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INSOLVENCY REGIMES, TECHNOLOGY DIFFUSION AND PRODUCTIVITY GROWTH: EVIDENCE FROM FIRMS IN OECD COUNTRIES

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ABSTRACT/RÉSUMÉ

Insolvency Regimes, Technology Diffusion and Productivity Growth: Evidence from Firms in OECD Countries

This paper explores the link between the design of insolvency regimes across countries and laggard firms' multi-factor productivity (MFP) growth, using new OECD indicators of the design of insolvency regimes. Firm-level analysis shows that reforms to insolvency regimes that lower barriers to corporate restructuring are associated with higher MFP growth of laggard firms. These results are consistent with the idea that insolvency regimes that do not unduly inhibit corporate restructuring can incentivise experimentation and provide scope to reconfigure production and organisational structures in order to facilitate technological adoption. The results also highlight policy complementarities, with insolvency regimes that reduce the cost of entrepreneurial failure potentially enhancing the MFP gains from lowering administrative entry barriers in product markets. Finally, we find that reducing debt bias in corporate tax systems and well-developed venture capital markets are associated higher laggard firm MFP growth, suggesting that equity financing can also be an important driver of technological diffusion. These findings carry strong policy implications, in light of the fact that there is much scope to reform insolvency regimes in many OECD countries and given evidence that stalling technological diffusion has contributed to the aggregate productivity slowdown

JEL Classification: D24; G33; G34; K35; O16; O40; O43; O47.

Keywords: Productivity, technological diffusion, laggard firms, insolvency, venture capital, equity financing

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Régimes d'Insolvabilité, Diffusion des Technologies et Croissance de la Productivité : Étude sur des Données d'Entreprises des Pays de l'OCDE

Ce document examine le lien entre les caractéristiques des regimes d'insolvabilité des pays et la croissance de la productivité multifactorielle (PMF) des entreprises à la traîne (en dessous de la frontière), en utilisant de nouveaux indicateurs de l'OCDE concernant les régimes d'insolvabilité. L'analyse au niveau des entreprises montre que les réformes des régimes d'insolvabilité visant à diminuer les barrières à la restructuration des entreprises sont associées à une croissance plus élevée de la PMF des entreprises à la traîne. Ces résultats sont conformes avec l'idée que des régimes d'insolvabilité qui n'entravent pas indûment la restructuration des entreprises peuvent encourager l'expérimentation et permettre de reconfigurer les structures de production et d'organisation afin de faciliter l'adoption technologique. Les résultats mettent également en évidence des complémentarités entre les politiques, les régimes d'insolvabilité réduisant le coût de l'échec entrepreneurial pouvant potentiellement augmenter les gains associés à la réduction des barrières à l'entrée administratives sur le marché des produits. Enfin, nous montrons aussi que la réduction du biais en faveur du financement par la dette dans les systèmes d'impôts sur les sociétés ainsi que des marchés du capital risque bien développés sont associés à une croissance de la PMF plus élevée des entreprises à la traîne, ce qui suggère que le financement en fonds propres peut aussi être un moteur important de la diffusion technologique. Ces résultats comportent de fortes implications politiques, au vu du fait qu'il existe une marge de manœuvre importante pour la réforme des régimes d'insolvabilité dans beaucoup de pays de l'OCDE, et étant donné les indices montrant que le blocage de la diffusion technologique a contribué au ralentissement de la productivité agrégée.

Classification JEL: D24; G33; G34; K35; O16; O40; O43; O47.

Mots-clés: Productivité, diffusion technologique, entreprises en difficulté, insolvabilité, capital-risque, financement en fonds propres

TABLE OF CONTENTS

Tables

Figures

INSOLVENCY REGIMES, TECHNOLOGY DIFFUSION AND PRODUCTIVITY GROWTH: EVIDENCE FROM FIRMS IN OECD COUNTRIES

By Müge Adalet McGowan, Dan Andrews and Valentine Millot[1]

1. Introduction and main findings

1. The productivity slowdown over the past 15 years highlights the need to identify the barriers to productivity growth in OECD economies. Firm-level research is increasingly linking the aggregate slowdown to the widening productivity dispersion across firms (Andrews et al., 2016), rising resource misallocation (Gopinath, et al., 2017), declining firm entry (Decker et al., 2016) and the increasing survival of "zombie firms" (Adalet McGowan et al., 2017a). In this context, one source of concern is that laggard firms are increasingly falling behind the global productivity frontier due to declining ability or incentives to adopt best practices from the frontier – i.e. a breakdown of the diffusion machine. In some countries, these problems are likely symptomatic of the inability of insolvency regimes to incentivise business experimentation and provide laggard firms with sufficient scope to implement the business changes that are needed to fully realise the productivity potential embodied in frontier technologies. But many cross-country indicators of insolvency regimes (e.g. World Bank Doing Business) have a number of drawbacks, which makes it difficult to identify the contribution of insolvency regimes to technology diffusion and productivity growth within-firms (Adalet McGowan and Andrews, 2016).

2. Accordingly, this paper exploits new OECD indicators of insolvency regimes (Adalet McGowan and Andrews, 2017; Adalet McGowan et al., 2017b) to examine the link between the design of these regimes and laggard firms' multi-factor productivity (MFP) growth, in a cross-section of 15 OECD countries over the period 2011-2013. This analysis is based on the identifying assumption that insolvency regimes should be most relevant for firm performance in industries with higher rates of firm turnover – i.e. those with more entry and exit. The results suggest that higher barriers to restructuring are associated with a disproportionately lower MFP growth of laggard firms in highly exposed industries than in low exposed industries. Assuming a causal relationship, our estimates imply that an insolvency reform which reduces barriers to restructuring from their high level in Hungary to the sample minimum (i.e. the United Kingdom) is associated with an increase in laggard firm MFP growth of 2.7 percentage points in high firm turnover industries, relative to other industries. Put differently, in industries with naturally higher firm turnover, the forces of technological diffusion will be relatively stronger in countries with insolvency regimes more conducive to corporate restructuring than in other countries.

3. These results are consistent with the idea that insolvency reforms can facilitate technological diffusion by promoting experimentation and providing laggard firms with sufficient scope to reconfigure organisational structures in ways that are complementary to the adoption of frontier technologies. At the same time, additional analysis suggests that insolvency regimes that entail lower barriers to corporate restructuring are also associated with disproportionately higher laggard firm MFP growth in industries that are more dependent on external finance, relative to other industries. These results are significant given the conventional wisdom that insolvency reforms which incentivize firms to experiment with risky technologies may come at the cost of a lower availability and higher cost of credit. Finally, important

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policy complementarities also emerge. In this regard, insolvency regimes that reduce the cost of entrepreneurial failure can enhance the MFP gains from lowering administrative entry barriers in product markets by reducing market congestion and thus providing new entrants with sufficient space to grow.

4. The analysis also identifies an important impact of equity financing on laggard firm MFP growth. For example, we find that higher debt bias in corporate tax systems – at the expense of equity financing – tend to disproportionately undermine the MFP catch-up of laggard firms to the global frontier in industries more dependent on external financing. This debt bias in the corporate tax system has been found to be associated with a higher share of debt in external financing and may undermine MFP growth by discriminating against knowledge-intensive firms, whose assets are more reliant on equity financing. Similarly, in industries more dependent on external financing, we find that higher venture capital (VC) investment as a share of GDP tends to foster the MFP catch-up of laggard firms to the global frontier, relative to other industries. This may reflect the idea that without well-developed VC markets, acute financing constraints may emerge for young knowledge-intensive firms that have limited internal funds and lack a track record to signal their "ability" to investors.

5. The next section explores the channels through which insolvency regimes may be relevant to productivity growth, as well as the other types of policies that may be relevant to firm-level productivity growth. Section 3 describes the firm-level data and policy indicators used in the empirical analysis and Section 4 presents the empirical framework used to estimate the link between insolvency regimes and the productivity growth of laggard firms, controlling for other country-level policy indicators. Sections 5.1 and 5.2 present the empirical results on the link between MFP growth, insolvency regimes and other policies. Section 5.3 discusses potential policy complementarities and the final section offers some concluding thoughts and outlines avenues for future research.

