degree of competition in upstream sectors.

⁴ This strategy is similar to Rajan and Zingales (1998), who use measures of financial dependence of US industries in a cross-country regression setting. The underlying assumption is that the US has a comparatively strong degree of competition in most non-manufacturing sectors and thus US coefficients may be adequate proxies of intersectoral input-output relations in the absence of competition-reducing policy distortions. Moreover, the data quality of the US Input-Output matrix seems to be superior to those of a number of other countries in our sample.

$$RI_{jct} = \sum_{j'} w_{jj'} \cdot PMR_{j'ct} \quad (1)$$

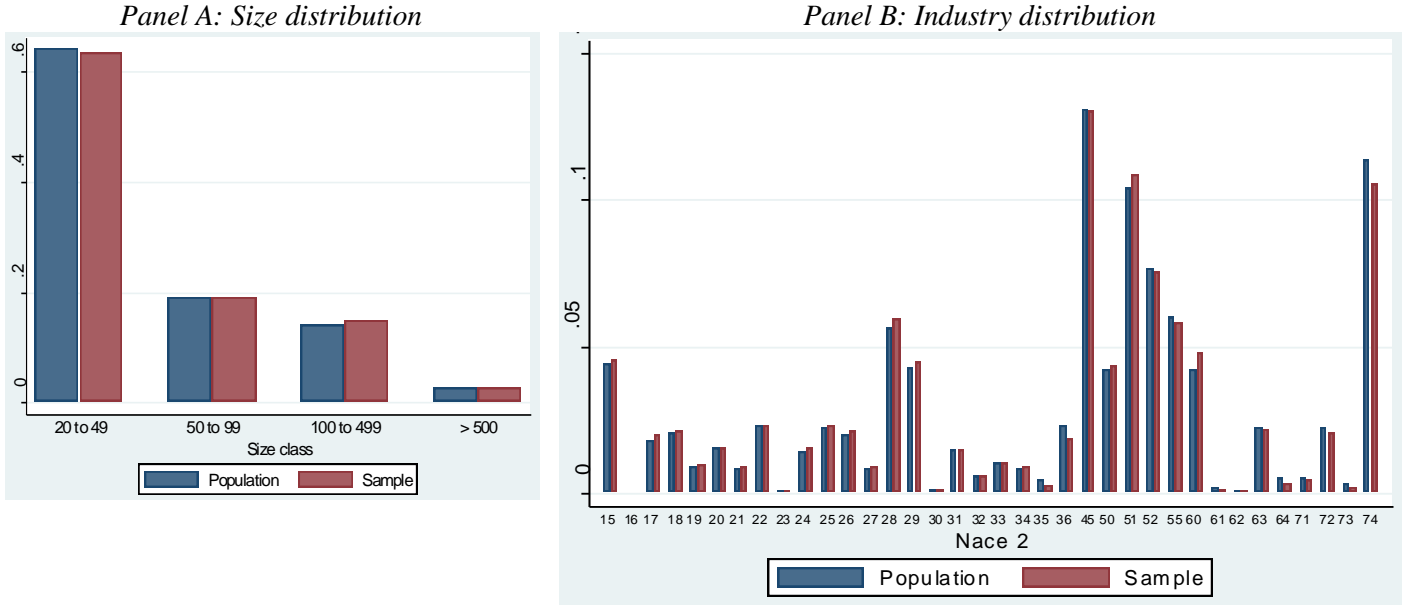
where subscripts c denote countries, j and j' industries (where j' is defined for the above-mentioned regulated services industries only) and t time. $w_{jj'}$ are input-output coefficients measuring the intensity with which industry j relies on services industry j' . Our identifying assumption is that sectors that are more dependent on a given kind of services inputs should be more affected by a lack of competition in this upstream sector. The so-constructed regulation impact indicators RI cover 39 sectors that use the outputs of services industries as intermediate inputs. Note that for services sectors, the cross-diagonal elements of the input-output matrix are often large.

