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Insolvency regimes, zombie firms and capital reallocation

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Valentine Millot

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ABSTRACT/RÉSUMÉ

Insolvency Regimes, Zombie Firms and Capital Reallocation

This paper explores cross-country differences in the design of insolvency regimes and their potential links with two inter-related sources of labour productivity weakness: the survival of "zombie" firms (firms that would typically exit in a competitive market) and capital misallocation. New cross-country policy indicators of insolvency regimes are constructed based on countries' responses to a recent OECD questionnaire, which aimed to better capture the key design features of insolvency which impact the timely initiation and resolution of insolvency proceedings. According to these metrics, cross-country differences in the design of insolvency regimes are significant. Firm level analysis shows that reforms to insolvency regimes which reduce barriers to corporate restructuring and the personal cost associated with entrepreneurial failure may reduce the share of capital sunk in zombie firms. These gains are partly realised via the restructuring of weak firms, which in turn spurs the reallocation of capital to more productive firms. 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 rising capital misallocation and the increasing survival of low productivity firms have contributed to the productivity slowdown.

JEL Classification: D24; K35; O40; O43; O47

Keywords: personal and corporate insolvency, zombie firms, capital misallocation, productivity, firm exit

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Régimes d'Insolvabilité, Entreprises Zombies et Réaffectation du Capital

Ce papier explore les différences de conception des régimes d'insolvabilité entre les pays et leurs liens potentiels avec deux sources interdépendantes de faiblesse de la productivité du travail : la survie d'entreprises « zombies » (entreprises qui typiquement disparaîtraient dans un marché concurrentiel) et la mauvaise répartition du capital. De nouveaux indicateurs de politique concernant les régimes d'insolvabilité des pays sont construits, se basant sur les réponses des pays à un questionnaire récent de l'OCDE ayant pour but de mieux saisir les caractéristiques-clé des systèmes d'insolvabilité qui impactent le déclenchement et le règlement dans les meilleurs délais des procédures d'insolvabilité. Selon ces indicateurs, les différences de conception des régimes d'insolvabilité entre les pays sont significatives. Une analyse au niveau des entreprises montre que les réformes des régimes d'insolvabilité réduisant les barrières à la restructuration des entreprises ainsi que le coût personnel associé à l'échec entrepreneurial peuvent réduire la part de capital renfermé dans les entreprises zombies. Ces gains sont en partie réalisés à travers la restructuration des entreprises vulnérables, ce qui en retour stimule la réaffectation du capital vers les entreprises plus productives. 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 qu'il existe des preuves que la mauvaise affectation du capital et l'accroissement de la survie des entreprises à faible productivité ont contribué ralentissement de la productivité.

Classification JEL : D24; K35; O40; O43; O47
Mots-clés : Insolvabilité personnelle et des entreprises, entreprises zombies, mauvaise répartition du capital, productivité, sortie d'entreprise

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INSOLVENCY REGIMES, ZOMBIE FIRMS AND CAPITAL REALLOCATION

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

1. Introduction

1. The productivity slowdown over the past decade brings into closer focus 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) and declining business dynamism (Decker et al., 2016). A related source of concern is that firms that would typically exit or be forced to restructure in a competitive market – i.e. "zombie firms" – are increasingly lingering in a precarious state, which may weigh on average productivity and crowd-out growth opportunities for more productive firms (Adalet McGowan et al., 2017). In some countries, these problems are likely symptomatic of the inability of insolvency regimes to facilitate the exit or downsizing of non-viable firms and the restructuring of viable firms that encounter temporary financial distress. But the available 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 productivity performance and generate country-specific proposals for reform (Adalet McGowan and Andrews, 2016).

2. Accordingly, this paper explores cross-country differences in the design of insolvency regimes and their potential links with two sources of labour productivity weakness: the survival of "zombie" firms and capital misallocation. New cross-country policy indicators of insolvency regimes are constructed based on countries' responses to a recent OECD questionnaire. This exercise – outlined in Adalet McGowan and Andrews (2016) – aimed to capture the key design features of insolvency regimes that are relevant for productivity outcomes. Thirteen key features are 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. These include: *i*) two features that raise the *personal costs to failed entrepreneurs*: time to discharge and fewer exemptions; *ii*) the absence of three mechanisms that aid *prevention and streamlining*: early warning mechanisms, pre-insolvency regimes and special insolvency procedures for small and medium-sized enterprises (SMEs); *iii*) five features that may potentially impose *barriers to restructuring*: 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; and *iv*) three *other* factors: a high degree of court involvement, a lack of a distinction between honest and fraudulent bankruptcy and restrictions on individual and collective dismissals during proceedings.

3. 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 and our working hypothesis is that this is likely to result in an insolvency regime which delays the timely restructuring of weak firms and slows down the reallocation of scarce resources to their most productive use. Moreover,

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these composite insolvency regime indicators are only weakly correlated with product and labour market regulations, leaving room for insolvency regimes to improve our understanding of cross-country productivity differences.

4. Armed with these new indicators, the paper then explores the link between insolvency regimes and some key sources of productivity weakness in OECD countries. It builds on our recent analysis (Adalet McGowan et al., 2017), which shows that: *i*) the prevalence and resources sunk in zombie firms – defined as old firms (i.e. ≥10 years) that cannot cover their interest payments with their profits for three consecutive years – have risen since the mid-2000s; and *ii*) a higher share of the industry capital stock sunk in zombie firms congests markets, which constrains the growth of productive firms, with adverse implications for aggregate business investment and multifactor productivity. The broad conclusion from this new paper is 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. These findings carry strong policy implications, since there is much scope to reform insolvency regimes in many OECD countries.

5. First, we exploit a cross-country econometric framework to study the link between the design of insolvency regimes (based on 2010 indicators) and the zombie capital share (i.e. zombie congestion) at the industry level in 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 personal costs to failed entrepreneurs and barriers to restructuring are associated with a disproportionately higher zombie congestion in highly exposed industries than low exposed industries. Put differently, industries with naturally higher firm turnover will be relatively less prone to zombie congestion in countries with more reallocation-friendly insolvency regimes than in other countries. There is also evidence of a positive correlation between zombie congestion and weaker rule of law and more stringent product market regulations, suggesting that these structural and policy factors are also relevant to the exit margin.

6. The economic magnitudes of our estimates are significant. Consider Greece, Italy and Spain, for example, where the share of capital sunk in zombie firms stood at 28%, 19% and 16% respectively in 2013. Assuming a causal relationship, our estimates imply that reducing barriers to restructuring in Greece and Italy and the personal cost to failed entrepreneurs in Spain to the sample minimum in 2010 could translate into a decline in the zombie capital share of at least 9 percentage points in each country. The good news, however, is that insolvency reforms since 2010 have likely gone some way to achieving these estimated gains, with reductions in barriers to restructuring (in Greece in 2011) and the personal cost to failed entrepreneurs (in Spain in 2015) carrying the potential to reduce the zombie capital share by at least 5 percentage points.

7. To shed further light on the potential channels at play, we study transitions in the status of zombie and non-zombie firms between 2010 and 2013. In a sample of continuing firms, we find that higher barriers to restructuring are associated with a lower likelihood that zombie firms subsequently return to better financial health and (more marginal) non-zombie firms avoid turning into zombie firms. From this perspective, cross-country differences in zombie congestion may emerge because insolvency regimes in some countries are more successful at restructuring weak firms than in others.

8. If the design of insolvency regimes matters for the capital sunk in zombie firms, then one would expect them to also influence capital reallocation patterns, given evidence that the extent of productivity-enhancing capital reallocation is lower in industries with more zombie congestion (Adalet McGowan et al., 2017). Accordingly, we augment the dynamic reallocation methodology proposed by Foster et al (2016) and find that insolvency regimes which raise barriers to restructuring disproportionately reduce the efficiency of capital reallocation – as measured by the ability of more productive firms to attract capital –

in high firm turnover industries relative to other industries. These findings are significant given that rising capital misallocation is emerging as a key explanation of the productivity slowdown in some countries.

9. The analysis also sheds light on the specific policy levers that may operationalise insolvency reform. A brief time to discharge, allowing creditors to initiate restructuring and having early warning mechanisms emerge consistently as the most important dimensions of insolvency regimes with respect to the effects of reforms on productivity. Evidence linking the latter design features to productivity performance is particularly significant, given that preventative measures have been recently endorsed by the European Commission and the IMF, in response to the crisis (Carcea et al., 2015; Laryea 2010). There is also scope to grant more exemptions protecting the insolvent debtor's assets that are not directly linked to the business and additional features that facilitate restructuring such as establishing an effective length of stay on assets and to a lesser extent granting priority to new financing over unsecured creditors.

10. While insolvency regime reform can spur productivity-enhancing creative destruction, a key concern is that workers may incur persistent earnings losses (Jacobson et al., 1993) and a range of negative social outcomes (Davis and von Wachter, 2011) from any resulting job displacement. Since this may create resistance to such reforms, there is a strong case for policies that manage the costs of worker displacement, such as well-designed active labour market policies, which are particularly effective at returning workers displaced by firm exit to work (Andrews and Saia, 2016). Even so, the costs to workers from insolvency reforms should not be overplayed, since reducing zombie congestion implies higher non-zombie employment growth (Adalet McGowan et al., 2017) and creates scope for some displaced workers to be reallocated to a job that better matches their skill (Adalet McGowan and Andrews, 2015).

