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THE IMPACT OF STRUCTURAL REFORMS ON PRODUCTIVITY: THE ROLE OF THE DISTANCE TO THE TECHNOLOGICAL FRONTIER

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ABSTRACT/RESUMÉ

The impact of structural reforms on productivity: The role of the distance to the technological frontier

In recent years, literature has linked structural reforms with productivity growth. Considering Portugal's recent comprehensive reform agenda, this topic acquires particular relevance. Using data for Portuguese firms for the period 2006-2014, this paper assesses the impact of structural reforms on firms' productivity. In line with existing literature, the analysis shows that most reforms entail long-term gains, despite, in some reform areas, the existence of short-term costs. In general, there are important differences across reform areas and across firms, namely when comparing firms with different productivity levels. The firms' distance to the technological frontier mediates the impact of reforms, either by potentiating its effects or by curbing them, depending on the reform area.

JEL codes: D04, D22, D24, O33

Keywords: Structural reforms, Growth, Total Factor Productivity, Distance to frontier.

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L'impact des réformes structurelles sur la productivité : le rôle de la proximité de la frontière technologique

La recherche économique récente a établi un lien entre les réformes structurelles et la productivité. Étant donné l'étendue des réformes qui ont été réalisées au cours des dernières années, ce domaine de recherche est particulièrement important pour le Portugal. Ce papier mobilise des données d'entreprise pendant la période 2006-14 pour vérifier l'impact des réformes structurelles sur la productivité. Les résultats de l'analyse montrent que la plupart des réformes produit des gains de productivité à long terme même si, dans certains domaines, ces réformes ont des coûts à court terme. L'analyse met en lumière que l'impact des réformes diffère de façon importante selon le type de politique et le type d'entreprise, notamment quand on compare les effets sur des entreprises qui ont des niveaux de productivité différents. La plus ou moins grande proximité de la productivité vis-à-vis de la frontière technologique affecte l'impact des réformes soit en les renforçant soit en les affaiblissant selon le type de politiques mises en place.

Classification JEL: D04, D22, D24, O33

Mots-clés: Réformes structurelles, Croissance, Productivité Multifactorielle, Éloignement de la frontière technologique

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THE IMPACT OF STRUCTURAL REFORMS ON PRODUCTIVITY: THE ROLE OF THE DISTANCE TO THE TECHNOLOGICAL FRONTIER

Ana Fontoura Gouveia, Sílvia Santos and Inês Gonçalves[1]

1. Introduction

1. To address the structural bottlenecks that acted as a drag on growth, Portugal implemented in the recent years important reforms, aimed at fostering productivity and promoting sustained economic growth. Indeed, reform indicators produced by the World Bank and the World Economic Forum show progress for Portugal almost in all reform areas (Table 1[2]).

Table 1. Reform indicators

Indicator	Source	2010	2015	Change 2015-2010
Institutions (1-7; 7 best)	WCI	4,4	4,4	⇨
Health and primary education (1-7; 7 best)	WCI	6,1	6,3	⇧
Higher education and training (1-7; 7 best)	WCI	4,8	5,2	⇧
Goods market (1-7; 7 best)	WCI	4,3	4,6	⇧
Labor market (1-7; 7 best)	WCI	3,9	4,3	⇧
Financial market (1-7; 7 best)	WCI	4,3	3,4	⇩
Innovation (1-7; 7 best)	WCI	3,8	4,0	⇧
Starting a Business (N Procedures)	DB	6	5	⇧
Paying Taxes (Total tax rate)	DB	42,6	40,9	⇧
Resolving Insolvency (Recovery rate)	DB	72,6	73,4	⇧

Source: WCI – World Competitiveness Index of the World Economic Forum; DB – Doing Business of the World Bank.

2. It is thus important to understand if these reforms translated into higher productivity growth. Looking at the evolution of Total Factor Productivity (TFP)[3] in Portugal, there is indeed an improvement in recent years (Figure 1).

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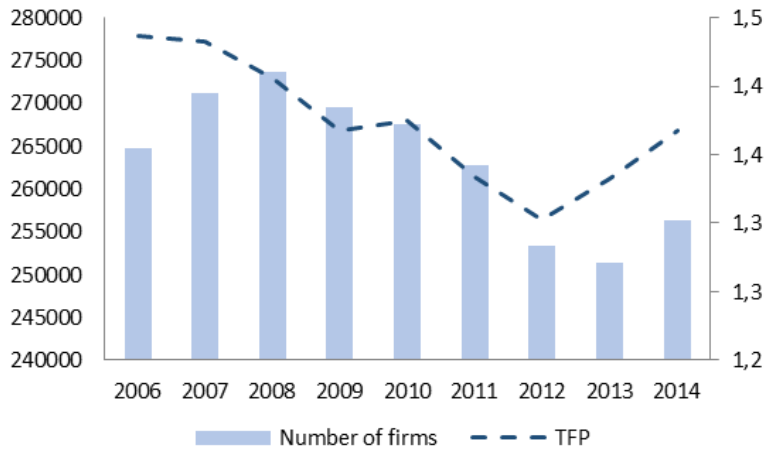
2. Annex 1 provides details on each of these indicators and Section 4 explains the criteria for their selection in this paper.

