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PRODUCT MARKETS' DEREGULATION: A MORE PRODUCTIVE, MORE EFFICIENT AND MORE RESILIENT ECONOMY?

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ABSTRACT/RESUMÉ

Product markets' deregulation: a more productive, more efficient and more resilient economy?

This paper assesses the impact of product market deregulation in upstream sectors on the productivity growth of firms in downstream sectors (i.e. those firms using the output of the reformed sectors as inputs in their production process). Relying on a firm level database for the period 2004-2014 covering all Portuguese firms, we show that reforms bring productivity gains already in the short-run and that are sustained in the long-run. The effects are more positive for those further away from the technological frontier and are also heterogeneous across sectors. In addition, reforms potentiate the exit of the least productive firms, improving the resource allocation in the economy by a process of selection – for the least productive, only those that have scope to catch-up with the frontier are able to remain. Finally, we show that the adoption of product market reforms in upstream sectors leads to a more resilient economy, better equipped to face adverse shocks.

JEL codes: D04, D22, L43, L51

Keywords: Structural Reforms, Product Markets, Total Factor Productivity, Growth, Exit Rates, Resource Allocation, Resilience.

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Déréglementation des marchés de produits : une économie plus productive, plus efficiente et plus résiliente?

Nous évaluons dans ce document l'impact de la déréglementation des marchés de produits dans les secteurs d'amont sur la croissance de la productivité des entreprises appartenant aux secteurs d'aval (i.e. des entreprises qui utilisent la production des secteurs réformés comme intrants dans leur propre processus de production). À partir d'une base de données sur les entreprises relatives à la période 2004-2014 couvrant l'ensemble des entreprises portugaises, nous montrons que les réformes se traduisent déjà par des gains de productivité à court terme, et que ceux-ci perdurent à long terme. Les effets induits sont d'autant plus positifs que les entreprises concernées sont éloignées de la frontière technologique. Cette hétérogénéité des effets produits se retrouve également lorsqu'on compare les secteurs d'activité. En outre, les réformes rendent plus efficace la sortie des entreprises les moins productives du marché, améliorant du même coup le redéploiement des ressources dans l'économie par un processus de sélection – parmi les entreprises les moins productives, seuls celles qui ont un potentiel de rattrapage par rapport à la frontière sont en mesure de subsister. Enfin, nous montrons que l'adoption de réformes des marchés de produits dans les secteurs d'amont débouche sur une économie plus résiliente, mieux équipée pour faire face aux chocs négatifs.

Codes JEL : D04, D22, L43, L51

Mots clés : réformes structurelles, marchés de produits, productivité totale des facteurs, croissance, taux de sortie, répartition des ressources, résilience.

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PRODUCT MARKETS' DEREGULATION: A MORE PRODUCTIVE, MORE EFFICIENT AND MORE RESILIENT ECONOMY?

By Gustavo Monteiro, Ana Fontoura Gouveia, Sílvia Santos [1]

1. Introduction

1. In recent years, Portugal implemented a large number of structural policies aimed at increasing productivity and improving resilience to shocks. Reforms covered many areas, such as the labour market, education and skills, the judicial and fiscal systems and several product market frameworks.

2. Product market reforms were a key area, given the dimension of the pre-existing challenges and the expected payoffs.[2] Indeed, in 2008 Portugal ranked 26th out of 34th countries in the OECD Product Market Regulation index, being one of the less competition-friendly countries.[3] In this context, the product market reform agenda covered a large number of measures, aimed at fostering competition and reducing the excessive rents of sheltered sectors. Examples of the main measures implemented during the economic adjustment programme (2011-2013) were the liberalization of gas and electricity markets, with the phasing out of regulated tariffs; negotiations with energy producers to reduce rents and eliminate the tariff debt; creation of a transport regulator; the reduction of ports operating costs; new telecommunications regulatory framework, including the reduction of termination rates and lower restrictions on customers' mobility; competition enhancing framework in the postal sector; several steps in the direction of the liberalisation of 19 regulated professions; revision of the competition law and improved enforcement (e.g. with the creation of specialized courts) and, elimination of State special rights in private companies.

3. As a consequence, Portugal displayed a clear positive trend between 2008 and 2013, climbing 14 places in the OECD's Product Market Regulation ranking and thus reaching the 12th position. According to the 2013 release, the country is in line with the OECD average for all the dimensions of the indicator - state control, barriers to entrepreneurship and barriers to trade and investment – and for all sectoral breakdowns – networks, retail and professional services.

4. By using firm-level data from 2004 to 2014 and the OECD's PMR indicators, we assess the impact of the liberalization of product markets in Portugal on firms' productivity, reallocation of resources and resilience to shocks. In particular, we consider the effect of deregulation of product market sectors in

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2. Several studies show that product market reforms produce the largest economic gains when compared to other reforms (see, for instance Égert and Gal, 2016 and Barnes, Bouis, Briard, Dougherty and Eris, 2013).

3. It should be noted that the index is a *de jure* measure, thus not assessing outcomes.

downstream industries, i.e. on firms using these markets' output as input in their production process. This is possible due to a newly available OECD dataset relying on input-output matrices (Égert and Wanner, 2016).[4]

5. We provide the following contributions. Firstly, we analyse the impact of reforms on productivity, showing that, on top of long-term gains, deregulation in upstream sectors increases productivity growth already in the short-term. These effects are stronger for those further away from the technological frontier, which had less scope to deal with the inefficiencies and market power of the upstream sectors. In addition, we show that the effects of reforms are heterogeneous across sectors. This is an expected result, as different sectors have different competitiveness structures, business models and initial regulatory stances. Also, reforms are expected to induce resource reallocations across sectors, meaning that there will be winners and loosers.

6. Secondly, we assess how the reforms affect firms' exit. Higher competition upstream is expected to reduce prices (or increase quality) of intermediate inputs, fostering entry in downstream sectors via increased margins. This, in turn, will increase competition downstream, creating pressures for the less productive to leave. Using a probit model, we show that less productive firms are more prone to exiting the market under a more flexible upstream regulatory setting (while for those that remain in the market, there are actually productivity gains). This result highlights the relevance of reforms to promote a more efficient resource allocation, by a process of firm selection: the least productive firms that have scope to improve and to catch-up with the frontier are able to remain in the market; but those that do not have conditions to enhance their productivity are forced to leave.

7. Finally, we assess the effects of reforms on firms' resilience to shocks. Relying on a difference-in-differences estimation and comparing two groups of firms – one more affected by the reforms and the other not as much – we show that previously enacted reforms allow firms to better manage the 2011 crisis, with a lower reduction in productivity.