11. The next section explores some key micro-level dimensions of the aggregate productivity slowdown, which highlight the exit margin as a source of productivity weakness. Section 3 explores the types of policies that may be relevant to firm exit – with a particular focus on insolvency regimes – and then presents new cross-country evidence on the design of insolvency regimes. Section 4 presents new empirical evidence on the link between insolvency regimes, zombie firms and capital reallocation. The final section discusses the policy relevance of the findings and plans for future research.

2. The exit margin as source of productivity weakness

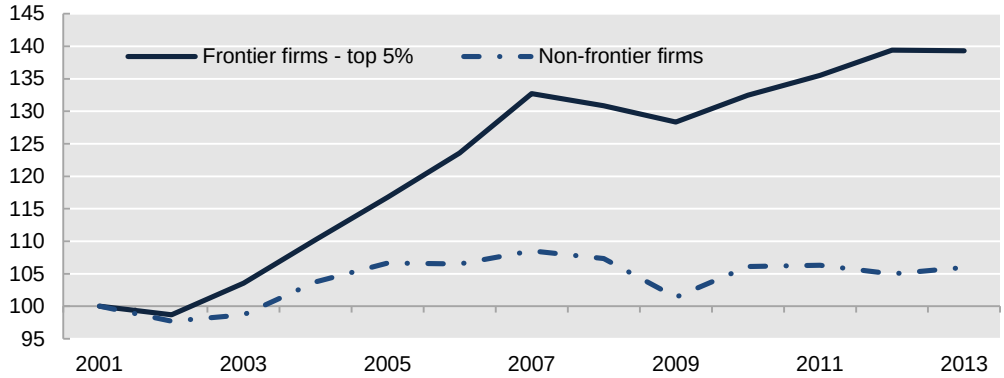
12. Potential output growth has slowed by about one percentage point per annum across the OECD since the late 1990s, which is entirely accounted for by a pre-crisis slowing in MFP growth and more recent weakness in capital deepening (Ollivaud, et al., 2016). The slowdown in aggregate labour productivity is particularly concerning in light of micro-level evidence, which raises questions about the functioning of the exit margin in OECD economies.

2.1 Micro dimensions to the aggregate productivity slowdown

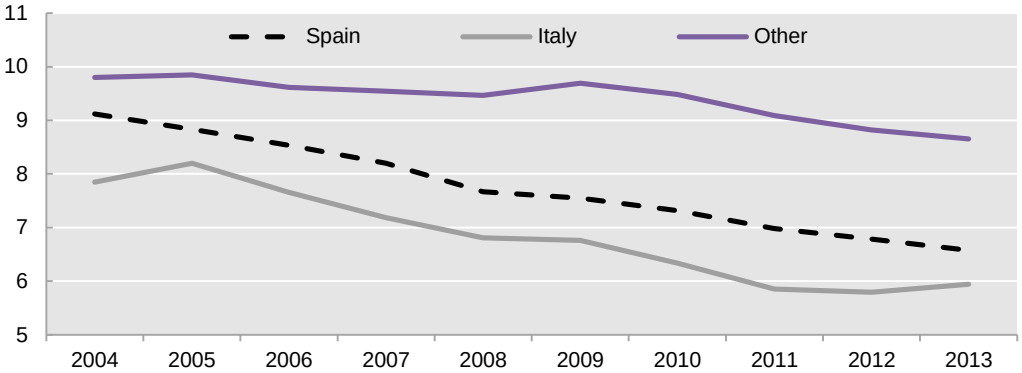
13. First, the level of productivity dispersion within industries has risen over time, implying a widening gap between more productive and less productive firms. For example, Andrews, Criscuolo and Gal (2016) document a rising labour productivity gap between global frontier and laggard firms, which remains after controlling for differences in capital intensity and mark-up behaviour (Figure 1, Panel A). The authors show that on average in the OECD, this productivity divergence is not just driven by frontier firms pushing the boundary outward, but by stagnating laggard firm productivity related to the declining ability or incentives of such firms to adopt best practices from the frontier.

Figure 1. Rising productivity dispersion but declining productivity-enhancing reallocation

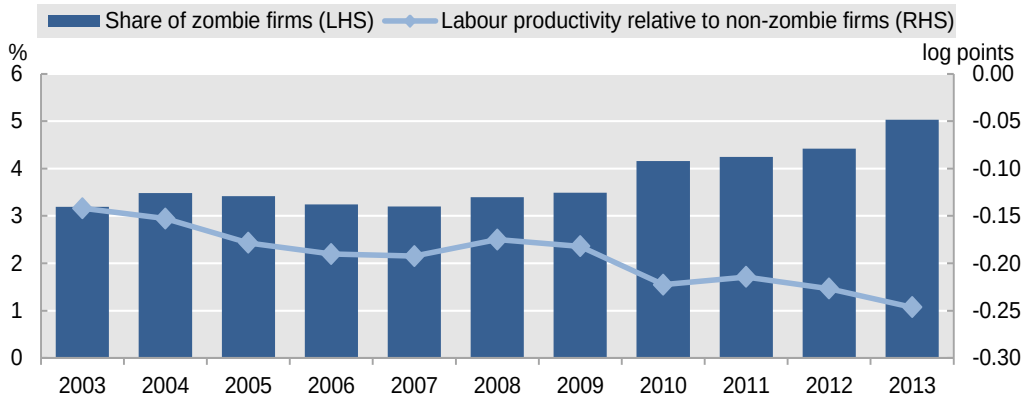
Panel A: Widening productivity gap between frontier and laggard firms



Panel B: Percentage point difference in capital stock growth of high and low productivity firms



C: The rise of zombie firms



Note: Panel A: "Frontier firms" is the average labour productivity (value added per worker) of the 5% globally most productive firms in each two-digit industry. "Non-frontier firms" is the average of all firms, except the 5% globally most productive firms. Included industries are manufacturing and business services, excluding the financial sector. The coverage of firms in the dataset varies across the 24 countries in the sample and is restricted to firms with at least 20 employees. Panel B: High (low) productivity firms are defined by being one standard deviation above (below) the industry mean multi factor productivity (MFP). The charts show the sensitivity of firm capital growth to firm MFP, based on a firm level regression of the growth in the real capital stock on the lagged deviation of firm MFP from its industry-year average, interacted with time trends (trend and trend-squared). The regressions also control for firm age, firm size classes, industry and year fixed effects. The cross-country regression includes Belgium, Finland, France, Korea, Slovenia, Sweden and the United Kingdom. Panel C shows the share of zombie firms, defined as firms aged ≥10 years and with an interest coverage ratio<1 over three consecutive years, and their labour productivity (based on gross output per employee) relative to other firms, for an unweighted average for Belgium, Finland, France, Italy, Korea, Spain, Sweden and the United Kingdom.

Source: Panel A: Andrews, Criscuolo and Gal (2016); Panels B and C: Adalet McGowan, Andrews and Millot (2017).

14. Second, rising productivity dispersion would ordinarily imply stronger incentives for productive firms to aggressively expand and drive out less productive firms, but if anything, the contribution of resource reallocation to aggregate productivity has declined. In the United States, this is reflected in a declining responsiveness of firm growth (employment and investment) to productivity over recent decades, which implies that the propensity of high productivity firms to expand and low productivity firms to downsize or exit has fallen (Decker et al., 2016). Data for eight European countries and Korea (Figure 1, Panel B) tell a similar story, with the decline in productivity-enhancing capital reallocation particularly marked in Italy and Spain, which is in line with the findings of Gopinath et al (2017).

15. Third, these patterns have coincided with a decline in a variety of measures of business dynamism, including start-up rates, job and worker flows. As discussed in Andrews et al. (2016), the decline in the share of recent entrants has been accompanied by a rising survival probability of marginal firms that would typically exit in a competitive market. These stylised facts are consistent with a decline in the contestability of markets and imply less indirect pressure on incumbent firms to improve their productivity via technology adoption (Bartelsman et al, 2004). The corollary is that it has become relatively easier for weak firms that do not adopt the latest technologies to survive.

