

# The short-term impact of structural reforms on productivity growth: beyond direct effects

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## Abstract

*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 firm's productivity in the short-run. In line with existing literature, the analysis reveals that some reforms produce positive effects already in the short-run. There are, however, important differences across reform areas and firms, namely when comparing those at the technological frontier and the others. In particular, frontier firms are better equipped to materialize the gains of improved framework conditions and to deal with competitive pressures, grasping more often short-term gains. In any case, gains for those at the frontier are also beneficial for laggards via spillover effects, as both diffusion and catching-up mechanisms are, in general, positive for Portuguese firms. Finally, our analysis shows that, in the short-run, these spillovers may be potentiated or curbed by reforms, which therefore impact the economy also through indirect effects. Indeed, while pass-through is, in most cases, hampered by reforms, the effects on catching-up mechanisms are mixed; they improve with some reforms but are deteriorated with others.*

**Key-Words:** Structural reforms, Growth, Productivity, Spillovers.

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## 1. Introduction

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 OECD, the World Bank and the World Economic Forum show progress for Portugal almost in all reform areas (Table 1<sup>1</sup>).

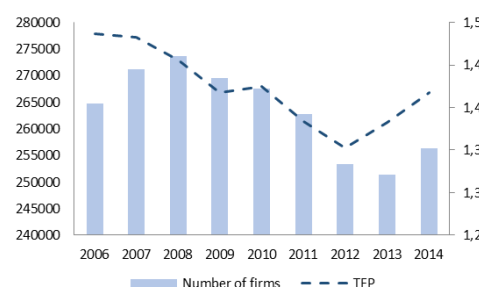
Table 1: Reform indicators

Indicator	Source	2010	2015	Change 2015-2010
Institutions (1-7; 7 best)	WCI	4,4	4,4	→
Infrastructure (1-7; 7 best)	WCI	5,3	5,5	↑
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	↓
Technological readiness (1-7; 7 best)	WCI	4,6	5,5	↑
Business sophistication (1-7; 7 best)	WCI	4,2	4,3	↑
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	↑
Network sectors (0-6; 0 best)	OECD	2,4	2,2	↓

Source: WCI – World Competitiveness Index of the World Competitiveness Forum; DB – Doing Business of the World Bank; OECD – OECD PMR indicators; Note: Data for the Network sectors refers to 2013, the latest year available.

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

Figure 1: TFP (RHS) and number of firms (LHS)



Source: Authors' own calculations based on firm-level data (see section 4 for details).

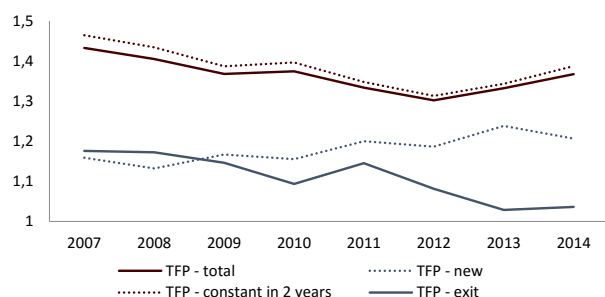
This recovery is not only driven by the incumbents, but also by the exit of firms which have lower productivity levels when compared with the ones that enter the market (Figure 2), which is exactly the goal of a better structural environment. The aim of this paper is thus to

<sup>1</sup> Annex 1 provides details on each of these indicators and Section 4 explains the criteria for their selection.

<sup>2</sup> Section 3 explains how this indicator was computed.

assess the link between the structural reforms implemented in recent years and productivity developments.

Figure 2 - TFP by status of firm: incumbents, new and exit firms



Source: Authors' own calculations based on firm-level data (see section 4 for details).

By using firm level data for the period 2006-2014, we conclude that for some reform areas the positive impact on productivity growth is visible already in the short-run. This is particularly true for firms at the technological frontier (i.e. those with higher productivity in the relevant industry), which are better equipped to grasp short-term gains. It should be noted that, in general, these positive effects on frontier firms are channelled to other firms via spillover mechanisms (both diffusion and catching-up), which are positive for Portuguese firms. Finally, we show that beyond their direct effect, reforms impact the economy via indirect effects, potentiating or curbing the spillover mechanisms. In general, in the short-run reforms tend to curb diffusion, while the effects we find on catching-up are mixed.

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, followed by an application, in Section 6, to the reforms enacted during the period 2010-2013 in Portugal. Finally, Section 7 concludes and discusses avenues for further work.

## 2. Literature review

This section focuses on the empirical relation between structural reforms and productivity growth, which is the focus of our paper.<sup>3</sup>

<sup>3</sup> 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,

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). 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).

Although the long-run effects of reforms are reasonably well established, the short-run effects have recently attracted attention, given their relevance for the political economy of the reform process and for the design of the different measures (e.g. the use of grandfathering rules or compensation mechanisms).

Indeed, reforms operate in a context of existing frictions in labor and product markets and entail, in some cases, grandfathering or transitory rules that may impact short-run aggregate supply and demand in ways that differ from their long-run effects. For instance, while competitive pressures may increase productivity already in the short-run, (costly) innovation activities take time to produce effects and may depress short-term aggregate supply. Investment in education also entails short-term costs, while benefits can only be seen in the longer-run. Depending on the financing of this measure, the short-run effects may also be quite different.<sup>4</sup> In addition, while a better allocation of resources improves the overall efficiency of the economy, in the short-run the main effects of a reduction of mark-ups may be determined by the exit of incumbents and thereby by (human and physical) capital scrapping, contracting aggregate supply. The effect of the entrance of new firms (and new hires) may only materialize over the medium-run and therefore unemployment may induce aggregate demand to contract. In addition, while reforms may boost confidence and generate expectation of increased income and wealth, increasing, via the permanent

Barkbu, Lusinyan and Muir (2014), Andrés, Arce and Thomas (2014), ECB (2015) and Aguiar, Ribeiro e Gil (2017).