3. Section 3 explains how this indicator was computed.

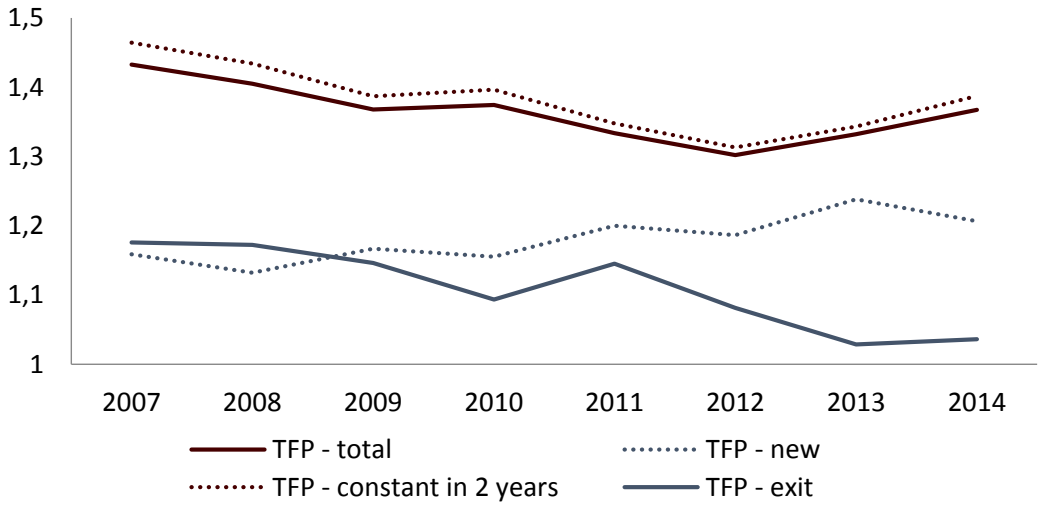
Figure 1. LnTFP (RHS) and number of firms (LHS)



Source: Authors' own calculations based on firm-level data (see section 4 for details). LnTFP is the natural logarithm of TFP.

3. This recovery is not only driven by the incumbents, but also by the exit of firms which have lower productivity levels when compared with the ones that enter the market (Figure 2), which is exactly the goal of a better structural environment. The aim of this paper is thus to assess the link between the structural reforms implemented in recent years and productivity developments.

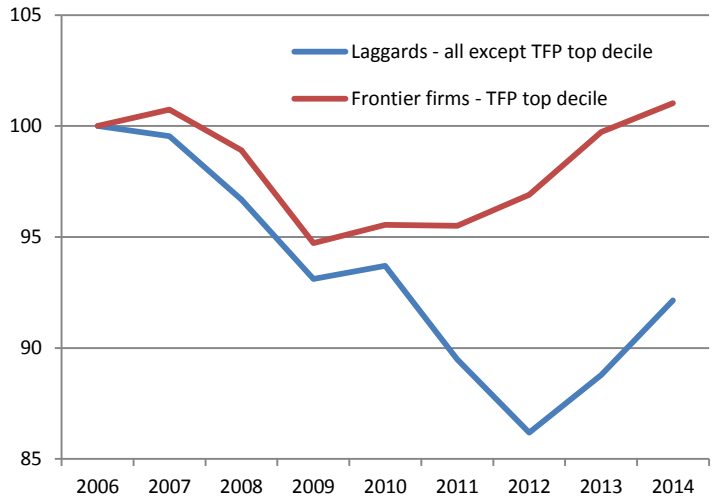
Figure 2. LnTFP by status of firm: incumbents, new and exit firms



Source: Authors' own calculations based on firm-level data (see section 4 for details). LnTFP is the natural logarithm of TFP.

4. The available data also points to a development common to other OECD countries (see, for instance, OECD, 2016a) – there is a growing divide between productivity developments of the most productive firms and the others (Figure 3). It is thus important to assess if reforms impact differently firms with different productivity levels.

