research paper series

Globalisation, Productivity and Technology

Research Paper 2018/12

Product market regulation, business churning and productivity: Evidence from the European Union countries

By

Robert Anderton, Barbara Jarmulska and Benedetta Di Lupidio

Product Market Regulation, Business Churning and Productivity: Evidence from the European Union Countries

By

Robert Anderton[1], Barbara Jarmulska[2] and Benedetta Di Lupidio[34]

October, 2018

Abstract

This paper empirically investigates the effects of product market regulation on business churning (i.e. entry and exit of firms) and their impacts on productivity, using annual data for the period 2000-2014 across individual EU countries and sectors. The paper hypothesises that product market reforms, which reduce entry barriers and increase the degree of competition, can allow new firms to enter the market and compete vis-à-vis incumbent firms. The higher competitive pressures can push competitive incumbent firms to innovate while other less productive and inefficient firms may exit. These possible mechanisms can result in improvements to the average industry-level productivity. By using business demography data (i.e, business churning) at the industry and firm size level, we perform a panel data analysis across European countries and sectors to evaluate the effect of product market regulation on firm churning and their impacts on productivity. In particular, we differentiate between micro (less than 10 employees) and other firms given the substantial degree of heterogeneity among these two size classes both in terms of business churning and productivity growth. The paper finds that reducing product market regulation increases business dynamism (i.e. increases the churn rate) by facilitating firms' entry and exit which, in turn, boosts sectoral total factor productivity.

[1] European Central Bank and Honorary Professor, University of Nottingham, UK.

[2] European Central Bank.

[3] European Central Bank.

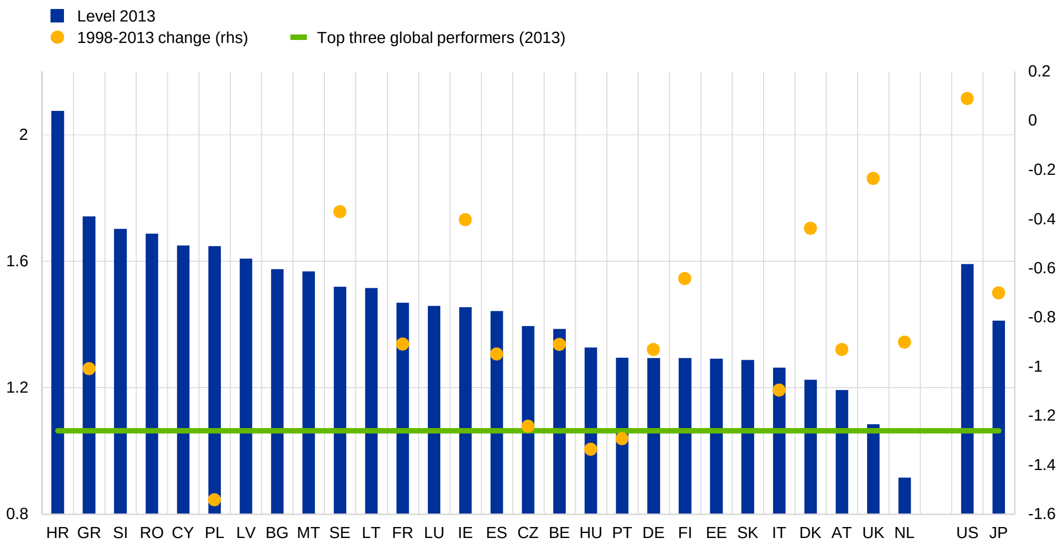
[4] All views expressed in this paper are those of the authors and do not necessarily correspond with those of the European Central Bank.

1. Introduction

Product market institutions and regulations can have a substantial impact on market access and structure. By facilitating the speedy entry of new firms and the exit of inefficient firms - i.e. higher rates of business churn - product market de-regulation can allow production factors to be more efficiently reallocated between firms and sectors, therefore encouraging productivity improvements and innovation.

During the last twenty years, many EU countries have made significant progress in improving product market structures with the objective of better-functioning markets and making the regulatory environment friendlier to competition. Product market reforms comprise a wide spectrum of policies, including liberalising or deregulating the professional services, retail trade and network industries, mainly by enhancing competition through the reduction of barriers to entry, the privatisation of network industries and state-owned enterprises.

Chart 1
OECD – Product Market Regulation (PMR) indicators



Notes: Countries are ordered by rank in 2013.The OECD Product Market Regulation (PMR) indicators are a comprehensive and internationally comparable set of indicators that cover formal regulations in the following areas: state control of business enterprises; legal and administrative barriers to entrepreneurship; and barriers to international trade and investment. A higher value means stricter regulation. The frontier is the best performer in the OECD (in this case, the Netherlands). The top three global performers in order of ranking are the Netherlands, the United Kingdom and Austria. Index ranges from 6 (worst) to 0 (best).
Sources: OECD PMR indicators and ECB calculations.

According to the OECD Product Market Regulation (PMR) indicators[5] (Chart 1), many EU countries, particularly several euro area countries, reduced product market regulation significantly due to structural reforms over the past two decades. Nevertheless, compared

[5] The latest data available are from 2013.

to the best performers, product market regulation is still high across many EU countries, where product market reforms remain a priority in order to catch up with best practices and push forward the convergence process. At the same time, the productivity performance of many euro area countries has been relatively subdued[6], which in turn contributed to a somewhat disappointing growth dynamics (ECB, 2017 and ECB, 2018). Conversely, many central and eastern European countries have performed relatively better on average in terms of productivity growth, mainly due to the process of convergence and catching up[7] (ECB, 2018).

As summarised by Griffith and Harrison (2004), the channels through which product market regulation affects countries' economic performance are manifold. One way is to stimulate productivity through competition-enhancing reforms that aim to liberalise or improve the market functioning by reallocating resources (allocative efficiency), improving the utilization of production factors (productive efficiency[8]) and providing incentives for firms to implement new technologies and move towards the technology frontier (dynamic efficiency[9]), thereby enhancing the framework conditions for growth (Nicoletti and Scarpetta, 2003; Nicodème and Sauner-Leroy, 2004).

In this paper, we aim to gauge whether product market reforms can affect productivity dynamics through business churning. We perform an EU cross-country panel econometrics analysis at industry and firm size level, and analyse the extent to which a less stringent regulatory framework is related to increased business churning and therefore able to boost aggregate productivity. The paper is organised as follows. The next section provides a brief overview of the existing literature. Section 3 describes the churning channel – through which deregulation of product markets could impact productivity – while section 4 discusses the data, including the definitions of various variables and the methods employed to evaluate our hypotheses. Section 5 reports the empirical results following a brief description of the methodology used, which comprises two empirical steps: first, we analyse the impact of deregulation on business churning; second, we examine the impact of business churning on productivity. Finally, section 6 concludes.

[6] Despite the large inflows of foreign capital from which euro area converging economies benefited before the crisis, the accumulated capital did not lead to rapid technological change and productivity growth[6] (Balta, 2013).
[7] The catching-up process is likely to result in positive inflation differentials vis-à-vis the euro area, unless this is counteracted by an appreciation of the nominal exchange rate.
[8] By increasing the number of competitors and hence reducing the incumbents' market power, firms are forced to decrease their mark-ups and allocate both inputs (labour and capital) and goods more efficiently to the production process (van Riet and Roma, 2006).
[9] Greater competitive pressures can influence dynamic efficiency by incentivising managers to adopt new technologies (Parente and Prescott, 1994), speed-up the replacement of old products and processes (Schumpeterian creative destruction process) in order to avoid bankruptcy (see Aghion, Dewatripont and Rey, 1999) and therefore increase the pace of productivity dynamics.