8. This empirical contribution, by providing evidence on the benefits of already enacted reforms, is key in promoting ownership and sustaining the reform momentum. This is particularly important in product markets, where vested interests are in general a strong impediment to reforms (as costs are concentrated on a small number of stakeholders, while gains are diffuse). The existence of sectoral differences also underscores the need to fine-tune policy action, in order to take into account sectoral specificities.

9. The paper proceeds as follows: Section 2 explores the most relevant literature and Section 3 presents the methodology. Section 4 introduces the database and the variables used and Section 5 provides the empirical results. Finally, Section 6 concludes.

4. This type of indicators was originally explored by Conway and Nicoletti (2006).

2. Literature Review

10. The long-run positive impact of product market reforms on productivity and growth is a well-established result, both in model-based simulations (e.g. Arpaia, Alfonso, Roeger, Varga and Veld, 2007; Everaert and Schule, 2008; Andrés, Arce and Thomas, 2014; IMF, 2016) and in applied econometric research, using aggregate, sectoral and firm-level data (e.g. Égert and Gal, 2016; Arnold and Barbosa, 2015; Barnes, Bouis, Briard, Dougherty and Eris, 2013; Bouis and Duval, 2011; Bouis, Causa, Demmou, Duval and Zdzienicka, 2012; IMF, 2015; and OECD, 2015).

11. However, these longer-run effects take time to materialize and may even be negative in the short-run – for instance, if the reforms induce incumbents to leave the market, this implies, at least in the short-run, physical and human capital scrapping, contracting aggregate supply; the increased unemployment due to the exit of the least productive firms increases unemployment, inducing also a reduction in short-term aggregate demand; agents' possible perception of increased income insecurity may increase precautionary savings, further reducing aggregate demand.

12. The results in the model-based literature indeed point to the presence of these short-term costs for small open economies (Cacciatore, Duval, Fiori and Ghironi, 2015), for economies at the zero lower bound (Eggertsson, Ferrero and Raffo, 2013) and during downturns (IMF, 2016).

13. The evidence on applied econometric literature corroborates that short-term gains are not granted. For instance, while Cacciatore and Fiore (2015) and Bouis, Causa, Demmou, Duval and Zdzienicka (2012) find evidence of short-term costs, Gal and Hijzen (2016) and Barone and Cingano (2011) show that product market reforms bring gains already in the short-run. Firm-level national studies, such as Forlani (2012) for France and Lanau and Topalova (2016) for Italy, also provide evidence of short-term gains.

14. Both short-run and long-run effects of reforms are mediated by a number of factors. One factor underlined by the literature is the role of the distance to frontier. For instance, Nicoletti and Scarpetta (2003) show that, in manufacturing, the gains are greater the further a given country is from the technology leader. The same result is found by Gouveia, Santos and Gonçalves (2017), considering the distance to the national technological leader. On the contrary, Arnold, Nicoletti and Scarpetta (2008) argue that regulation is particularly detrimental for firms that are close to international best practice. In the same vein, Bourles, Cette, Lopez, Mairesse and Nicoletti (2013), show that the effects of product market reforms are different for different firms, as increased competition may increase the returns to innovation for the most productive firms but reduce the incentives to innovate for the least productive.

15. Other authors highlight important sectoral differences. Dabla-Norris, Guo, Haksar, Kim, Kochhar, Wiseman and Zdzienicka (2015) and Gal and Hijzen (2016) show that the impact of product market reforms differs across industries, due to different levels of competition and regulation before the implementation of such reforms. In particular, by comparing the effect of upstream regulation on manufacturers and services, Gal and Hijzen (2016) show that, while the effect is positive for both, it is more visible for manufacturers, which is, in general, more competitive (and thus have more to gain in terms of increase output from potential price reductions made possible for lower priced inputs). By further exploring the direct effects on the reformed sectors, the authors argue that higher initial regulation may bring higher short-term costs but also larger long-term gains.[5]

16. Finally, a number of papers (e.g. IMF, 2016; Adhikari, Duval, Hu and Loungami, 2016; and Dabla-Norris, Guo, Haksar, Kim, Kochhar, Wiseman and Zdzienicka, 2015) argue that the macroeconomic

5. In line with these results, Égert and Gal (2016) and Bouis, Causa, Demmou, Duval and Zdzienicka (2012) show that the impact of reforms is not independent of the initial conditions nor of other reforms.

conditions influence the impact of structural reforms, notably in the short-run, with downturns reducing the expected gains.[6]

17. In a nutshell, the existing empirical literature shows that liberalized product markets foster productivity growth in the long-run, while highlighting important heterogeneous effects and potential short-run costs. Overall, gains are grasped due to a more competitive environment, which decreases mark-ups in upstream sectors and increases churn-rates. The first effect was already studied for the Portuguese economy (Amador and Soares, 2013 and Folque, 2017), showing the important role of reforms, while highlighting the significant sectoral differences. For churn rates, existing literature shows that product market reforms potentiate firm entry and exit (European Commission, 2005; Schiantarelli, 2005; and Lanau and Topalova, 2016, Gal and Hijzen, 2016). The reduction in mark-ups and the increased churn rates improve the allocation of resources within the economy, fostering productivity growth. Indeed, the link between a more efficient resource allocation and higher productivity is widely explored in the literature.[7]

18. In addition to higher productivity growth, product market reforms are also expected to improve the economy's shock resilience, a result corroborated by Duval, Elmeskov and Vogel (2007). Ernst, Gong and Semmler (2007) also conclude that these reforms reduce consumption volatility in the economy. Pelkmans, Montoya and Maravalle (2008) show that product market reforms lubricate shock adjustments, price stickiness and inflation persistence. Finally, Cacciatori and Fiori (2016) prove that business cycle fluctuations and economic volatility decrease with the implementation of product market reforms.

19. Following this literature, we investigate the impact of the deregulation of upstream sectors which occurred in Portugal in recent years. In particular, we assess the short-run and long-run effects on downstream firms' productivity, taking special attention to sectoral differences and to heterogeneous effects for firms with different initial productivity levels. Additionally, we assess if reforms are fostering a more efficient allocation of resources, by potentiating the exit of the least productive firms with no growth potential. Finally, we investigate if reforms improve the resilience to adverse shocks.