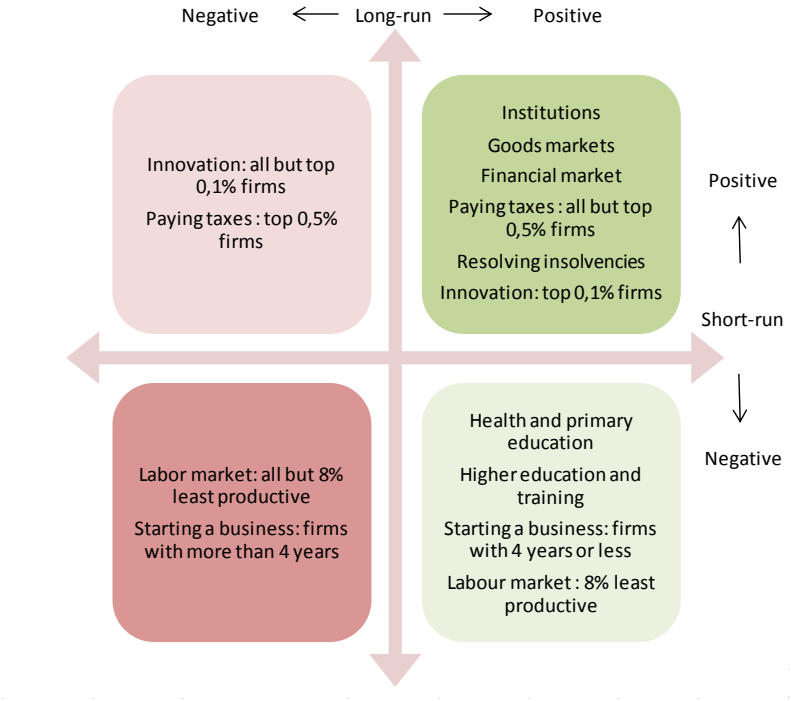
Figure 3. TFP evolution (2006=100)



Source: Authors' own calculations based on firm-level data (see section 4 for details). Unweighted average across individual firms TFP.

5. By using firm level data for the period 2006-2014, we show that, despite some short-run costs, most reform areas considered in this paper bring long-term productivity gains (see Figure 4). However, the effects depend on firms' distance to the sector technological frontier. While reforms of institutions, goods markets, financial markets and the tax framework bring larger gains for the less productive firms, reforms affecting the insolvencies' framework, health, education, training and innovation are more beneficial for those with higher productivity. In particular, reforms that potentiate the innovation framework entail Schumpeterian effects, where only the most productive (0.1% of the firms in our sample) are able to grasp gains. For the case of reforms directly potentiating entry (i.e. those that reduce the number of procedures to start a business), long-term benefits only accrue to younger firms. Finally, concerning the labor market, the effects on productivity are, for most firms, negative. Only some of the firms in the bottom TFP decile manage to benefit from the reforms.

Figure 4. Impact of reform areas on productivity – summary of the results



Source: Authors' own computations. Top firms defined in terms of productivity levels (distance to frontier).

6. The remainder of the paper is organized as follows. Section 2 presents the literature review, Section 3 the methodology, and Section 4 the data. The results are presented in Section 5. Section 6 concludes and discusses avenues for further work.

2. Literature review

7. This section focuses on the empirical relation between structural reforms and productivity growth, which is the focus of our paper.[4]

8. Both cross country and national studies, using either firm-level, sectoral-level or aggregate panel data, show that the impact of reforms is, in general, positive in the long-run and growing over time (see for instance Bouis and Duval, 2011; Égert and Gal, 2016a; Arnold and Barbosa, 2015; Barnes, Bouis, Briard, Dougherty and Eris, 2013; Bouis, Causa, Demmou, Duval and Zdzienicka, 2012; IMF, 2015 and 2016; and OECD, 2015).

9. There are, however, some exceptions. In particular, the evidence on the effects of labor market reforms, namely those affecting employment protection legislation (EPL), is inconclusive (see OECD, 2007 for a review of the literature).

10. Also, some authors argue that effects are not uniform across firms, depending, in particular, on the firms' distance to the technological frontier. For instance, Arnold, Nicoletti and Scarpetta (2008), relying on industry and firm-level data, show that regulations are particularly harmful for ICT-using

4. For theoretical models or for applications using DSGE, please see for instance Blanchard and Giavazzi (2003), Cacciatore, Duval and Fiori (2012), Lusinyan and Muir (2013), Anderson, Barkbu, Lusinyan and Muir (2014), Andrés, Arce and Thomas (2014), ECB (2015) and Aguiar, Ribeiro and Gil (2017) .

sectors and for higher productivity firms, i.e. those that are closer to the technology frontier. In the same vein, Bourlès, Cette, Lopez, Mairesse and Nicoletti (2010), following the theoretical contributions of Acemoglu, Aghion and Zilibotti (2006) and Aghion and Howitt (2006), argue that productivity growth depends positively on the growth of the technological frontier and the technological gap to frontier countries and that these mechanisms may be affected by reforms (as restrictions to competition may affect productivity by impacting the incentives of firms to adopt existing technologies and to innovate). In line with the theoretical models, the authors argue that a boost in competition may increase the returns from innovation for frontier firms ("*escape-competition effect*") but reduce the incentives for laggards to innovate ("*Schumpeterian effect*"). By using a panel of OECD industry-level data, Bourlès, Cette, Lopez, Mairesse and Nicoletti (2010) show that the lack of competition curbs productivity more strongly for observations closer to frontier. Dabla-Norris, Ho and Kyobe (2013), using a panel of industry-level data for more than 100 economies, also show that the effects of reforms vary with the distance to the world sectoral technological frontier.