2. Theoretical and empirical background

A large literature investigates the effects of relaxing anti-competitive product market regulation on productivity gains (Bourlès et al., 2010; Conway *et al*, 2006), both from a static and dynamic perspective. Static gains are mostly associated with a one-off shift of the status quo, when long-lasting inefficiencies are eliminated, for instance through the opening of monopolistic markets to competition. While in the short-run greater competition generally leads to an increase in the level of productivity through gains in allocative and productive efficiency, in the long-run an increase in competition may also potentially affect dynamic efficiency, by stimulating firms to innovate products and processes and hence move towards the technology frontier. Nicoletti and Scarpetta (2003) demonstrate that policies of market entry liberalisation are associated with productivity dynamics. Moreover, based on a firm level analysis for the UK, Nickell (1996) finds a significant positive relationship between competition[10] and productivity growth.

Disney, Haskel, and Heden (2000) find similar results for UK firms using a large data set. In particular, they find that the pressure exerted by new competitors is key for pushing firms to adopt new technology and implement organizational changes (so-called 'internal' restructuring), which in turn has an impact on productivity growth. In terms of relative importance though, the 'external' restructuring alone (i.e. entry of new competitive firms and exit of inefficient ones) accounts for 90% of productivity growth. By introducing market entry and allowing incumbent firms to innovate, the new endogenous growth models[11] extend the Schumpeterian models and show that more product market competition due to new competitors entering the market may stimulate innovation to overcome competition. Foster, Haltiwanger and Krizan (2001) and Bartelsman et al (2004) show that aggregate productivity is driven to a large extent by net firms' entry.

Moreover, many micro-econometric studies addressing the effects of regulatory reforms in the service sector (especially in utilities, communication, and the transport sector) on the dynamics of productivity and conclude that, on many occasions, greater competition results in productivity gains. Olley and Pakes (1996) find that the US telecommunication industry, following deregulation, experienced productivity growth. A number of other empirical studies conclude that there is a positive relation between an increase in competition and the productivity level of industrial firms (see Caves and Barton, 1990; Haskel, 1991; Green and Mayes, 1991; Nickell et al., 1992; Nickell, 1996; Pilat, 1996).

[10] As measured by increased number of competitors or by lower levels of rents.

[11] See for instance Aghion, Harris, Vickers (1997), Aghion, Harris, Howitt, Vickers (2001), Aghion, Bloom, Blundell, Griffith and Howitt (2002), Aghion, Burgess, Redding and Zilibotti (2003), Aghion, Blundell, Griffith, Howitt and Prantl (2003), Aghion and Griffith (2005).

3. The effect of product market regulation on productivity: the churning channel

Against this background, we focus on the possible effects that product market deregulation has on increasing business churning and demonstrate that the latter has a positive impact on productivity performance. Decreasing product market regulation may increase competition and raise productivity by shifting resources towards more productive firms within the same sector. Inefficient firms might be forced to exit, high productivity incumbent firms could expand and new competitive ones would be able to enter the market. The threat of entry of new competitors generates pressure on the incumbents and this competitive pressure, along with the resource reallocation driven by the business churning, may lead to an increase in aggregate productivity at the sector level, fostering innovation and adoption of new technology.

This mechanism, also known as the Schumpeterian creative destruction process (Schumpeter, 1942), is often regarded as key to business dynamism and economic growth. [12] In more detail: by relaxing regulation in the product market, the number of competitors increases – due to easier access to the market – and so do the competitive pressures between companies in the same sector. As a result, in the medium-term, inefficient firms are driven out of the market, while new competitive firms enter, hence the business churn increases. This, in turn, will improve the allocation of resources between firms and have a positive impact on aggregate productivity. These developments usually materialize through two different channels. First, the likely entry of new, innovative and dynamic competitors into the market will exercise pressure on the incumbents. As a consequence, incumbent firms threatened by competition will be encouraged to innovate.[13] Second, the replacement of old products and processes, as well as the adoption of new technologies, generally leads to an increase of the aggregate productivity at industry level[14].

The wave of product market deregulation that took place in the EU over the past years was aimed at making the regulatory environment friendlier to competition. Therefore, in

[12] Over the long run, firm entry and exit account for a major component of within-industry productivity growth and for this reason, obstacles to resource reallocation can have severe economic consequences. The Schumpeterian creative destruction refers to the process whereby new, dynamic and innovative products and processes replace outdated ones. As such, in order to develop more efficient economic structures, the hitherto established products, processes and companies have to be eliminated. This process could be triggered by the implementation of product market reforms aimed at cutting red tape and lower barriers to entrepreneurship. Studies for the US manufacturing sector show that the between-plant reallocation accounts for over 50 per cent of the ten-year productivity growth between 1977 and 1987 (Foster, Haltiwanger and Krizan, 2001). Other studies based on somewhat different methodologies concur with similar conclusions (see Baily, Hulten and Campbell, 1992; Bartelsman and Dhrymes, 1994).

[13] According to the Schumpeterian growth model, firms innovate step by step (i.e. a laggard firm must first innovate to catch up with the technology leader before becoming itself a leader in the future).

[14] Scarpetta and Nicoletti (2003) find evidence that regulation limiting entry may hinder the adoption of existing technologies, possibly by reducing competitive pressures, technology spillovers, or the entry of new high-technology firms. In manufacturing, the productivity gains to be expected from lower entry barriers are greater the further a given country is from the technology leader.

countries – and/or sectors – where the creative destruction process is somewhat distorted by inefficient regulation, it is likely that business churning and hence productivity will be lower. For instance, artificially high barriers to entry will lead to reduced firm turnover and to a less efficient allocation of resources. Thus, making entry and exit (and adjustment more generally) prohibitively costly via distorted market structure and institutions may result in a reduced pace of churning and ultimately to lower productivity levels and growth. Likewise, reforms to insolvency regimes – which reduce barriers to corporate restructuring and improve the reallocation of capital to more productive firms – are key to avoid the survival of "zombie" firms. In a more competitive regulatory environment, weak inefficient firms kept alive by an "evergreening" of loans[15] would typically exit or be forced to restructure (Andrews and Petroulakis, 2017; Storz et al., 2017).

4. Data description and definitions

The analysis is performed using data from Eurostat's Business Demography Database, which provides statistics on firms' birth and death rates. The birth (death) rate is defined as the number of enterprise births (deaths) in the reference period (t) divided by the number of enterprises active in t. The business ''churn'' – or firm turnover – is computed as the sum of the birth and death rates. Our dataset covers 28 European Union countries over the period 2000-2014. These annual data are available with a sectoral breakdown, for all companies and for two different firm size categories: below and above ten employees. Eurostat provides business demography statistics on enterprises in two different databases: the first one collects data until 2007 according to NACE Rev. 1.1 while the second one starts in 2004 and uses the new NACE Rev. 2 classification. In order to merge the two databases and coherently match the different classification of industries to allow comparability, the NACE Rev. 2 industry breakdown has been converted into the previous NACE Rev. 1.1. Therefore, the economic activities under analysis correspond to the NACE Rev.1.1 classification and relate to manufacturing; electricity, gas and water supply; construction; wholesale and retail trade; hotels and restaurants; transport, storage and communications; real estate, renting and business activities.[16]

The analysis of firm demography, i.e. births and deaths of enterprises, can contribute substantially to the understanding of market dynamism and the economic growth process. The data show that there is a reallocation of resources that differs across sectors and countries and especially across firm characteristics. In particular, we see a remarkable difference in the birth/death/churn rate of smaller (less than 10 employees) and larger

[15] It also allows weak banks to avoid recapitalisation by postponing the disclosure of losses in their accounts.