The firm-level database

We relate these regulation impact indicators to firms' productivity, using firm-level data drawn from the Amadeus database of the Bureau van Dijk. Our firm-level sample includes ten European countries for which the Amadeus database has a good coverage of firms,⁵ over the years 1998 to 2004. As any firm-level data set, the raw Amadeus data contain missing values for some variables that are required for the productivity estimates. This implies that once TFP estimates are obtained, we are in fact left with a different sample from the original one. In order to ensure representativeness of our effective firm-level sample along the three dimensions country, sector and size groups, we resample the original Amadeus data set. In a first step, we obtain information about the true underlying population of firms above 20 employees along these three dimensions from the Eurostat Structural Business Statistics database for the year 2000. The size group below 20 employees had to be discarded due to an unsatisfactory coverage in the Amadeus data. Then we set the total sample size to 100,000 firms (not observations) and divide this number into size-sector-country strata according to the true population. As a final step, random draws with replacement from each size-sector-country strata in the TFP sample are taken until the weight of each strata corresponded to its population weight. The results of this resampling procedure are shown in Figure 1, where Panel A compares the size distributions of our estimation sample with the true population, while Panel B does the same for the industry distribution. In both cases, our re-sampled firm-level data set comes very close to the true population.

⁵ Austria, Belgium, Finland, France, Germany, Italy, Portugal, Spain, Sweden, United Kingdom.

Figure 1. Firm population vs. Estimation Sample after resampling



TFP estimates

TFP estimates are obtained using a superlative index number approach (see Caves *et al.* 1982a,b, and Griffith *et al.* 2009 for an application), which –unlike TFP estimates based on parametrisations of the production function– allows comparisons in levels across countries and sectors. Following Griffith *et al.* (2009), the superlative index measures of TFP growth and TFP level in firm i at time t are calculated as a function of value added Y and the two input factors labour and capital, denominated x^z (with $z=1,2$):

$$\Delta TFP_{it} = \Delta \ln Y_{it} - \sum_{z=1}^2 \tilde{\alpha}_{it}^z \Delta \ln x_{it}^z, \quad (2)$$

$$TFP_{it} = \ln(Y_{it}/\bar{Y}_j) - \sum_{z=1}^2 \sigma_i^z \ln(x_{it}^z/\bar{x}_j^z) \quad (3)$$

where $\tilde{\alpha}_{it}^z$ is a two-period average of the factor compensation shares in value added ($\tilde{\alpha}_{it}^z = 1/2 \alpha_{it}^z + 1/2 \alpha_{it-1}^z$). In the levels equation, upper bars depict geometric means of all firms in the same industry over all countries and years, and $\sigma_i^z = \alpha_i^z + \bar{\alpha}_j^z$ is the average of the factor share in firm i and the geometric mean factor share in industry j . Constant returns to scale are assumed by imposing $\sum_z \tilde{\alpha}_{it}^z = 1$ and $\sum_z \sigma_i^z = 1$. Note that as a robustness check, section 5 presents results on the basis of TFP estimates obtained through the semi-parametric estimation technique of Levinsohn and Petrin (2003).⁶ In both cases we use a value

⁶ Note that it is not possible to follow the methodology of Olley & Pakes (1996). The reason is that we do not have primary information on investment in Amadeus so that investment has to be calculated as the residual between current and lagged capital stock after correcting for depreciation. This clearly violates Olley & Pakes' (1996) orthogonality condition between lagged capital stock and investment

added specification, based on primary information for value added, correcting for extraordinary profits. In those cases where primary information on value added was not available we imputed value added as the residual between operating revenue and material inputs. For capital stocks we use primary information on net capital stocks. For labour we use primary information on the total wage bill. Nominal values are deflated using price indices from the EUKLEMS or OECD STAN databases. We do not use estimated MFP values which either the coefficient on capital stocks or the wage bill is negative. Productivity observations for which the sum of the coefficients is smaller than 0.6 are also dropped.