11. Although the long-term effects of reforms are reasonably well established, the short-term impact has recently attracted attention, given its relevance for the political economy of the reform process and for the design of the reform packages (e.g. bundling, sequencing, the use of grandfathering rules or compensation mechanisms).

12. Indeed, reforms operate in a context of existing frictions in labor and product markets and may also imply immediate (public or private) investments but delayed gains that are likely to impact short-term aggregate supply and demand in ways that differ from their long-term effects. Also, depending on the financing of the measures, the short-term effects may be quite different.[5] In addition, while reforms may boost confidence and generate expectation of increased income and wealth, increasing, via the permanent income hypothesis, consumption and investment already in the short-run, they may also have the opposite effect – the uncertainty over the future may increase precautionary savings, decreasing demand.

13. The short-term effects of reforms are, thus, an empirical question. For instance, while Gal and Hijzen (2016), using firm level data for 18 advanced economies, show that product market reforms in general bring benefits for the reformed sectors and downstream industries already in the short-run, Bouis, Causa, Demmou, Duval and Zdzienicka (2012), using a long time-series of aggregate data for a sample of OECD countries, show that some labor and product market reforms may have short-term recessionary effects, a result confirmed by Cacciatore and Fiori (2015). Some authors argue that these effects are potentiated during economic downturns, as, for instance, the entrance of new firms is further delayed and agents' uncertainty is higher (IMF, 2016, OECDb, 2016, Dabla-Norris, Guo, Haksar, Kim, Kochhar, Wiseman and Zdzienicka, 2015; and Adhikari, Duval, Hu and Loungani, 2016).

14. Building on this literature, and using firm-level data for Portugal, we explore the link between structural reforms and productivity over the short- and long-run, by reform area. In addition, we explore heterogeneous effects of reforms according to the firms' distance to the national technological frontier.

3. Method

15. The framework considered in this paper builds on the work on the effect of reforms on productivity and their interaction with technological spillovers, as reviewed in the previous section, but applying it to developments within a country. Our technological frontier is therefore defined at firm level, within each sector (and not at country level).

5. In general, the fiscal impact, including their financing (e.g. financing via debt or increased revenues / decreased expenses) may have important short-term effects.

16. Applying the country-industry approach followed by Bourlès, Cette, Lopez, Mairesse and Nicoletti (2010) to firm-level data, we depart from the notion that, in the long-run, the TFP of an individual firm depends both on the TFP at the technological frontier and on the prevailing level of regulation. We thus estimate the following Error Correction Model[6]:

$$\Delta \ln TFP_{i,s,t} = \beta_0 + \beta_1 \Delta \ln TFPFrontier_{s,t} + \beta_2 \Delta REF_t + \delta \left[TFP_{i,s,t-1} - \alpha_1 TFPFrontier_{s,t-1} - \alpha_2 REF_{t-1} \right] + \mu_t + \nu_s + \varepsilon_{i,t}$$

where ΔlnTFP is the annual TFP growth rate for firm i, in sector s and year t. ΔlnTFPFrontier represents the average productivity growth of frontier firms within the sector of firm i at time t, REF is the reform indicator, entered separately in each regression (to avoid correlation between the regressors). Time and industry fixed effects are also included (μ_t and ν_s).

17. Notice that when α_1 is restricted to unity, the above equation can be re-written 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).[7]

$$\Delta \ln TFP_{i,s,t} = \beta_0 + \beta_1 \Delta TFPFrontier_{s,t} + \beta_2 \Delta REF_t + \eta \left[DTF_{i,s,t-1} + \alpha_2 REF_{t-1} \right] + \mu_t + \nu_s + \varepsilon_{i,t} \quad [1]$$

18. In this context, 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. β_1 and η (defined as $-\delta$), if positive, translate pass-through and catching-up effects.

19. Following the literature, we explore whether reforms affect differently frontier and laggard firms. Indeed, it can be argued that the potential gains of some reforms are larger for laggards or that frontier firms are better equipped to grasp the benefits of reforms. To assess this, and following Bourlès, Cette, Lopez, Mairesse and Nicoletti (2010), we estimate the following model:

$$\Delta \ln TFP_{i,s,t} = \beta_0 + \beta_1 \Delta TFPFrontier_{s,t} + \beta_2 \Delta REF_t + \eta \left[DTF_{i,s,t-1} + \alpha_2 REF_{t-1} + \alpha_3 REF_{t-1} * DTF_{i,s,t-1} \right] + \mu_t + \nu_s + \varepsilon_{i,t} \quad [2]$$

20. The long-term impact of reforms is thus given by $\alpha_2 + \alpha_3 DTF_{i,s,t-1}$. When (i) $\alpha_2 > 0$ and $\alpha_3 < 0$, the effect of the reform is positive and higher for the most productive firms. For firms sufficiently far from the technological frontier the effect of the reform may even turn negative. Conversely, (ii) if $\alpha_2 > 0$ but $\alpha_3 > 0$, the positive impact is stronger for the less productive. It may also happen that (iii) the reform entails a negative impact ($\alpha_2 < 0$), which is exacerbated for the less productive ($\alpha_3 < 0$). Finally, (iv) the impact of the reform may be negative for the most productive ($\alpha_2 < 0$), but less so for those further away from the frontier ($\alpha_3 > 0$) and eventually turning positive for firms sufficiently away from the frontier.