[16] Education, mining and quarrying, health, financial intermediation and other sectors were excluded from the analysis for two main reasons: (1) these sectors have been only marginally affected by changes in the product market regulation; (2) their aggregate productivity dynamics is more likely driven by idiosyncratic sectoral characteristics than changes in regulation and business churning.

companies (10 employees or above), with smaller businesses showing much higher rates as compared to the larger firm size category (Table 1). Overall, births and deaths are on average positively correlated in all EU Member States. However, while the magnitude of entry and exit rates in larger companies may differ across a number of countries, churning rates of small companies are generally more homogeneous (Chart 2). Moreover, the business churn rate of small companies is much more dispersed[17] across sectors than of companies employing more than ten people.

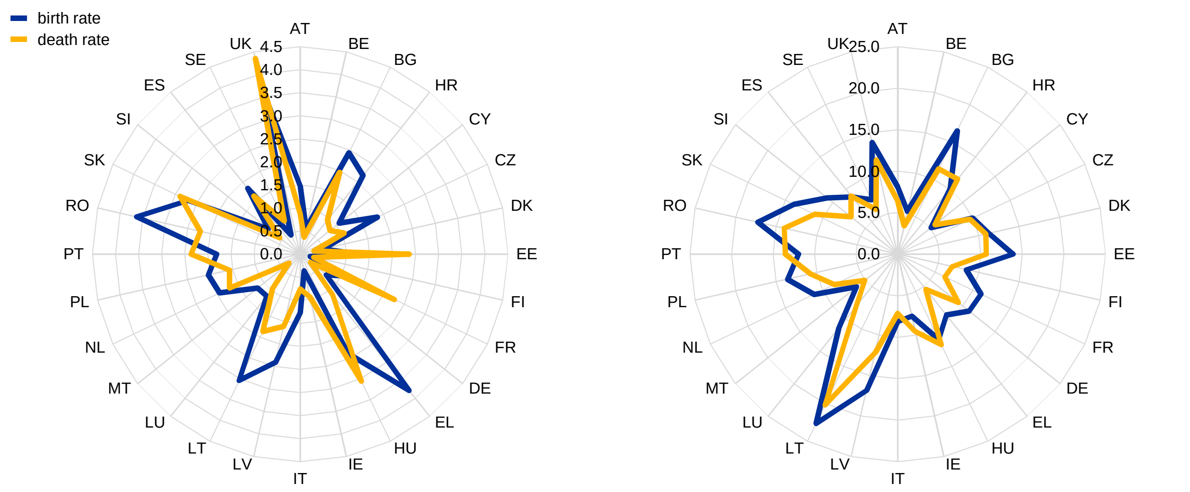
Table 1
Average cross-sectoral entry, exit and churn rates in the EU by firm's size categories over the period 2000-2014

Variable	Small companies	Other companies
	(<10 employees)	(>= 10 employees)
Churn rate	20.67	3.14
Birth rate	11.29	1.70
Death rate	9.44	1.44

Notes: The average birth and death rates are computed across the following sectors: manufacturing; electricity, gas and water supply; construction; wholesale and retail trade; hotels and restaurants; transport, storage and communications; real estate, renting and business activities.
Sources: Eurostat Business Demography Database and ECB calculations.

Chart 2
Average cross-sectoral entry and exit rates by country over the period 2000-2014

(lhs chart: companies above ten employees; rhs chart: companies below ten employees)



Notes: The average birth and death rates are computed across the following sectors: manufacturing; electricity, gas and water supply; construction; wholesale and retail trade; hotels and restaurants; transport, storage and communications; real estate, renting and business activities.
Sources: Eurostat Business Demography Database and ECB calculations.

[17] The business churn rate of small companies shows a standard deviation of 7.21, compared to 1.82 of larger companies.

Another key variable of our analysis is total factor productivity (TFP) growth. TFP is generally defined as the portion of output that is not explained by the amount of inputs used in production, and therefore referred to as a representation of technological progress. We compute TFP on the basis of a production function, as a residual of the gross domestic product after the contributions of labour and capital have been taken into account[18]. Its level is determined by how efficiently and intensely the inputs are utilised in production. As such, the computation of TFP requires some assumptions. In particular, we assume that the elasticities of labour and capital are equal to 2/3 and 1/3, respectively. Moreover, using aggregate values of total employment in millions of persons[19] and consumption of fixed capital in millions[20] we assume constant skill composition of the employed skill force and constant composition of the capital stock. TFP variables were obtained using Ameco[21] data on the basis of neo-classical Cobb-Douglas production function:

$$Y_{ijt} = A_{ijt} {L_{ijt}}^{\alpha} {K_{ijt}}^{\beta}$$

where real value added in each country, sector and time is produced with labour (total employment, L_{ijt}) and physical capital (K_{ijt}), and the process is enhanced by the index of technological efficiency, A_{ijt}, being the measure of the total factor productivity. The TFP figures are computed at country and sector level, without differentiating between firm's size categories.

The variable of interest in our analysis, namely product market regulatory provisions across countries, is measured by the OECD Regulation in Energy, Transport and Communications Index (PMR ETCR). The OECD provides also a broader set of Product Market Regulation (PMR) indicators, which measure the degree to which policies promote or inhibit competition in areas of the product market where competition is viable. However, data availability for the PMR indicators is limited to the years 1998, 2003, 2008 and 2013. Hence, the advantage of using the PMR ETCR indicator is that it provides annual observations over a long sample period[22] and is therefore well suited for time-series analysis. Moreover, it's highly positively correlated with the broader PMR indicator mentioned above. The PMR ETCR is an index which spans from 0 to 6 (a low value corresponds to light regulation).

[18] Olley and Pakes (1996) decompose aggregate productivity into an unweighted average of firm-level productivity and a term that captures the covariance between firm size and firm productivity which shows whether greater market shares are associated to more efficient firms. Alternatively, aggregate productivity growth can be decomposed in a "within" component (capturing enhanced productivity at firm level), a "between" component (capturing enhanced productivity due to reallocation effects), and other components capturing the productivity contribution of firm turnover (Baily, Hulten and Capbell (1992); Griliches and Regev (1995); Foster, Haltiwanger and Krizan (2001). Depending on the aggregate productivity decomposition used, whether it is multi-factor or labour productivity, the type of weights (employment or product) assigned to each component, the length of the time period under analysis, the estimated results may differ substantially.

[19] Eurostat, ESA2010.

[20] Eurostat, ESA2010.

[21] AMECO is the annual macro-economic database of the European Commission's Directorate General for Economic and Financial Affairs.

[22] The PMR ETCR data are available on an annual basis from 1975 to 2013.

However, the range of regulatory provisions covered by the ETCR indicators is not as broad as that of the indicators of the product market regulation (PMR) indicator. The PMR ETCR covers 7 non-manufacturing sub-sectors (telecoms, electricity, gas, post, rail, air passenger transport, and road freight) in which anti-competitive regulation tends to be concentrated. Given that manufacturing sectors are typically lightly regulated and open to international competition, the PMR ETCR index is commonly used as a good proxy of product market regulation in the whole economy[23].