2. Productivity and public policies

2.1 Insolvency regimes

6. Insolvency regimes may affect labour productivity growth through a variety of channels. First, to the extent that insolvency regimes can distinguish ex-ante between non-viable and viable firms, they can strengthen market selection by facilitating the exit of the former and successful internal restructuring of the latter. Second, they can reduce the likelihood that scarce resources are trapped in inefficient or "zombie" firms and in turn improve the ease and speed at which such resources are reallocated to more productive uses. Third, insolvency regimes that do not unduly penalise entrepreneurial failure and inhibit corporate restructuring can spur firm creation and incentivise new firms to enter with more radical – as opposed to conservative – business strategies. Finally, insolvency regimes that facilitate corporate restructuring in a timely fashion can promote technological adoption and within-firm productivity gains. In this regard, firms typically need to adopt new technologies as part of a "system" of mutually reinforcing organisational changes (Brynjolfsson *et al.*, 1997). Moreover, economic history shows that the full payoffs from general purpose technologies are only realised once organisational structures can be reconfigured to exploit the gains provided by frontier technologies (David and Wright, 2005).[2] It therefore follows that insolvency reforms, which loosen barriers to experimentation and internal restructuring, will be complementary to technological adoption.

2. While electrification of US factories began in the 1890s, productivity did not start to increase significantly until 30 years later, with the arrival of a new generation of managers that invented new work practices and redesigned factories in order to fully exploit electricity's possibilities (Brynjolfsson and McAfee, 2011).

7. The introduction of new OECD indicators of insolvency regimes (See Section 3.1) has made it possible to explore the scope for insolvency regime reform to boost aggregate productivity growth via different channels. For example, recent OECD research has demonstrated that insolvency regimes that do not unduly raise barriers to corporate restructuring and the personal costs associated with entrepreneurial failure can reduce the capital sunk in zombie firms and spur productivity-enhancing capital reallocation (Adalet McGowan, Andrews and Millot, 2017b). Recent ECB-OECD analysis finds that insolvency regimes which entail impediments to corporate restructuring may reduce the economic incentives for banks to commence restructuring proceeding (Andrews and Petroulakis, 2017).

8. This paper uses the new OECD indicators to evaluate the links between insolvency regimes and within-firm productivity growth. Previous OECD analysis – based on World Bank Doing Business Indicators – suggests that a lower cost to close a business tends to be associated with more experimentation with risky technologies, consistent with the idea that insolvency regimes that do not sanction business failure too severely are likely to increase innovation (Andrews et al., 2014). Furthermore, a lower cost to close a business is associated with a more rapid spillover of new innovations from the frontier (Saia et al., 2015) and adoption of existing technologies (Westmore et al., 2013). One weakness of these analyses, however, is that the cost to close a business is an outcome variable, with no underlying policy levers attached to it. A key innovation of the new OECD insolvency regimes indicators is that they capture specific design features of insolvency regimes which can clearly be levered by policy.

9. In the following analysis, we mainly concentrate on barriers to restructuring to the extent that restructuring of viable firms holds out the prospect for higher within-firm productivity growth in the future (Adalet McGowan and Andrews, 2016).[3] Indeed, the specific design features of insolvency regimes that *inhibit corporate restructuring* can affect productivity growth through a variety of channels. When only debtors can initiate restructuring and minority shareholders can block a restructuring plan (i.e. cram-down is absent), it is less likely that weak firms that encounter temporary distress are successfully restructured in a timely fashion, leading more resources to be trapped in marginal firms. These frictions will be exacerbated when there is no priority given to new financing over unsecured creditors in the event of liquidation, since capital injections are typically required to facilitate internal reorganisation. Moreover, these design features could be expected to affect within-firm productivity growth to the extent that firms typically need to adopt new technologies as part of a "system" of mutually reinforcing organisational changes (Brynjolfsson et al., 1997), which requires internal restructuring. Finally, insolvency regimes that do not retain incumbent management during restructuring and lack a temporary stay on assets can curb productivity growth via lower business experimentation and less efficient restructuring.[4]

2.2 Other policies

10. As is customary, we control for the typical framework policies used in cross-country growth studies as well-designed framework policies allow productive firms to thrive, via a number of different channels.

3. We also focus on barriers to corporate restructuring – as opposed to personal insolvency regimes – since small entrepreneurial firms are less well-represented in the ORBIS database that is used in the analysis, compared to larger firms for which corporate insolvency regimes are relevant.

4. Dismissal of incumbent management during restructuring may increase the private incentives of management to hide the true financial state of the firm and gamble on resurrection, delaying the initiation of restructuring. Similarly, the lack of a stay on assets for a limited period of time could prevent the firms from having the breathing space to successfully restructure.

11. Product market regulations (PMR) have a pervasive impact at each stage of the innovation process, as suggested in empirical studies that show a negative relationship between PMR and productivity at the aggregate level (Bouis et al., 2011) and the firm and sectoral levels (Aghion et al., 2004; Bourles et al., 2013) and an inverted U-shaped relationship between indicators of competition and innovation (Aghion et al., 2005). PMR shape the formation of new ideas via their effects on innovative effort. Lower entry regulations increase the supply of new ideas by raising firm entry rates (Fisman and Sarria-Allende, 2010; Klapper et al., 2006;), which in turn increase the pressure on incumbent firms to innovate via heightened competitive pressure. Similarly, the positive impact of knowledge spillovers from abroad on domestic patenting activity is significantly higher in countries where barriers to entry for new firms are relatively low (Westmore, 2013), suggesting that reforms to PMR can also raise the incentives for firms to incorporate foreign technologies (Holmes et al., 2008).

12. Employment protection legislation (EPL) could have ambiguous effects on within-firm MFP growth. On the one hand, more stringent EPL might raise worker commitment and firms' incentives to invest in firm-specific human capital, which is likely to increase within–firm productivity (Autor, 2003; Wasmer, 2006). While evidence for this hypothesis is scarce (Andrews and Criscuolo, 2013), one concern is that the asymmetric liberalisation of employment protection for temporary contracts while leaving in place stringent regulations on permanent contracts may undermine the accumulation of firm-specific human capital (Martin and Scarpetta, 2012).[5] On the other hand, higher EPL could discourage experimentation with risky business strategies to the extent it raises labour adjustment costs, lowering MFP growth.

13. We also consider a range of taxation variables. For example, lower corporate tax rates have been shown to be associated with disproportionately higher firm MFP growth in industries with higher relative profitability (Schwellnus and Arnold, 2008). Similarly, lower top marginal tax rates have been shown to be associated with disproportionately higher firm MFP growth in industries with higher firm turnover (Andrews and Criscuolo, 2013). But we also explore the implications for within-firm MFP growth of the debt-bias in the corporate taxation system. For example, the effective average tax rates on stock market finance generally exceed those on debt finance, primarily because interest expenses are cost-deductible. This debt bias in the corporate tax system has been found to be associated with a higher share of debt in external financing and may undermine productivity growth by discriminating against innovative fast-growing firms that invest heavily in intangible property and thus have less access to debt financing and are more reliant on equity financing.

14. Finally, we explore the contribution of venture capital (VC) markets for productivity. Indeed, it is likely that reviving productivity growth will require equity financing to tap the new sources of growth – i.e. intangible investment. The latter reflects the fact that knowledge-based assets are difficult to collateralise – partly because they are less easy to define and transfer than tangible assets – which makes them less conducive to traditional debt financing. As a result, countries with more developed VC markets are also more effective at channelling investment to innovative firms, which in turns facilitates the implementation and commercialisation of new ideas (Andrews, Criscuolo and Menon, 2014). Evidence from the United States demonstrates a causal positive impact of VC financing on innovation and growth (Samila and Sorenson, 2011), while recent cross-country studies find that VC financing can increase the productivity and size of national frontier firms (Andrews, Criscuolo and Gal, 2015) and foster productivity diffusion from the global frontier (Saia et al., 2015).

5. This might occur if firms substitute temporary for regular workers and temporary workers are less likely to participate in job-related training.

3. Data

3.1. Policy indicators

15. To analyse the links between insolvency regimes and within-firm productivity growth, we use the new OECD indicators of insolvency regimes, introduced in Adalet McGowan et al. (2017b). These indicators, based on countries' responses to an OECD questionnaire, were designed to identify the contribution of personal and corporate insolvency regimes to productivity performance and generate country-specific proposals for reform. Specifically, thirteen key features were identified, which – based on international best practice and existing research – may carry adverse consequences for productivity growth by delaying the initiation of and increasing the length of insolvency proceedings.

16. Figure 1 presents the three main sub-indicators. The indicator, *personal costs to failed entrepreneurs,* is based on a lengthy time to discharge and stringent exemptions of debtors' assets. Lack of *prevention and streamlining* uses three features, namely the lack of early warning mechanisms, pre-insolvency regimes and special insolvency procedures for small and medium-sized enterprises (SMEs). Finally, the five features that may potentially impose *barriers to restructuring* include creditors' inability to initiate restructuring, an indefinite stay on assets, lack of priority given to new financing, no cram-down of restructuring plans on dissenting creditors and the dismissal of incumbent management during restructuring (see Appendix B for more details).