4. Data

21. The analysis is based on annual, firm-level data for Portuguese companies obtained from *Informação Empresarial Simplificada* (IES) for the period 2006-2014.[8] Our main database is the Sistema de Contas Integradas das Empresas (SCIE) from the Statistics Portugal (INE), in which the information from IES is compiled and subject to quality checks.

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

7. 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).

8. IES is the system by which all enterprises in Portugal meet their obligation to report their annual accounts simultaneously to the Ministries of Finance and Justice, Banco de Portugal and Statistics Portugal. Data are available from 2004 onwards but as most reforms indicators are available only from 2006, we only considered the period from 2006 onwards.

22. Our initial dataset, covering nine years of data, includes 3,232,481 firm-level observations.[9] In order to increase the robustness of the results, a number of adjustments are done to the dataset. In particular, firms with negative or nil values of output, intermediate inputs and number of employees are excluded (13% of the observations). In addition, financial and insurance activities, health and social services, artistic and sport activities, international organizations and families that employ domestic service are also excluded, given their specificities (6% of the observations). Finally, to ensure comparability, nominal values are adjusted for inflation.

23. The technological frontier is computed at the firm level for each sector and period and taking into account firms in the top decile of productivity[10]. The measure of firm-level productivity is total factor productivity, computed following the methodology developed by Levinsohn and Petrin (2003)[11]. As not all firms have all the needed input variables available, the final number of observations is smaller than our initial dataset.[12] The distance to frontier is computed by sector and period as the difference between the productivity at the frontier and the firm's productivity.

24. Table 2 presents the descriptive statistics for the observations considered in our regressions, for the period 2006-2014. The firms from our dataset have an average of 10 workers and 1.6 million euro in assets. Their annual revenues reach, on average, 1.2 million euro. The annual TFP growth is, on average, negative (-0.02%) while the technological frontier displays a nil average annual growth, reflecting also the financial and economic crisis that affected Portugal during the period considered.

25. Looking at the differences between frontier and laggard firms, we conclude that the former are larger in terms of output, assets and number of workers. Frontier firms, on top of being more productive in level terms (by definition), also display higher productivity growth rates, with an average growth over the period of 0.23%, which compares to -0.05% for the laggards.[13]

9. The database also includes sole proprietorships, which were excluded from our analysis. The figure presented already excludes them.

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 authors develop a method that addresses the endogeneity problem arising from methods such as OLS or fixed-effects estimators. 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, Levinsohn and Petrin (2003) develop an estimator using intermediate inputs to proxy for the unobservable productivity term. The implementation of this methodology in STATA was done by Petrin, Poi and Levinsohn (2004).

12. The actual number of observations is indicated in the regression outputs presented in the annex.

13. The average productivity growth for frontier firms (0.23%) differs from the average of annual growth at the frontier (0.00%), as we are working with an unbalanced sample (where the number of firms is not constant across years).

Table 2. Descriptive statistics for firm level data (2006-2014)

Variable	*Unit*	Mean	Mean frontier	Mean laggards	Std Dev	Min	Max
Output	*10^3 euro*	1213	5580	728	27200	1	10300000
Operating costs	*10^3 euro*	286	616	250	5712	1	1820000
Cost of employees	*10^3 euro*	173	280	161	2093	1	469000
Assets	*10^3 euro*	1604	3304	1415	55000	1	21200000
TFP growth [D.lnTFP]	*%*	-0,02	0,23	-0,05	0,55	-10,76	12,20
TFP growth of frontier [D.lnFront]	*%*	0,00	-	-	0,04	-1,21	1,30
Number of workers	*unit*	10	15	9	92	1	22734

Source: Authors' own calculations based on firm-level data.

26. The measures of reforms are taken from two datasets: the World Economic Forum Global Competitiveness Index[14]; and the World Bank Doing Business Indicators[15]. Our criteria for the selection of reform indicators are (i) the availability of annual data for at least 8 years; (ii) variability across years; (iii) indicators that reflect structural reforms with a potential overall impact in the economy. The selected indicators include the following: Institutions, Health and primary education, Higher education and training, Goods market, Labor market, Financial market, Innovation, Starting a business, Paying taxes and Resolving insolvency (Annex 1 provides a description of the indicators and Annex 2 presents the time series used in the regressions).

5. Results

27. By estimating equation [1], we find that, in line with existing literature, short and long-term effects of reforms on firms' productivity differ and are not uniform across reform areas (see Figure 5; detailed regression output available in Annex 3).