2.2 Zombie congestion as a barrier to productivity growth

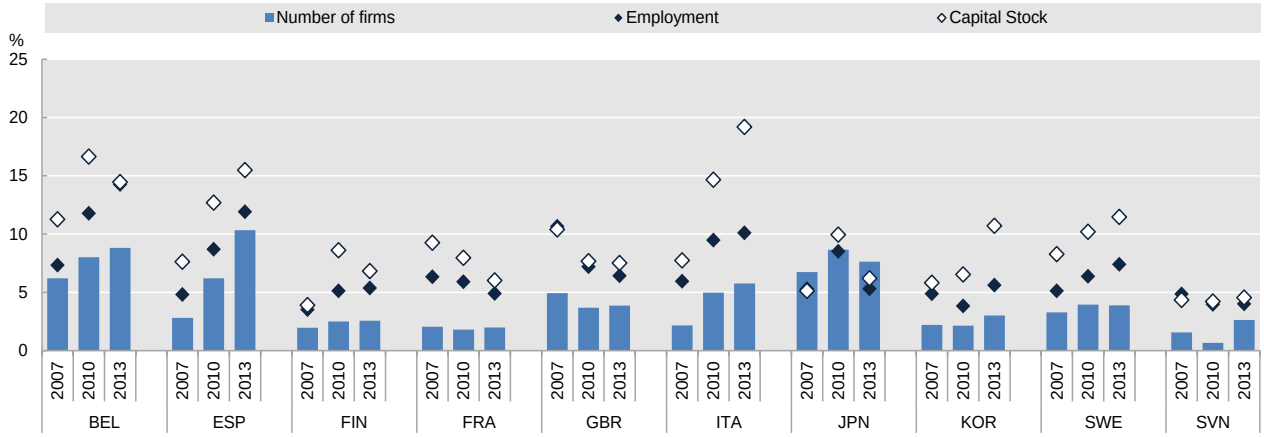
16. The survival of weak companies drags down average productivity, but the consequences for growth are even worse. Since such firms take up scarce resources, their prolonged survival (or their delayed restructuring) can inflate wages relative to productivity, depresses market prices and undermines investment – all of which deters the expansion of productive companies, particularly start-ups. Today, the risk is that this phenomenon may contribute to a period of macroeconomic stagnation, just as it did in Japan during the 1990s (Caballero et al., 2008).

17. This phenomenon is studied in more depth by Adalet McGowan et al (2017), who document the rise in zombie firms and their implications for aggregate productivity. In this analysis, zombies are defined as old firms (i.e. age 10 years or above) that cannot cover their interest payments with their profits for three consecutive years, but the key conclusions are not particularly sensitive to a range of other criteria used to identify zombie firms (see Section 4). On average across countries, the prevalence of zombie firms – based on this measure – has risen between 2003 and 2013, despite a decline in their labour productivity relative to non-zombie firms (Figure 1, Panel C). Figure 2, Panel A shows that these patterns are also generally born out at the country level and in a number of countries, the productive resources sunk in "zombie" firms have risen since the mid-2000s. In Italy, for example, the share of the industry capital stock sunk in zombie firms rose from 7% to 19% between 2007 and 2013.

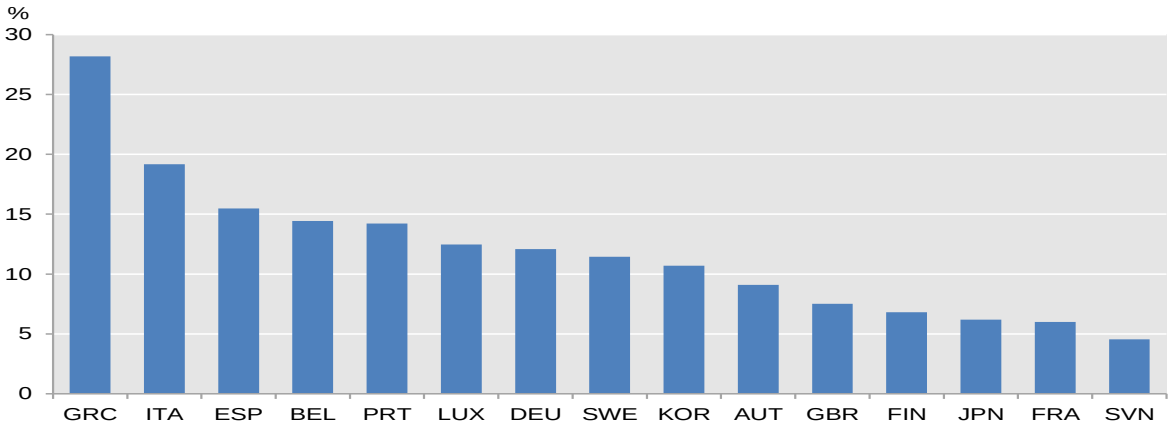
18. Econometric analysis – which controls for cyclical influences – shows that when more industry capital is sunk in zombie firms (i.e. zombie congestion), the *average* non-zombie firm undertakes less investment than otherwise (Adalet McGowan et al., 2017). Simulations suggest that the rise in zombie congestion in Italy could perhaps account for one-quarter of the actual decline in aggregate business investment between 2008 and 2013. But the story does not end there because the concept of the average firm is tenuous in the context of the widespread heterogeneity in firm productivity within narrowly-defined sectors. In fact, zombie congestion disproportionately crowds-out the growth of more productive firms, thus slowing aggregate MFP growth via less efficient capital reallocation (Adalet McGowan et al., 2017). In Spain, for example, estimates suggest that about one-half of the decline in the efficiency of capital reallocation (in Figure 1, Panel B) can be accounted for by the rise in the zombie congestion. The corresponding estimate for Italy is significantly higher, while in the remaining country grouping, the rise in the zombie share can account for around 15% of the decline in the efficiency of capital reallocation.

Figure 2. The rise of zombie congestion

Panel A: The share of zombie firms over time; 9 OECD countries



Panel B: The share of capital sunk in zombie firms in 2013; 15 OECD countries



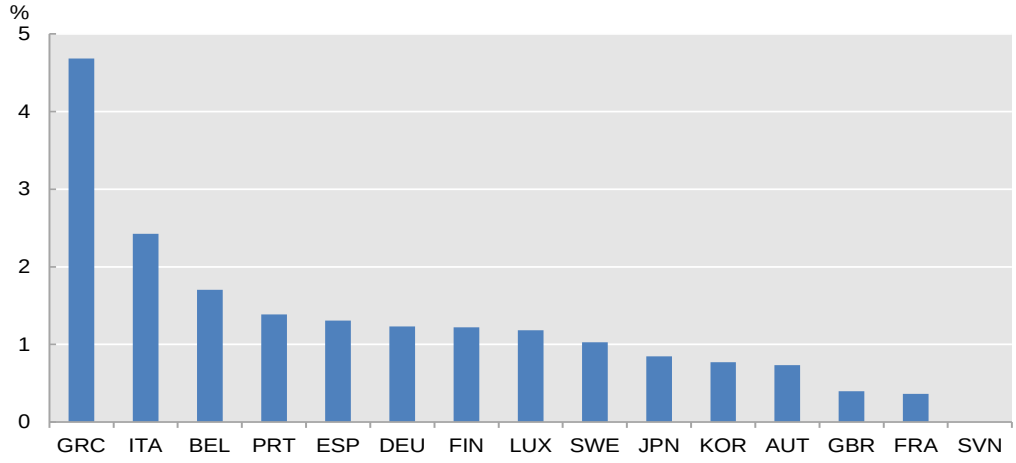
Note: Firms aged ≥10 years and with an interest coverage ratio<1 over three consecutive years. Capital stock and employment refer to the share of capital and labour sunk in zombie firms. The sample excludes firms that are larger than 100 times the 99th percentile of the size distribution in terms of capital stock or number of employees.

Source: Adalet McGowan, Andrews and Millot (2017).

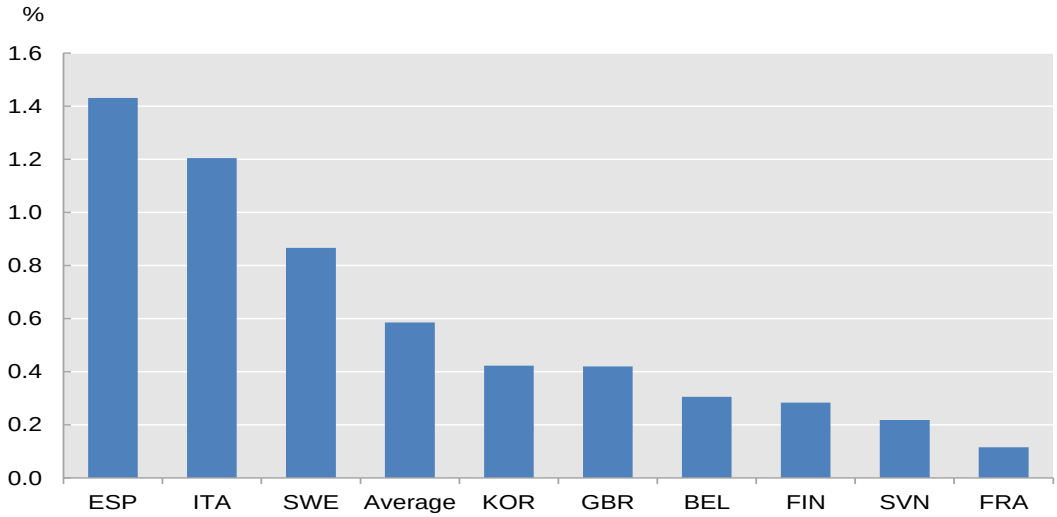
19. Cross-country differences in zombie congestion (Figure 2, Panel B) are also relevant for understanding the barriers to labour productivity growth in OECD countries. Simulations suggest that reducing zombie capital shares to the sample minimum would be associated with a gain in investment for a typical non-zombie firm of between 0.4% in France and 4.7% in Greece (Figure 3, Panel A), with potentially significant corresponding gains to aggregate MFP via more efficient capital reallocation (Figure 3, Panel B). Taken together, the estimates imply that there is considerable scope for policy reforms that affect the exit margin to boost aggregate labour productivity. Accordingly, this paper explores the potential for exit policies to reduce zombie congestion and improve productivity-enhancing capital reallocation, with a particular focus on the contribution of insolvency regimes.