17. According to these indicators, the design of insolvency regimes varies significantly across countries. The insolvency regime in the United Kingdom for example, entails relatively low personal costs to failed entrepreneurs and barriers to restructuring, while it contains a number of provisions to aid prevention and streamlining. In Estonia and Hungary, however, the reverse is true. For example, a high time to discharge means that failed entrepreneurs must wait five years before starting another business, compared to just one year in the United Kingdom. Similarly, an inability of creditors to initiate restructuring and a lack of priority given to new financing over unsecured creditors in both countries (plus an indefinite stay on assets in Estonia) translates into significant barriers to restructuring. Finally, a lack of early warning mechanisms, pre-insolvency regimes and special insolvency procedures for SMEs imply that prevention and streamlining is weak.

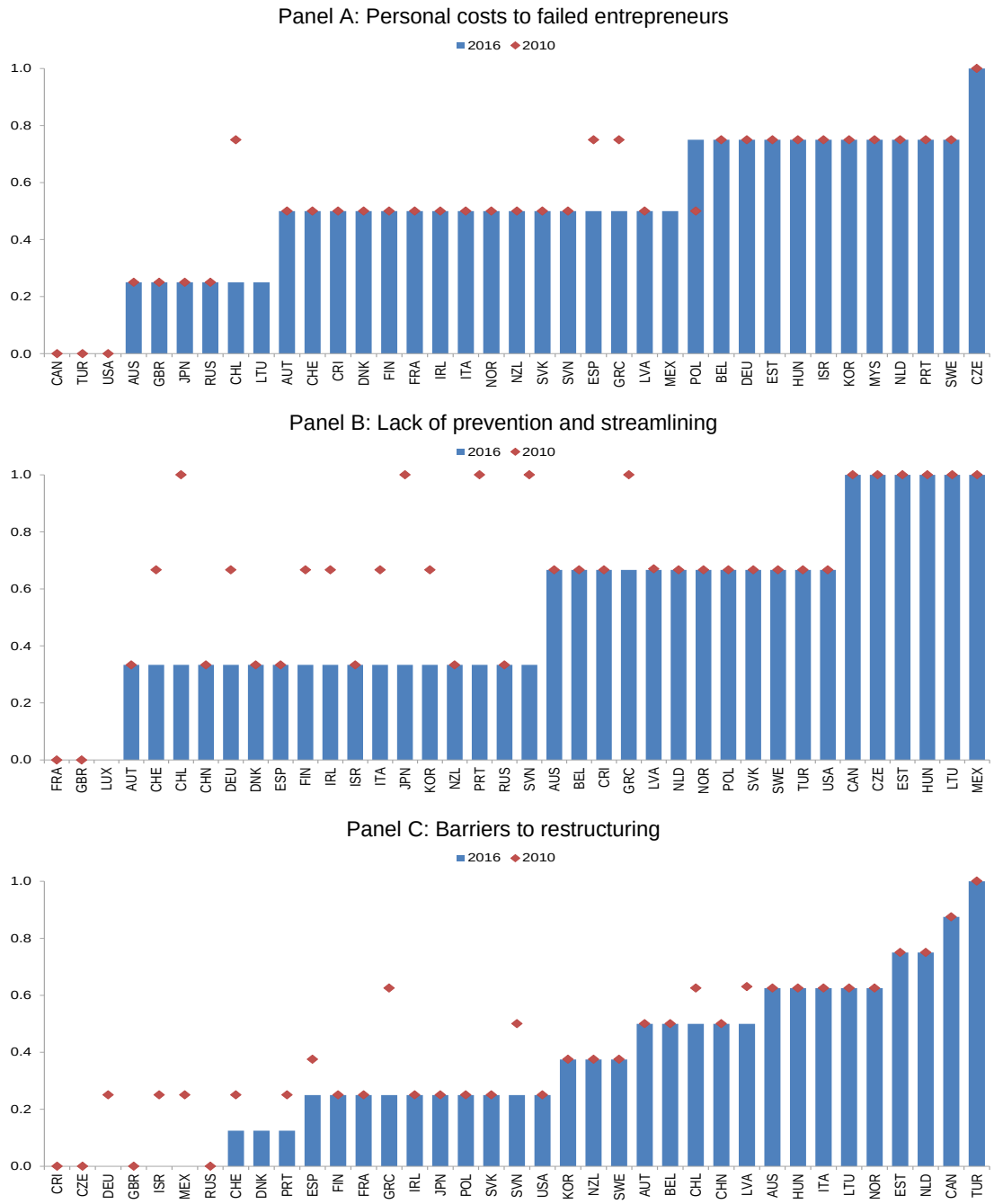
18. The data for the other policy indicators come from a variety of sources (for more details, see Table A4 in Appendix). Indicators for the stringency of product and labour markets are from the OECD product market regulation (PMR) and employment protection legislation (EPL) databases, respectively. Regulatory impact[6] at the country-industry level is also included to control for the knock-on effect of product market regulations in upstream services sectors (see Bourles et al., 2013; Conway and Nicoletti, 2006). Indicators for venture capital as a percentage of GDP come from the *OECD Science Technology and Industry Scoreboard 2007* and are based on the OECD Venture Capital database, drawing from various data sources: EVCA for Europe, NVCA for the United States, CVCA for Canada, AVCAL for Australia, NZVCA for New Zealand, and Asian Venture Capital Journal (The 2003 Guide to Venture Capital in Asia) for Japan and Korea.[7] Indicators on statutory corporate income tax rate and the top marginal personal income tax rate come from the OECD Tax Database. Finally, the indicator for the debt

6. Data for 2007.

7. For more details, see http://www.oecd-ilibrary.org/industry-and-services/entrepreneurship-at-a-glance_22266941.

bias of the tax system (calculated as the percentage point difference between effective average tax rates on equity and debt finance) is from Cournède, Denk and Hoeller (2015).[8]

Figure 1. Sub-components of OECD indicator of insolvency regimes



Source: Calculations based on the OECD questionnaire on insolvency regimes. See Adalet McGowan, Andrews and Millot (2017b) and Adalet McGowan and Andrews (2017) for more details.

8. Indicator calculated by the authors based on Centre for European Economic Research (2011), Effective Tax Levels Using the Devereux/Griffith Methodology, Project for the EU Commission, TAXUD/2008/CC/099, Mannheim.

3.2. Firm-level productivity

19. The baseline econometric analysis exploits a harmonised cross-country firm-level dataset, where the underlying data are sourced from ORBIS, a commercial database provided to the OECD by the electronic publishing firm Bureau Van Dijk (see Box 1 for details). Given that, at the time of writing, the ORBIS vintage ended in 2013, we exploit insolvency indicators from 2010 in the baseline econometric analysis.[9]

20. While ORBIS covers a larger number of countries, the final sample of countries is driven by the availability of data that are necessary to build firm-level productivity indicators. The empirical analysis generally exploits harmonised firm-level data for the following 15 OECD countries: Austria, Belgium, Finland, France, Germany, Ireland, Italy, Hungary, South Korea, Poland, Portugal, Slovenia, Spain, Sweden and the United Kingdom. The sample is restricted to the non-farm non-financial business sector (NACE Rev.1.1 codes 15-74, excluding 65-67). The analysis using firm-level data is based on unconsolidated accounts in order to avoid double-counting of firms, which might occur if both the consolidated account of the parent-company and the unconsolidated accounts of its subsidiaries are present in the database. To address issues rising from under-representation of certain industries and of small and young firms in ORBIS, we use re-sampling weights relying on the Structural Demographic Business Statistics (SDBS) collected by the OECD and Eurostat, based on confidential national business registers.[10]

Box 1. Firm level data

ORBIS is the largest cross-country firm-level database that is available and accessible for economic and financial research. However, since the information is primarily collected for use in the private sector typically with the aim of financial benchmarking, a number of steps need to be undertaken before the data can be used for economic analysis. The steps we apply closely follow suggestions by Kalemli-Ozcan, et al. (2015) and previous OECD experience (Gal, 2013). As discussed in Gal and Hijzen (2016) and Andrews et al. (2016), these data are cleaned and benchmarked using a number of common procedures such as keeping accounts that refer to entire calendar year, using harmonized consolidation level of accounts, dropping observations with missing information on key variables as well as outliers identified as implausible changes or ratios. Monetary variables are deflated using 2-digit industry deflators from OECD STAN and national accounts and prices are expressed in industry purchasing power parities (PPPs).