<sup>4</sup> In general, the fiscal impact of the measures, including their financing (e.g. via debt or increased revenues / decreased expenses) also has important short-run effects.

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. Some of these effects are potentiated during economic downturns: the entrance of new firms is further delayed and agents' uncertainty is higher.

In this context, the short-run effect of reforms is an important empirical question. Bouis, Causa, Demmou, Duval and Zdzenicka (2012), using a long time-series of aggregate data for a sample of OECD countries, show that while some reforms produce gains already in the short-run, some labor and product market reforms may have short-term recessionary effects, a result confirmed by Cacciatore and Fiori (2015).

Some authors have further explored the reasons for these short-term effects, taking into account the impact of the cycle, of the initial conditions and of technological differences.

#### *i) The effect of the cycle*

IMF (2016), relying on aggregate, sectoral and firm-level data for a sample of advanced economies, show that the short-run effects of reforms are curbed by macroeconomic conditions. In the same vein, OECD (2016), using industry level data for a group of OECD countries, argues that the short-term costs of reforms lowering barriers to entry and the cost of dismissal are larger under downswings. Dabla-Norris, Guo, Haksar, Kim, Kochhar, Wiseman and Zdzenicka (2015), relying on industry-level data, argue that the short-term impact of reforms may be negative depending on the type of reform and the sector considered but also on the position over the cycle; in this context, reforms affecting product markets, the labor market and infrastructures may have negative effects in the short-run. Adhikari, Duval, Hu and Loungani (2016), based on aggregate data for a cross-country panel, also show that weak macroeconomic conditions hamper the benefits of reforms.

#### *ii) Initial conditions*

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. However, by further exploring the effects on the reformed sectors, they show that results are only visible in the case of larger reforms and are more positive the

lower the pre-existing restrictions, arguing that higher initial regulation may bring higher costs (but also higher longer term benefits). In the case of downstream industries, the authors show that the gains for manufactures are higher than those for services, possibly because the former display higher competitive pressures and thus have higher incentives to materialise the potential benefits from lower priced intermediate inputs. Égert (2016), Égert and Gal (2016b) and Bouis, Causa, Demmou, Duval and Zdzenicka (2012), relying on aggregate data, show that different reforms interact with each other and their effects depend on initial institutional settings.

#### *iii) Productivity differentials and technological spillovers*

Saia, Andrews and Albrizio (2015) argue that a country's productivity growth is influenced by the distance to the productivity frontier (the catching-up effect) and the ability to learn from the frontier (the pass-through or diffusion effect). For economies further away from the technological frontier, the catching-up effect is the most significant as it implies adopting existing technologies. As an economy gets closer to the technological frontier, spillovers from the frontier are the main effect, as innovation becomes more relevant than imitation. By relying on sectoral-level data, the authors show that technological spillovers are improved by a supportive institutional setting, namely by lower barriers to entry, efficient judicial systems and bankruptcy laws and university-industry R&D partnerships.

Following the theoretical contributions of Acemoglu, Aghion and Zilibotti (2006) and Aghion and Howitt (2006), Bourlès, Cette, Lopez, Mairesse and Nicoletti (2010) 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.

Nicoletti and Scarpeta (2003), using industry level for a panel of OECD countries, argue that the negative effect of product market regulation on productivity works mainly by slowing down technological catch-up. The authors show that the positive gains of entry liberalisation are higher the further the country is from the technological leader. Dabla-Norris, Guo, Haksar, Kim, Kochhar, Wiseman and Zdzienicka (2015), relying on industry-level data for a sample of advanced economies, show that there are important spillovers at play, both by a process of catching-up by laggards and by pass-through effects from the frontier to the others. Dabla-Norris, Ho and Kyobe (2013), using a panel of industry-level data for more than 100 advanced, emerging market and developing economies, show that the short-term effect of reforms varies with the distance to the world sectoral technological frontier.

Building on this literature, and using firm-level data for Portugal, we explore the direct link between structural reforms and productivity over the short-run, by reform area. The choice of short-run effects is motivated by data availability but also by the relevance of this time horizon for the political economy of reforms. In addition, and departing from the notion of spillover effects across countries, we assess spillover effects within firms in the same country. In particular, we assess catching-up and pass-through effects from firms at the technological frontier to those lagging behind. In particular, we assess whether structural reforms amplify these spillover effects.

### 3. Method

The framework considered in this paper follows the work on the short-run effect of reforms 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).

Using firm-level data, we depart from the estimation of the following model:

$$\Delta Y_{i,s,t} = \beta_0 + \beta_1 \Delta Y_{Frontier,s,t} + \beta_2 DTF_{i,s,t-1} + \beta_3 REF_{t-1} + \mu_t + v_s + \varepsilon_{i,t} \quad (1)$$

where  $\Delta Y$  is the annual productivity growth rate for firm  $i$ , in sector  $s$  and year  $t$ .  $\Delta Y_{Frontier}$  represents the average productivity growth of frontier firms within the sector of firm  $i$  at time  $t$ ,  $DTF$  is the productivity gap between laggards and frontier firms in the beginning of the period,  $REF$  is the reform indicator lagged one period, entered separately in each regression (to avoid correlation between the regressors). Time and industry fixed effects are also included ( $\mu_t$  and  $v_s$ ). In this context,  $\beta_3$  gives us the effect of the reform while  $\beta_1$  and  $\beta_2$ , if positive, translate pass-through and catching-up effects.