Figure 3. Much scope to boost aggregate labour productivity from reducing zombie congestion, 2013

Panel A: Gains to non-zombie investment from reducing zombie congestion to the country minimum



Panel B: Gains to aggregate MFP from reducing zombie congestion to industry minimum



Note: Panel A shows the counterfactual gains to investment of a typical non-zombie firm from reducing the share of zombies to the sample minimum level (i.e. Slovenia in 2013). Zombie shares refer to the share of capital sunk in zombie firms, defined as firms aged ≥10 years and with an interest coverage ratio<1 over three consecutive years. Panel B shows the counterfactual gains to aggregate business sector MFP via more efficient capital reallocation from reducing the shares of zombies in each country to the sample minimum level in each industry and year. The country level numbers are an unweighted average of all industries (2-digit level detail according to NACE Rev. 2, covering the non-farm non-financial business sector). See Adalet McGowan et al. (2017) for more details.

Source: Adalet McGowan, Andrews and Millot (2017).

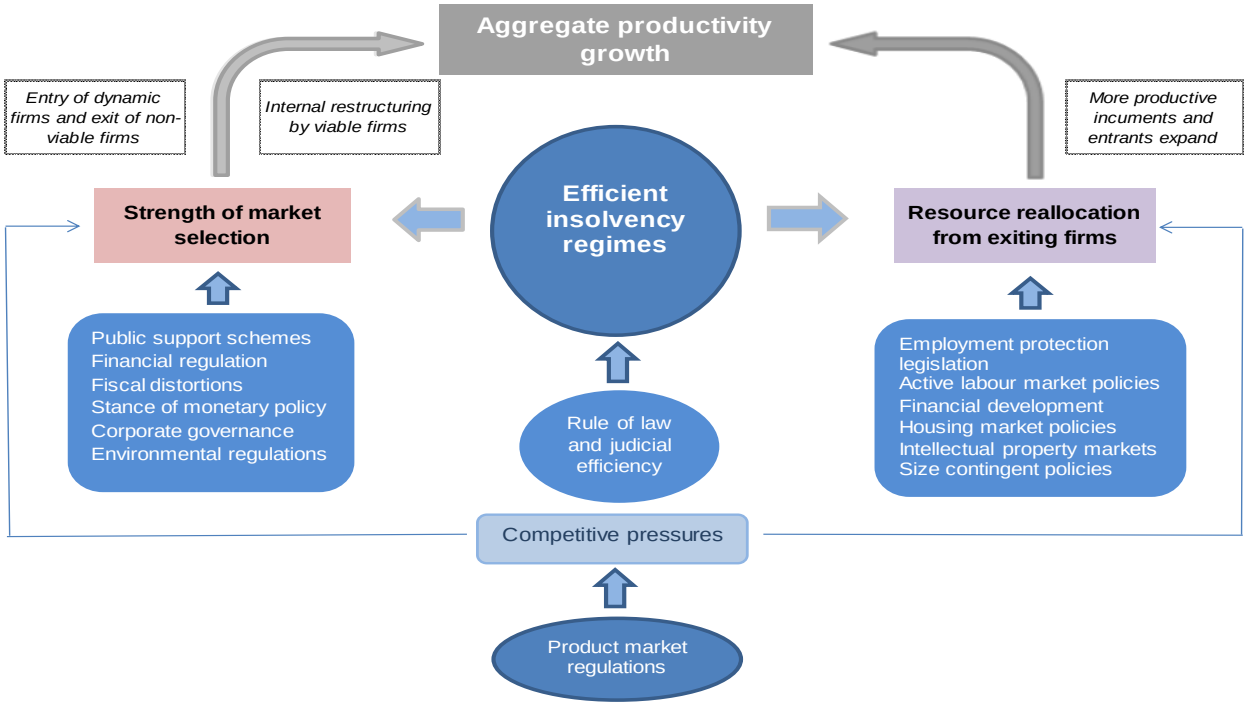
3. Insolvency regimes: relevance and design

3.1 Insolvency regimes and the exit margin

20. The source of the micro-level dimensions to the aggregate productivity slowdown are still contested but are nonetheless consistent with an increase in adjustment frictions, which constrain the growth of productive firms (resource reallocation) and in particular, create barriers to the downsizing and market exit of inefficient firms (market selection). The stylised framework linking public policies to the exit margin developed in Adalet McGowan and Andrews (2016) can be useful in understanding the connection between policy failures and zombie congestion and the nature of the policy response required to alleviate this source of productivity weakness. Figure 4 illustrates how policies directly shape aggregate

productivity along the exit margin through their impact on two key channels: *i*) the strength of market selection; and *ii*) the reallocation of resources to more productive uses.[2]

Figure 4. A stylised depiction of how policies can shape productivity growth along the exit margin



Source: Adalet McGowan and Andrews (2016).

21. Clearly, a range of policies are relevant (see Box 1) but insolvency regimes are crucial due to market imperfections – i.e. coordination problems, incomplete contracts and information asymmetries – which make it difficult in practice for the private market to facilitate the exit of failing firms in an orderly fashion (Adalet McGowan and Andrews, 2016). When a debtor is suspected of being insolvent, creditors have an incentive to engage in a "rush to the exit", rapidly enforcing their individual claims, even if it results in a reduction in the total value of recoverable assets. In practice, it is also difficult for debtors and creditors to write a complete private contract that ensures an optimal outcome ex ante due to the high number of contingencies and the fact that the debtor can acquire new assets and liabilities after the initial contract (Hart, 2000).

22. For these reasons, insolvency regimes that contain provisions to bring debtors and creditors to the table and thus deal in an orderly fashion with the financial distress of commercial entities (i.e. corporate insolvency regimes) and entrepreneurs who have either been trading as a sole proprietor or who are part of a closely-held private company (i.e. personal insolvency regimes) are crucial. The corporate *vs* non-corporate distinction in assets and liabilities, however, is often blurred for small entrepreneurial firms, either because lenders require personal guarantees or security – e.g. a second mortgage on the owner's home – or because prior to incorporating and obtaining limited liability protection, entrepreneurs typically use personal finances (Berkowitz and White, 2004; Cumming, 2012). This leads us to consider key design

2. For simplicity, the framework abstracts from other channels through which exit policies can shape aggregate productivity growth, such as those affecting within-firm productivity directly (e.g. innovation and adoption; see Adalet McGowan and Andrews, 2016).

features of personal insolvency regimes in conjunction with those that apply specifically to corporate insolvency regimes.

Box 2. Other policies relevant to the exit margin

While efficient insolvency regimes are crucial to aggregate productivity growth, the framework in Figure 4 suggests a need for coherence across a range of other policies:

- First, strong rule of law and an efficient judicial system is crucial for the effectiveness of – and in turn the incentives for stakeholders to utilise – formal insolvency procedures, since: *i)* court involvement accounts for a large share of insolvency costs; *ii)* the efficient resolution of financial distress depends on courts' ability to verify information and enforce contracts; and *iii)* the ability of insolvency regimes to distinguish viable from non-viable firms will be reduced when courts are congested and judges lack the requisite expertise.
- Second, product market reforms that raise competitive pressures will strengthen market selection by making it more difficult for weak firms to survive and will increase the likelihood that the resources released by exiting firms will be reallocated to more productive uses.
- Third, even if product market regulations are well-designed, inefficient firms may still linger in the market due to policy weakness in other areas, including: inappropriate public support schemes, the "evergreening" of loans to zombie firms by fragile banks and weak environmental regulations, which may enable laggard firms armed with obsolescent technologies to linger in the market (Albrizio et al., 2014; Johnstone and Koźluk, 2017).
- Fourth, the aggregate impact of policies that strengthen market selection will be enhanced by reallocation-friendly policies, particularly those that facilitate job turnover (i.e. employment protection legislation, EPL) and labour mobility (i.e. active labour market and housing policies). Policies that facilitate the growth of productive firms will over time make it increasingly difficult for weak firms to survive, thus indirectly strengthening market selection and help channel the released resources to more productive uses.

23. Insolvency regimes that can address the aforementioned market imperfections 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 can spur firm creation, draw more talented individuals into entrepreneurship and incentivise radical innovation over conservative business strategies.[3] Even so, insolvency regimes that provide no safeguards for creditors may reduce the supply of credit, so some balance is required.