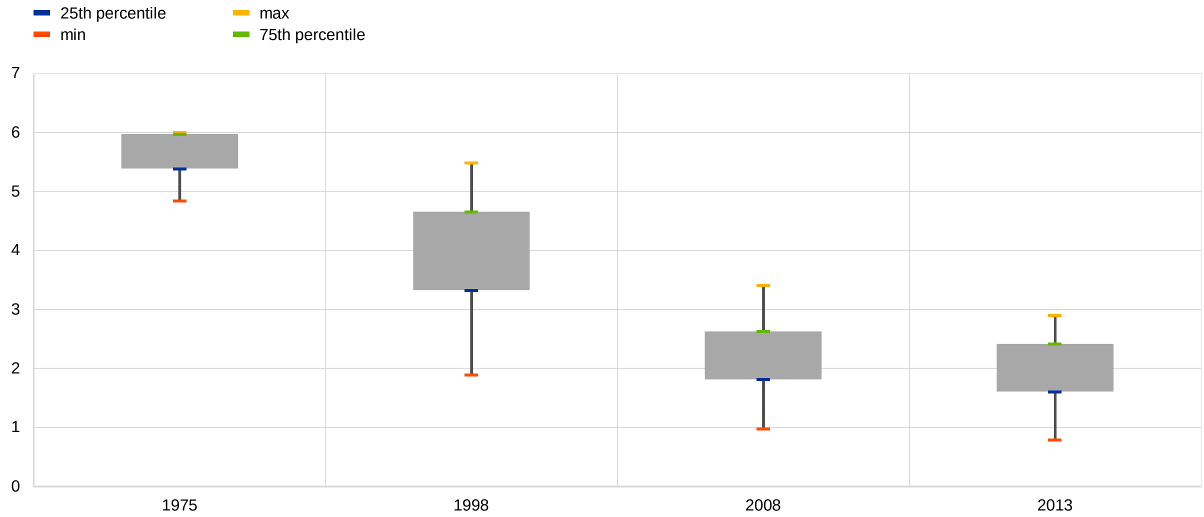
Chart 3 documents the evolution of the PMR ETCR indicator on the restrictiveness of product market regulations in network industries from 1975 to 2013, in terms of average dispersion across EU countries as measured by the 25th and the 75th percentiles, as well as the minimum and the maximum. Compared to 1975, when EU countries between the 25th and 75th percentile scored on average above 5.5 in the PMR ETCR indicator, product markets in 2013 are much less strictly regulated, which is a similar profile over time as the PMR indicator. The dispersion in the restrictiveness of the PMR ETCR indicator across countries declined substantially from 1998 to 2013, as shown by the 25th and 75th percentile. Nevertheless, despite the considerable reform progress, in some European countries there remains significant scope for further reforms, as these markets are still heavily regulated compared to the OECD best performer, namely Great Britain.

[23] See for instance Bordon A., Ebeke C., and Shirono K. (2016), ‘When Do Structural Reforms Work? On the Role of the Business Cycle and Macroeconomic Policies’, IMF Working Paper WP/16/62, and Anderton, et al (2017) ‘’Sectoral wage equations and structural rigidities’’ Open Economies Review, where PMR ETCR is also used as a proxy for the PMR indicator and shows that the two product market regulation series are highly correlated.

Chart 3

OECD – Product Market Regulation in energy, transport and communications (PMR ETCR) indicators

(Scale 0-6 from least to most restrictive)



Notes: The box plot shows, in each year, the extreme values (min-max, i.e. the two whiskers extending from the box), as well as the third and second quartiles (the edges of each box) of the regulatory indicator for the EU cross-country distribution. The OECD Product Market Regulation in energy, transport and communications (PMR ETCR) are a comprehensive and internationally comparable set of synthetic indicators of the strictness of product markets regulation in the fields of energy, transport and communication (e.g. entry, public ownership, vertical integration and market structure).
Sources: OECD PMR ETCR indicators and ECB calculations.

5. Empirical Analysis

The aim of the empirical analysis is to investigate whether the reduction of regulatory barriers has successfully enhanced firm churning and therefore increased aggregate sectoral productivity. In particular, we use a two-step approach to investigate whether aggregate productivity gains could be attributed to product market reforms through an increase in the rate of business churning. In the first step, we empirically investigate whether product market deregulation facilitates the entry and exit of firms. In the second step, we explore whether total factor productivity dynamics at sector and firm size level is affected by a higher rate of business churning.[24]

5.1 The effect of product market regulation on business churning

[24] A somewhat similar approach based on two sequential steps is used by Cincera and Galgau (2005) and in European Commission (2014). European Commission, 2014. *Market Reforms at Work in Italy, Spain, Portugal and Greece*, 5/2014.

In the first step of the analysis, we assess the impact of product market regulation on the business churn rate and, separately, on its two components: birth and death rates. This relationship is explored through the estimation of the following equation:

$$rate_{ijt} = \beta_0 + \beta_1 * GDPgrowth_{it-1} + \beta_2 PMR\_ETCR_{it} + \gamma_i + \delta_j + \omega_t + \varepsilon_{ijt}$$

where countries are denoted by *i* = 1,…,N and sectors by *j* = 1,…,N. $rate_{ijt}$ identifies birth, death and churn rates (in percentage points) of companies in a given country, sector and time, while lagged GDP growth ($GDPgrowth_{it-1}$) and PMR_ETCR_{it} refer only to country and time and do not differ by sector. γ_i, δ_j and ω_t represents country, sector and time fixed effects while ε_{ijt} is the error term. The above equation is estimated separately for the two firm size classes under analysis, namely small and larger companies[25].. Our priors are that the parameter for the GDP variable is positively signed for the firm birth rate and negatively signed for the death rate, while the PMR ETCR parameter will be negatively signed.

We carry out regression analysis using country, sector and time fixed effects.[26] We also perform a number of tests to check the robustness of the model. The Wooldridge test for autocorrelation in panel data models (Wooldridge, 2001)[27] and the likelihood ratio test show, respectively, the existence of first-order serial correlation and heteroskedasticity. In addition, an issue which has to be addressed is the standard error clustering bias originating from the use of dependent and explanatory variables which vary at different level of aggregation. For instance, in the first step regression, the PMR_ETCR variable varies at country level while the outcome variables (i.e. birth, death and churn rates) vary at a higher level of disaggregation, namely at industry level. This means that the effective sample size of each estimated regression is somewhat close to the number of clusters at the lower level of aggregation. When the number of clusters is very small, the results may underestimate either the serial correlation in a random shock or the intra-class correlation as in the Moulton problem. In our case, for instance, the standard errors of the PMR_ETCR coefficient can be downward biased due to contemporaneous correlation of the error terms across industries within countries (Moulton, 1990).[28] To account for this problem, we estimated each regression using Driscoll and Kraay's standard errors[29] – which correct not only for heteroskedasticity and general forms of cross-sectional ("spatial") correlation, but also for temporal dependence (Hoechle, 2007). For a robustness check, we also use cluster-robust

[25] Results for the whole population of companies are presented in Annex I.

[26] The standard F-tests for the presence of country, industry and time dummies strongly support (at the 1 per cent level) their inclusion in the productivity equation. In the sensitivity analysis, we also considered country-specific time trends. However, none of the estimated coefficients of the time trend was statistically significant (even at the 10 per cent level) and, thus, these trend variables were not included in the preferred specifications.

[27] Stata command xtserial.