3. Empirical approach

The regression approach we use for relating firm productivity to the regulation impact indicators is based on a catch-up specification of firm-level productivity whereby, within each sector, the production possibility set is influenced by technological and organisational transfer from the technology-frontier firms (measured as the 5% most productive firms in sector s and year t in our sample of countries) to other firms and on the distance of the firm to the technological frontier.⁷ This specification is consistent with recent models of endogenous growth like Acemoglu *et al.* (2003) or Aghion and Howitt (1998, Ch. 8) in which productivity growth depends on both the ability to catch up and the ability to innovate. We model firm-level TFP for a given firm i in country c , industry s at time t as an auto-regressive distributed lag ADL(1,1) process in which the level of TFP is co-integrated with the level of TFP of the frontier firm F . Formally,

$$\ln A_{icst} = \alpha_0 \ln A_{icst-1} + \alpha_1 \ln A_{F_{cst}} + \alpha_2 \ln A_{F_{cst-1}} + \alpha_3 RI_{cst-1} + \gamma_s + \gamma_{ct} + \varepsilon_{icst} \quad (4)$$

where A_{icst} is the TFP level of a non-frontier firm i , $A_{F_{cst}}$ is the TFP level at the technological frontier F , RI is the regulation impact indicator, and γ_s , γ_{ct} are sector and country-year fixed effects, respectively. Finally, ε_{icst} is a random error term. Under the assumption of long-run homogeneity ($\alpha_0 + \alpha_1 + \alpha_2 = 1$), the ADL(1,1) process in equation (2) has the following Error Correction Model (ECM) representation:

$$\Delta \ln A_{icst} = \alpha_1 \Delta \ln A_{F_{cst}} - (1 - \alpha_0) \ln \left(\frac{A_{icst,t-1}}{A_{F_{cst},t-1}} \right) + \alpha_3 RI_{cst-1} + \gamma_s + \gamma_{ct} + \varepsilon_{icst} \quad (5)$$

Equation 5 is the baseline specification of the policy-augmented TFP equation. The inclusion of dummy variables for each country-year combination implies that we control for all possible omitted factors that are specific to each country in each year, which substantially reduces concerns about a possible endogeneity of policies and reverse causation. The coefficient α_3 is identified using only cross-industry variation within the same country and year, which is possible because of the interaction of the original PMR regulation indicators with the industry-specific Input-Output coefficients. Since the identification strategy is based on comparisons of changes across industries within countries and year, compared across different countries and years, it can be given a *difference-in-difference* interpretation.⁸ Standard errors are clustered by country and sector to allow the error term to be correlated across firms and time within sectors in the same country (Moulton, 1991, Bertrand *et al.* 2004).

The analysis focuses on productivity growth of incumbents across different industries and countries. Reallocation of productive inputs and outputs via the entry and exit of firms cannot be explored with the

⁷ In the robustness checks based on Levinsohn-Petrin TFP estimates, we use a national productivity frontier definition because these TFP estimates come from country-specific production function estimates. One of the advantages of the superlative index measure is that it avoids this national frontier definition.

⁸ See Rajan and Zingales (1998) for a similar estimation approach.

Amadeus data, which do not accurately distinguish between entry into the market and entry into the sample or mergers, and between exit from the market and from exit from the sample. We can look at the role of reallocation among incumbents for productivity developments, however, by singling out those firms that are characterised by a fast catch-up to the productivity frontier (those that have approached the frontier faster than the median firm in the same country and industry over the last year) and interact an indicator variable for these firms with the regulation impact indicator. This allows us to test whether these “dynamic” firms are affected differently by anti-competitive regulation.

The PMR regulation indicators also allow a further breakdown of regulations into purely domestic regulations that apply to all firms operating in the regulated services industries regardless of their national origin, and rules that affect foreign direct investors in particular. Given that foreign direct investment (FDI) is often more relevant for cross-border market entry in these sectors than arms-length exports and that tariffs were zero for trade within the European Union throughout our sample period, we interpret this breakdown as distinction between the effects of upstream domestic regulation and upstream border regulation on domestic firms, and report distinct estimates for these two aspects of services regulation.