28. Indeed, while reforms affecting institutions, goods markets, financial markets, corporate taxation and the insolvency frameworks produce benefits already in the short-run, reforms boosting health, education and training, due to their very nature, take time to pay-off.

29. On the contrary, reforms increasing the flexibility of the labor market negatively affect firms' productivity both in the short- and long-run. A possible explanation is that higher job turnover reduces firms' incentive to invest in job specific training and reduce the scope for workers' specialization.

30. Reforms boosting firm entry also display a negative impact on both time horizons. While new entrants could take time to become more productive, it would be expectable that in the long-run the reallocation of resources potentiates productivity. Thus, in a second step, we extend our regression to allow for heterogeneous effects across firms, shedding light on this result.

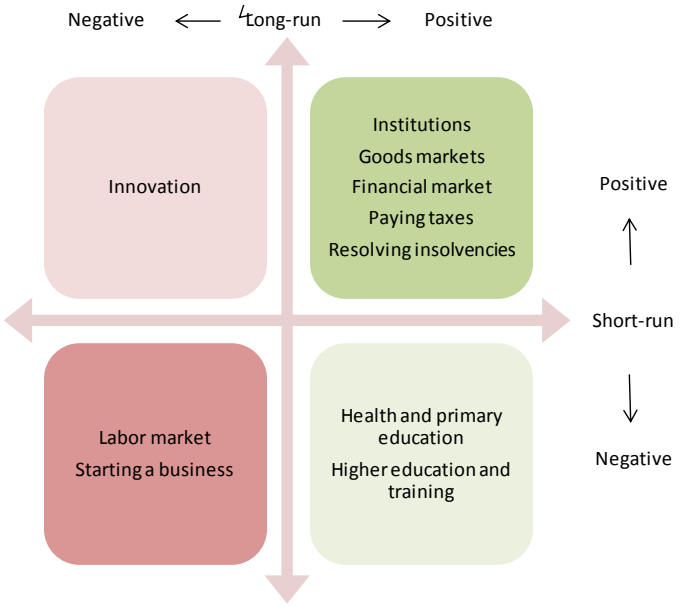
31. Finally, reforms boosting the innovation environment have a negative impact on productivity in the long-run, despite some initial gains. In line with the Schumpeterian approach discussed in Section 2, this is a reasonable result for the average firm, which is small and presents low productivity. However, for the most productive one would expect an "escape competition" effect (see Section 2). We thus extend the

14. http://reports.weforum.org/global-competitiveness-report-2015-2016

15. http://www.doingbusiness.org/

analysis of the long-run to assess heterogeneous effects across firms with different productivity levels, allowing us to provide further insights on the mechanisms at work.

Figure 5. Impact of reform areas on productivity - regression [1]



Source: Authors' own computations. Top firms defined in terms of productivity levels (distance to frontier).

32. Indeed, by estimating equation [2] (where the reform variable is interacted with the distance to the technological frontier), we find that reforms of institutions, goods markets, financial markets and the tax framework[16] have higher benefits for less productive firms, i.e. those further away from the frontier (see Figure 6; detailed regression output available in Annex 4). A possible explanation relates to the market and bargaining power that the most productive firms already possess and that allow them to thrive even in a less prone environment; for the least productive, depending more on prevailing framework conditions and being price-takers, the effects are stronger.

33. In the case of the insolvency framework, although there are gains for all firms, these gains increase with the productivity level of the firm. In this case, it may be that the most productive are better equipped to grasp the gains of the improved resource allocation that arises with more efficient insolvency frameworks.

34. For reforms affecting health, education and training, long-term benefits are also increasing with productivity. Again, this may be related to the fact that those with higher productivity levels can more easily translate a better, more qualified workforce into productivity gains.

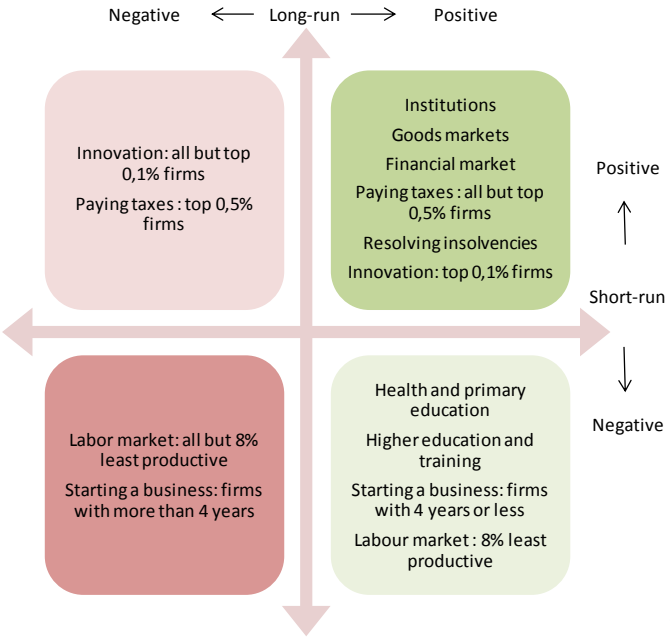
35. On reforms potentiating innovation, our results indicate that the benefits only accrue to a very small share of firms. Indeed, only the top 1% in the frontier (0.1% of all firms) is able to strive in an innovation conductive environment, while other firms fail to grasp any gains, providing evidence for the "*escape competition"* and "*Schumpeterian effects"* discussed in Section 2.