[28] The tests for cross-sectional dependence (contemporaneous correlation) have not been performed due to insufficient observations across the panel. According to Baltagi (2008), cross-sectional dependence is a problem mainly in macro panels with long time series (over 20-30 years), which is not the case in our analysis.

[29] Stata command xtscc.

variance estimators (i.e. clustered standard errors) at country-sector level, which account for both heteroskedasticity and serial correlation[30]. Statistical inference based on these cluster-robust standard errors broadly confirms the previous results.

"Outlier" observations can exert a strong influence on the fitted least square regression models, both on the slopes and the intercept. For this reason, we use the Cook's distance or Cook's D[31] statistical approach to deal with outliers in the least-squares regression analysis. The Cook's D methodology identifies influential data points by estimating robust regression[32] using two different functions assigning weights to the observations, Huber weights and biweights (Hamilton 1991). This technique assigns each observation a weight between 0 and 1, where a lower weight corresponds to a higher residual. In order to eliminate the effect of the outliers in the fitted model, we exclude the observations that are assigned with a weight equal to zero.[33]

Results from the first stage of the analysis suggest that an increase in the stringency of regulation, measured by the PMR ETCR indicator, has a negative impact on the churning dynamics of small firms (LHS Table 2). As expected, GDP growth significantly contributes to explain business churning, in line with our priors.[34] The analysis provides different and somewhat mixed results for those companies that employ more than 10 employees (RHS Table 2). For these companies, a more stringent regulation seems to depress business churning through the exit channels – i.e. the less competition-friendly the regulatory environment, the more likely incumbent firms are to remain in business, regardless of their productivity and efficiency performance. On the other hand, the entry of new big competitors into the market seems not to be deterred by a stricter regulation, possibly because this effect captures companies that may start already fairly large and who are more able to pay any costs associated with regulation. When the whole population of companies (small and large companies together) is analysed, a stricter regulation seems to negatively affect churning, especially the death rate component [see Table A1 in Annex 1]. The results in Table 2 are robust across various alternative specifications (see Annex I Tables A2 and A3 where the GDP growth variable is excluded).

[30] David M. Drukker, 2003. *Testing for serial correlation in linear panel-data models*, The Stata Journal 3, Number 2, pp. 168–177.

[31] Excluding observations for which Cook's D is above 1.

[32] We used *rreg* Stata command.

[33] Trimmed observations were almost exclusively attributable to one of two cases. The first category are individual observations in small countries (Luxembourg, Slovenia, Slovakia, Czech Republic) where in some years particularly high death or birth rates can happen even without a particular reason, due to low denominator (number of active firms). The second category is connected with the years of a financial crisis, where some sectors in some countries were particularly hard hit – for example we trim the observations of death rates in Portugal in real estate and construction.

[34] Namely, positive (negative) growth leads to an increase (decrease) in birth (death) rates.

Table 2

Impact of product market regulation (PMR ETCR) on business churning – first step results

	companies < 10 employees			companies >= 10 employees		
	(1)	(2)	(3)	(4)	(5)	(6)
1st step	Churn rate	Birth rate	Death rate	Churn rate	Birth rate	Death rate
GDP growth (t-1)	0.0523	0.1667**	-0.0980***	-0.0549*	0.0007	-0.0470**
	(0.0748)	(0.0649)	(0.0311)	(0.0224)	(0.0097)	(0.0172)
PMR ETCR	-0.0344***	-0.0176***	-0.0133**	0.0001	0.0024***	-0.0030*
	(0.0052)	(0.0037)	(0.0043)	(0.0020)	(0.0004)	(0.0016)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	1204	1241	1230	1464	1496	1496
R-sq	0.6294	0.5239	0.6595	0.7039	0.6410	0.7092

Notes: Fixed-Effects Model. Dataset trimmed for outliers. Robust Driscoll and Kraay's standard errors in parentheses:* p<0.1, ** p<0.05, *** p<0.01

Overall, we can conclude from these results that a higher degree of competition due to deregulation positively affects the process of firm exit, regardless of their size. In terms of birth rates, the impact of relaxing regulation on the creation of new firms is mixed – positive for small companies and negative for larger ones. It is worth noting that since new businesses usually start small, it sounds reasonable that product market deregulation has a stronger and positive effect on the entry rate of companies with a small size. As a result, product market deregulation seems to play a key role in fostering the creative destruction process for small firms.

5.2 The effect of business churning on productivity growth

The second stage of the analysis quantifies the relationship between business churning and aggregate TFP growth at the industry-level. As in the previous stage, we estimate the model for the two different firm size categories.

Following the approach employed by Cincera and Galgau (2005) we estimate the following equation:

$$\Delta\, ln\_tfp_{ijt} = \beta_0 + \beta_1 * GDPgrowth_{it-1} + \beta_2 * rate_{ijt-1} + \gamma_i + \delta_j + \omega_t + \varepsilon_{ijt} \quad \text{(a1)}$$

where $\Delta\, ln\_tfp_{ijt}$ is the total factor productivity dynamics at country-sector level. $rate_{ijt}$ identifies birth, death and churn rates of companies in a given country, sector and time, while GDP growth ($GDPgrowth_{it}$) refers only to country and time and do not differ by sector. γ_i, δ_j and ω_t represent country, sector and time fixed effects while ε_{ijt} is the error term. In order to eliminate possible endogeneity issues, the GDP growth and the churn/birth/death rates are lagged one period. We expect the parameters for GDP growth and churn/birth/death rates to be all positively signed.

Table 3

Impact of business churning on aggregate productivity

	companies < 10 employees			companies >= 10 employees		
	(1)	(2)	(3)	(4)	(5)	(6)
2nd step	TFP growth					
GDP growth (t-1)	0.0321	0.0547	0.0424	0.0594	0.1033	0.0541
	(0.1193)	(0.0897)	(0.1173)	(0.0849)	(0.0787)	(0.0745)
Churn rate (t-1)	0.0330			0.3235***		
	(0.0259)			(0.0696)		
Birth rate (t-1)		0.0286			0.2905**	
		(0.0289)			(0.1058)	
Death rate (t-1)			0.0908			0.5893***
			(0.0629)			(0.1244)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	1323	1357	1334	1653	1715	1666
R-sq	0.2565	0.2590	0.2587	0.2543	0.2524	0.2582

Notes: Fixed-Effects Model. Dataset trimmed for outliers. Robust Driscoll and Kraay's standard errors in parentheses:* p<0.1, ** p<0.05, *** p<0.01

As envisaged by the literature, results from the equation show a positive and statistically significant relationship between the business dynamics variables, as measured by the churn/birth/death rates, and the aggregate productivity growth at sector level (Table 3). As shown in Table 3 (RHS), the TFP growth of companies employing more than 10 employees is substantially affected by the business churning channel: the least productive firms exit the market, thereby allowing surviving firms to take advantage of all the increasing returns and increasing their aggregate productivity dynamics, while aggregate productivity can also increase merely by the exit of less productive firms; at the same time, entries of companies with more than ten employees have a positive and significant impact on the TFP growth at industry level. [35] On the contrary, results for small companies (LHS Table 3) do not deliver significant impacts of the business churning on TFP growth. Therefore, we can conclude that enhancing the creative destruction process seems to benefit the aggregate sectoral productivity of companies employing more than ten employees, while the churning of companies with a small size does not directly lead to an increase in TFP growth. Note that results in Annex 1 Table A6 re-estimates the same equations but with GDP growth at time t and finds statistically significant positive impacts of churning (as well as births and deaths), as well as GDP, on TFP for all categories of firm size, including firms with less than ten employees.[36]