4. Results

Table 1 presents estimates of the baseline specification of the productivity equation for the regulation impact indicators in column 1 and for the additional distinction between domestic and border regulations in column 2. We find that outward shifts in the technological frontier (labelled *frontier growth* in the table) increase the productivity of follower firms, and that productivity growth increases in the distance to the technology frontier (*TFP gap* in the table), reflecting some degree of conditional productivity convergence.⁹ Our main variable of interest, the coefficient estimate for the regulatory impact variable (α_3 in equation 5), has a statistically significant negative coefficient, consistent with the idea that more stringent product market regulation upstream reduces the productivity of firms in downstream sectors. When we further distinguish between domestic and border regulations, we find that this result is mainly driven by domestic regulations, while border regulations do not seem to have statistically significant effects.

When we add an additional distinction between more and less dynamic firms in columns 3 and 4, we obtain a larger coefficient estimate for firms with an above-average catch-up rate with the productivity frontier, and the difference is statistically significant as shown in the F-test at the bottom of the table. When we then distinguish between domestic and border regulations we find that while domestic regulations have a strong and statistically significant effect on both dynamic and non-dynamic firms, border regulations have a statistically significant effect on dynamic firms only, while the effect on non-dynamic firms is still estimated with a large standard error.

⁹ This is a standard finding in line with previous cross-country evidence at the sectoral level (Griffith et al., 2004; Nicoletti and Scarpetta, 2003, Conway et al., 2006 and Inklaar et al, 2008) and national evidence at the firm level (Griffith et al. 2009, for the United Kingdom).

Table 1. Regulation and TFP: the effects of firm-level heterogeneity

Variable	(1)	(2)	(3)	(4)
	Baseline		Dynamic vs non-dynamic firms ¹	
	Overall regulation	Border vs domestic regulation	Overall regulation	Border vs domestic regulation
<i>Frontier Growth</i>	0.065 *** (0.008)	0.071 *** (0.009)	0.145 *** (0.010)	0.152 *** (0.011)
<i>MFP Gap, t-1</i>	-0.113 *** (0.009)	-0.126 *** (0.006)	-0.135 *** (0.009)	-0.149 *** (0.005)
<i>Regulation, t-1</i>	-0.093 *** (0.028)			
<i>Regulation, t-1* Dynamic</i>			-0.111 *** (0.031)	
<i>Regulation, t-1* Non-dynamic</i>			-0.075 *** (0.030)	
<i>Dynamic firm dummy</i>			0.139 *** (0.005)	0.140 *** (0.006)
<i>Regulation domestic, t-1</i>		-0.073 *** (0.027)		
<i>Regulation border, t-1</i>		-0.091 (0.077)		
<i>Regulation dom., t-1 * Dynamic</i>				-0.077 *** (0.024)
<i>Regulation dom., t-1 * Non-dynamic</i>				-0.059 ** (0.025)
<i>Regulation border, t-1 * Dynamic</i>				-0.167 ** (0.083)
<i>Regulation border, t-1 *Non-dynamic</i>				-0.129 * (0.078)
Dynamic = Non-dynamic (F-test)			3.84 **	
<i>Observations</i>	217797	182104	217797	182104
<i>R square</i>	0.10	0.11	0.23	0.25
<i>Country-year fixed effects</i>	Yes	Yes	Yes	Yes
<i>Industry fixed effects</i>	Yes	Yes	Yes	Yes

TFP is measured as a superlative index, calculated as described in equations 2 and 3 in the main text. Standard Errors are in parentheses. *, **, *** indicate statistical significance at the 10, 5 and 1% levels, respectively. Agriculture, forestry, fishing, mining and construction are excluded, as are public administration, education and health sectors.

1. Dynamic firms are defined as firms that catch-up to the global frontier in their respective sector.

5. Robustness Checks

In order to evaluate the robustness of our findings, we check whether they are robust to an alternative definition of productivity and to the inclusion of additional variables that may affect the firm productivity. Table 2 replicates columns (1) and (3) of Table 1, using TFP estimates obtained via the semi-parametric method suggested by Levinsohn and Petrin (2003). These estimates are based on an estimation of country- and sector-specific production function coefficients, with TFP being the residual of the production function. The method uses material inputs in order to proxy for unobserved productivity shocks, which could create biased input coefficients in ordinary least square estimates. One drawback of the method is that because the TFP estimates come from country- and sector-specific parameterisations of

the production function, one cannot draw comparisons across countries, which implied that we had to define the productivity frontier as the average productivity of the top 5% of firms within the same sector and country, while the TFP index results are based on a global productivity frontier. This may be the reason why the estimated coefficient for the TFP gap between a firm and the technological frontier is one of the coefficients that differ most between Tables 1 and 2.