One may wonder if 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, we disentangle the reform effect for laggards and frontier firms, as follows:

$$\Delta Y_{i,s,t} = \beta_0 + \beta_1 \Delta Y_{Frontier,s,t} + \beta_2 DTF_{i,s,t-1} + \beta_3 REF_{t-1} + \beta_4 D_{front,i,s} * REF_{t-1} + \beta_5 D_{front,i,s} + \mu_t + v_s + \varepsilon_{i,t} \quad (2)$$

where  $D_{front}$  is a dummy which takes the value 1 if the firm belongs to the sectoral frontier and 0 otherwise. Therefore,  $\beta_3 + \beta_4$  provide an estimate of the effect of the reforms on frontier firms whereas  $\beta_3$  provides estimates for the impact on laggards.

However, as discussed in the previous section, structural reforms may also impact the mechanisms of pass-through and catching-up. To analyse this indirect effects of reforms, we interact the reform variable with the productivity growth of frontier firms and with the distance to frontier, as follows:

$$\Delta Y_{i,s,t} = \beta_0 + \beta_1 \Delta Y_{Frontier,s,t} + \beta_2 DTF_{i,s,t-1} + \beta_3 REF_{t-1} + \beta_4 D_{front,i,s} * REF_{t-1} + \beta_5 D_{front,i,s} + \beta_6 \Delta Y_{Frontier,s,t} * REF_{t-1} + \beta_7 DTF_{i,s,t-1} * REF_{t-1} + \mu_t + v_s + \varepsilon_{i,t} \quad (3)$$

$\beta_6$  and  $\beta_7$  represent, respectively, the change of pass-through and catching-up effects driven by the reform.

### 4. Data

The analysis is based on annual, firm-level data for Portuguese companies obtained from *Informação Empresarial Simplificada* (IES) for the period 2006-2014.<sup>5</sup> Our main database is the Sistema de Contas

<sup>5</sup> IES is the system by which all enterprises in Portugal meet their obligation to report their annual accounts simultaneously



Integradas das Empresas (SCIE) from the Statistics Portugal (INE), where the information from IES is compiled and subject to quality checks.

Our initial dataset, covering nine years of data, includes 3,232,481 firm-level observations.<sup>6</sup> 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.

The technological frontier is computed at the firm level for each sector and period and taking into account firms in the 90<sup>th</sup> percentile of productivity. The measure of firm-level productivity is total factor productivity (TFP), computed following the methodology developed by Levinsohn and Petrin (2003)<sup>7,8</sup>. As not all firms have all the needed input variables available, the final number of observations is smaller than our initial dataset.<sup>9</sup> The distance to frontier (DTF) is computed by sector and period as the difference between the lower bound of the

productivity at the frontier and the firm's productivity (for all laggard firms).

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 euros. The annual TFP growth is, on average, negative (-0.02%) while the technological frontier displays a nil annual growth, reflecting also the financial and economic crisis that affected Portugal during the period considered.

Looking at the differences between frontier and laggard firms, we conclude that the former are larger in terms of output, assets or number of workers. By definition, frontier firms are also more productive, with an average productivity growth over the period of 0.23%, which compares to -0.05% for the laggards.<sup>10</sup>

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

Variable	Unit	Mean	Mean frontier	Mean laggards	Std Dev	Min	Max
Output	10 <sup>3</sup> euro	1213	5580	728	27200	0	10300000
Operating costs	10 <sup>3</sup> euro	286	616	250	5712	0	1820000
Cost of employees	10 <sup>3</sup> euro	173	280	161	2093	0	469000
Assets	10 <sup>3</sup> euro	1604	3304	1415	55000	0	21200000
TFP growth [D.InTFP]	%	-0,02	0,23	-0,05	0,55	-10,76	12,20
TFP growth of frontier [D.InFront]	%	0,00	-	-	0,02	-0,47	0,51
Distance to frontier (DTF)	p.p.	1,33	0,00	1,01	0,81	0,00	14,74
Number of workers	unit	10	15	9	92	1	22734

Source: Authors' own calculations based on SCIE.

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.

<sup>6</sup> The database also includes sole proprietorships, which were excluded from our analysis. The figure presented already excludes them.

<sup>7</sup> 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).

<sup>8</sup> For robustness, we have also computed our regressions for labor productivity (ratio of output to employment) and the results are broadly unchanged. However, as the classification of a firm as belonging to the sectoral frontier depends upon the measure of productivity used (TFP or LP), the outcome for frontier firms (a group which is, by construction, smaller than the one of the laggards) differs for some reform areas.

<sup>9</sup> The actual number of observations is indicated in the regression outputs presented in the annex.

The measures of reforms are taken from three datasets: the OECD Product Market Reforms database<sup>11</sup>; the World Economic Forum Global Competitiveness Index<sup>12</sup>; and the World Bank Doing Business Indicators<sup>13</sup>. 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 indicators selected include the following: Institutions, Infrastructure, Health and Primary Education, Higher education and training, Goods market, Labor market, Financial market, Technological readiness, Business sophistication, Innovation, Starting

<sup>10</sup> 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).

<sup>11</sup> OECD (2013).

<sup>12</sup> <http://reports.weforum.org/global-competitiveness-report-2015-2016>.

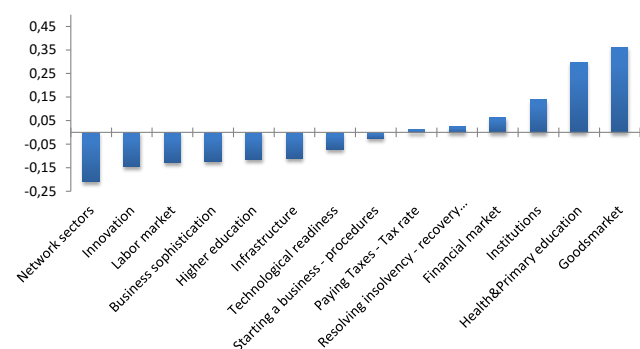
<sup>13</sup> <http://www.doingbusiness.org>.

a business, Paying taxes, Resolving insolvency and Network sectors. As most of reform indicators are only available from 2006, this is the starting period of our analysis (Annex 1 provides a description of the indicators and Annex 2 presents the time series used in the regressions).