To check whether technological diffusion has an impact on enhancing the aggregate sectoral productivity of companies, we follow Nicoletti and Scarpetta (2003) and include two additional variables to the above specification: the TFP dynamics of the leading country in a given sector[37] and a TFP technology catch-up variable which partly captures technological diffusion and is proxied by the lagged ratio between the productivity level of a given country sector and the productivity level of the country leader in that sector (Table 4).[38,39] :

$$\Delta\, ln\_tfp_{ijt} = \beta_0 + \beta_1 * GDPgrowth_{it-1} + \beta_2 * rate_{ijt-1} + \beta_3 \max\_\Delta\, ln\_tfp_{jt} + \beta_{34}\left({tfp_{ijt-1}}\big/{\max\_tfp_{jt-1}} \right) + \gamma_i + \delta_j + \omega_t + \varepsilon_{ijt} \qquad \text{(a2)}$$

where $\max\_\Delta\, ln\_tfp_{jt}$ is the TFP growth in the leader country and ${tfp_{ijt-1}}\big/{\max\_tfp_{jt-1}}$ measures the technological catch-up vis-à-vis the leader country. The equations are estimated, as in the previous equations, by means of an OLS panel regression, including country, sector and time fixed effects. As before, we perform the estimation using Driscoll and Kraay's standard errors.

Table 4

[35] In support of our findings, it is worth noting that small companies entering the market are generally less efficient than large entrants and incumbents. Hence, they seem to struggle to narrow down the efficiency differential with large firms. See Taymaz, E., 2005. Are Small Firms Really Less Productive?, Small Business Economics.

[36] Meanwhile, Table A4 drops the GDP growth variable from the Table 3 regression and finds similar results for the exit rate..

[37] This variable captures possible technology diffusion from the leader country. We assume that the level of productive efficiency may also depend on knowledge transfer and technology absorption from the leader in a given country/sector.

[38] Following Nicoletti and Scarpetta (2003).

[39] 75% of the leading countries (per year and sector) were among those lightly regulated, as proxied by the PMR indicators being below average.

Impact of business churning on aggregate productivity

2nd step	companies < 10 employees			companies >= 10 employees		
	(1)	(2)	(3)	(4)	(5)	(6)
	TFP growth					
GDP growth (t-1)	0.0384	0.0374	0.0466	0.0798	0.0731	0.0688
	(0.1173)	(0.1061)	(0.1166)	(0.0909)	(0.0916)	(0.0568)
Churn rate (t-1)	0.0198			0.2752***		
	(0.0249)			(0.0640)		
Birth rate (t-1)		0.0171			0.2851***	
		(0.0357)			(0.0777)	
Death rate (t-1)			0.0665			0.4715**
			(0.0652)			(0.1398)
TFP catch-up	-0.0844***	-0.0872***	-0.0833***	-0.0730***	-0.0772***	-0.0713***
	(0.0117)	(0.0128)	(0.0115)	(0.0071)	(0.0083)	(0.0064)
TFP leader	0.1155	0.1224	0.1170	0.1117	0.1096	0.1087
	(0.0926)	(0.0958)	(0.0924)	(0.0779)	(0.0772)	(0.0760)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	1324	1361	1335	1656	1720	1669
R-sq	0.2852	0.2908	0.2874	0.2783	0.2765	0.2780

Notes: Fixed-Effects Model. Dataset trimmed for outliers. Robust Driscoll and Kraay's standard errors in parentheses:* p<0.1, ** p<0.05, *** p<0.01

The previous general findings presented in Table 3 are confirmed in the above more elaborate specification (Table 4). Table 4 shows that the TFP leader variables tend to be not statistically significant, while the statistical significance of the TFP catch-up variable suggest that technological diffusion may play role in TFP growth. Evidence from the literature suggest that technology diffusion and adoption play a key role in enhancing firm productivity, and rely on substantial and well-directed technological efforts and on absorptive capacity (Cohen & Levinthal, 1989). In each industry, the countries that are further away from the technological frontier tend to experience higher levels of productivity growth as they try to catch-up with, and learn from the technology leader. However, the small magnitude of the TFP technology catch-up parameter in our empirical results in Table 4 suggests that technology diffusion may be hampered in Europe as catching up with the TFP leaders on productivity seems to be a weak and slow process[40] (for further results, please see Tables A5 and A6 in Appendix I which show that the results of the TFP catch-up and churning impacts on TFP are robust across various alternative specifications).[41] Results are consistent with the view that a high degree of product market regulation in EU countries can deter TFP-catch up and technological diffusion; hence product market reforms and deregulation may enhance the TFP catch-up process. In addition, as shown in Table A7 in Appendix I, further results reveal that the TFP catch-up process in central eastern European (CEE) countries, which are experiencing a convergence process, is faster than in the rest of the EU countries. As a result, when the catch-up variable is interacted with the CEE countries dummy, the magnitude of its coefficient is further reduced for the rest of the EU countries, implying that technology diffusion across more advanced EU countries is even slower than suggested by the results in Table 4.

Overall, our results confirm that a well-functioning technology transfer channel is essential for companies to achieve significant productivity gains. In this respect, it is worth reiterating that structural reforms help in creating a productivity-enhancing environment where the transfer of technology from the more efficient companies to the less efficient ones could be facilitated. The higher the capacity to absorb and adapt foreign knowledge for a given country-sector, the faster it would be to catch-up with the technology leader.

Overall, we performed a number of robustness checks to address technical issues with the analysis. First, we estimate both the first set of equations on regulation and churning (Tables A1-A3 in Annex I) and the TFP equations (Tables A4-A7) without the GDP growth as it may be a possible source of endogeneity, along with other various specifications. Overall, the results in the Appendix confirm the main findings of the analysis. Finally, to check the robustness of the TFP equations, we regress the residuals from the second step regressions (equation a1) on the PMR_ETCR index (Table A8 in Appendix I), following Ciapanna and Genito (2014). The idea behind this is to check whether there are other aspects in productivity dynamics that can be affected by a changing level of regulation. Therefore, we estimate the following equation:

$$\varepsilon_{ijt} = \beta_0 + \beta_1 PMR\_ETCR_{it} + u_{ijt}$$

where ε_{ijt} are residuals from the second step regressions (extended specification).

[40] While technology diffusion to frontier firms seems to have been increasingly fast in recent years, its diffusion to the rest of the firms has been increasingly slow, which in turn negatively affects the productivity growth of the total economy (Andrews et al., 2015).
[41] For example, excluding the GDP variable, or when pooling across all companies of all sizes, the TFP catch-up and churning impacts on TFP are robust across all specifications.

Since we argue that churn/birth/death rates are (partly) determined by product market regulation, we expect the coefficients of PMR ETCR to be insignificant. This is related to the fact that the effect of regulation, or at least the part impacting through business dynamics, is already captured in the first set of regressions. The coefficients prove low and statistically insignificant, confirming that product market regulation primarily affects productivity through the churning channel.

6. Conclusions

To conclude, our results show that reducing product market regulation helps to increase business dynamics through higher churning which, in turn, improves sectoral productivity performance.

We find that an increase in the stringency of regulation, proxied by the OECD's product market regulation ETCR indicator, negatively affects the business churn rate. In the case of firms with less than ten employees, results are confirmed for both transmission channels (death and birth rates), while in companies employing more than ten people, the impact of product market regulation on business churn tends to be more robust for firm exits (while total churning, the sum of entry and exit rates, also shows a negative and statistically significant impact from product regulation). However, it also sounds reasonable that product market deregulation mainly affects the creation of micro companies as usually new firms start small.