Our main findings, however, are quite similar using this different productivity definition. The coefficient for regulation remains significant, although now only at the 10% level, in our baseline specification. When we distinguish between the regulation effect on dynamic and non-dynamic firms, it loses its statistical significance for the non-dynamic firms, and stays highly significant for the dynamic firms. Note that even though both coefficients are statistically significant in Table 1, the estimated effect for dynamic firms is larger using the TFP index definition as well. This may suggest that regulation hampers particularly those firms that are on an upward trajectory of catching up with the best firms in the industry.

Table 2. Using Levinsohn-Petrin TFP estimates and country-specific frontier

Variable	(1)	(2)
	<i>Baseline</i>	<i>Dynamic vs non-dynamic firms</i>
<i>Frontier growth</i>	0.044 *** (0.009)	0.182 *** (0.012)
<i>TFP Gap, t-1</i>	-0.059 *** (0.008)	-0.068 *** (0.008)
<i>Regulation, t-1</i>	-0.055 * (0.032)	
<i>Regulation, t-1*Dynamic</i>		-0.074 ** (0.035)
<i>Regulation, t-1*Non-dynamic</i>		-0.031 (0.036)
<i>Dynamic firm dummy</i>		0.121 *** (0.005)
<i>Observations</i>	208284	208284
<i>R square</i>	0.08	0.19
<i>Country-year fixed effects</i>	Yes	Yes
<i>Industry fixed effects</i>	Yes	Yes

TFP is measured as a superlative index, calculated as described in equations 2 and 3 in the main text. Standard Errors are in parentheses. *, **, *** indicate statistical significance at the 10, 5 and 1% levels, respectively. Agriculture, forestry, fishing, mining and construction are excluded, as are public administration, education and health sectors. Dynamic firms are defined as firms that catch-up to the national technology frontier in their respective sector.

As a second robustness check, we introduce measures of labour market regulations and of financial development into the regression, to check whether our estimated regulation effect may be due to cross-country correlations between different policies. However, it should be stressed that our specifications presented in Table 2 always include country-specific year dummies that remove all country-wide changes in regulatory or institutional settings. This limits the degree to which most other policy changes could bias our findings on product market regulations even when they're not explicitly controlled for.

We capture labour market regulation by exploiting an indicator of employment protection legislation (EPL) created by the OECD (OECD, 2010). This indicator measures the stringency of regulations affecting the hiring and firing of workers. EPL tends to raise labour adjustment costs possibly discouraging firms to innovate and adopt new technologies, both of which may require adjusting the workforce to reorganise the production process. The effect of stringent EPL on TFP is likely to be stronger in industries that are characterised by inherently large job turnover rates because of more frequent fluctuations in demand or wider technological shocks. For this reason, we interact the EPL indicator with a measure of job flows at the industry level from the United States in order to obtain a variable that varies at the country and sector level.¹⁰

In addition to considering labour market policies, we proxy for the degree of financial development by using the sum of two standard indicators of financial intermediation and the structure of financial systems: the ratio of bank credit to the private sector to GDP; and the share of stock market capitalisation in GDP. These indicators capture broad patterns of financial development and do not distinguish between sectors of the economy. To consider the possibility that financial development influences productivity outcomes differently depending on the extent to which firms in different sectors rely on external finance, we interact the synthetic indicator of financial development with a sector-specific measure of dependence on external finance (following Rajan and Zingales, 1998). The latter measure is constructed from the average ratio of debt to fixed assets across firms at the industry level (see Inklaar and Koetter, 2008, for a similar approach). In order to limit the possible endogeneity of this variable, we construct it only on the basis of firms from the United Kingdom, arguably the economy with the most developed financial market in our sample. Hence, the amount of external finance used by UK firms in different sectors is probably the best available proxy for the technologically-driven differences in exposure to external finance across sectors.¹¹ Given that financial development is likely to have a positive effect (if any) on TFP, because it may improve firms' options for making productivity-enhancing investments regardless of current cash-flow, the expected sign on this variable is positive.