## 5. Results

By estimating equation 1<sup>14</sup>, we find, in line with existing literature, that the short-term impact of reforms is not uniform across reform areas (see Figure 3; detailed regression output available in Annex 3). Indeed, some reforms do have positive effects, already in the short-run. This is the case of reforms affecting the goods market, health and primary education, institutions, financial markets, insolvency procedures (recovery rate) and taxation.

Figure 3: Coefficients of the direct short-term impact of reforms - regression (1)



Source: Authors' own computations. All coefficients are significant at 5%.

However, other reforms fail to deliver benefits in the short-run, consistently with the literature focusing on the short-term costs of reforms. This is the case of labor market reforms, higher education and R&D (technological readiness, innovation and business sophistication), as these are areas where benefits need time to materialize, while costs are already visible in the short-run. Infrastructure reforms also present a negative impact, which may be related with decreasing returns to scale, with returns failing to compensate for the associated investment costs. The easiness of starting

a business and the liberalization in the network sectors also display negative short-term effects on productivity growth, as the potential effects of increased competitiveness pressures are only visible in the medium term.

In all cases, we do find evidence of positive spillover effects, meaning that laggards are catching-up with frontier firms and that growth at the frontier is beneficial to all firms, via diffusion mechanisms.

To better understand the impact of reforms, and given that frontier and laggard firms may benefit differently from reforms (either because the potential gains are larger for laggards or because frontier firms are better equipped to grasp the benefits of reforms), we refine equation (1) to allow for differentiated effects. Equation (2) allows capturing the direct impact of reforms on firms at the frontier ( $\beta_3 + \beta_4$ ) and on laggards ( $\beta_3$ ).

Focusing on the effects of reforms in this new setting, we see that, for the set of reform indicators which have a negative short-term impact on productivity growth under equation (1), there are four reform areas where benefits are actually positive for frontier firms (see Table 3; detailed regression output in Annex 4).

Again, positive spillover effects from frontier firms are always present and are driven both by pass-through and catching-up effects. This raises an important point: even when the impact of the reform is negative for laggards, there are second round effects on those firms (due to spillovers) from the positive impact of reforms on frontier firms.

Equation (2) captures the direct effect of reforms and second round effects from spillovers. However, it does not capture the indirect effects related with reforms impacting the strength of these spillover mechanisms.

By estimating these indirect effects of reforms under equation (3), we show that, in general, diffusion mechanisms are curbed by reforms, at least in the short-run. For catching-up, the results are more mixed, with some reforms allowing for increased benefits for firms further away from the frontier and others being more beneficial for firms closer to the frontier (see Annex 5).

Adding these amplification effects to the direct effect of the reform, we are able to assess the overall effect of the

<sup>14</sup> For presentational purposes, all reform indicators were adjusted so that a higher value means more flexibility or less barriers.

reforms. In fact, under regression (3), the overall (direct and indirect) impact of a reform is driven by<sup>15</sup>:

$$\text{Reform Impact}_{i,s,t} = \beta_3 + \beta_4 \text{Dfront}_{i,t} + \beta_6 \Delta Y \text{Frontier}_{s,t} + \beta_7 \text{DTF}_{i,s,t-1}. \quad (4)$$

Note that for firms at the frontier, equation (4) simplifies to:

$$\text{Reform Impact}_{i,s,t} = \beta_3 + \beta_4 + \beta_6 \Delta Y \text{Frontier}_{s,t} \quad (5)$$

Whereas, for laggards, it becomes:

$$\text{Reform Impact}_{i,s,t} = \beta_3 + \beta_6 \Delta Y \text{Frontier}_{s,t} + \beta_7 \text{DTF}_{i,s,t-1}. \quad (6)$$

Given that this overall effect depends both on the productivity growth at the frontier and on the distance to frontier (DTF), we illustrate the results by fixing one of these variables. Given that DTF is firm specific, we opted to provide an illustration considering productivity growth of frontier firms of 1%. This allows us to solve, in the case of laggards, for the threshold DTF, i.e. the DTF below/above which the laggards firms have an overall positive impact of the reform. Knowing the threshold DTF, we are also able to compute the share of enterprises that benefit from each reform.

Table 3: Coefficients of the direct short-term impact of the reform, broken down by type of firm: laggards and frontier firms – regression (2)

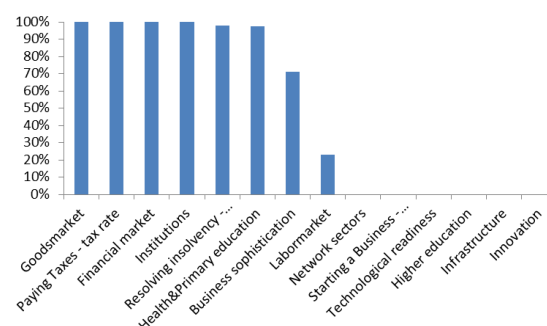
Reform areas	Laggards firms	Frontier firms
Network sectors	-0,221	-0,001
Innovation	-0,183	0,081
Labormarket	-0,164	-0,391
Business sophistication	-0,160	-0,465
Higher education	-0,146	-0,024
Infrastructure	-0,139	0,015
Technological readiness	-0,077	0,010
Starting a Business - procedures	-0,029	0,001
Paying Taxes - tax rate	0,015	0,067
Resolving insolvency - recovery rate	0,023	0,020
Financial market	0,066	0,001
Institutions	0,147	-0,006
Health&Primary education	0,289	0,227
Goodsmarket	0,370	0,082

Source: Authors' own computations. All coefficients are significant at 5%.