3. Methodology

20. This section outlines the methodology of each part of the paper. Firstly, we investigate the relationship between product market regulation in upstream sectors and firms' performance in downstream ones. Our baseline equation follows the one developed in Gouveia, Santos and Gonçalves (2017), which builds on the the country-industry approach followed by Bourlès, Cette, Lopez, Mairesse and Nicoletti (2010). We depart from the notion that, in the long-run, the TFP of an individual firm depends both on the TFP at the (national) technological frontier and on the regulatory impact on that firm of upstream regulation. In this context, we consider the following Error Correction Model[8]:

6. The studies presented in the paragraphs above evaluate the impact of product market reforms from two angles: their direct effect on regulated sectors (which are usually upstream sectors, such as electricity or gas) and their effects on the economy at large, by their impact on downstream sectors (which use the output of upstream sectors as inputs in the production process). For instance, while Gal and Hijzen (2016) and Lanau and Topalova (2016) focus mainly on upstream effects, Barone and Cingano (2011), Forlani (2012) and Bourles, Cette, Lopez, Mairesse and Nicoletti (2013) study the impact of reforms on downstream industries. The latter are based on sectoral or firm-level intensities of upstream inputs usages.

7. For instance, Foster, Haltiwanger, and Krizan (2001) and Restuccia and Rogerson (2007), both using firm-level data for the United States, conclude that a better resource allocation leads to productivity improvements.

8. For the statistical properties of Error Correction Models, please refer to Hendry (1996).

$$\Delta \ln TFP_{i,k,t} = \beta_0 + \beta_1 \Delta \ln TFPFrontier_{k,t} + \beta_2 \Delta Regimpact_{k,t} + \delta [\ln TFP_{i,k,t-1} - \alpha_1 \ln TFPFrontier_{k,t-1} - \alpha_2 Regimpact_{k,t-1}] + \sum_{s=1}^{4} \psi_i D_i + \alpha_k + \alpha_t + \alpha_r + \varepsilon_{i,k,t} \quad [1]$$

Where $\Delta \ln TFP_{i,k,t}$ is the growth of total factor productivity for firm i in sector k at year t. $\Delta \ln TFPFrontier_{k,t}$ stands for the productivity growth of the sectoral technological frontier within the sector k. $Regimpact_{k,t-1}$, our regulatory variable, is an index that ranges from 0 (low impact of regulation in downstream sectors) to 1 (high impact).[9] Hence, we expect a negative coefficient for this variable. Additionally, sectoral, time and region fixed effects are included (α_k , α_t , α_r, respectively) to control for characteristics that are specific to the sector, year and region. Firm size controls are also included ($\sum_{s=1}^{4} \psi_i D_i$).

21. By restricting α_1 to unity in equation [1], we can rewrite it in terms of the firms' distance to the technological frontier (DTF, defined, at sectoral level, as TFP at the top decile minus TFP of the individual firm).[10]

$$\Delta \ln TFP_{i,k,t} = \beta_0 + \beta_1 \Delta \ln TFPFrontier_{k,t} + \beta_2 \Delta Regimpact_{k,t} \eta[DTF_{i,k,t-1} + \alpha_2 Regimpact_{t-1}] + \sum_{s=1}^{4} \psi_i D_i + \alpha_k + \alpha_t + \alpha_r + \varepsilon_{i,k,t} \quad [2]$$

22. By estimating equation [1], β_2 gives us the effect of the reform in the short-run while α_2 provides us with an estimate of long-term effects. While, in line with the literature, α_2 is expected to be negative, the sign of β_2 may be positive or negative. β_1 and η (defined as $-\delta$) allow us to assess whether more productive firms are spreading innovative features across the economy through so-called diffusion (or pass-through) mechanisms and whether there is a process of catching-up.

23. Given that the existing literature highlights the existence of heterogeneous effects, we assess potential differences across firm productivity levels by interacting our regulatory variable with the distance to frontier:[11]

$$\Delta \ln TFP_{i,k,t} = \beta_0 + \beta_1 \Delta \ln TFPFrontier_{k,t} + \beta_2 \Delta Regimpact_{k,t} \eta[DTF_{i,k,t-1} + \alpha_2 Regimpact_{t-1} + \alpha_3 Regimpact_{t-1} * DTF_{i,k,t-1}] + \sum_{s=1}^{4} \psi_i D_i + \alpha_k + \alpha_t + \alpha_r + \varepsilon_{i,k,t} \quad [3]$$

24. The long-term impact of reforms is thus given by $\alpha_2 + \alpha_3 DTF_{i,k,t-1}$.

25. The impact on productivity may be driven by changes in the intensive margin (i.e. changes in the TFP of firms in the market) or in the extensive margin (i.e. exit of firms with lower TFP). We investigate this second mechanism through the probit equation:

$$\Pr(Exit_{i,k,t}) = \beta_0 + \beta_1 Regimpact_{k,t-1} * \ln TFP_{i,k,t-1} + \beta_2 Regimpact_{k,t-1} + \beta_3 lnTFP_{i,k,t-1} + \varepsilon_{i,k,t} \quad [4]$$

9. The index may increase because the downstream sector relies more heavily on regulated upstream sectors or because upstream regulation is tightened.

10. The definition of the technological frontier as firms belonging to the top decile in terms of productivity is the approach also followed in OECD (2016b).

11. The same is done in Bourlès, Cette, Lopez, Mairesse and Nicoletti (2010).

Where $Exit_{i,k,t}$ is equal to 1 when a firm exits the market and 0 otherwise, $TFP_{i,k,t-1}$ stands for the level of productivity and $Regimpact_{i,k,t-1}$ is defined as in [1]. If reforms potentiate the exit of low productivity firms, the coefficient of the interaction term should be negative. The coefficient of $Regimpact_{i,k,t-1}$ is also expected to be negative, as a higher value represents a higher impact of regulation in upstream sectors. $TFP_{i,k,t-1}$ should also have a negative coefficient, because more productive firms are more likely to survive. We cluster standard errors at the sector level.

26. Finally, we apply a difference in differences (*DiD*) approach to evaluate whether firms in the downstream sectors that benefit the most from reforms (*treated* group) are more resilient to crisis. We expect their productivity levels to be less affected by the 2011 crisis, as compared to the *control* group (firms which are less affected by reforms).