Table 3 replicates our main regressions including these two additional policy measures. Our findings with respect to product market regulation are not affected by the inclusion of these additional controls. In both regressions, the coefficients of these additional explanatory variables are estimated with large standard errors and are not statistically significant at the conventional level. There are a number of possible explanations for this. Most importantly, our sample of mostly continental European countries (with the United Kingdom being the only exception to this) implies that there is not much variation in these policy variables. By extending our sample to other non-European countries, there might be enough variation to estimate a statistically significant effect. While it would be beyond the scope of this paper to explore these questions, we nonetheless take comfort from the fact that the product market regulation indicators remains statistically significant even once other policy dimensions are controlled for.

¹⁰ Flows in the United States are used as a benchmark because of data availability at a fine level of disaggregation and because the United States is one of the least regulated labour markets in the OECD and its job flows are likely to characterise well the technology and market-driven need for labour reallocation of different industries.

¹¹ We have also tried a different sectoral measure of external dependence on finance, based on Compustat data for the US. This is a similar measure as the one originally employed by Rajan and Zingales (1998), except that it uses more recent data. Using this measure instead of the one employed below, we find the same results for product market regulation. It should be stressed, however, that the indicator used in Table 3 – the industry-level averages of the ratio of debt to fixed assets in the United Kingdom – drawing from the Amadeus database that also covers unlisted businesses is arguably more appropriate to characterise the average dependence of external finance than a measure based on Compustat for the United States that only considers larger listed businesses.

Table 3. Controlling for additional policy variables

(using superlative index TFP and global frontier)

Variable	Baseline model	Dynamic vs non-dynamic firms
<i>Frontier growth</i>	0.066 *** (0.008)	0.148 *** (0.010)
<i>TFP Gap, t-1</i>	-0.113 *** (0.009)	-0.135 *** (0.010)
<i>Regulation, t-1</i>	-0.090 *** (0.031)	
<i>Regulation, t-1*Dynamic</i>		-0.110 *** (0.034)
<i>Regulation, t-1*Non-dynamic</i>		-0.075 ** (0.032)
<i>Dynamic firm dummy</i>		0.138 *** (0.005)
<i>Labour Market Regulation</i>	0.006 (0.038)	0.003 (0.038)
<i>Financial Development</i>	0.006573 (0.011)	0.003249 (0.012)
Dynamic = Non-dynamic (F-test)		3.25 *
<i>Observations</i>	209351	209351
<i>R square</i>	0.08	0.22
<i>Country-year fixed effects</i>	Yes	Yes
<i>Industry fixed effects</i>	Yes	Yes

Standard errors are in parentheses. *, **, *** indicate statistical significance at the 10.5 and 1% levels, respectively. Agriculture, forestry, fishing, mining are excluded, as are public administration, education and health sectors. Dynamic firms are defined as firms that catch-up to the global frontier in their respective sector.

6. Conclusion

In this paper, we shed some light on the role of product market reforms for firm-level productivity patterns for a number of European countries. We use a large comparable panel data set of European firms, estimate firm-level productivity and relate it to detailed indicators of anti-competitive product market regulation. Our results confirm previous evidence from country studies that the level of competition may affect aggregate productivity and growth (see Aghion and Griffith, 2005 for a detailed theoretical and empirical analysis). In particular, our results suggest that product market regulations that curb competitive pressures tend to reduce the productivity performance of firms. Moreover, such regulation may have negative effects on allocative efficiency because they have a disproportionately strong effect on firms characterised by an above-average productivity growth. Domestic regulations that affect all regulated firms in the same way seem to be more important than border regulations in this context.

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