Therefore, looking at laggard firms, we confirm the results of regression (2) concerning the direct positive effects of the mentioned reforms (goods market,

taxation, financial market, institutions, insolvencies and health and primary education). Even accounting for indirect effects, we show that, for those six areas, all or nearly all laggard firms are positively impacted with the reform (see Figure 4). Finally, for two of the reforms with negative direct effects (business sophistication and labor market), the positive indirect effects allow for overall positive benefits, although this only affects a fraction of firms (71% and 23%, respectively).

Figure 4: Illustration: percentage of laggard firms with a positive effect of reforms (direct and indirect) when sectoral frontier grows at 1% (2014) – regression (3)



Source: Authors' own computations.

Turning now to frontier firms, and with the example of 1% productivity growth at the frontier, we are interested in the sign of expression (5): if positive, then the impact of the reform is positive in the short-run.

Therefore, when controlling for indirect effects on spillover mechanisms, we do not confirm the positive direct effects visible in equation (2) for infrastructure, innovation and financial market (Table 4). Moreover, the direct effect of network reform turns positive (it was negative under regression (2)).

It is interesting to note that, under the conditions of this simulation, the evidence on indirect short-term effects is mixed, both for frontier and laggard firms. In a number of reform areas, spillovers (diffusion and catching-up) are being amplified by reforms, but in some others there is no amplification mechanism or it is even negative.

Therefore, we may conclude that, even in the short term (and considering a hypothetical scenario where productivity growth at the frontier is 1%), seven of the reform areas under analysis have an overall positive impact on frontier firms. In addition, seven reform areas produce positive short-run effects on all or at least a majority of laggards. This should be seen as a lower bound as there are also second round effects from the

<sup>15</sup> Note that this expression accounts for the effects of the reform, either direct or indirect (via the impact of reforms on spillover effects). Second round effects are not incorporated in this expression but may also be derived from equation (3).

positive spillovers from frontier firms. These means that if a reform benefits frontier firms, the positive spillovers may more than compensate the negative effects of reforms on laggards.

Table 4: Illustration: Overall effect of reforms on frontier firms when sectoral frontier grows at 1% (2014) – regression (3)

	Overall effect	Direct effect	Indirect effect
Goods market	+	+	-
Paying Taxes - tax rate	+	+	+
Resolving insolvency - recovery rate	+	+	-
Health&Primary education	+	+	-
Network sectors	+	+	none
Starting a Business - procedures	+	+	+
Technological readiness	+	+	+
Financial market	-	-	-
Institutions	-	-	-
Business sophistication	-	-	-
Labormarket	-	-	-
Higher education	-	-	none
Infrastructure	-	-	+
Innovation	-	-	none

Source: Authors' own computations. Note: "+" stands for a positive effect whereas "-" represents a negative impact.

## 6. An application for reforms between 2010 and 2013

In order to better understand the actual impact of reforms on productivity growth, we estimate the change in TFP driven by reforms that occurred during the period 2010-2013. The starting year was chosen to capture the reforms implemented after the adjustment programme; the end date is due to firm-level data availability (which is available up to 2014; reforms enter the equation with a lag). We thus compute, at firm level, the change in the growth rate of productivity between 2012 and 2014 driven by the reforms enacted between 2010 and 2013. The exercise focuses on the reform areas that improved on efficiency grounds between 2010 and 2013, as presented in Table 5.

Table 5 – Reform areas which improved between 2010 and 2013

Reform area	2010	2013
Infrastructure (1-7; 7 best)	5,30	5,55
Health and primary education (1-7; 7 best)	6,13	6,28
Higher education and training (1-7; 7 best)	4,76	5,15
Technological readiness (1-7; 7 best)	4,63	5,24
Innovation (1-7; 7 best)	3,77	3,93
Starting a Business (N Procedures)	6	5
Paying Taxes (Total tax rate)	42,6	42,3
Network sectors (0-6; 0 best)	2,37	2,18

Source: World Competitiveness Index except Starting a business and Paying taxes (Doing Business – World Bank) and Network sectors (OECD – PMR).

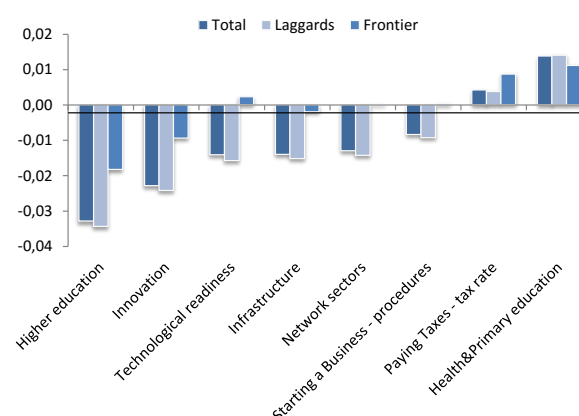
By computing the change in productivity growth driven by reforms for each firm and each year, we conclude that the reforms undertaken between 2010 and 2013 improving health and primary education and decreasing the corporate tax rate increased the average annual TFP growth at firm level by 0.014 and 0.004 percentage points, respectively (Figure 5). The effect of the tax rate is stronger for frontier firms as compared to laggards.

Reforms affecting network sectors, the technological readiness and the cost of starting a business, although entailing short-term costs for laggards, have positive (but small) positive effect on frontier firms.

The other reforms fail to bring short-term gains. This is particularly true for reforms affecting higher education, infrastructure and innovation. Still, frontier firms loose much less than the others.

These negative effects may be linked with different factors, as presented in detail in Section 2. In particular, our results are in line with the literature highlighting the short-term costs of implementing reforms during downturns, precisely the case during the period under consideration. In addition, most of the reforms were implemented broadly simultaneously, in a large reform wave, without carefully incorporating the sequencing considerations that derive from the interactions among reforms and the impact of initial institutional settings, as discussed in Section 2.