Following Gal (2013), capital stock variables and firm level multi-factor productivity using several methodologies are created. An estimate of firm level real capital stocks is constructed by deriving the real value of gross investment flows by deflating the difference in the book value of net capital stocks and depreciation between two years and applying the perpetual inventory method to gross investment flows using the book value of fixed tangible assets as the starting value.

21. Our baseline MFP measure relies on a value added based production function estimation with the number of employees and real capital as inputs, using the IV estimation method proposed by Wooldridge (2009). This approach mitigates the endogeneity problem of input choices by using material inputs as proxy variables for unobserved productivity and lagged values of labour as instruments. The production function is estimated separately for each 2-digit industry but pooled across all countries, controlling for

9. Insolvency reforms in recent years have tended to happen between 2012 and 2014, making it unlikely that our firm level dataset (which concludes in 2013) would fully capture their impacts on firm performance. Hence, we use 2010 indicators for the econometric analysis.

10. The post-stratification procedure applies re-sampling weights based on the number of employees in each SDBS country-industry-size class cell to 'scale up' the number of ORBIS observations in each cell so that they match those observed in the SDBS (see Gal, 2013). For example, if SDBS employment is 30% higher than ORBIS employment in a given cell, then the 30% 'extra' employment is obtained by drawing firms randomly from the pool of ORBIS firms, such that the 'extra' firms will make up for the missing 30%.

country and year fixed effects. This allows for inherent technological differences across industries, while at the same time ensures comparability of MFP levels across countries and over time by having a uniform labour and capital coefficient along these dimensions.[11] We also test the robustness of our results to an alternative measure of MFP based on the Solow residual (see Appendix E of Andrews, Criscuolo and Gal (2016) for more details).

4. Empirical framework

22. To investigate the links between insolvency regimes and within-firm productivity growth, a difference-in-difference specification is adopted. This approach, popularised by Rajan and Zingales (1998), is based on the assumption that there exist industries that have a 'naturally' high exposure to a given policy (i.e. the treatment group), and such industries – to the extent that the policy is relevant to the outcome of interest – should be disproportionally more affected than other industries (i.e. the control group). For example, policies that raise the cost of firm exit may disproportionately affect firms that operate in industries where firm turnover rates (i.e. entry and exit) are higher. We implement this approach in the context of the workhorse neo-Schumpeterian growth framework (Aghion and Howitt,1998), which has been exploited in a number of previous growth studies (e.g. Griffith et al., 2006; Arnold et al., 2011; Andrews and Criscuolo, 2013).

23. Specifically, we consider a baseline specification for a cross section of 15 countries and 40 industries, based on the following model:

$$\Delta MFP_{ics} = \alpha + \beta_1 gap_{ics} + \beta_2 Insol_c * Exp_s^{insol} + \sum_k \beta_3^k Pol_c^k * Exp_s^k + \sum_k \beta_4^k X_{ics}^k + \delta_c + \delta_s + \varepsilon_{ics} \qquad [1]$$

where: ΔMFP_{ics} refers to the cumulative productivity growth observed within firm *i* over the period (between 2011 and 2013 in the baseline specification), gap_{ics}refers to the size of the gap in productivity between firm *i* and the frontier at the beginning of the period (2011). Following Arnold et al. (2011), the productivity frontier is defined as the average MFP of the 5% most productive firms in industry *s* in the sample of countries analysed. In turn, frontier firms are excluded from the analysis, leading us to focus on how policies shaped the MFP growth of laggard firms. *Insol* refers to the index level of barriers to restructuring in country *c* in 2010 and Exp^{insol} refers to industry *s* exposure to insolvency regimes. We use the firm turnover rates at the industry level for the United States as exposure variable in the baseline model. We also test the robustness to using external finance dependency for the US as exposure variable, as a greater reliance on external creditors increases the likelihood of having to go through a formal insolvency process. *X* denotes a vector of firm age (0-2, 3-4, 5-9, 10-29 and 30+) and firm size (1-9, 10-49, 50-99, 100-249, 250-999 and 1000+) controls observed at the beginning of the period (in 2011). Table A4 in the Appendix A provides details on the other exposure variables used to generate within-country variation for the other country-level policy controls (Pol_c). The model includes country and industry fixed effects to control for omitted time-invariant country-specific and common industry-specific technological factors and standard errors are clustered at the country and industry level to allow the error term to be correlated in an unrestricted way across firms within industries in the same country (Moulton, 1991; Bertrand et al., 2004).

11. Nevertheless, a number of issues that commonly affect productivity measurement should be kept in mind, including: i) differences in the quality and utilisation of inputs cannot be accounted for as the capital stock is measured in book values; ii) firm-level prices cannot be observed, so firm-level differences in measured productivity may also reflect differences in market power; and iii) measuring outputs and inputs in internationally comparable price levels remains an important challenge.

24. The main parameter of interest is β_2. If *Insol* refers to barriers to restructuring and $\beta_2 < 0$, for example, then higher barriers to restructuring disproportionately decrease within-firm productivity growth in highly exposed industries – i.e. those with naturally higher firm turnover – relative to low-exposed industries – i.e. those with naturally lower firm turnover. It is important to note, however, that this approach does not provide an estimate of the average effect of the insolvency regimes on within-firm productivity growth, and instead yields a differential impact.

5. Empirical results

5.1 Insolvency regimes and MFP growth

25. Table 1 shows the results from equation (1), analysing the link between barriers to restructuring and within-firm productivity growth. Column (1) presents the baseline specification, without controlling for other policies. As expected, the coefficient on the gap to frontier term is positive, reflecting the fact that as a firm gets closer to the frontier, the speed of catching-up slows down. The estimated negative coefficient on barriers to restructuring interacted with firm turnover rate at the industry level indicates that higher barriers to restructuring are associated with a relatively lower within-firm productivity growth in highly-exposed industries (i.e. those with high firm turnover), than in low-exposed industries (i.e. those with low firm turnover). Put differently, in industries with naturally higher firm turnover, the forces of technological diffusion will be relatively stronger in countries with insolvency regimes more conducive to corporate restructuring than in other countries.

Table 1. Firm level MFP growth and barriers to restructuring

Dependent variable: MFP growth, selected OECD countries, 2011-13						
	(1)	(2)	(3)	(4)	(5)	(6)
Gap with frontier	0.21102***	0.21151***	0.22071***	0.21252***	0.20938***	0.20950***
	(0.012)	(0.012)	(0.014)	(0.012)	(0.012)	(0.012)
Barriers to restructuring*Turnover	-0.02058*	-0.02157**	-0.01985*	-0.01986**	-0.01934**	-0.01848**
	(0.011)	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)
Firm age and size controls	YES	YES	YES	YES	YES	YES
Country Dummies	YES	YES	YES	YES	YES	YES
Industry Dummies	YES	YES	YES	YES	YES	YES
Policy controls						
Administrative burden on start-ups*Turnover	NO	YES	YES	YES	YES	YES
Regulation Impact	NO	YES	YES	YES	YES	YES
EPL including CD*Layoff	NO	YES	YES	YES	YES	YES
Venture Capital*External finance dependency	NO	YES	YES	YES	YES	YES
Corporate Income Tax Rate*Relative profitability	NO	NO	YES	NO	NO	NO
Top marginal tax rate*Turnover	NO	NO	NO	YES	NO	YES
Debt bias*External finance dependency	NO	NO	NO	NO	YES	YES
Observations	673,748	669,063	641,810	669,063	655,340	655,340
AdjR2	0.0958	0.0962	0.101	0.0967	0.0921	0.0922

Notes: MFP estimates are based on the one-step GMM estimation method proposed by Wooldridge (2009). MFP growth and gap with the frontier are trimmed at the 99th percent of the distribution. Industry refers to NACE Rev. 1 classes at the 2-digit level, covering the nonfarm non-financial business sector (industry codes 15-74, excluding 65-67). The regression in column 3 is based on a restricted sample (excluding industry codes 37, 40, 41, 70, for which data on relative profitability are not available).The regression in column 1 is based on a cross section of 15 countries (AUT, BEL, DEU, ESP, FIN, FRA, GBR, HUN, IRL, ITA, KOR, POL, PRT, SWE and SVN) in 2011-2013.Regressions in columns 2 to 4 are based on 13 countries (as regulatory impact is not available for SVN and IRL), Regressions 5 and 6 further exclude Korea, for which the debt bias is not available. Our aim is to always maximise the sample size, but the results are robust to estimation in a common sample across specifications. Barriers to restructuring refers to the insolvency regime indicators presented in Section 3.1. *** denotes statistical significance at the 1% level, **significance at the 5% level, * significance at the 10% level. Robust standard errors are shown in parentheses. The full results with the estimated coefficients for the various policy controls are shown in Appendix A (Table A1).