16. The effects of the tax framework even turn negative for the 0.5% most productive firms.

36. For reforms reducing the number of procedures to start a business, long-term effects also remain negative, even considering possible heterogeneous effects for firms with different productivity levels. We thus explore another avenue: given that these reforms potentiate entry, we assess whether gains are different for new firms and for incumbents. In fact, we do find long-term benefits for entrants (4 years or less), while incumbents face long-term costs.

37. Finally, labor market reforms are shown to have a negative effect in the long-run for all but the least productive (in particular, the 8% least productive firms in our dataset). A possible explanation is that a more flexible labor market entails less stable firm-worker relations, decreasing the incentives for both firms and workers to invest in firm specific human capital. This firm specific human capital is less relevant for firms further away from the technological frontier but it is likely to play an important role for more productive firms.

Figure 6. Impact of reform areas on productivity - regression [2]



Source: Authors' own computations. Top firms defined in terms of productivity levels (distance to frontier).

6. Conclusions and way forward

38. In recent years, Portugal undertook a broad-based reform agenda, spanning across different reform areas. Reform indicators produced by different international institutions and fora, such as the World Bank and the World Economic Forum, reflect these improvements.

39. Understanding the impact of the reforms undertaken is crucial both for policy makers – as it allows fine-tuning reform efforts and better designing future reforms – and for the ownership of reforms by the different stakeholders.

40. In this paper, we rely on firm-level data for Portugal from 2006 to 2014 and assess the impact of structural reforms on firms' productivity. We show that, despite some short-run costs, most reform areas considered in this paper bring long-term productivity gains. However, these effects are heterogeneous across firms. While reforms of institutions, goods markets, financial markets and the tax framework have

higher benefits for less productive firms, measures affecting the insolvency framework, health, education, training and innovation are more beneficial for the more productive. In particular, in the case of reforms potentiating innovation, only the very high performers (0.1% of all firms) are able to grasp gains. For reforms directly potentiating entry (i.e. reducing the number of procedures to start a business), long-term gains are only visible for the new entrants. In the case of labor market reforms, we only find evidence of positive long-term effect on productivity for some firms in the bottom TFP decile. We argue that this may be related with the reduced incentives to invest in firm-specific human capital, which are relevant to all firms but the less productive.

41. As a possible avenue for further research, it would be important to assess if, in line with existing empirical literature, the cycle is curbing potential short-term gains or even inducing short-term costs. In general, a better framed sequencing and bundling of reforms could mitigate these costs. While some authors defend that, even during downturns, reforms should be frontloaded to grasp the reform momentum (European Commission, 2016), others consider that a strong commitment of implementing reforms in the future (e.g. by passing today legislation that is enacted in some years from now) may be a good compromise in terms of the political process and achieve, for some reform areas, better efficiency results (IMF, 2016).

42. In any case, it should be noted that growth depends on both labor utilisation and labor productivity. The first is affected by employment and participation while the second by capital deepening and TFP. We focus on TFP, given its relevance for growth, but a full picture of the impact of reforms can only be grasped if all these dimensions are taken into account. Equity considerations should also be considered, as reforms may have redistributional implications that need to be accounted for. To date, there are very few studies focusing on this last dimension, given the limits of available toolkits and datasets. Going forward, we aim at enlarging our research to provide a more encompassing picture.

43. In addition, the results are at firm-level, thus allowing us to gain important insights on the impact of reforms on the productivity growth of the average firm and on different types of firms, according to their productivity levels. However, as different firms have different weights in the economy (and our regressions are unweighted), the results cannot be used as a measure of the aggregate effects on the economy. This would be possible with the use of aggregate data (or of weighted regressions) and is the focus of our subsequent research.

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ANNEX 1 – DESCRIPTION OF REFORM INDICATORS

World competitiveness index indicators	
Institutions	Determined by the legal and administrative framework within which individuals, firms, and governments interact to generate wealth. Considers management of public finances, private-sector transparency, property rights among others.
Health and primary education	Takes into account the quantity and quality of the basic education received by the population, in addition to the investment in the provision of health services.
Higher education and training	Measures secondary and tertiary enrollment rates as well as the quality of education as evaluated by business leaders. The extent of staff training is also taken into consideration.
Goods market	Considers healthy market competition, both domestic and foreign and demand conditions such as customer orientation and buyer sophistication.
Labor market	Takes into account the flexibility to shift workers from one economic activity to another rapidly and at low cost, and to allow for wage fluctuations without much social disruption as well as the incentives for employees and the promotion of meritocracy at the workplace. Considers also the equity in the business environment between women and men.
Financial market	Measures the sophistication of financial markets: sound banking sector, well-regulated securities exchanges, venture capital, and other financial products, as well as the trustworthiness and transparency of the banking sector.
Innovation	Considers the environment that is conducive to innovative activity and supported by both the public and the private sectors. In particular, it means sufficient investment in R&D, especially by the private sector; the presence of high-quality scientific research institutions; extensive collaboration in research and technological developments between universities and industry; and the protection of intellectual property.