Figure 5 – Short-term impact of reforms on the average change of annual firm-level productivity growth between 2012 and 2014 (percentage points) – all firms, laggards and frontier firms



Source: Authors' own computations. Note: The black line represents the average change in the annual growth of firms' individual productivity.



## 7. Conclusions and way forward

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 OECD, the World Bank and the World Competitiveness Forum, reflect these improvements.

Understanding the impact of the reforms undertaken is crucial both for policy makers – as it allows them to fine-tune reform efforts and to better design future reforms – and for ownership of reforms by the different stakeholders. Looking at the short-term impact of reforms is particularly relevant for the political economy of the process and for devising appropriate compensatory, complementary or transitory measures, where needed.

In this paper, we rely on firm-level data for Portugal from 2006 to 2014 and assess the impact of structural reforms on firm's productivity in the short-run. We show that, for some reform areas, benefits are already seen in the short-run. In addition, frontier firms are better equipped to grasp short-term gains, meaning that while some reforms do have detrimental short-term effects for laggards, they produce gains for firms at the frontier. This may be linked with the *"escape competition"* and *"Schumpeterian effect"* described in Bournès, Cetté, Lopez, Mairesse and Nicoletti (2010), whereby reforms potentiate innovation for the most productive firms but reduce the incentives to do so for the least productive (as they won't be able to survive in a more competitive environment). In any case, improvements at the frontier are beneficial also for (surviving) laggards, via spillover effects. Indeed, diffusion and catching-up mechanisms are positive for Portuguese firms, meaning that gains at the frontier are translated into gains to all firms. Finally, we show that, in the short run and at firm-level, these spillovers may be potentiated or curbed by reforms (in line with industry-level results in the available literature). While diffusion mechanisms are being curbed by the reforms, at least in the short run, existing catching-up effects are either being potentiated or mitigated, depending on the reform area.

With the results of our econometric analysis, we also assess the short-run effects of the reforms implemented in Portugal between 2010 and 2013. We show that reforms in two areas are already translating into higher

firm-level productivity growth; but there are also short-term costs. In line with the existing empirical literature, this may be linked with the effect of the cycle, as downturns are detrimental for the reform process. In addition, a better framed sequencing and bundling of reforms could also, as argued by the literature, mitigate these costs given the relevance of initial conditions and of complementary policies. While some authors defend that, even in the presence of short-term costs, 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 three 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). While the current dataset does not allow us to further exploit the effects of the cycle, given the reduced available time-span, it allows for a more detailed analysis of the effects of the initial conditions and on the cross-effects of reforms. This is the focus of our subsequent research.

It should be noted that growth depends on both labor utilisation and labor productivity. The first is affected by both employment and participation while the second by capital deepening and total factor productivity (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 taken into account as reforms may have redistributive 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.

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. In particular, we are able to distinguish between the effects on the most productive and the others (frontier firms and laggards). However, as different firms have different weights in the economy (and our regressions are unweighted), our 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).

Finally, and while an analysis of short-term effects is crucial for policy makers and the society at large, the long-term impact of reforms should also be carefully monitored. However, for the time being, the short time span of our firm level database (nine years) is an important limitation.

## References

- Acemoglu, D., Aghion, P. and Zilibotti, F. 2006. Distance to Frontier, Selection and Economic Growth. *Journal of the European Economic Association*, Vol. 4(1), pp. 37-74.
- Adhikari, B., Duval, R., Hu, B. and Loungani, P. 2016. Can reform waves turn the tide? Some case studies using the synthetic Control Method. IMF Working Paper 16/171.
- Aghion, P. and Howitt, P. 2006. Joseph Schumpeter Lecture: Appropriate Policy Growth: A Unifying Framework. *Journal of the European Economic Association* 4, No. 2-3, pp. 269-314.
- Aguiar, A., Ribeiro, A. P. e Gil, P. 2017. Structural Reforms in Justice and Education: A Model-Based Assessment of Macroeconomic Impacts for Portugal. GPEARI article. Forthcoming.
- Anderson, D., Barkbu, B., Lusinyan, L. and Muir, D. 2014. Assessing the Gains from Structural Reforms for Jobs and Growth, *Jobs and Growth: supporting the European recovery*, IMF Chapter 7, 151.
- Andrés, J., Arce, O. and Thomas, C. 2014. Structural Reforms in a Debt Overhang. Banco de España Documentos de Trabajo 1421.
- Arnold, J. and Barbosa, N. 2015. Structural policies and productivity: evidence from Portuguese firms. OECD Economics Department Working Paper 1259. OECD publishing. Paris.
- Barnes, S., Bouis, R., Briard, P., Dougherty, S. and Eris, M. 2013. The GDP impact of reform: a simple simulation framework. OECD Economics Department Working Papers 834. OECD publishing. Paris.
- Blanchard, O. and Giavazzi, F. 2003. Macroeconomic effects of regulation and deregulation in goods and labor markets. *Quarterly Journal of Economics*, pp. 879-907. August 2003.
- Bouis, R. and Duval, R. 2011. Raising potential growth after the crisis: a quantitative assessment of the potential gains from various structural reforms in the OECD area and beyond. OECD Economics Department Working Paper 835. OECD publishing. Paris.
- Bouis, R., Causa, O., Demmou, L., Duval, R. and Zdzienicka, A. 2012. The short-term effects of structural reforms: an empirical Analysis. OECD Economics Department Working Paper 949. March 2012.
- Bourlès, R., Cetté, G., Lopez, J., Mairesse, J., Giuseppe Nicoletti, G. 2010. Do product market regulations in upstream sectors curb productivity growth? Panel data evidence for OECD countries. Economics department working papers 791. OECD publishing. Paris.
- Cacciatore, M., Duval, R. and Fiori, G. 2012. Short term pain or gain? A DSGE model-based analysis of the short-term effects of structural reforms in product and labor markets. OECD Economics Department Working Paper 948. OECD publishing. Paris.
- Cacciatore, M. and Fiori, G. 2016. The macroeconomic effects of goods and labor markets deregulation. *Review of Economic Dynamics* 20 (2016) 1-24.
- Dabla-Norris, E., Guo, S., Haksar, V., Kim, M., Kochhar, K., Wiseman, K. and Zdzienicka, A. 2015. The New Normal: A Sector-Level Perspective on Productivity Trends in Advanced Economies. Staff Discussion Notes No. 15/3.
- Dabla-Norris, E., Ho, G. and Kyobe, A. 2013. Reforms and distance to frontier. IMF. December 2013.
- Égert, B. 2016. Regulation, institutions and productivity: new macroeconomic evidence from OECD countries. *American Economic Review: Papers & Proceedings* 2016. 106 (5) 109-113.
- Égert, B. and P. Gal. 2016a. The Quantification of Structural Reforms: A New Framework. OECD Economics Department Working Paper No. 1354. OECD publishing. Paris.
- Égert, B. and P. Gal. 2016b. The quantification of structural reforms: introducing country-specific policy effects. OECD Economics Department. mimeo.
- European Central Bank. 2015. Progress with structural reforms across the euro area and their possible impacts, *Economic Bulletin* Issue 2 / 2015.
- European Commission. 2016. Ex-post evaluation of the economic adjustment programme in Portugal: 2011-2014. Institutional paper 040. November 2016.
- Gal, P. and Hijzen, A. 2016. The short-term impact of product market reforms: A cross-country firm-level analysis. IMF Working Paper 16/116.
- IMF. 2015. Structural reforms and macroeconomic performance: initial considerations for the fund. Staff report, November 2015.
- IMF. 2016. Time for a supply-side boost? Macroeconomic effects of labor and product. World