24. More specifically, our working hypothesis is that the inefficiencies on the exit margin discussed in Section 2 – i.e. weak market selection, zombie congestion and inefficient capital reallocation – are likely to be more pronounced in economies where insolvency regimes:

- Impose a high personal cost to failed entrepreneurs, which may occur when:

3. At the same time, reforms to insolvency regimes can stimulate business investment, especially to the extent that they can address the rise in non-performing loans (NPLs), which can tie up capital and burden banks' loan officers with restructuring tasks rather than making new loans that could finance investment (Bergthaler, et al., 2015; OECD, 2015). Moreover, without suitable debt restructuring tools, over-extended firms could have little incentive to invest because any return is used to service their debt.

- 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.[4]

- 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).[5]

  - 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.[6]

  - 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.[7]

  - 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.[8]

  - 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:

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

5. 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.

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

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

8. 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).

- 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.

25. One important trade-off in designing insolvency procedures concerns on the one hand, the incentives it provides investors to extend credit and to monitor firm performance, and on the other hand, the incentives it provides debtors to manage the firm efficiently and transparently. Insolvency regimes can promote efficient outcomes by providing these incentives: *i*) prior to insolvency when the firm is healthy (ex ante efficiency); and *ii*) once the firm is in distress and enters insolvency (ex post efficiency). While ex ante efficiency will be important in order to discourage risky behaviour from creditors and managers (i.e. moral hazard), the available indicators – including the new indicators presented below – tend to place more emphasis on ex post efficiency incentives, partly because it is easier to measure.[9] Moreover, while our indicators focus on those design features that may impact the timely initiation and resolution of insolvency proceedings, the quality of resolution – which is very difficult to measure – will also matter. While these theoretical limitations should be kept in mind, they provide further motivation for an analysis of the empirical links between the design features of insolvency regimes and some key sources of labour productivity weakness in OECD countries undertaken in Section 4.

3.2 The measurement of insolvency regimes

26. While insolvency reform emerges as a potentially relevant tool to revive productivity growth, the available cross-country indicators of insolvency regimes (e.g. World Bank Doing Business; Carcea, et al., 2015) have a number of drawbacks, particularly with respect to design features that are relevant for productivity outcomes. In turn, this makes it difficult to identify the potential growth dividends from insolvency reform in a cross-country econometric setting (see Adalet McGowan and Andrews, 2016).

27. More specifically, outcome-based measures from World Bank Doing Business – i.e. time to complete and the costs of insolvency procedures – are based on a very stylised case study. The simplicity of the case study is appealing and is preferable to survey-based approaches that attempt to gauge the average time of insolvency proceedings given survey respondents typically find it difficult to give an exact answer without details on the complexity of the case. Yet, as outlined in Adalet McGowan and Andrews (2016), the case study approach also has several limitations as it: *i*) refers only to corporate insolvency; *ii*) involves debt covered by collateral – i.e. the hotel, a tangible asset – while intangible assets are difficult to collateralise and can complicate the insolvency proceedings; *iii*) relates only to one senior secured creditor, which is a bank, and does not take into account issues of priority, which is an important element of insolvency regimes; and *iv*) focuses only on formal insolvency proceedings as the respondents are not offered the option of out-of court settlements and informal work-out options.

28. Similarly, the recent World Bank indicators on the strength of insolvency framework refer only to corporate insolvency and thus abstract from the features of personal insolvency regimes, which clearly matter for the timely resolution of firm distress (see Section 3.1). Moreover, these indicators do not capture

9 It is also important to note that the ability of an efficient design of insolvency regime to deliver timely and effective resolution will depend on partly on the efficiency of complementary institutions (e.g. enforcement quality and judicial efficiency).

fully the availability and the length of the stay on assets, restrictions on dismissal of employees during insolvency proceedings, the relative power of courts, the fate of management and prevention and streamlining tools as they only focus on formal insolvency proceedings. While some of these gaps can be addressed using the data from the European Commission (Carcea et al., 2015) – including the role of courts and the fate of incumbent management – these indicators are only available for a sub-sample of European countries and refer to 2012, and hence do not reflect the extensive reforms to insolvency regimes, especially in Southern Europe.

29. Accordingly, a questionnaire on corporate and personal insolvency regimes was circulated to member and partner countries (see Box 2). The questionnaire yielded cross-country comparable information on 13 key design features (see Section 3.1 and Figure 5) for which there was a sufficient response rate and which – based on international best practice and existing research – may impact the timely initiation and resolution of insolvency proceedings. In order to facilitate cross-country comparisons with respect to the individual and composite indicators, the responses are scaled to take a value between 0 and 1 and are increasing in the extent to which the insolvency regime delays the initiation of and increases the length of insolvency proceedings (see Appendix A for definition of each individual feature and detailed cross-country information). The choice of questions and coding of the potential responses to each question is based on the main conclusions of the theoretical and empirical literature on insolvency regimes and economic growth, summarised in Adalet McGowan and Andrews (2016) and Section 2.2. The new OECD indicators are discussed in more detail in Adalet McGowan and Andrews (2017).

Box 2. The OECD questionnaire on insolvency regimes

In April 2016, a questionnaire aimed at collecting specific information (mostly in the form of Yes/No questions and numbers) about personal and corporate insolvency regimes was circulated to 35 OECD member and 11 non-member countries. Responses were received from 39 countries: all OECD countries (except Iceland) plus China, Costa Rica, Lithuania, Malaysia and Russia. Argentina, Brazil, Colombia, India, Indonesia and South Africa have not responded.

The questionnaire was designed to capture design features of insolvency regimes in eight key areas: the initiation of restructuring, stay on assets, possibility of new financing, fate of incumbent management, treatment of dissenting creditors, role of courts, priority order of claimants (e.g. the role of employees and government) and the availability of a fresh start. It also contained questions on the heterogeneity of insolvency proceedings according to type of firm and entrepreneur and preventative measures and pre-insolvency proceedings. For some questions, the answers were requested for two types of proceedings: *i)* liquidation; and *ii)* restructuring. In order to get a better understanding of reforms over time, countries were also asked to indicate the state of play with respect to the different features of insolvency regimes at five year intervals since 1995 (i.e. 1995, 2000, 2005, 2010 and 2016), but the final responses only allowed the construction of indicators for 2010 and 2016.

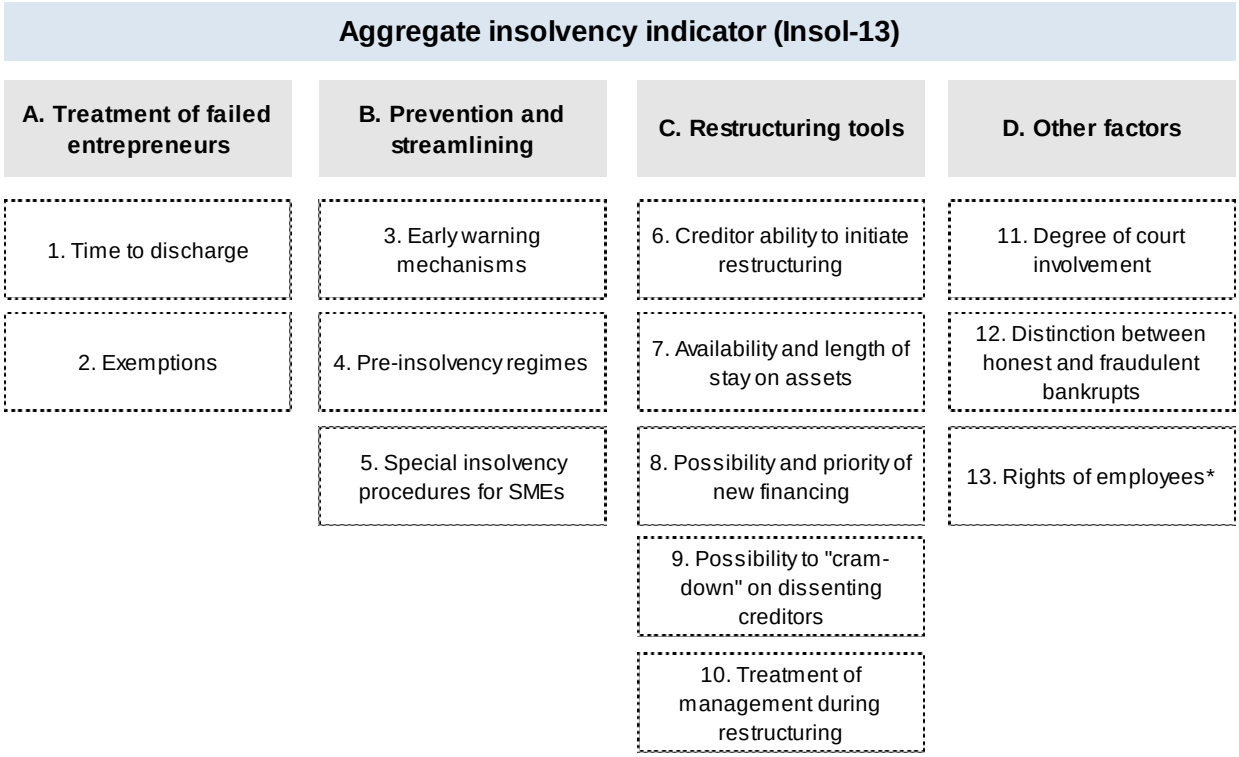
3.3 Cross-country differences in the design of insolvency regimes