Source: Calculations based on ORBIS and OECD indicators of insolvency regimes (see Adalet McGowan et al. 2017b).

26. Table 1 also shows that this effect is robust to including a range of other policy variables: administrative burdens on start-ups, regulatory impact, employment protection legislation (EPL) and the development of venture capital (VC) financing (Columns 2 to 6). We also control for various tax-related policy indicators: corporate income tax rate (Column 3), top marginal tax rate (Column 4) and the extent to which the tax system favours debt over equity financing (Column 5).[12] The last column (Column 6) shows that our coefficient of interest is also robust to controlling for all policies at the same time.[13]

27. Results on barriers to restructuring and within-firm productivity growth are also robust to adding sales growth at the country-industry level over the period 2007-2009, in order to control for the severity of the crisis shock (which is likely to affect the pace of catching up in subsequent years), as well as to the use of an alternative MFP measure, based on the Solow residual[14] (see Table A2 in Appendix A). Results are also broadly robust to using a three year window for within-firm productivity growth, i.e. 2010-2013.[15]

28. Finally, the results are robust to the use of external finance dependency as the exposure variable (instead of firm turnover), which is likely to be relevant for insolvency regimes, given that a greater reliance on external creditors increases the likelihood of having to go through a formal insolvency process. The results in Table A3 in Appendix A show that lower barriers to restructuring are associated with disproportionately higher within-firm MFP growth in industries that are highly dependent on external finance, relative to other industries. These results are significant given the conventional wisdom that insolvency reforms which incentivize firms to experiment with risky technologies may come at the cost of a lower availability and higher cost of credit.

29. To understand the economic magnitude of the effect, consider the difference in within-firm productivity growth between a high turnover industry (i.e. at the 75th percentile distribution, such as Construction) and a low turnover industry (i.e. at the 25th percentile distribution, such as Manufacture of coke, refined petroleum products and nuclear fuel). Using the most conservative coefficient (Table A2, Column 7), these estimates imply that an insolvency reform which would lower barriers to restructuring from their high level in Hungary to the sample minimum (i.e. the United Kingdom; see Figure 1, Panel C) is associated with a 2.7% increase in laggard firm MFP growth in high turnover relative to low turnover industries (Figure 2). This is indicated by the bars in Figure 2, which shows the estimated potential impact on MFP growth associated with lowering barriers to restructuring from their 2010 levels to the sample minimum in 2010 (differential impact between industries with high and low firm turnover). In turn, the diamonds quantify the potential increase in laggard firm MFP growth due to recent reforms to insolvency regimes between 2010 and 2016. For example, reforms introduced since 2010 in Portugal have the potential to deliver around one-half (i.e. 0.5 percentage points) of the initially estimated potential MFP growth gains (i.e. around 1 percentage point) from reducing barriers to restructuring.

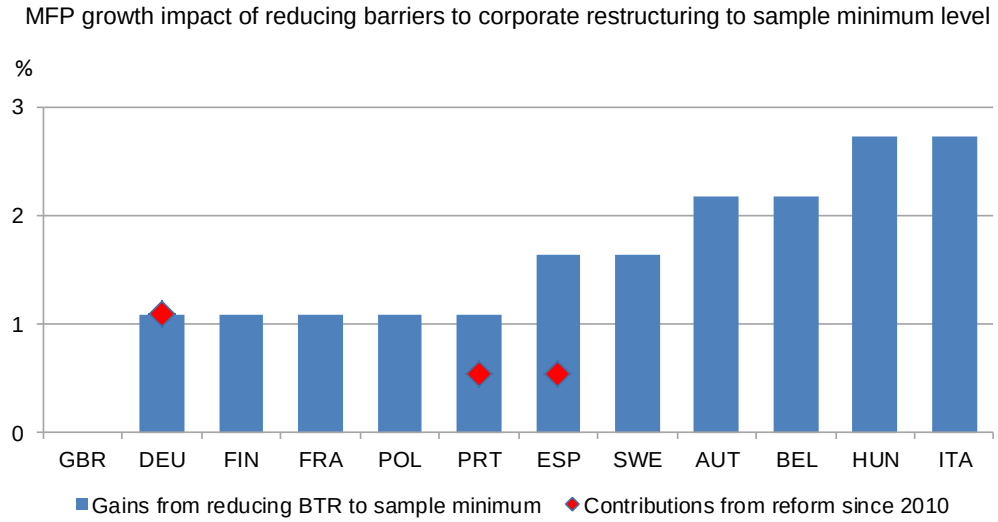
12. Proxied by the difference between the effective tax rates on equity finance and debt finance

13. In this specification, we exclude the corporate tax rates as it is typically insignificant and as the corresponding exposure variable (relative profitability) is only available for a restricted set of industries.

14. MFP based on Solow residual is calculated as log (value added)-(1 − sL)log(Capital Stock) − sL(Employment), where sL is the share of value added going to labour at the country-industry level (for more details, see Gal 2013).

15. These results are available on request.

Figure 2. Insolvency reform can promote productivity growth of laggard firms



Notes: The blue bars shows the potential gains to within-firm productivity growth associated with lowering the level of barriers to restructuring observed in 2010 to the sample minimum in 2010. The red diamonds exist for countries which have reformed their insolvency regimes between 2010 and 2016 and quantify the potential gains to within-firm productivity growth from these reforms. This is calculated as the blue bars (as defined above) *minus* the estimated gains to within-firm productivity growth associated with reducing barriers tor restructuring from their 2016 levels to the sample minimum in 2016. The MFP growth impact shows the differential impact between industries with high and low firm turnover.

Source: Calculations based on ORBIS and the OECD questionnaire on insolvency regimes

5.2 Equity financing, tax and MFP growth

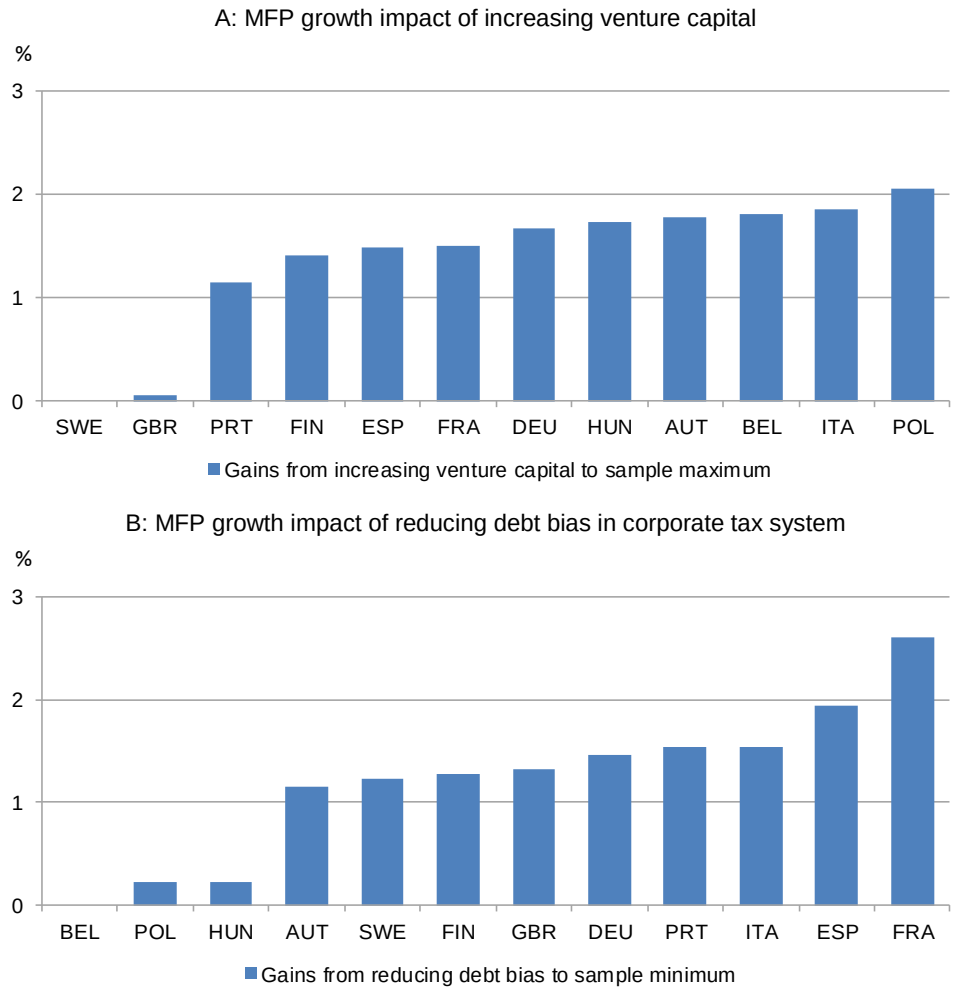
30. As for the other policy variables (see Table A1 in Appendix A for the full set of policy variables coefficients), we find that higher venture capital (VC) investment as a share of GDP tends to foster the productivity catch-up of laggard firms to the global frontier relatively more in highly-exposed industries (i.e. more dependent on external finance). This is consistent with previous literature showing that more developed VC markets foster innovation and productivity diffusion from the global frontier (Samila and Sorenson, 2011; Andrews, Criscuolo and Menon, 2014; Saia et al., 2015). Using the most conservative coefficients, our results suggest that increasing VC financing in Poland to the sample maximum (i.e. Sweden) is associated with an increase in the annual MFP growth of laggard firms operating in industries with high reliance on external financing by 2 percentage points (Figure 3, Panel A), relative to firms in other industries.