- Economic Outlook – too slow for too long?. Chapter 3. April 2016.
- Levinsohn, J. and Petrin, A. 2003. Estimating production functions using inputs to control for unobservables. *Review of Economic Studies* 70(2): 317–342.
- Lusinyan, L. and Muir, D. 2013. Assessing the Macroeconomic Impact of Structural Reforms: The Case of Italy. IMF Working Paper European Department and Research Department. WP 13/22.
- Nicoletti, G. and Scarpetta, S. 2003. Regulation, productivity and growth. OECD Economics Department Working Paper 347. OECD publishing. Paris.
- OECD. 2007. More jobs but less productive? The impact of labor market policies on productivity. OECD Employment Outlook 2007.
- OECD. 2013. Product Market Regulation Database. [www.oecd.org/economy/pmr](http://www.oecd.org/economy/pmr).
- OECD. 2015. Italy Structural reforms: impact on growth and employment. February 2015.
- OECD. 2016. Short-term labor market effects of structural reforms: pain before the gain?. OECD employment outlook. Chapter 3.
- Petrin, A., Poi, B., and Levinsohn, J. 2004. Production function estimation in Stata using inputs to control for unobservables. *The Stata Journal* 4, Number 2, pp. 113–123.
- Saia, A., Andrews, D. and Albrizio, S. 2015. Productivity Spillovers from the Global Frontier and Public Policy: Industry Level Evidence. OECD Economics Department Working Paper, No 1238.

**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.
Infrastructure	Considers modes of transport, electricity supplies and a solid and extensive telecommunications network to measure the extension and efficiency of a country's infrastructure.
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.
Technological readiness	Measures the agility with which an economy adopts existing technologies to enhance the productivity of its industries, with specific emphasis on its capacity to fully leverage information and communication technologies (ICTs) in daily activities and production processes for increased efficiency and enabling innovation for competitiveness.
Business sophistication	Concerns two elements that are intricately linked: the quality of a country's overall business networks and the quality of individual firms' operations and strategies.
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.

**OECD Product Market Reforms indicator**

Network sectors	Summarizes regulatory provisions in seven sectors: telecoms, electricity, gas, post, rail, air passenger transport, and road.
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## 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
Infrastructure (1-7; 7 best)	WCI	4,83	4,98	5,07	5,23	5,30	5,48	5,50	5,55	5,66
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
Technological readiness (1-7; 7 best)	WCI	4,09	4,28	4,51	4,73	4,63	5,31	5,27	5,24	5,42
Business sophistication (1-7; 7 best)	WCI	4,23	4,37	4,39	4,28	4,19	4,19	4,17	4,18	4,29
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
Network sectors (0-6; 0 best)	OECD	2,57	2,55	2,55	2,55	2,37	2,31	2,31	2,18	-

**Annex 3 – Regression output – equation (1) – dependent variable: firm-level TFP growth****Regression (1)**

	Total factor productivity growth													
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Institutions	Infrastructure	Health&Prim education	Goods market	Labor market	Higher education	Financial market	Technological readiness	Business sophistication	Innovation	Starting a business - procedures	Paying Taxes - Tax rate	Resolving insolvency - recovery rate	Network sectors
D.lnFront	0,898***	0,898***	0,898***	0,898***	0,898***	0,898***	0,898***	0,898***	0,898***	0,898***	0,898***	0,898***	0,898***	0,898***
P> z	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]
L.DTF	0,545***	0,545***	0,545***	0,545***	0,545***	0,545***	0,545***	0,545***	0,545***	0,545***	0,545***	0,545***	0,545***	0,545***
P> z	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]
L.Reform variable	0,140***	-0,11***	0,299***	0,362***	-0,129***	-0,115***	0,064***	-0,072***	-0,126***	-0,144***	0,027***	-0,012***	0,024***	0,211***
P> z	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]
country effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
industry effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
R-squared														
within	0,366	0,366	0,366	0,366	0,366	0,366	0,366	0,366	0,366	0,366	0,366	0,366	0,366	0,366
between	0,079	0,079	0,079	0,079	0,079	0,079	0,079	0,079	0,079	0,079	0,079	0,079	0,079	0,079
overall	0,112	0,112	0,112	0,112	0,112	0,112	0,112	0,112	0,112	0,112	0,112	0,112	0,112	0,112
Number of observations	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224