27. Given that, up to 2011, the most important reforms tackled electricity and gas (Figure 1), we focus on these two upstream sectors to create the *treated* and *control* groups. The treated sectors use electricity and gas more intensively, i.e. belong to the 70th sectoral percentile, while the control sectors use them less intensely (30th sectoral percentile of gas and electricity usage).[12] To build the sectoral intensities, we use the OECD input-output matrix for the Portuguese economy. Importantly, we define the *treated* and *control* at the sectoral level, but we then implement a firm-level analysis.[13]

We thus estimate the following equation:

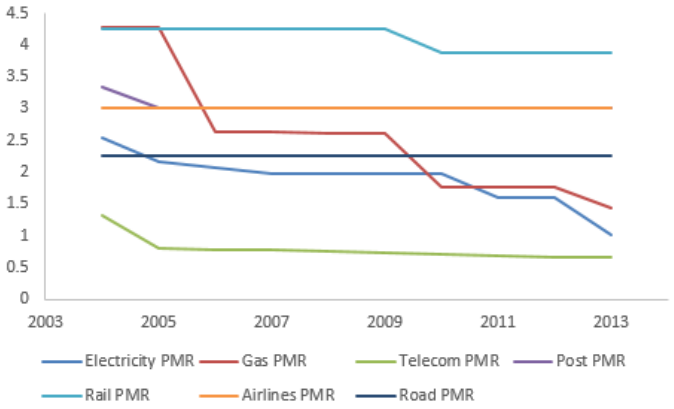
$$TFP_{i,k,t} = \alpha_0 + \alpha_1 T_k + \alpha_2 S_t + \alpha_3 T_k * S_t + \varepsilon_{i,k,t} \quad [5]$$

28. The dependent variable is the level of total factor productivity; T_k is the treatment dummy, i.e., it indicates firms in *treated* sectors; S_t is a time dummy that turns one from 2011 onwards, while $T_k * S_t$ is the *DiD* term, that we expect to have a positive coefficient, implying that the *treated* group reacts better to a negative shock, registering a lower decrease in TFP as compared to the *control* group.

12. Treated group sectors (70th percentile): Electricity, gas and water supply; Other non-metallic mineral products; Mining and quarrying; Basic metals; Hotels and Restaurants; Agriculture, hunting, forestry and fishing; Pulp, paper, paper products, printing and publishing and Rubber and plastics products; control group sectors (30th percentile): Post and telecommunications; Electrical machinery and apparatus, nec; R&D and other business activities; Construction; Motor vehicles, trailers and semi-trailers; Computer, Electronic and optical equipment; Renting of machinery and equipment and Coke, refined petroleum products and nuclear fuel.

13. Ideally, one would prefer to use firm-level intensities, but this information is not available in our firm-level database.

Figure 1. Product market regulation in network industries in Portugal



Source: OECD, Product Market Regulation Database. These indicators vary between 0 and 6 with 6 standing for maximum regulation.

4. Data

4.1. The dataset

29. We use the IES database - *Informação Empresarial Simplificada* (Simplified Corporate Information) provided by INE - *Instituto Nacional de Estatística* (Statistics Portugal), which includes the annual accounts (income statements and balance sheet) of all Portuguese firms, as reported simultaneously to the Ministry of Finance, the Ministry of Justice, Bank of Portugal and Statistics Portugal. Data are available from 2004 onwards.

30. The initial dataset covered 3,916,315 observations for the period 2004-2014.[14] To ensure consistency and robustness of our results, we focus on firms with positive values of assets, turnover, external supplies and services and with non-negative personnel expenses and number of employees. In addition, using the 3-digit level NACE Rev. 3, we exclude specific sectors, namely financial activities and insurance services, health care, entertainment, domestic staff and international organizations, given the specificities of their business models. With these exclusions, we reach a dataset of 3,199,118 observations. Moreover, due to lack of underlying data, we are not able to compute total factor productivity (TFP) for around 300,000 observations, leaving us with a total of 2,892,449 observations.[15]

4.2. Variables

31. This section describes the variables used in the study. The main performance variable is TFP, although we also compute Labour Productivity (LP) (output per worker), for robustness checks. TFP was computed using the Levinsohn and Petrin (2003) estimation method, which addresses the endogeneity problem arising from methods such as OLS or fixed-effects estimators.[16] The technological frontier was

14. We focus solely on companies and we have thus excluded individual entrepreneurs (empresários em nome individual).

15. Please refer to Section 4.2. for detailed information about our estimation of total factor productivity (TFP).

16. As the authors argue, when estimating production functions, one must account for the correlation between input levels and productivity, as otherwise one gets inconsistent estimates of the parameters of the production function. Therefore, they develop an estimator using intermediate inputs to proxy for the

defined as the firms in the 90th percentile for the estimated TFP, by year and sector. Firms outside the technological frontier are labelled as laggards. The distance to frontier (DTF) is computed for each firm as the difference between its TFP level and the productivity at the frontier, for each year and sector.

32. Sectoral fixed effects are constructed using the 3-digit level NACE Rev 3.[17] Region fixed effects are obtained with the NUT 2 Portuguese region division.[18] Additionally, firm size controls are included. Following Statistics Portugal methodology, we construct each firm-size bracket according to the conditions presented in Table 1.

33. Table 2 presents the descriptive statistics. The firms in our sample have an average of 10 workers, 1.2 million € of output and 1.6 million € of assets. Concerning firm size, 82% are micro firms, 15% are small, 2% are medium and 0.4% are large. Operational costs and cost of employees account for, on average, 0.3 and 0.2 million €, respectively. Frontier firms are, on average, larger – they have a much higher output, their assets are more than the double of those of laggards and their number of workers is also higher. Figure 2 presents the estimated TFP, again highlighting the differences between frontier and non-frontier firms. As is the case in other countries, the gap between the groups has increased considerably in recent years.

Table 1. Firm size - criteria

Type of Firm	Number of Workers		Output
Micro	<10	and	<2 Million
Small	>10 and <50	and	>2 Million and <10 Million
Medium	>50 and <250	and	>10 Million and <50 Million
Large	>250	or	>50 Million

Source: Statistics Portugal

unobservable productivity term. To compute the TFP, we rely on the STATA code developed by Petrin, Poi and Levinsohn (2004), using external supplies and services as a proxy for intermediate inputs.

17. The included sectors are Agriculture, hunting, forestry and fishing; Mining and quarrying; Food products, beverages and tobacco; Wood and products of wood and cork; Pulp, paper, paper products, printing and publishing; Coke, refined petroleum products and nuclear fuel; Chemicals and chemical products; Rubber and plastics products; Other non-metallic mineral products; Textiles, textile products, leather and footwear; Basic Metals; Fabricated metal products except machinery and equipment; Machinery and equipment n.e.c; Motor vehicles, trailers and semi-trailers; Other transport equipment; Electricity, gas and water supply; Construction; Transport and storage; Post and telecommunications; Real estate activities; Office, accounting and computing machinery; Electrical machinery and apparatus n.e.c; Radio, television and communication equipment; Medical, precision and optical instruments; Manufacturing n.e.c and recycling; Wholesale and retail trade, repairs; Hotels & Restaurants; Renting of machinery and equipment; Computer and related activities; Other Business Activities; Research and Development.