31. We also find that debt bias in corporate tax systems tends to undermine the productivity catch-up of laggard firms to the global frontier relatively more in industries that are more dependent on external finance (Table A1). Tax systems which favour debt over equity financing are indeed more likely to discriminate against innovative fast-growing firms that invest heavily in intangible property and thus have less access to debt financing and are more reliant on equity financing. In terms of economic magnitude, the estimates imply that reducing debt bias in the corporate tax system from the high level in France to the sample minimum (i.e. Belgium) is associated with an increase in the annual MFP growth of laggard firms operating in industries with high reliance on external financing by 2.6 percentage points, relative to firms in other industries (Figure 3, Panel B).

32. Within-firm productivity growth also tends to be negatively associated with regulatory burden indicators (which captures the knock-on effect of PMR in upstream sectors on downstream sectors) and top marginal tax rate, although the significance of the coefficient is sensitive to the inclusion of other policy variables. The coefficients for the other policy variables (administrative burden on start-ups, EPL and

corporate tax rate) are less robust across specifications, although as discussed below, the impact of administrative burden on start-ups on MFP growth is conditioned by the design of the insolvency regimes.

Figure 3. Equity financing can promote productivity growth of laggard firms



Notes: The chart shows the potential gains to within-firm productivity growth associated with increasing venture capital financing to the sample maximum (Panel A) and reducing debt bias to the sample minimum (Panel B). The MFP growth impact shows the differential impact between industries with high and low reliance on external financing.

Source: Calculations based on ORBIS and the OECD questionnaire on insolvency regimes.

5.3 Policy complementarities between exit and entry barriers

33. There are also reasons to expect insolvency regimes to shape the productivity impact of other policies. For instance, Acemoglu et al. (2013) show that R&D tax subsidies are only truly effective when policy-makers can encourage the exit of weak firms, in order to free-up skilled labour for innovative firms. In a similar vein, one might expect a policy complementarity between insolvency regimes and policy-induced entry barriers. In this regard, reducing administrative burdens on start-up firms might only translate into significant MFP gains if young firms have sufficient space to experiment with new business strategies and attract the necessary resources to commercialise and implement new ideas – a process that is more likely if if entrepreneurial failure is not overly sanctioned and scarce resources are not trapped in zombie firms.

Table 2. Firm level MFP growth and barriers to restructuring: complementarity between insolvency regimes and policy-induced entry barriers

Dependent variable: MFP growth, selected OECD countries, 2011-13						
	High barriers to exit			Low barriers to exit		
	(1)	(2)	(3)	(4)	(5)	(6)
Gap with frontier	0.20442***	0.19954***	0.19939***	0.22374***	0.22647***	0.22605***
	(0.014)	(0.008)	(0.008)	(0.021)	(0.021)	(0.021)
Administrative burden on start-ups*Turnover	0.00673	0.00632	0.00589	-0.02081**	-0.02200**	-0.02139**
	(0.004)	(0.007)	(0.007)	(0.009)	(0.009)	(0.009)
Firm age and size controls	YES	YES	YES	YES	YES	YES
Country Dummies	YES	YES	YES	YES	YES	YES
Industry Dummies	YES	YES	YES	YES	YES	YES
Sales Growths,c,2007-09	NO	NO	YES	NO	NO	YES
Policy controls						
Regulation Impact	NO	YES	YES	NO	YES	YES
EPL including CD*Layoff	NO	YES	YES	NO	YES	YES
Venture Capital*External finance dependency	NO	YES	YES	NO	YES	YES
Top marginal tax rate*Turnover	NO	YES	YES	NO	YES	YES
Debt bias*External finance dependency	NO	YES	YES	NO	YES	YES
Observations	384,189	370,466	370,466	289,559	284,874	284,852
AdjR2	0.0924	0.0820	0.0825	0.110	0.111	0.112

Notes: MFP estimates are based on the one-step GMM estimation method proposed by Wooldridge (2009). MFP growth and gap with the frontier are trimmed at the 99th percent of the distribution. Industry refers to NACE Rev. 1 classes at the 2-digit level, covering the nonfarm non-financial business sector (industry codes 15-74, excluding 65-67). The regressions in Columns 1 and 4 are based on a cross section of 15 countries (AUT, BEL, DEU, ESP, FIN, FRA, GBR, HUN, IRL, ITA, KOR, POL, PRT, SWE and SVN) in 2011-2013, split in two separate samples depending on the stringency of exit costs in the country: high (low) exit barriers refer to those countries that are above (below) the sample median of the personal costs to failed entrepreneurs. Regressions in columns 2, 3, 5 and 6 exclude SVN, IRL (for which regulatory impact data are not available) and KOR (for which debt bias is not available). *** denotes statistical significance at the 1% level, **significance at the 5% level, * significance at the 10% level. Robust standard errors are shown in parentheses.

Source: Calculations based on ORBIS and OECD indicators of insolvency regimes.

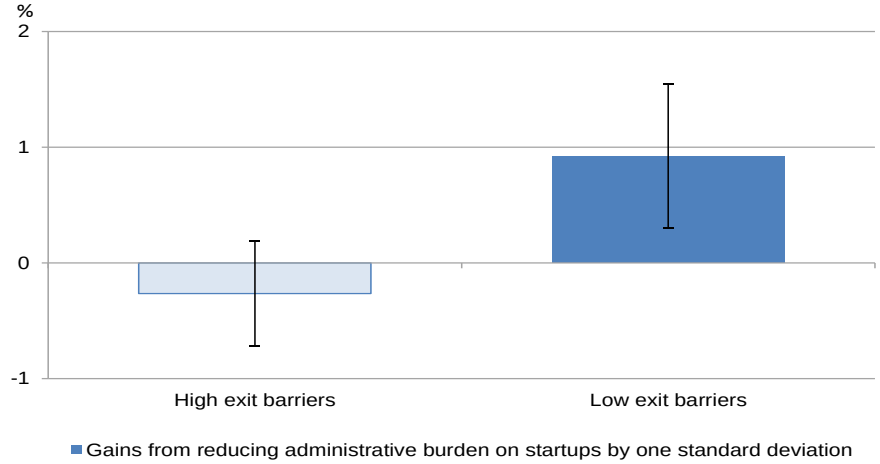
34. To test this hypothesis, Table 2 explores the link between laggard firm MFP growth and administrative burdens on start-ups, which is interacted with firm turnover rates, in two sub-samples: countries with high exit barriers (i.e. those countries that are above the sample median of the personal costs to failed entrepreneurs) and countries with low exit barriers (i.e. those countries that are below the sample median of the personal costs to failed entrepreneurs).[16] Consistent with our working hypothesis, the estimates imply that reducing administrative burdens on start-ups has a statistically significant effect in raising MFP growth when exit barriers are low, while the coefficient is statistically insignificant from zero when exit barriers are high.

35. In terms of economic magnitude, when exit barriers (i.e. personal costs to failed entrepreneurs) are low, a one standard deviation decrease in policy-induced entry barriers is associated with an increase of 0.9 percentage points in laggard firm MFP growth in high firm turnover industries, relative to other industries (Figure 4). When exit barriers are high, however, the effects of reforming entry barriers on laggard firm MFP growth are negligible.

16. We consider the personal costs to failed entrepreneurs indicator in this context because they are more likely to apply to entrepreneurs and start-ups.