The second step of our analysis estimates the relationship between business dynamics and sectoral productivity (total factor productivity). Overall, we find a statistically significant positive correlation between our key dependent variables (churn, birth and death rates) and the TFP dynamics, which suggests that increased business churning is indeed associated with increased productivity. The results also show that a TFP-catch up process vis-a-vis TFP leaders may also be part of the determinants of productivity growth. However, although this suggests that technological diffusion from higher to lower productivity performers is ongoing, the parameters indicate that this is quite a slow and weak process in Europe which may be related to the product market regulation framework.

The results from our analysis point towards substantial benefits that could follow further deregulation in product markets. Such deregulation seems to be beneficial for fostering the entry of new companies, which usually start small. At the same time, providing supportive business regulatory environment would allow them to grow and become more productive. This could hold true especially in some of European countries, since the differences in the level of regulation, as measured by the product market regulation indices, and the trends observed in recent years, are very heterogeneous. However, we have to bear in mind that the conclusions are somewhat illustrative, given that they are based on aggregate regressions. As such, it's important to be aware of the limitations of the presented analysis. This holds true especially with regard to the information on the level of regulation available, since aggregate indexes do not allow for differentiation between various ways that regulation has been implemented across the countries. As far as data on business dynamism is concerned, enhancing the analysis with the use of granular, micro-level data could be a useful next step leading to a better understanding of the issues. This would possibly allow for a better understanding on the differences between firms in terms of their reaction to changes in the level of regulation.

7. Bibliography

Alfaro, L., & Chen, M. X. (2018). Selection and market reallocation: Productivity gains from multinational production. American Economic Journal: Economic Policy, 10(2), 1-38.

Andersson, L. F. (2007). Firm demography and aggregate productivity growth.

Arnold, J., Nicoletti, G., & Scarpetta, S. (2008). Regulation, allocative efficiency and productivity in OECD countries.

Anderton, R., Hantzsche, A., Savsek, S., & Tóth, M. (2017). Sectoral wage rigidities and labour and product market institutions in the Euro Area. Open Economies Review, 28(5), 923-965.

Baltagi, B. (2008). Econometric analysis of panel data. John Wiley & Sons.

Bartelsman, E., Haltiwanger, J., & Scarpetta, S. (2004). Microeconomic evidence of creative destruction in industrial and developing countries.

Bartelsman, E., Haltiwanger, J., & Scarpetta, S. (2013). Cross-country differences in productivity: The role of allocation and selection. American Economic Review, 103(1), 305-34.

Boone, J. (2008). A new way to measure competition. The Economic Journal, 118(531), 1245-1261.

Bordon, A. R., Ebeke, C., & Shirono, K. (2018). When Do Structural Reforms Work? On the Role of the Business Cycle and Macroeconomic Policies. In Structural Reforms (pp. 147-171). Springer, Cham.

Bourlès, R., Cette, G., Lopez, J., Mairesse, J., & Nicoletti, G. (2013). Do product market regulations in upstream sectors curb productivity growth? Panel data evidence for OECD countries. Review of Economics and Statistics, 95(5), 1750-1768.

Brandt, N. (2005). Business dynamics and policies. OECD Economic Studies, 2004(1), 9-36.

Canton, E., Ciriaci, D., & Solera, I. (2014). The economic impact of professional services liberalisation (No. 533). Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.

Cette, G., Lopez, J., & Mairesse, J. (2017). Upstream product market regulations, ICT, R&D and productivity. Review of Income and Wealth, 63(s1).

Cincera, M., & Galgau, O. (2005). Impact of market entry and exit on EU productivity and growth performance (No. 0503013). EconWPA.

Ciriaci, D. (2014). Business dynamics and red tape barriers (No. 532). Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.

Cohen, W. M., & Levinthal, D. A. (1989). Innovation and learning: the two faces of R & D. The economic journal, 99(397), 569-596.

Cohen, W. M., & Levinthal, D. A. (2000). Absorptive capacity: A new perspective on learning and innovation. In Strategic Learning in a Knowledge economy (pp. 39-67).

Conway, P., De Rosa, D., Nicoletti, G., & Steiner, F. (2006). Regulation, competition and productivity convergence.

Decker, R. A., Haltiwanger, J., Jarmin, R. S., & Miranda, J. (2017). Declining dynamism, allocative efficiency, and the productivity slowdown. American Economic Review, 107(5), 322-26.

Diaz del Hoyo, J. L., Dorrucci, E., Heinz, F. F., & Muzikarova, S. (2017). Real convergence in the euro area: a long-term perspective.

Drukker, D. M. (2003). Testing for serial correlation in linear panel-data models. Stata Journal, 3(2), 168-177.

European Central Bank (2017). Economic Bulletin, Issue 3 / 2017 – Articles. The slowdown in euro area productivity in a global context.

European Commission (2014). Market Reforms at Work in Italy, Spain, Portugal and Greece. European Economy 5/2014, European Commission, Directorate-General for Economic and Financial Affairs.

Gal, P. N., & Hijzen, A. (2016). The short-term impact of product market reforms: A cross-country firm-level analysis. International Monetary Fund.

Griffith, R., & Harrison, R. (2004). The link between product market reforms and productivity: Direct and indirect impacts. The EU Economy: 2004 Review.

Griffith, R., Harrison, R., & Simpson, H. (2010). Product market reform and innovation in the EU. The Scandinavian Journal of Economics, 112(2), 389-415.

Hamilton, L. C. (1992). How robust is robust regression?. Stata Technical Bulletin, 1(2).

Hoechle, D. (2007). Robust standard errors for panel regressions with cross-sectional dependence. Stata Journal, 7(3), 281.

Jelili, R. B., & Goaid, M. (2009). Entry, Exit, Resource Reallocation and Productivity Growth in the Tunisian Private Manufacturing Industries. Middle East Development Journal, 1(2), 189-208.

Loayza, N. V. (Ed.). (2010). Business regulation and economic performance. World Bank Publications.

Masuch, K., Anderton, R., Setzer, R., Benalal, N. (2018). Structural policies in the euro area.

Moulton, B. R. (1990). An illustration of a pitfall in estimating the effects of aggregate variables on micro units. The review of Economics and Statistics, 334-338.

Nickell, S. J. (1996). Competition and corporate performance. Journal of political economy, 104(4), 724-746.

Nicodème, G., & Sauner-Leroy, J. B. (2004). Product market reforms and productivity: a review of the theoretical and empirical literature on the transmission channels (No. 218). Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.

Nicoletti, G., & Scarpetta, S. (2003). Regulation, productivity and growth: OECD evidence. Economic policy, 18(36), 9-72.

Olley, G. S., & Pakes, A. (1992). The dynamics of productivity in the telecommunications equipment industry (No. w3977). National Bureau of Economic Research.

Pelkmans, J. (2010). Product Market Reforms in EU Countries: Are the methodology and evidence sufficiently robust?.

Schiantarelli, F. (2005). Product market regulation and macroeconomic performance: A review of cross-country evidence (Vol. 1791). World Bank Publications.

Schumpeter, J. A. (1942). Socialism, capitalism and democracy. Harper and Brothers.

Taymaz, E. (2005). Are small firms really less productive?. Small Business Economics, 25(5), 429-445.European Commission (2013). Product Market Review 2013: Financing the real economy. European Economy 8/2013, European Commission, Directorate-General for Economic and Financial Affairs.