18. This division includes 7 regions, covering Mainland Portugal and Islands.

Table 2. Descriptive Statistics – firm level data

Variables	Unit	Mean	Std Dev	Min	Max	Mean frontier	Mean laggards
Output	10^3 €	1 218	26 700	0	10 300 000	5 214	774
Operational Costs	10^3 €	288	5 621	0	1 820 000	735	238
Cost of employees	10^3 €	174	2 114	0	5,030,00	252	152
Assets	10^3 €	1 586	53 500	0	21 200 000	3 051	1 423
Number of workers	*unit*	10	89	1	22 734	13	9
Micro Firms	*unit*	0,82	0,38	0	1	0,72	0,83
Small Firms	*unit*	0,15	0,36	0	1	0,2	0,14
Medium Firms	*unit*	0,02	0,15	0	1	0,06	0,02
Large Fimrs	*unit*	0	0,07	0	1	0,01	0,00

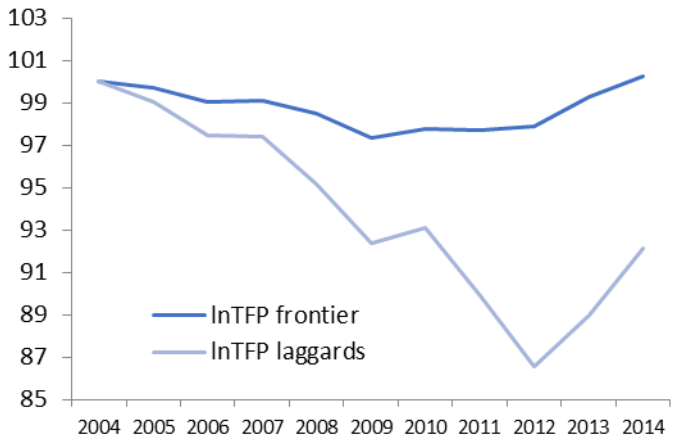
Source: Authors' own calculations based on IES.

34. The Regulatory Impact variable (*Regimpact*) is an OECD index of the potential costs of the anti-competitive regulation in network sectors, retail distribution and professional services on 37 sectors of the economy that uses the output of these sectors as intermediate inputs (see Égert and Wanner, 2016, for more information). This variable is computed by the OECD by weighing the degree of regulation in the non-manufacturing sectors (*Regnmi*) by the input-output coefficient (*w*) of sector *k* from the non-manufacturing sector *j*:

$$Regimpact_{k,t} = \sum_{j=1}^{n} Regnmi_{j,t} * w_{j,k}$$

35. We rely on the wide version of the indicator, which includes network sectors, retail distribution and professional services as upstream sectors, and use the narrow version, which only considers regulation in network sectors, for robustness purposes.[19] Figure 3 shows the evolution of the wide and narrow indicators for Portuguese firms between 2004 and 2013.

Figure 2. Estimated TFP – non-weighted average across firms (2004=100)



Source: Authors' own computations based on IES.

19. For a discussion on the pros and cons of each type of indicator, see Égert and Wanner (2016).

Figure 3. Regulatory Impact indicators 2004–2013 – non-weighted average across firms; LHS panel – wide indicator, RHS panel – narrow indicator



Source: Authors' own computations based on OECD, Product Market Regulation Database and IES.

Table 3. Descriptive statistics –firm level data - DiD estimation

Variable	Unit	Treated	Control	t[a]
Output	*10 ³ €*	1,120	1,289	-2.48
		(28)	(70)	
Operational Costs	*10 ³ €*	164	434	-32.81
		(3)	(10)	
Cost of Employees	*10 ³ €*	118	195	-21.18
		(2)	(4)	
Assets	*10 ³ €*	1,622	1,762	-1.13
		(81)	(48)	
lnTFP	*unit*	2	1	200
		(0)	(0)	
Number of workers	*unit*	8	11	-16.09
		(0.11)	(0.14)	

Source: Authors' own calculations based on IES. A Test of equality of means in treated and control groups.

36. The *treated* and *control* sectors used in the *DiD* estimation have, by construction, very different intensities of electricity and gas input usage: between 4% and 54% of total inputs for the *treated* and from 0% to 1% for the *control*.[20] In addition to these differences, Table 3 shows that firms in *treated* sectors are more productive but are also smaller, both in terms of number of employees and output. Operational costs and the cost of employees are higher in the *control* group.

5. Empirical Results and Robustness Checks

5.1. Impact on Productivity

37. By estimating equation [3] (Table 4 – column "TFP growth - wide"), we show that the impact of deregulation in upstream sectors brings productivity gains already in the short-run. These gains are also

20. Details about the construction of treated and control groups available in Section 3.

present in the long-run and increase with the distance to the technological frontier. The exception are the highly productive firms (according to the estimated DTF threshold, the 2% most productive), which lose with the implementation of reforms. An explanation may be that these firms had sufficient market power to circumvent some of the limitations in upstream sectors and thus benefited from a competitive edge vis-à-vis the other firms and this is eliminated with the reforms. A reduction in this competitive edge may reduce the incentive to engage in costly innovation activities (which were carried by the most productive).

38. To assess the validity of our results, we conduct several robustness tests (Table 4 – columns TFP growth – narrow; LP growth – wide; LP growth – narrow). In particular, we replace our regulatory impact indicator with its narrow version. As argued by Égert and Wanner (2016), while the wide indicator is more suitable for cross-country or cross-sector studies, the narrow indicator is better suited for time-series analysis (as only the network indicator has an annual frequency). Furthermore, we test the regression with Labour Productivity, instead of TFP, as our performance variable. The results are qualitatively the same and corroborate our findings. In the case of the narrow indicator, the effects are positive for all firms, even the highly productive.

39. In general, our estimations point to the existence of both pass-through from the most productive firms and of catching-up with the frontier, as the coefficients of the frontier productivity growth and of the distance to frontier are positive.

5.2. Sectoral differences

40. Given that different sectors have different business specificities and operate in different frameworks, it is important to understand if these gains are broad-based, affecting firms in different sectors equally, or if we face heterogeneous effects. In this section, we thus explore this heterogeneity across firms in different sectors by estimating equation [3] at sectoral level.

41. As can be seen in Table 5, there are indeed very different effects across different sectors. In the short-run, only 4 sectors face negative effects of reforms and in 12 the effects are positive. For the remaining 14, deregulation in upstream sectors has no short-run effect on productivity.

42. In the long-run, 9 sectors see their productivity curbed and 8 face no impact. For the remaining 13, the reforms bring long-term gains and no short-run costs, thus being always beneficial.

43. Also, our sectoral analysis highlights that the more positive (or less negative) effects for the least productive firms are only present in 12 sectors. In 18 industries the impact does not depend on the distance to the technological frontier and there is actually one sector (hotels) where the effect is more detrimental (or less positive) for the least productive.

44. This shows that the effects of the reforms depend on the sectoral environment in which firms operate and calls for targeted policy action.