Figure 4. Entry-exit policy complementarities and the MFP growth of laggard firms

MFP growth impact of reforming administrative burdens on start-ups according to stringency of exit costs



Notes: The MFP growth impact shows the differential impact between industries with high and low firm turnover of a one standard deviation reform to the PMR administrative burdens on start-ups index for countries with high and low exit barriers. High (low) exit barriers refer to those countries that are above (below) the sample median of the personal costs to failed entrepreneurs. The estimates in the high exit barrier sample are not statistically significantly different than zero.

Source: Calculations based on ORBIS and the OECD questionnaire on insolvency regimes.

6. Conclusion

36. Recent OECD research demonstrates that insolvency regimes that do not unduly raise barriers to corporate restructuring and the personal costs associated with entrepreneurial failure can reduce the capital sunk in zombie firms and spur productivity-enhancing capital reallocation. This paper extends this work by exploring the link between insolvency regimes and productivity growth of laggard firms, which have increasingly fallen behind the global productivity frontier since the early 2000s. The results suggest that there is considerable scope for insolvency regime reforms that reduce barriers to corporate restructuring to boost within-firm productivity growth. Specifically, we find that higher barriers to restructuring are associated with a disproportionately lower MFP growth of laggard firms in highly exposed industries (i.e. structurally higher firm turnover) than low exposed industries (i.e. structurally lower firm turnover). Furthermore, having more developed venture capital markets and reducing the debt bias in corporate tax systems could also promote the productivity growth of laggard firms. Finally, the results highlight the importance of policy complementarities and suggest that insolvency regimes that reduce the cost of entrepreneurial failure can enhance the productivity gains from lowering administrative entry barriers in product markets by reducing market congestion and the stigma of failure and thus providing new entrants with sufficient scope for experimenting and growing.

37. Future research could dig deeper into some of the issues raised in this paper and exploit the data further. For example, given the literature on the links between managerial quality and productivity growth (Bloom et al., 2013), one could test the hypothesis that the productivity effects of less stringent barriers to restructuring will be higher, when managerial quality is high, as good managers can facilitate a more effective restructuring of resource and work practices. Furthermore, as the availability of firm-level data extends beyond 2013, the analysis could be extended to use the 2016 values for the insolvency regime indicator to get a better understanding of the links between productivity growth and insolvency regime reform.

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APPENDIX A: ADDITIONAL TABLES AND FIGURES

Table A1. Firm level MFP growth and barriers to restructuring: full results

Dependent variable: MFP growth, selected OECD countries, 2011-13						
	(1)	(2)	(3)	(4)	(5)	(6)
Gap with frontier	0.21102***	0.21151***	0.22071***	0.21252***	0.20938***	0.20950***
	(0.012)	(0.012)	(0.014)	(0.012)	(0.012)	(0.012)
Barriers to restructuring*Turnover	-0.02058*	-0.02157**	-0.01985*	-0.01986**	-0.01934**	-0.01848**
	(0.011)	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)
Administrative burden on start-ups*Turnover		0.00083	-0.00041	-0.00383	-0.00094	-0.00423
		(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Regulation Impact		-0.12527	-0.36849*	-0.09328	0.17349	0.18226
		(0.192)	(0.199)	(0.184)	(0.157)	(0.158)
EPL including CD*Layoff		-0.00235	0.00664	-0.00219	-0.00244	-0.00237
		(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Venture Capital*External finance dependency		0.09571*	0.06595	0.09601*	0.10464**	0.10593**
		(0.055)	(0.048)	(0.054)	(0.053)	(0.052)
Corporate Income Tax Rate*Relative profitability			-0.00248			
			(0.003)			
Top marginal tax rate*Turnover				-0.00088**		-0.00059
				(0.000)		(0.000)
Debt bias*External finance dependency					-0.00624**	-0.00613**
					(0.003)	(0.003)
Firm age and size controls	YES	YES	YES	YES	YES	YES
Country Dummies	YES	YES	YES	YES	YES	YES
Industry Dummies	YES	YES	YES	YES	YES	YES
Observations	673,748	669,063	641,810	669,063	655,340	655,340
AdjR2	0.0958	0.0962	0.101	0.0967	0.0921	0.0922

Notes: MFP estimates are based on the one-step GMM estimation method proposed by Wooldridge (2009). MFP growth and gap with frontier are trimmed at 99th percent of the distribution. Industry refers to NACE Rev. 1 classes at the 2-digit level, covering the nonfarm non-financial business sector (industry codes 15-74, excluding 65-67). Regression in column 3 are based on a restricted sample (excluding industry codes 37, 40, 41, 70, for which data on relative profitability are not available). The regression in column 1 is based on a cross section of 15 countries (AUT, BEL, DEU, ESP, FIN, FRA, GBR, HUN, IRL, ITA, KOR, POL, PRT, SWE and SVN) in 2011-2013. Regressions in columns 2 to 4 are based on 13 countries (as regulation impact is not available for SVN abd IRL), Regression 5 and 6 further exclude Korea, for which the debt bias is not available. Our aim is to always maximise the sample size, but the results are robust to estimation in a common sample across specifications. Barriers to restructuring refers to the insolvency regime indicators presented in Section 3.1. *** denotes statistical significance at the 1% level, **significance at the 5% level, * significance at the 10% level. Robust standard errors are shown in parentheses.

Source: Calculations based on ORBIS and OECD indicators of insolvency regimes (see Adalet McGowan et al. 2017).

Table A2. Firm level MFP growth and barriers to restructuring: robustness to other MFP measure and additional controls

Dependent variable: MFP growth, selected OECD countries, 2011-13								
	MFP Wooldridge				MFP Solow			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Gap with frontier	0.21102***	0.21053***	0.20950***	0.20890***	0.08786***	0.08797***	0.07946***	0.07914***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.017)	(0.017)	(0.017)	(0.017)
Barriers to restructuring*Turnover	-0.02058*	-0.02179**	-0.01848**	-0.01973**	-0.02176**	-0.02336**	-0.01486*	-0.01681**
	(0.011)	(0.011)	(0.009)	(0.009)	(0.010)	(0.010)	(0.008)	(0.008)
Firm age and size controls	YES	YES	YES	YES	YES	YES	YES	YES
Country Dummies	YES	YES	YES	YES	YES	YES	YES	YES
Industry Dummies	YES	YES	YES	YES	YES	YES	YES	YES
Sales Growth$_{s,c,2007-09}$	NO	YES	NO	YES	NO	YES	NO	YES
Policy controls								
Administrative burden on start-ups*Turnover	NO	NO	YES	YES	NO	NO	YES	YES
Regulation Impact	NO	NO	YES	YES	NO	NO	YES	YES
EPL including CD*Layoff	NO	NO	YES	YES	NO	NO	YES	YES
Venture Capital*External finance dependency	NO	NO	YES	YES	NO	NO	YES	YES
Corporate Income Tax Rate*Relative profitability	NO	NO	NO	NO	NO	NO	NO	NO
Top marginal tax rate*Turnover	NO	NO	YES	YES	NO	NO	YES	YES
Debt bias*External finance dependency	NO	NO	YES	YES	NO	NO	YES	YES
Observations	673,748	673,726	655,340	655,318	677,101	677,072	657,022	656,993
AdjR2	0.0958	0.0961	0.0922	0.0924	0.0666	0.0670	0.0630	0.0635

Notes: MFP estimates are based on the one-step GMM estimation method proposed by Wooldridge (2009) in the four first columns, and on the Solow residual in Columns 5 to 8. MFP growth and gap with frontier are trimmed at 99th percent of the distribution. Industry refers to NACE Rev. 1 classes at the 2-digit level, covering the nonfarm non-financial business sector (industry codes 15-74, excluding 65-67). The regressions in column 1-2 and 5-6 are based on a cross section of 15 countries (AUT, BEL, DEU, ESP, FIN, FRA, GBR, HUN, IRL, ITA, KOR, POL, PRT, SWE and SVN) in 2011-2013. Regressions in column 3-4 and 7-8 exclude SVN, IRL (for which regulation impact data are not available) and KOR (for which debt bias is not available). Barriers to restructuring refers to the insolvency regime indicators presented in Section 3.1. *** denotes statistical significance at the 1% level, **significance at the 5% level, * significance at the 10% level. Robust standard errors are shown in parentheses.

Source: Calculations based on ORBIS and OECD indicators of insolvency regimes (see Adalet Mc Gowan et al. 2017).