30. In order to facilitate cross-country comparisons and generate higher variability across countries than is entailed in any given individual indicator, we construct various composite indicators. In each case, the aggregation methodology applies equal weights to each feature in the absence of any strong prior indication of their relative importance.[10] Nevertheless, we explore separately the respective components of the composite indicator in the econometric analysis in Section 4. The composite indicator, *Insol-13* – which aggregates the thirteen features described above – is available for 34 countries. Given the lack of response on the rights of employees from two countries (Denmark and Korea), we also consider *Insol-12*, based on the other twelve features, which is available for 36 countries. Finally, we construct composite indicators for three specific sub-indicators contained in Figure 5 – personal cost to failed entrepreneurs,

10. An alternative approach would be to apply Data Envelopment Analysis (DEA) techniques to aggregate the components (see Cherchye et al., 2008), which could be addressed in future research.

lack of prevention and streamlining and barriers to restructuring. The discussion generally focuses on 2016 indicator values in order to provide the most timely overview of the state of insolvency regimes. But we also show 2010 indicator values in order to highlight recent insolvency reforms and since these indicators are exploited in the econometric analysis in Section 4 to match the period coverage of the firm-level data.

Figure 5. The structure of the OECD insolvency indicator

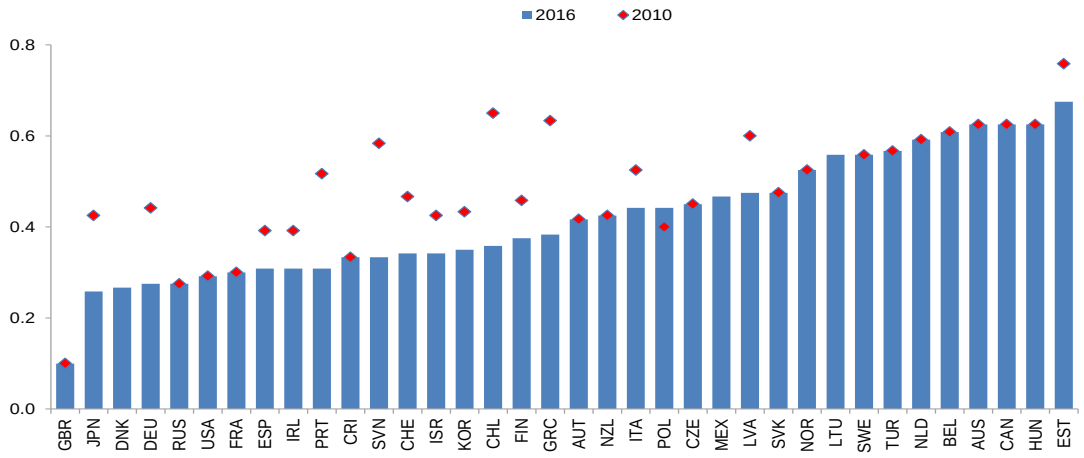


Notes: * denotes that data on Rights of Employees are missing for Denmark and Korea.

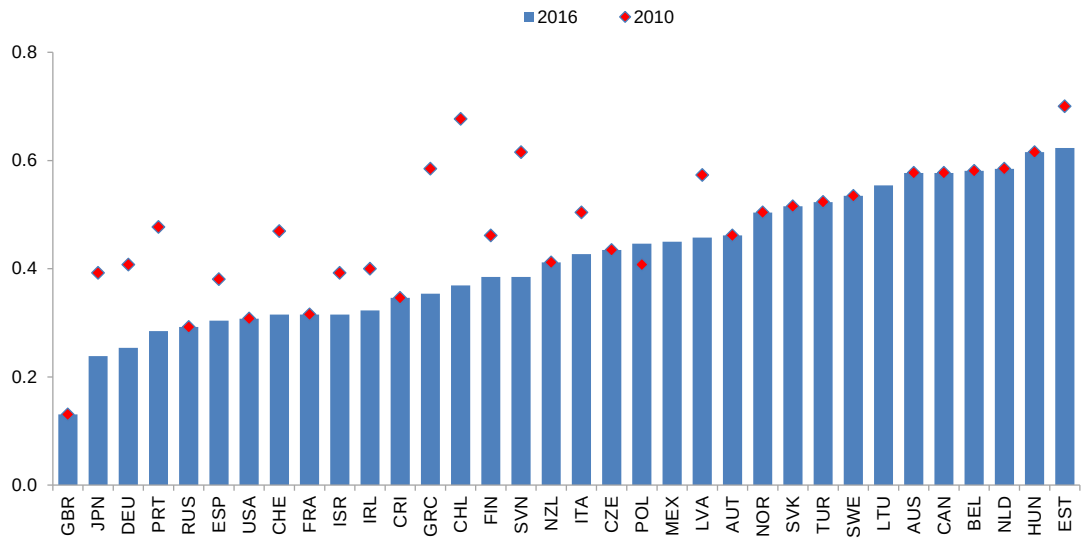
31. According to these metrics, cross-country differences in the design of insolvency regimes are significant. For example, the United Kingdom's low value on the aggregate composite indicators in Figure 6 reflects the fact that the personal costs associated with entrepreneurial failure (Figure 7, Panel A) and barriers to restructuring (Figure 7, Panel C) are low, while there is also a number of provisions to aid prevention and streamlining (Figure 7, Panel B). In Estonia and Hungary, however, the reverse is true. Closer inspection of Table 1 – where darker shades denote the specific design features that are likely to delay the initiation of and increase the length of insolvency proceedings – provides more specific insights into why this is so. In Estonia and Hungary, the personal costs associated with entrepreneurial failure are high due to a high time to discharge, which 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 in Estonia and Hungary.

Figure 6. OECD indicator of insolvency regimes

Panel A: Composite indicator based on 12 components; 36 countries



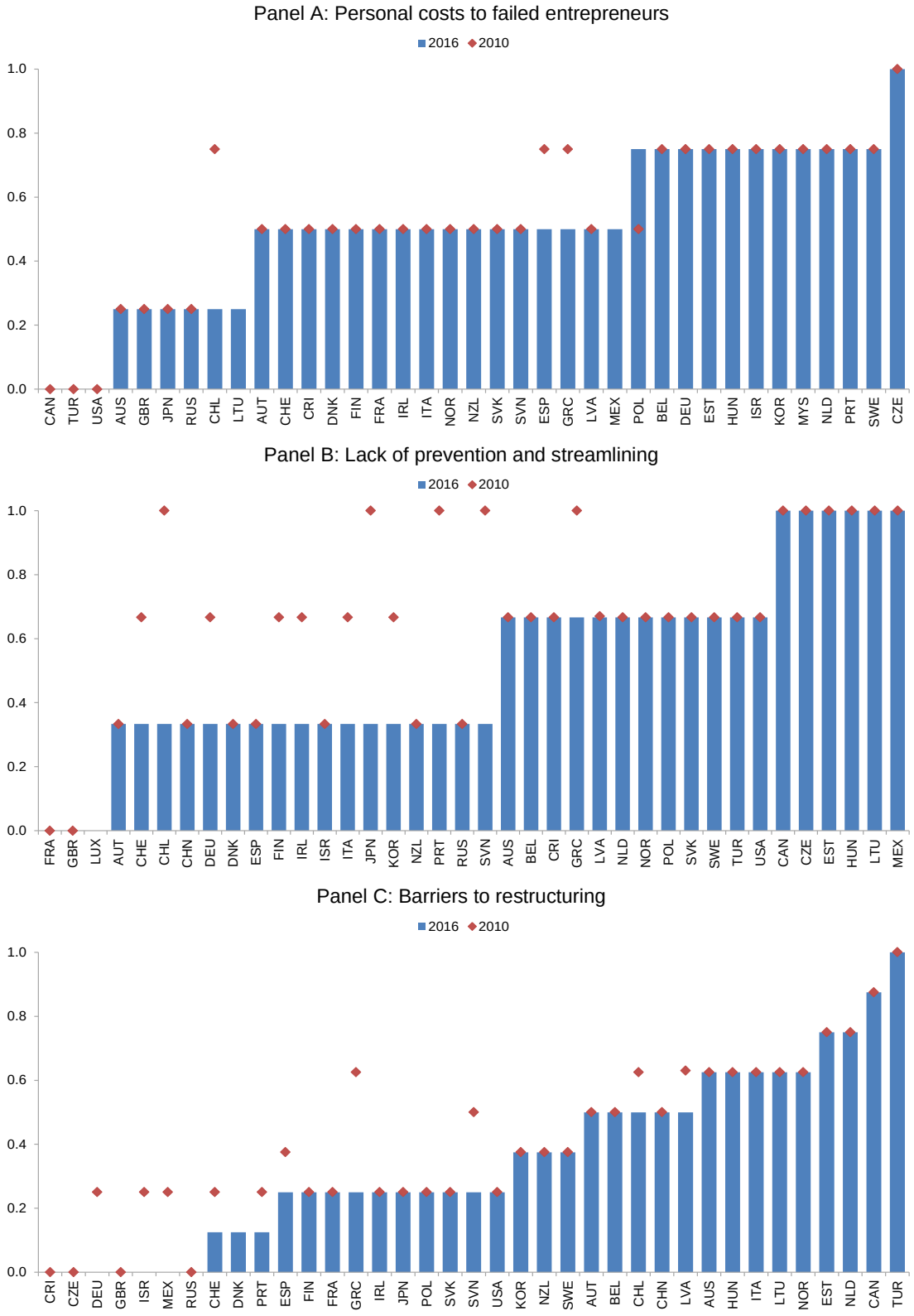
Panel B: Composite indicator based on 13 components; 34 countries



Source: Calculations based on the OECD questionnaire on insolvency regimes. See Figure 5 for details on the composition of the various indicators.