Table 4. Results of equation [3] estimation – baseline

	TFP growth - wide	TFP growth - narrow	LP growth - wide	LP growth - narrow
TFP growth frontier	0,38	0,34	0,23	0,22
	0,00	0,00	0,00	0,00
DTF (lag)	0,69	0,57	0,58	0,51
	0,00	0,00	0,00	0,00
Reform variable (lag)				
Short-term	-0,12	-0,30	-0,13	-1,95
	0,00	0,03	0,00	0,00
Long-term	-0,32	-1,46	-7,69	-11,60
	0,00	0,00	0,00	0,00
Long-term#DTF	-0,13	-0,56	-0,88	-0,88
	0,00	0,00	0,00	0,00
Firm size effects	yes	yes	yes	yes
Region effects	yes	yes	yes	yes
Year effects	yes	yes	yes	yes
Sectoral effects	yes	yes	yes	yes
N	1522076	1522076	1669162	1669162

Source: Authors' own computations using IES and OECD data for the years 2004-2014. Notes: All equations were estimated by maximum likelihood. The first line reports the estimated coefficients and the second the associated P-value. Standard errors for the long-term coefficients were obtained using the delta method in STATA.

Table 5. Summary of the results of equation [3] estimation – baseline by sector

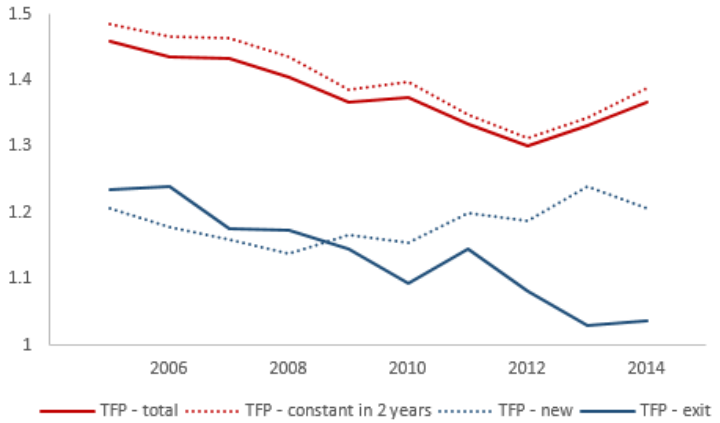
		Long-run		
		Negative	**Nill**	**Positive**
Short-run	**Negative**	Food products, beverages and tobacco Real estate activities	Post and telecommunications Medical, precision and optical instruments	
	Nill	Agriculture, hunting, forestry and fishing Research and Development Fabricated metal products except machinery and equipment	Chemicals and chemical products Other transport equipment Basic metals	Machinery and equipment n.e.c (LR 96,5%) Computer and related activities Renting of machinery and equipment (LR 96,4%) Manufacturing n.e.c; recycling (LR 96,6%) Radio, television and communication equipment (LR 96,6%) Electrical machinery and apparatus n.e.c Office, accounting and computing machinery (LR 96,4%) Transport and storage
	Positive	Coke, refined petroleum products and nuclear fuel Construction Motor vehicles, trailers and semi-trailers Textiles, textile products, leather and footwear	Pulp, paper, paper products, printing and publishing Electricity, gas and water supply Other non-metallic mineral products	Mining and quarrying (LR 97,5%) Other Business Activities Hotels and restaurants Wholesale and retail trade, repairs Rubber and plastics products

Source: Authors' own computations.

5.3. Improved Resource Allocation

45. Figure 4 shows the changing pattern of firm entry and exit in the last decade. While up to 2008 the firms exiting the market have higher productivity than those entering, from 2009 the pattern is reversed. In this section, we investigate whether this is related with product market reforms.

Figure 4. TFP by status of firm: incumbents, new and exit firms



Source: Authors' own computations based on IES.

46. By estimating a probit model on the probability of exiting the market (as defined in equation [4] of the methodological section), we show that low productivity firms are more prone to exit the market. But deregulation in upstream sectors *per se* does not foster firm exit (Table 6); however, the coefficient of the interaction between productivity and the reform variable is negative, meaning that reforms are, as expected, increasing the exit rates for low productivity firms.

47. In Figure 5 we report the marginal effect of the interaction variable varying TFP, with the regulatory variable set at its maximum and minimum (i.e. 1 and 0 – see panel 4A) and varying regulation, for two given values of productivity (one high and one low – see panel 4B). In Panel 4A, we show that the lower the level of productivity, the higher the impact of regulation on the exit probability. Similarly, by comparing two firms with different productivity levels (Panel 4B), one highly productive and the other less so, we again show that the difference between their exit probabilities is much higher in less rigid regulatory environments.

48. Following the aforementioned procedure to test the robustness of our calculations, the same equation was estimated using the narrow version of the reform indicator, and using LP instead of TFP (Table 6). The sign of the interaction term remains negative and significant for all specifications.

Table 6. Results of equation [4] estimation - probability of exiting (Probit)

Pr(Exit)	Coef	Coef	Coef
Regimpact wide (lag)	0	-	4.59***
	(0.28)		(1.42)
Regimpact narrow (lag)	-	0	-
		(0.15)	
lnTFP (lag)	-0.13***	-0.14***	-
	(0.04)	(0.03)	
lnLP (lag)	-	-	-0.11***
			(0.06)
Regimpact wide (lag)*lnTFP (lag)	-0.2*	-	-
	(0.11)		
Regimpact narrow (lag)*lnTFP (lag)	-	-0.8***	-
		(0.2)	
Regimpact wide (lag)*lnTFP (lag)	-	-	-0.51***
			(0.15)
Constant	-1.03**	-1.04***	0.02
	(0.05)	(0.05)	(0.5)
N	1,678,664	1,678,664	1,847,730
Pseudo R^2	1%	2%	5%

Notes: Standard Errors adjusted for clusters in sector.

Source: Authors' own computations.