## Annex 4 – Regression output – equation (2) – dependent variable: firm-level TFP growth

## Regression (2)

	Total factor productivity growth													
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Institutions	Infrastructure	Health&Prim education	Goods market	Labor market	Higher education	Financial market	Technological readiness	Business sophistication	Innovation	Starting a business - procedures	Paying Taxes - Tax rate	Resolving insolvency - recovery rate	Network sectors
D.lnFront	1,090***	1,091***	1,095***	1,091***	1,088***	1,092***	1,093***	1,093***	1,090***	1,092***	1,094***	1,095***	1,095***	1,090***
P> z	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]
L.DTF	0,604***	0,604***	0,604***	0,604***	0,604***	0,604***	0,604***	0,604***	0,604***	0,604***	0,604***	0,604***	0,604***	0,604***
P> z	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]
L.Reform	0,147***	-0,139***	0,289***	0,370***	-0,164***	-0,146***	0,066***	-0,077***	-0,16***	-0,183***	0,029***	-0,015***	0,023***	0,221***
P> z	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]
D.Frontier	1,439***	-0,061***	1,128***	2,016***	1,647***	0,161***	1,026***	0,333***	2,039***	-0,246***	0,934***	2,955***	0,966***	1,278***
P> z	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]
D.Frontier*L.Reform	-0,153***	0,154***	-0,062***	-0,289***	-0,227***	0,123***	-0,065***	0,087***	-0,304***	0,264***	-0,030***	-0,052***	-0,003***	-0,219***
P> z	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]
country effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
industry effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
R-squared														
within	0,417	0,417	0,416	0,417	0,417	0,417	0,417	0,417	0,417	0,417	0,417	0,417	0,416	0,417
between	0,149	0,149	0,150	0,150	0,149	0,150	0,150	0,149	0,150	0,150	0,149	0,149	0,150	0,150
overall	0,188	0,188	0,188	0,188	0,188	0,188	0,188	0,188	0,188	0,188	0,188	0,188	0,188	0,188
Number of observations	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224

## Annex 5 – Regression output – equation (3) – dependent variable: firm-level TFP growth

## Regression (3)

	Total factor productivity growth													
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Institutions	Infrastructure	Health & Prim education	Goods market	Labor market	Higher education	Financial market	Technological readiness	Business sophistication	Innovation	Starting a business - procedures	Paying Taxes - Tax rate	Resolving insolvency - recovery rate	Network sectors
D.lnFront	5,856***	-2,705***	6,574***	9,489***	4,106***	1,299	2,262***	-1,037***	6,778***	2,015	2,358***	18,393***	11,766***	2,095***
P> z	[0,000]	[ 0,008]	[0,000]	[0,000]	[0,000]	[0,110]	[0,000]	[0,049]	[0,000]	[0,175]	[0,000]	[0,000]	[0,000]	[0,001]
L.DTF	0,438***	0,822***	1,489***	0,035	0,106***	1,187***	0,48***	0,712***	-0,601***	1,592***	0,621***	1,249***	1,352***	0,217***
P> z	[0,000]	[0,000]	[0,000]	[ 0,477 ]	[0,001]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]
L.Reform	0,116***	-0,142***	0,419***	0,253***	-0,168***	-0,15***	0,039***	-0,057***	-0,16***	-0,187***	0,032***	-0,015***	0,033***	0,068***
P> z	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]
Dummy_Front	1,309***	0,113***	1,851***	1,565***	1,253***	0,642***	0,926***	0,42***	1,072***	0,569***	0,949***	3,479***	1,584***	0,966***
P> z	[0,000]	[ 0,002]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]
Dummy_Front*L.Reform	-0,124***	0,121***	-0,18***	-0,186***	-0,127***	0,022**	-0,042***	0,069***	-0,077***	0,047***	-0,032***	-0,064***	-0,012***	-0,09***
P> z	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,014]	[0,000]	[0,000]	[0,000]	[0,018]	[0,000]	[0,000]	[0,000]	[0,000]
D.lnFront*L.Reform	-1,057***	0,724***	-0,901***	-1,911***	-0,748***	-0,038	-0,274***	0,449***	-1,326***	-0,238***	-0,213***	-0,407***	-0,15***	-0,396
P> z	[0,000]	[0,000]	[0,000]	[0,000]	[0,001]	[0,828]	[0,001]	[0,000]	[0,002]	[0,000]	[0,001]	[0,001]	[0,000]	[0,105]
L.DTF*L.Reform	0,037***	-0,042***	-0,144***	0,13***	0,126***	-0,122***	0,029***	-0,023***	0,284***	-0,263***	-0,003*	-0,015***	-0,01***	0,16***
P> z	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,076]	[0,000]	[0,000]	[0,000]
country effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
industry effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
R-squared														
within	0,418	0,418	0,417	0,418	0,418	0,418	0,418	0,418	0,418	0,418	0,417	0,417	0,417	0,418
between	0,149	0,149	0,147	0,149	0,149	0,148	0,149	0,149	0,149	0,148	0,149	0,149	0,150	0,148
overall	0,188	0,188	0,188	0,188	0,188	0,188	0,188	0,188	0,188	0,188	0,188	0,187	0,188	0,188
Number of observations	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224	1900224