Wooldridge, J. M. (2010). Econometric analysis of cross section and panel data. MIT press.

Annex I

Table A1

Impact of product market regulation (PMR ETCR) on business churning – all companies

	All companies		
	(1)	(2)	(3)
1st step	Churn rate	Birth rate	Death rate
GDP growth (t-1)	-0.0163	0.1070	-0.1121**
	(0.0783)	(0.0538)	(0.0330)
PMR ETCR	-0.0169**	-0.0079	-0.0087**
	(0.0072)	(0.0050)	(0.0037)
Country dummies	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
N	1554	1599	1560
R-sq	0.5960	0.4867	0.6592

Notes: Fixed-Effects Model. Dataset trimmed for outliers. Robust Driscoll and Kraay's standard errors in parentheses:* p<0.1, ** p<0.05, *** p<0.01

Table A2

Impact of product market regulation (PMR ETCR) on business churning (GDP growth variable excluded)

	companies < 10 employees			companies >= 10 employees		
	(1)	(2)	(3)	(4)	(5)	(6)
1st step	Churn rate	Birth rate	Death rate	Churn rate	Birth rate	Death rate
PMR ETCR	-0.0349***	-0.0166***	-0.0145***	-0.0014	0.0024***	-0.0042***
	(0.0049)	(0.0038)	(0.0045)	(0.0013)	(0.0004)	(0.0012)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	1225	1261	1251	1548	1581	1581
R-sq	0.6292	0.5145	0.6581	0.6919	0.6326	0.7065

Notes: Fixed-Effects Model. Dataset trimmed for outliers. Robust Driscoll and Kraay's standard errors in parentheses:* p<0.1, ** p<0.05, *** p<0.01

Table A3

Impact of product market regulation (PMR ETCR) on business churning (GDP growth variable excluded) – all companies

	All companies		
	(1)	(2)	(3)
1st step	Churn rate	Birth rate	Death rate
PMR ETCR	-0.0174***	-0.0064*	-0.0086**
	(0.0053)	(0.0033)	(0.0039)
Country dummies	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
N	1638	1691	1644
R-sq	0.5848	0.4705	0.6493

Notes: Fixed-Effects Model. Dataset trimmed for outliers. Robust Driscoll and Kraay's standard errors in parentheses:* p<0.1, ** p<0.05, *** p<0.01

Table A4

Impact of business churning on aggregate productivity (GDP growth variable excluded) – all companies

	All companies		
	(1)	(2)	(3)
1st step	TFP growth		
Churn rate (t-1)	0.02623		
	(0.0168)		
Birth rate (t-1)		0.0006	
		(0.0251)	
Death rate (t-1)			0.1427***
			(0.0406)
Country dummies	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
N	1718	1772	1724
R-sq	0.2477	0.2469	0.2494

Notes: Fixed-Effects Model. Dataset trimmed for outliers. Robust Driscoll and Kraay's standard errors in parentheses:* p<0.1, ** p<0.05, *** p<0.01

Table A5

Impact of business churning on aggregate productivity (GDP growth variable excluded) – all companies

	All companies					
	(1)	(2)	(3)	(4)	(5)	(6)
2nd step	TFP growth					
Churn rate (t-1)	0.0262			0.0258		
	(0.0168)			(0.0182)		
Birth rate (t-1)		0.0006			0.0040	
		(0.0251)			(0.0240)	
Death rate (t-1)			0.1427***			0.1374**
			(0.0406)			(0.0437)
TFP catch-up	-0.0728***	-0.0775***	-0.0737***	-0.0688***	-0.0704***	-0.0699***
	(0.0073)	(0.0072)	(0.0072)	(0.0072)	(0.0070)	(0.0070)
TFP leader	-	-	-	0.1083	0.1109	0.1034
				(0.0811)	(0.0814)	(0.0794)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	1718	1772	1724	1718	1775	1725
R-sq	0.2477	0.2469	0.2494	0.2578	0.2568	0.2593

Notes: Fixed-Effects Model. Dataset trimmed for outliers. Robust Driscoll and Kraay's standard errors in parentheses:* p<0.1, ** p<0.05, *** p<0.01

Table A6

Impact of business churning on aggregate productivity (GDP growth at time t) – companies employing more than 10 employees

	companies >= 10 employees					
	(1)	(2)	(3)	(4)	(5)	(6)
2nd step	TFP growth					
GDP growth	0.0068***	0.0064***	0.0070***	0.0068***	0.0066***	0.0070***
	(0.0006)	(0.0006)	(0.0005)	(0.0006)	(0.0005)	(0.0006)
churn (t-1)	0.0034***			0.0028***		
	(0.0006)			(0.0006)		
birth rate (t-1)		0.0022**			0.0019*	
		(0.0009)			(0.0005)	
death rate (t-1)			0.0063***			0.0054***
			(0.0011)			(0.0015)
TFP Leader				0.0968	0.0934	0.1024
				(0.0693)	(0.0705)	(0.0731)
TFP catch-up				-0.0711***	-0.0790***	-0.0696***
				(0.0073)	(0.0079)	(0.0073)
constant	-0.0307***	-0.0540***	-0.0437***	0.0011	0.0373**	0.0121
	(0.0053)	(0.0070)	(0.0086)	(0.0153)	(0.0111)	(0.0158)
N	1644	1710	1662	1647	1714	1665
R-sq	0.3370	0.3254	0.3358	0.3532	0.3496	0.3565

Notes: Fixed-Effects Model. Dataset trimmed for outliers. Robust standard errors in parentheses, adjusted for clustering by country-sector: * p<0.1, ** p<0.05, *** p<0.01.
Source: Masuch, K., Anderton, R., Setzer, R., Benalal, N. (2018). Structural policies in the euro area.

Table A7

Impact of business churning on aggregate productivity – CEE countries

	All companies		
	(1)	(2)	(3)
1st step	TFP growth		
GDP growth (t-1)	0.0810	0.0782	0.1091
	(0.1018)	(0.0984)	(0.1021)
Churn rate (t-1)	0.0413**		
	(0.0195)		
Birth rate (t-1)		0.0213	
		(0.0324)	
Death rate (t-1)			0.1518***
			(0.0431)
CEE*TFP catch-up	-0.1170***	-0.1075***	-0.1207***
	(0.0303)	(0.0286)	(0.0311)
TFP catch-up	-0.0481***	-0.0521***	-0.0470***
	(0.0046)	(0.0048)	(0.0041)
CEE	0.0452**	0.0340**	0.0424**
	(0.0164)	(0.0142)	(0.0159)
Country dummies	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
N	1694	1750	1704
R-sq	0.2651	0.2632	0.2687

Notes: Fixed-Effects Model. Dataset trimmed for outliers. Robust Driscoll and Kraay's standard errors in parentheses:* p<0.1, ** p<0.05, *** p<0.01

Table A8

Impact of product market regulation (PMR ETCR) on residuals from the second stage analysis

	All companies		
	(1)	(2)	(3)
1st step	Residuals from the second stage analysis		
PMR ETCR	-0.0006	-0.0000	-0.0009
	(0.0008)	(0.0012)	(0.0010)
Country dummies	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
N	1375	1430	1385
R-sq	0.09230	0.09155	0.09134

Notes: Fixed-Effects Model. Residuals from the second stage analysis (regression a1) are regressed on PMR ETCR. Dataset trimmed for outliers. Robust Driscoll and Kraay's standard errors in parentheses: * p<0.1, ** p<0.05, *** p<0.01