32. The aggregate indicators (Figure 6) often conceal some interesting variation across the sub-components (Figure 7). In this regard, Canada, Turkey and to a lesser extent Australia combine very low personal costs to entrepreneurial failure with very high barriers to restructuring, while the reverse is true in the Czech Republic, Israel, Germany and to a lesser extent Portugal. In the United States, personal costs to failed entrepreneurs and barriers to restructuring are relatively low, but preventative and streamlining measures are generally lacking. The latter is not too surprising, given that such features emerged as a policy response to the financial crisis in Europe (see below), but were not part of policy reform outside of non-European OECD countries (e.g. Canada and Mexico).

Figure 7. Sub-components of OECD indicator of insolvency regimes



Source: Calculations based on the OECD questionnaire on insolvency regimes. See Figure 5 for details on the composition of the various indicators.

33. Digging deeper into the individual features in Table 1, the time to discharge – and thus the personal costs associated with entrepreneurial failure – remains high in many countries. Concerning prevention and streamlining, while pre-insolvency regimes are present in almost three-quarters of countries, early warning systems and special insolvency procedures for SMEs are only available in about one-third of countries analysed. Turning to barriers to restructuring, creditors lack the ability to initiate restructuring and the stay on assets is indefinite in over one-third of countries analysed. Meanwhile, incumbent management is retained during restructuring in all but four countries, while "cram-down" on dissenting creditors – which allows the approval of a restructuring plan by only a requisite majority of creditors – is only absent in three countries. That said, even in those countries that allow cram-down, cross-country differences emerge in the specific design features. For instance, the provision that dissenting creditors should receive at least as much under the restructuring plan as they would receive under liquidation is not present in 14 out of the 34 countries that allow cram-down (i.e. the grey shading).

Table 1. Cross-country variation in the design features of insolvency regimes, 2016

	Insol-13												
	Treatment of failed entrepreneurs		Prevention and streamlining			Restructuring tools					Other factors		
	Time to discharge	*Exemptions*	*Early warning systems*	*Pre-insolvency regimes*	*Special procedures for SMEs*	*Creditor ability to initiate restructuring*	*Availability and length of stay on assets*	*Possibility and priority of new financing*	*Possibility to "cram-down" on dissenting creditors*	*Treatment of management during restructuring*	*Degree of court involvement*	*Rights of employees*	*Distinction between honest and fraudulent bankrupts*
AUS													
AUT													
BEL													
CAN													
CHE													
CHL													
CHN	N/A	N/A											
CRI													
CZE													
DEU													
DNK												N/A	
ESP													
EST													
FIN													
FRA													
GBR													
GRC													
HUN													
IRL													
ISR													
ITA													
JPN													
KOR												N/A	
LTU													
LUX		N/A					N/A		N/A			N/A	
LVA													
MEX													
MYS			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NLD													
NOR													
NZL													
POL													
PRT													
RUS													
SVK													
SVN													
SWE													
TUR													
USA													
Number of countries with best practice	8/38	8/37	15/38	27/38	13/38	24/38	20/37	21/38	20/37	34/38	1/37	11/35	29/38

Notes: Darker shades denote the specific design features that are likely to delay the initiation of and increase the length of insolvency proceedings. Specifically, a white cell refers to the best practice and cells are ordered such that a black cell refers to features that are most likely to delay the initiation of and increase the length of insolvency proceedings.

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

34. A comparison of the 2010 and 2016 values for the composite indicator, *Insol-13*, shows that 15 out of 36 countries have reformed their insolvency regimes recently. The countries which have exhibited the largest decline on this indicator are Chile, Germany, Greece, Japan, Portugal and Slovenia (Figure 6, Panel A). Looking at the sub-components suggests that recent reform efforts have been largest for prevention and streamlining, especially in European countries (Figure 7, Panel B), with reforms observable in 11 countries. This may reflect the fact that such measures have been recently endorsed by the European Commission and the IMF, in response to the crisis (Carcea et al., 2015; Bergthaler et al., 2015; Laryea, 2010). Barriers to restructuring have also declined in 10 out of 36 countries (Figure 7, Panel C), while reform activity has been lowest with respect to the personal costs to failed entrepreneurs, with only Chile, Greece and Spain undertaking reforms in this area since 2010 (Figure 7, Panel A). Interestingly, a high level of a respective indicator in 2010 tends to be a poor predictor of subsequent reform activity. This stands in contrast to recent studies of product market regulations, which find that reforms are more likely in countries where the initial stance of market regulations is stricter (Bouis, Duval and Eugster, 2016).

4. New evidence on insolvency regimes, zombie firms and capital reallocation

35. After describing the underlying firm-level data used in the analysis, this section uses cross-country econometric analysis to test the hypothesis that features of insolvency regimes that may delay the initiation and increase the length of insolvency proceedings are likely to: *i*) increase the resources sunk in zombie firms by reducing the likelihood that weak firms are successfully restructured; and *ii*) stymie productivity-enhancing capital reallocation.

4.1 Firm level data

36. 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 3 for details). While ORBIS covers a larger number of countries, the final sample of countries is driven by the availability of data that are necessary to construct zombie firm measures. As discussed in Adalet McGowan et al (2017), since the analysis of zombie firms requires looking at the bottom of the productivity distribution and more productive firms are better represented in ORBIS, we adopt a conservative strategy and limit the sample to a set of countries where the data coverage is more complete.[11] Given that, at the time of writing, the ORBIS vintage ended in 2013, we exploit insolvency indicators from 2010 in the baseline econometric analysis.[12]

37. The empirical analysis generally exploits harmonised firm level data for the following 14 OECD countries: Austria, Belgium, Finland, France, Germany, Greece, Italy, Japan, Korea, Portugal, Slovenia, Spain, Sweden and the United Kingdom. The analysis in Section 4.3, however, is based on 12 countries due to the lack of reliable multifactor productivity estimates for Greece and Japan. The sample is restricted to the non-farm non-financial business sector (NACE Rev.1.1 codes 15-74, excluding 65-67).

38. 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. One potential source of bias when

11 The sample is restricted to countries and years for which ORBIS covers at least 40% of aggregate employment (based on national account figures), and where profit, debt and MFP variables are available for the majority of observations.

12 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, but the results are typically robust to using 2016 indicators.

using unconsolidated accounts is that these data might be affected by corporate profit shifting strategies. In order to address this issue, we also conducted the analysis on the sample excluding firms which are part of multinational group (MNEs), relying on ORBIS ownership links data. When excluding MNEs from the sample, the share of capital sunk in zombie firms (see Figure 2) remains nearly unchanged, increasing only by 0.9% on average across countries included in our sample. As discussed below, the baseline econometric results are robust to excluding MNEs from the sample.

39. To address issues rising from underrepresentation of certain industries and of small and young firms in ORBIS, it is possible to align the ORBIS firm sample with the distribution of the firm population from the Structural Demographic Business Statistics (SDBS) collected by the OECD and Eurostat, based on confidential national business registers.[13] This post-stratification procedure is of course based on the assumption that within each specific cell, ORBIS firms are representative of the true population – an assumption that may be problematic if the nature of selection varies across countries. Given this, it is reassuring that the baseline results are also robust to the application of SDBS re-sampling weights.

Box 3. 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 and industry 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.

The analysis exploits MFP estimates on the Solow residual approach and a value added based production function estimation with the number of employees and real capital as inputs. To implement the latter, we employ the one-step GMM estimation method proposed by Wooldridge (2009), which mitigates the endogeneity problem of input choices by using material inputs as proxy variables for productivity and (twice) lagged values of labour as instruments. The production function is estimated separately for each 2-digit industry but pooled across all countries, controlling for 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. For more details, see Appendix E of Andrews, Criscuolo and Gal (2016).

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.

13. 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%.

4.2 Insolvency regimes and capital sunk in zombie firms

4.2.1 Empirical framework

40. To investigate the links between insolvency regimes and the share of industry capital sunk in zombie firms, 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 '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. In other words, identification will be based on comparing the zombie capital share between highly-exposed industries and marginally-exposed industries in countries with different insolvency regimes.