Doing Business indicators	
Starting a business	This topic measures the paid-in minimum capital requirement, number of procedures, time and cost for a small- to medium-sized limited liability company to start up and formally operate in economy's largest business city. In this paper the indicator considered covers the number of procedures.
Paying taxes	This topic records the taxes and mandatory contributions that a medium-size company must pay or withhold in a given year, as well as measures the administrative burden in paying taxes and contributions. In this paper the indicator considered is the tax rate.
Resolving insolvency	This topic identifies weaknesses in existing insolvency law and the main procedural and administrative bottlenecks in the insolvency process. The indicator considered in our analysis is the recovery rate.

ANNEX 2 – REFORM INDICATORS – 2006-2014

Reform variables	Source	2006	2007	2008	2009	2010	2011	2012	2013	2014
Institutions (1-7; 7 best)	WCI	4,91	4,87	4,75	4,49	4,37	4,20	4,28	4,32	4,43
Health and primary education (1-7; 7 best)	WCI	6,56	6,04	6,00	5,95	6,13	6,12	6,19	6,28	6,39
Higher education and training (1-7; 7 best)	WCI	4,62	4,62	4,59	4,58	4,76	4,82	4,98	5,15	5,37
Goods market (1-7; 7 best)	WCI	4,49	4,59	4,53	4,39	4,32	4,27	4,31	4,26	4,58
Labor market (1-7; 7 best)	WCI	4,12	4,14	4,18	4,04	3,85	3,79	3,80	3,79	4,09
Financial market (1-7; 7 best)	WCI	4,80	4,94	4,71	4,26	4,26	3,98	3,71	3,50	3,65
Innovation (1-7; 7 best)	WCI	3,70	3,71	3,66	3,69	3,77	3,77	3,86	3,93	4,08
Starting a Business (N Procedures)	DB	8,00	7,00	6,00	6,00	6,00	6,00	6,00	5,00	5,00
Paying Taxes (Total tax rate)	DB	43,80	42,90	42,50	42,30	42,60	42,60	41,90	42,30	42,30
Resolving Insolvency (Recovery rate)	DB	75,00	74,00	69,40	69,40	72,60	70,90	74,60	71,60	72,20

Notes: WCI: World Competitiveness Indicators from the World Economic Forum; DB: Doing Business from the World Bank

ANNEX 3 – REGRESSION OUTPUT – EQUATION [1]

	Institutions	Health and primary education	Goods market	Labor market	Higher education and training	Financial market	Innovation	Starting a business - procedures	Paying taxes - corporate tax rate	Resolving insolvency - recovery rate
TFP growth at the frontier	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44
	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
DTF (lagged)	0,48	0,48	0,48	0,48	0,48	0,48	0,48	0,48	0,48	0,48
	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Reform variable (lagged)										
Short-term	0,12	-0,07	0,10	-0,33	-1,78	0,08	0,16	-0,07	0,25	0,04
	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Long-term	0,38	0,34	1,02	-0,02	1,22	0,14	-1,01	-0,11	0,19	0,10
	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Year effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Sectoral effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Number of observations	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224

Source: Authors' own computations. Notes: All equations were estimated by maximum likelihood. For each variable, the first line report 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.

ANNEX 4 – REGRESSION OUTPUT – EQUATION [2]

	Institutions	Health and primary education	Goods market	Labor market	Higher education and training	Financial market	Innovation	Starting a business - procedures	Paying taxes - corporate tax rate	Resolving insolvency - recovery rate
TFP growth at the frontier	0,45	0,45	0,45	0,45	0,45	0,45	0,45	0,44	0,45	0,46
	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
DTF (lagged)	0,40	1,17	0,16	0,16	0,81	0,43	1,04	0,53	1,30	1,11
	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Reform variable (lagged)										
Short-term	0,12	-0,07	0,10	-0,42	-1,86	0,08	0,11	-0,07	0,32	0,04
	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Long-term	0,40	0,27	2,48	-1,10	0,88	0,12	-0,25	-0,12	0,01	0,05
	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Long-term#DTF	0,04	-0,09	0,45	0,48	-0,09	0,03	-0,14	0,02	0,01	-0,01
	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Year effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Sectoral effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Number of observations	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224

Source: Authors' own computations. Notes: All equations were estimated by maximum likelihood. For each variable, the first line report 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.

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