Table A3. Firm level MFP growth and barriers to restructuring: external finance dependency as exposure variable

Dependent variable: MFP growth, selected OECD countries, 2011-13						
	(1)	(2)	(3)	(4)	(5)	(6)
Gap with frontier	0.21234***	0.21190***	0.22086***	0.21297***	0.21063***	0.21074***
	(0.012)	(0.012)	(0.014)	(0.012)	(0.012)	(0.012)
Barriers to restructuring*External finance dependency	-0.05414**	-0.06118*	-0.05160**	-0.06030*	-0.07363**	-0.07335**
	(0.028)	(0.036)	(0.025)	(0.035)	(0.035)	(0.035)
Administrative burden on start-ups*Turnover		-0.00365	-0.00422	-0.00818	-0.00466	-0.00792
		(0.005)	(0.006)	(0.005)	(0.005)	(0.006)
Regulation Impact		-0.10600	-0.37250*	-0.07392	0.16708	0.17504
		(0.191)	(0.195)	(0.185)	(0.158)	(0.159)
EPL including CD*Layoff		0.00059	0.00841	0.00062	0.00039	0.00041
		(0.009)	(0.008)	(0.009)	(0.009)	(0.009)
Venture Capital*Knowledge intensity		-0.23452	-0.55155	-0.20185	-0.28783	-0.28602
		(0.638)	(0.509)	(0.625)	(0.646)	(0.643)
Corporate Income Tax Rate*Relative profitability			-0.00284			
			(0.003)			
Top marginal tax rate*Turnover				-0.00093**		-0.00062
				(0.000)		(0.000)
Debt bias*External finance dependency					-0.00915***	-0.00903***
					(0.003)	(0.003)
Firm age and size controls	YES	YES	YES	YES	YES	YES
Country Dummies	YES	YES	YES	YES	YES	YES
Industry Dummies	YES	YES	YES	YES	YES	YES
Observations	673,748	669,063	641,810	669,063	655,340	655,340
AdjR2	0.0960	0.0961	0.101	0.0966	0.0922	0.0923

Notes: MFP estimates are based on the one-step GMM estimation method proposed by Wooldridge (2009). MFP growth and gap with frontier are trimmed at 99th percent of the distribution. Industry refers to NACE Rev. 1 classes at the 2-digit level, covering the nonfarm non-financial business sector (industry codes 15-74, excluding 65-67). Regression in column 3 are based on a restricted sample (excluding industry codes 37, 40, 41, 70, for which data on relative profitability are not available). The regression in column 1 is based on a cross section of 15 countries (AUT, BEL, DEU, ESP, FIN, FRA, GBR, HUN, IRL, ITA, KOR, POL, PRT, SWE and SVN) in 2011-2013. Regressions in columns 2 to 4 are based on 13 countries (as regulation impact is not available for SVN abd IRL), Regression 5 and 6 further exclude Korea, for which the debt bias is not available. Barriers to restructuring refers to the insolvency regime indicators presented in Section 3.1. *** denotes statistical significance at the 1% level, **significance at the 5% level, * significance at the 10% level. Robust standard errors are shown in parentheses.

Source: Calculations based on ORBIS and OECD indicators of insolvency regimes (see Adalet McGowanet al. 2017).

Table A4. Structure of the differences-in-differences estimator and data sources

Variable	Country-level variable	Industry-level exposure variable
$Insol_c$ X $Turnover_s$	Insolvency index: barriers to restructuring or personal cost to failed entrepreneurs, depending on specification	Firm turnover rate (defined as the entry rate + exit rate) at the industry level in the United States. Sourced from Bartelsman et al., (2008)
Administrative Burdens on $Start\text{-}Ups_c$ X $Turnover_s$	Administrative Burdens on Start-Ups sub-component of the Barriers to Entrepreneurship indicator in the OECD Product Market Regulation (PMR) index. Data from 2008.	Firm turnover rate at the industry level in the United States (see above).
EPL_c X $Layoff_s$	EPLR is the OECD Employment Protection Legislation (EPL) sub-index of restrictions on individual dismissal of workers with regular contracts, including collective dismissal. Data from 2008.	Layoff rates (defined as the percentage ratio of annual layoffs to total employment) at the industry level in the United States. Sourced from Bassanini et al., (2010).
Venture $capital_c$ X External finance $dependency_s$	Total (early and expansion stages) venture capital investment as a percentage of GDP based on the OECD, Venture Capital database, drawing from various external data sources. Data from 2005.	The variable measuring industries' dependence on external finance is computed from information contained in the Thomson Financial Worldscope database for US listed firms with less than 1000 employees. These estimates are sourced from de Serres et al., (2006) and following Rajan and Zingales (1998), a firm's dependence on external finance is defined as its capital expenditure minus internal funds (cash flow from operations) divided by capital expenditure.
Corporate income tax $rate_c$ X Relative $profitablity_s$	Statutory Corporate income tax rate from the OECD Tax Database. Data from 2011.	Relative profitability for the United States. Sourced from Schwellnus and Arnold (2008).
Top marginal tax $rate_c$ X $Turnover_s$	Top marginal personal income tax rate from the OECD Tax Database. Data from 2011.	Firm turnover rate at the industry level in the United States (see above).
Debt $bias_c$ X External finance $dependency_s$	Debt bias of the tax system, proxied by the percentage point difference between effective average tax rates on equity and debt finance. Sourced from Cournède, Denk and Hoeller (2015)[17]. Data from 2011.	Industries' dependence on external finance in the United States (see above).

17. Indicator calculated by the authors based on Centre for European Economic Research (2011), Effective Tax Levels Using the Devereux/Griffith Methodology, Project for the EU Commission, TAXUD/2008/CC/099, Mannheim.

APPENDIX B: THE OECD INSOLVENCY REGIME INDICATORS

The new OECD policy indicator is based on the working hypothesis is that the inefficiencies on the exit margin are likely to be more pronounced in economies where insolvency regimes:

- ⇒ Impose a high personal cost to failed entrepreneurs, which may occur when:
  - ⇒ Time to discharge is higher, which raises the costs and the stigma of failure of insolvency proceedings, making it less likely that non-viable firms exit the market in a timely fashion.[18]
  - ⇒ There are fewer exemptions protecting the insolvent debtor's assets that are not directly linked to the business (e.g. the family house or a spouse's assets), which raises the costs and the stigma of failure.
- ⇒ Lacks sufficient preventative and streamlining measures, due to:
  - ⇒ A lack of early warning mechanisms and pre-insolvency regimes, which may push viable firms experiencing temporary financial distress into lengthy and costly formal insolvency proceedings, when firm distress could have been addressed via informal workouts (i.e. without the involvement of courts).[19]
  - ⇒ An absence of special procedures for small and medium enterprises (SMEs), which could lead to many inefficient small firms continuing to operate because they lack scale to cover the fixed costs associated with formal insolvency proceedings.
- ⇒ Lacks tools to facilitate restructuring, owing to:
  - ⇒ An inability of creditors to initiate restructuring, which may increase the likelihood that zombie firms linger in their impaired state and viable firms which encounter temporary financial distress become zombie firms due to a lack of impetus to restructure.
  - ⇒ The stay on assets is indefinite, which delays the resolution of financial distress.[20]
  - ⇒ There is no priority given to new financing over unsecured creditors, which may lead to insufficient restructuring of weak firms, in instances where capital injections are required to facilitate the reorganisation of firms.[21]

18. Time to discharge refers to the number of years a bankrupt must wait until they are discharged from pre-bankruptcy indebtedness.

19. Early warning mechanisms include early-stage interventions such as training to firms or on-line tests to assess their financial position and financial and debt counselling to companies with financial difficulties.

20. A stay on assets stops actions by creditors, with certain exceptions, to collect debts from a debtor.

21. Priority rules refer to the order in which various stakeholders get paid in the event of liquidation.

⇒ It is not possible to "cram-down" on dissenting creditors that try to block a restructuring plan; i.e. to override the votes of a minority of creditors who vote against the restructuring plan.[22]

⇒ Incumbent management is dismissed during restructuring, which increases the private incentives of management to hide the true financial state of the firm and gamble on resurrection.

⇒ There are other features – related to the role of courts, employee rights and the treatment fraudulent activities – which may delay the timely resolution of financial distress, including:

⇒ A high degree of court involvement, which may prolong the exit of weak firms, particularly in countries with inefficient judicial systems.

⇒ Stringent restrictions on worker dismissals and collective dismissals that cannot be negotiated during proceedings, which may delay the exit or downsizing of weak firms.

⇒ An insufficient distinction between honest and fraudulent bankrupts, which raises the costs and the stigma of failure of insolvency proceedings, making it less likely that weak firms exit the market in a timely fashion.

22. The indicator also takes into account design features that ensure that dissenting creditors receive as much under the restructuring plan as they would in the case of liquidation (which is likely to lead to more restructuring).