Figure 5. Predictive Margins

Figure 5A – Predictive Margins (Fixing Regulatory Impact indicator)

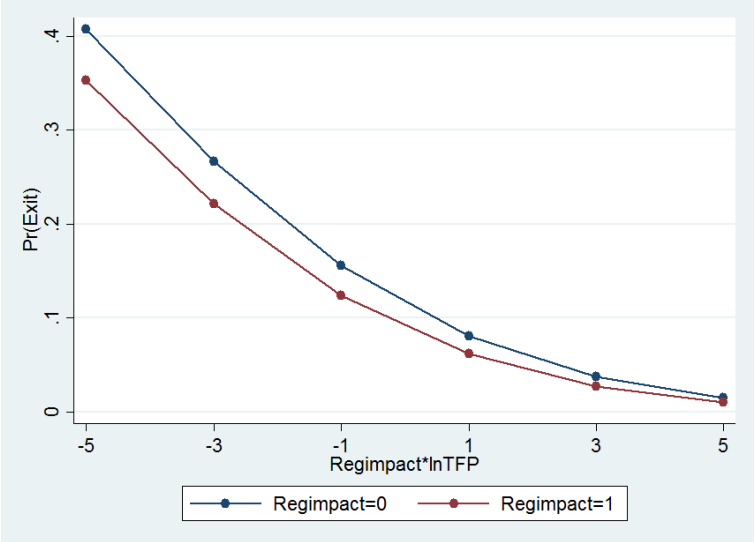
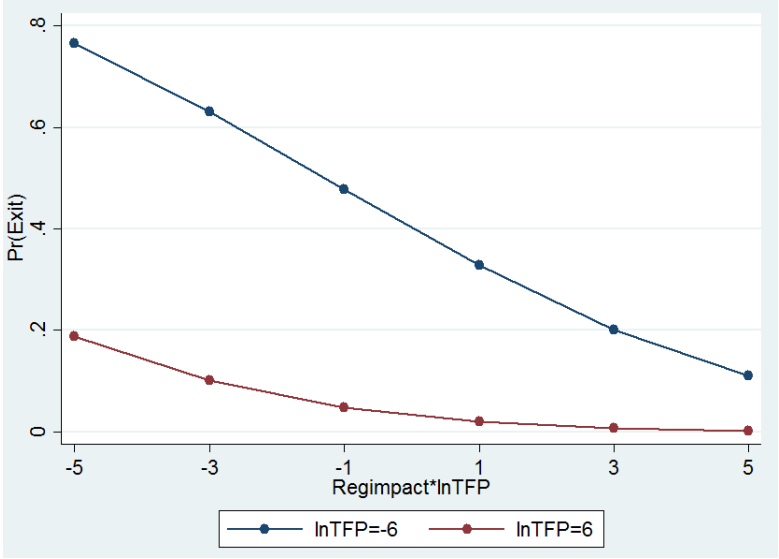


Figure 5B – Predictive Margins (Fixing lnTFP)

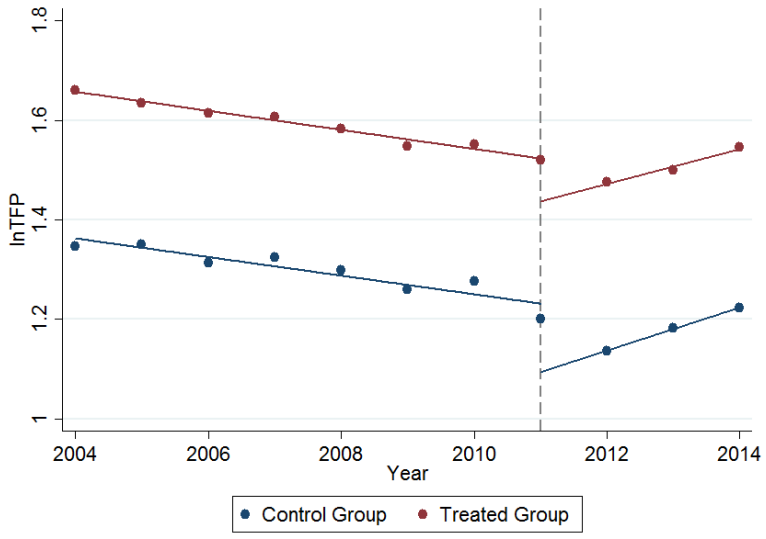


Source: Authors' own computations.

5.4. Enhanced resilience to shocks

49. We now use a difference in differences estimation to assess if firms in sectors most affected by reforms (*treated* group) were better equipped to face the 2011 economic crisis, as suggested by the preliminary evidence in Figure 6.

Figure 6. Mean TFP levels for treated and control groups



Note: This graph was produced using Binscatter command in Stata.
Source: Author's own calculations using IES data for the years 2004-2014. N= 1,373,056.

50. The results in Table 7 confirm that firms in *treated* sectors are more resilient to negative shocks when compared to the control group, i.e. in the face of the 2011 crisis their TFP decreased less markedly.

51. Ideally, we should have a placebo group, running the same *DiD* in a period with a crisis but no deregulation policies. However, this is not possible, as our dataset only covers the period starting in 2004. In any case, we perform two robustness checks based on the available data. First, we compute the same regression without the electricity and gas sectors. These sectors could potentially bias our results, as they were directly affected by the reforms (on top of the usual downstream effects affecting all sectors). The results remain unchanged, as we continue to see more resilience in the *treated* group (Table 7). In addition, using LP instead of TFP also keeps the results qualitatively unchanged.

Table 7. Difference in Differences estimation results (equation [5])

lnTFP	Complete	Without Electicity and Gas Sectors	Complete (LP)
Time	-0.12***	-0.12***	-0.29***
	(0)	(0)	(0.01)
Treated	0.29**	0.29**	0.12
	(0.11)	(0.11)	(0.2)
DiD	0.04**	0.04**	0.11***
	(0.01)	(0.01)	(0.02)
Cons	1.31***	1.31***	10.6***
	(0.01)	(0.01)	(0.02)
Controls	YES	YES	YES
N	1,373,056	1,373,056	1,490,905
R^2	3%	3%	1%

Source: Authors' own computations.

6. Conclusion and way forward

52. In recent years, Portugal implemented a large number of structural reforms. Quantitative information on their effects in the economy is crucial for policy makers, as it allows fine-tuning past reform efforts and better designing future reforms, and potentiates ownership, thus promoting a sustained reform process. Taking stock of what was achieved so far is crucial to define the way forward.[21]

53. In this study we focus on the effects of product market reforms, given their relevance in the Portuguese reform agenda in recent years, their large potential pay-offs and the usual resistance to reform, particularly acute in this area (with concentrated costs and diffuse benefits). In particular, we assess the short-run and long-run effects of product market reforms in upstream sectors on the firm-level productivity of downstream sectors, allowing for heterogeneous effects, evaluating also the impact on the allocation of resources and on the resilience to adverse shocks.

54. Relying on firm-level data for Portugal covering the period between 2004 and 2014, we show that upstream deregulation brings productivity gains for downstream firms already in the short-run, a result in line with Topalova (2016), Gal and Hijzen (2016), Forlani (2012) and Barone and Cingano (2011). These positive effects are sustained in the long-run. In addition, and in line with Nicoletti and Scarpetta (2003), we show that the gains are larger the higher the distance to frontier. Our sectoral analysis highlights that these positive effects are not spread by all sectors, which face different levels of competition and

21. We assess the effects of the reforms implemented up to 2013. Reform efforts in more recent years can only be evaluated when additional data periods become available.

regulation before the implementation of the reforms, which corroborates the results by Dabla-Norris, Guo, Haksar, Kim, Kochhar, Wiseman and Zdzienicka (2015) and Gal and Hijzen (2016). This is an expected result, as pro-competitive reforms are also intended to promote a re-allocation of resources across sectors.

55. Additionally, and in line with the existing literature, we show that the exit of the least productive is potentiated by the reform process, promoting a better resource allocation in the economy. Improved margins downstream are expected to foster entry, which, in turn, increases competition downstream and thus drives less productive firms out of the market. According to our results, this works via a process of firms' selection: for the least productive, only those with ability to catch-up remain in the market; the others, without growth potential, leave.

56. Finally, we find evidence that reforms increase firms' resilience to negative shocks, as firms in sectors more affected by reforms were able to better weather the crisis.

57. These results point to the relevance of product market reforms, given the productivity gains associated and the scope to further grasp additional gains. It also highlights relevant sectoral differences, calling for targeted policy action. In any case, results should be interpreted with caution as there are a number of limitations. We rely on an estimated measure of productivity (TFP) and the results may depend on the estimation approach, even though the use of Labour Productivity, in the robustness checks, provides some degree of confidence. Also, the aggregate measures of regulation are *de jure* and not *de facto* measures and the timing of the identified reform may be inaccurate. Furthermore, the analysis is based on sectoral exposure to regulation, which, although being a reasonable proxy for the conditions the firms' in each sector face, may differ from actual firm exposure.

58. Going forward, it would be important to enrich our results in a number of ways.

59. Following the literature, we could enlarge our analysis by accounting for the effect of the cycle. However, a robust assessment would need to rely on a longer time-series. We could also explore the role of the initial framework conditions and the interactions with other reform areas, shedding light on the sectoral results.

60. Finally, and while total factor productivity is a key determinant of growth, a full assessment of the reforms' impact can only be done by also considering the impact on investment and labour utilisation, in particular on employment. Equity considerations are also key and it would thus be important to complement our firm-level analysis with worker or household level data.

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ANNEX 1 – REGRESSION OUTPUT – EQUATION [2] BY SECTOR

	Agriculture, hunting, forestry and fishing	Mining and quarrying	Food products, beverages and tobacco	Wood and products of wood and cork	Pulp, paper, paper products, printing and publishing	Coke, refined petroleum products and nuclear fuel	Chemicals and chemical products	Rubber and plastics products
TFP growth at the frontier	0,25	-0,25	-1,90	-3,11	-0,06	-0,55	-0,17	-2,12
	0,02	0,40	0,00	0,00	0,57	0,18	0,37	0,00
DTF (lagged)	0,40	-1,30	0,68	0,00	0,57	0,36	-1,17	0,51
	0,00	0,00	0,00	0,99	0,00	0,40	0,00	0,01
Reform variable (lagged)								
Short-term	-0,40	2,58	-0,67	2,06	4,11	0,22	4,05	-2,14
	0,32	0,10	0,00	0,00	0,00	0,89	0,00	0,00
Long-term	-14,35	14,46	-90,73	-16694,86	-48,69	-65,90	69,58	-167,80
	0,00	0,00	0,00	0,99	0,00	0,44	0,01	0,01
Long-term#DTF	-3,93	10,41	2,42	2286,36	2,36	-5,68	9,19	0,89
	0,19	0,00	0,00	0,99	0,22	0,74	0,00	0,72
Firm size effects	yes	yes	yes	yes	yes	yes	yes	yes
Region effects	yes	yes	yes	yes	yes	yes	yes	yes
Year effects	yes	yes	yes	yes	yes	yes	yes	yes
Sectoral effects	yes	yes	yes	yes	yes	yes	yes	yes
Number of observations	56233	6033	45111	21524	19260	1277	3477	7339

	Other non-metallic mineral products	Textiles, textile products, leather and footwear	Basic metals	Fabricated metal products except machinery and equipment	Machinery and equipment n.e.c	Motor vehicles, trailers and semi-trailers	Other transport equipment	Electricity, gas and water supply
TFP growth at the frontier	-0,34	-0,08	0,21	1,10	0,28	6,30	-0,21	0,00
	0,58	0,19	0,03	0,00	0,15	0,00	0,16	0,00
DTF (lagged)	-0,03	0,53	0,06	0,26	-0,30	1,44	0,00	0,00
	0,70	0,00	0,82	0,01	0,18	0,00	1,00	0,00
Reform variable (lagged)								
Short-term	2,39	1,21	0,17	0,24	0,21	23,03	1,89	0,81
	0,02	0,00	0,84	0,60	0,78	0,00	0,42	0,04
Long-term	249,95	-19,69	-261,77	-123,87	246,29	-174,58	-89569,96	-0,48
	0,69	0,00	0,83	0,02	0,18	0,00	1,00	0,36
Long-term#DTF	82,54	1,66	-47,69	-10,19	23,44	6,19	-10447,86	-0,03
	0,67	0,17	0,85	0,18	0,03	0,00	1,00	0,89
Firm size effects	yes	yes	yes	yes	yes	yes	yes	yes
Region effects	yes	yes	yes	yes	yes	yes	yes	yes
Year effects	yes	yes	yes	yes	yes	yes	yes	yes
Sectoral effects	yes	yes	yes	yes	yes	yes	yes	yes
Number of observations	21059	66112	2045	44957	9309	3387	1175	2573

	Manufacturing n.e.c; recycling	Wholesale and retail trade, repairs	Hotels and restaurants	Renting of machinery and equipment	Computer and related activities	Other Business Activities	Research and Development
TFP growth at the frontier	-2,00	0,51	-1,50	2,41	-0,26	-2,61	0,21
	0,00	0,00	0,00	0,18	0,00	0,00	0,39
DTF (lagged)	-0,22	0,40	0,42	0,90	0,51	0,53	1,27
	0,12	0,00	0,00	0,01	0,00	0,00	0,03
Reform variable (lagged)							
Short-term	-0,28	0,20	6,73	-36,06	-0,39	1,04	-2,66
	0,48	0,00	0,00	0,20	0,54	0,00	0,74
Long-term	113,14	7,11	-507,33	7,57	159,51	2,10	-175,51
	0,16	0,00	0,00	0,78	0,00	0,00	0,10
Long-term#DTF	28,44	0,08	-2,18	5,77	-1,42	-0,10	10,05
	0,03	0,25	0,00	0,02	0,68	0,73	0,00
Firm size effects	yes	yes	yes	yes	yes	yes	yes
Region effects	yes	yes	yes	yes	yes	yes	yes
Year effects	yes	yes	yes	yes	yes	yes	yes
Sectoral effects	yes	yes	yes	yes	yes	yes	yes
Number of observations	19579	388728	196086	1521	26816	84780	1551

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