41. More specifically, we estimate the following baseline econometric specification on a cross-section of 14 countries and 40 industries for 2013:

$$ZombieShare_{cs} = \alpha + \sum_j \beta_1^j Insol_c^j * Exp_s + \sum_k \beta_2^k Pol_c^k * Exp_s + \delta_c + \delta_s + \varepsilon_{cs} \quad [1]$$

where: *ZombieShare* refer to the share of industry capital sunk in zombie firms (defined below) in industry *s* and country *c*. *Insol* refers to different features of the insolvency regime (where j=number of features) in country *c* and *Exp* refers to industry *s* exposure to policies. To proxy for industry exposure to insolvency and other policies that may affect firm exit, we follow a long literature and use firm turnover rates for the United States (sourced from Bartelsman et al., 2013), which is generally viewed as a reasonable proxy of the frictionless economy benchmark due to its relatively low level across a range of regulatory burden indicators. The model includes country and industry fixed effects to control for omitted time-invariant country-specific factors and common industry-specific technological factors. At various times, we also control for the influence of other national level policies (*Pol*).

42. Following Adalet McGowan et al (2017), a firm is defined as a zombie firm in 2013 if it is aged 10 years or older in 2013 and it has an interest coverage ratio less than one – i.e. cannot cover their interest payments with their profits – for three consecutive years (2011-2013).[14] The (tangible) capital stock is then aggregated across zombie firms in a given two-digit industry in 2013 and divided by the total industry capital stock to construct the zombie capital share. The 10-year age restriction in the zombie firm definition is employed since it may be difficult to distinguish real zombie firms from young innovative start-ups only based on profitability measures but the results are robust to alternative age thresholds (i.e. 15 years instead of 10). Looking at the persistence of financial weakness via the three year window somewhat addresses the concerns regarding the business cycle effects on the prevalence of zombie firms but the baseline results are not particularly sensitive to employing alternative persistence time windows (5 years instead of 3). We also employ a proxy for the approach outlined in Caballero et al (2008), which defines zombie firms as those potentially receiving subsidised bank credit. Under this approach, zombie firms as those whose actual interest payments fall short of an estimated benchmark based on firm debt structure and market interest rates.[15] While this is an arguably more exogenous definition of zombie firms, it is impossible to

14. The zombie shares are calculated based on the firm-level sample excluding firms that are larger than 100 times the 99th percentile of the size distribution in terms of capital stock. The country-industry shares are then winsorised at the 90th percentile level. See Adalet McGowan et al. (2017) for more details.

15. Caballero et al. (2008) defines zombie firms as those whose actual interest payments fall short of an estimated benchmark R* based on firm debt structure and market interest rates. More specifically, $R_{i,t}^* = rs_{t-1}BS_{i,t-1} + \left(\frac{1}{5}\sum_{j=1}^{5} rl_{t-j}\right) BL_{i,t-j}$, where $BS_{i,t}$ is the short-term loans (less than one year)

perfectly replicate this measure with the firm-level debt data at hand in ORBIS, thus we adopt the broader interest coverage ratio definition in our baseline estimation. [16]

43. The main parameter of interest is $ß_1$. If $Insol^j$ refers to barriers to restructuring and $ß_1>0$, for example, then higher barriers to restructuring disproportionately raise zombie congestion 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 precludes inferences about the average effect of insolvency regimes on zombie congestion, and instead yields a differential impact. In order to provide a more direct estimate of the impact, the methodology proposed by Guiso et al. (2004) is also adopted (see Appendix C). However, since this approach involves a number of assumptions, the resulting estimates should be interpreted with caution.

4.2.2 Baseline empirical results

44. Table 2 shows the results from equation (1), analysing the link between a range of insolvency indicators and the share of capital sunk in zombie firms (exploring the impact of one policy at a time). As expected, the estimated positive coefficients in the first column of Panel A indicates that higher values of the aggregate insolvency composite indicator *Insol-12* are associated with a disproportionately higher zombie capital share in highly-exposed industries (i.e. those with high firm turnover), than in low-exposed industries (i.e. those with low firm turnover).[17] Put differently, industries with naturally higher firm turnover will be relatively less prone to zombie congestion in countries with insolvency regimes that facilitate timely initiation and resolution of insolvency proceeding than in other countries.

45. To understand the extent to which this is true, consider the difference in the zombie capital share between a high turnover industry (i.e. at the 75th percentile distribution, such as Construction) and a low turnover (i.e. at the 25th percentile distribution, such as Manufacture of coke, refined petroleum products and nuclear fuel). Assuming a causal relationship, these estimates imply that an insolvency reform which lowered *Insol-12* from its high level in Belgium to the sample minimum (i.e. the United Kingdom; see Figure 6, Panel A) would yield a reduction in the above differential of 4.7 percentage points. This is significant considering that the difference in the zombie capital share between Belgium and the United Kingdom for the business sector was around 8 percentage points in 2013 (Figure 2, Panel B).

46. Table 2 also displays the coefficients for the key sub-components of the composite index in Panel A and the statistically most relevant individual features of each sub-index in Panel B. Column 2 shows a higher personal cost to failed entrepreneurs – particularly a higher time to discharge – is associated with a disproportionately higher zombie capital share in high exposed industries than low exposed industries. For example, if the time to discharge was reduced from the high level in Belgium to the sample minimum, then the difference in zombie capital shares between industries with high and low exposure would be reduced by 4 percentage points (see Figure B1, Panel D). These results have to be interpreted with caution, as the individual effect of these features may be difficult to entirely disentangle, insofar as these features are positively correlated across countries. Similarly, higher barriers to restructuring – and more specifically, an

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and $BL_{i,t}$ is the long-term debt (more than one year) of firm i at the end of year t, rs_t is the short-term prime rate and rl_t is the long-term rate at year t (see Adalet McGowan et al., 2017).

16. The use of the Caballero et al. (2008) definition of zombie firms requires very detailed information on the debt distribution of each firm in order to calculate an accurate lower bound measure (distinguishing between short-term and long-term bank borrowings as well as the amount of outstanding corporate bonds).

17. The empirical results focus on the aggregate composite indicator Insol-12 since the Insol-13 indicator is unavailable for Korea due to missing data on employee rights. However, the results using Insol-13 are virtually identical and are available from the authors on request.

inability of creditors to initiate restructuring – are associated with a disproportionately higher zombie capital share in high-exposed industries than low-exposed industries (Column 4), and the economic magnitude is broadly similar to that for personal cost to failed entrepreneurs (see Figure B1, Panel C). Crucially, both personal cost to failed entrepreneurs and barriers to restructuring remain statistically significant when included in the same regression, although the size of the coefficients fall by around one-quarter to one-third (Table B1, Column 4).[18] Finally, the lack of prevention and streamlining tools – particularly early warning mechanisms – are associated with a higher zombie capital share in the baseline regression (Column 3). The statistical significance of these coefficients, however, is often sensitive to the inclusion of other policy variables (see Tables B1 and B2), which leads us to focus on other features of insolvency regimes in the remainder of this section.

Table 2. Zombie capital shares and insolvency regimes

Dependent variable: zombie capital shares				
Panel A: **Composite insolvency indicators**	**Insol-12**	Personal costs to failed entrepreneurs	Lack of prevention and streamlining	Barriers to restructuring
Insolvency*Turnover	0.01558***	0.01420***	0.00418*	0.01296***
	(0.006)	(0.004)	(0.002)	(0.004)
Number of observations	558	558	558	558
AdjR2	0.313	0.319	0.306	0.314
Panel B: **Individual features**		*Time to discharge*	*Lack of early warning mechanisms*	*Creditors cannot initiate restructuring*
Insolvency*Turnover		0.00705***	0.00318**	0.00287*
		(0.002)	(0.001)	(0.001)
Number of observations		558	558	558
AdjR2		0.324	0.308	0.306
Panel C: **Other policies**	Administrative burdens on start-ups	Rule of law	EPL including collective dismissals	
Policy*Turnover	0.00403**	-0.00337**	0.00295	
	(0.002)	(0.001)	(0.002)	
Number of observations	558	558	558	
AdjR2	0.307	0.309	0.304	
Country Fixed Effects	YES	YES	YES	YES
Industry Fixed Effects	YES	YES	YES	YES

Notes: Zombie shares refer to the share of industry capital sunk in zombie firms, defined as firms aged ≥ 10 years and with an interest coverage ratio<1 over three consecutive years. 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 are based on 14 countries (AUT, BEL, DEU, ESP, FIN, FRA, GBR, GRC, ITA, JPN, KOR, PRT, SWE and SVN) in 2013. The insolvency indicators refer to the insolvency regime indicators presented in Section 3.3. *** 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: Zombie shares sourced from Adalet McGowan et al. (2017), based on ORBIS Database; Insolvency indicators based on the OECD questionnaire on insolvency regimes; Administrative burden on start-ups from OECD, Product Market Regulation (PMR) Database; Rule of law from World Bank, Worldwide Governance Indicators; and Employment Protection Legislation (including collective dismissals) from the OECD Indicators of Employment Protection.

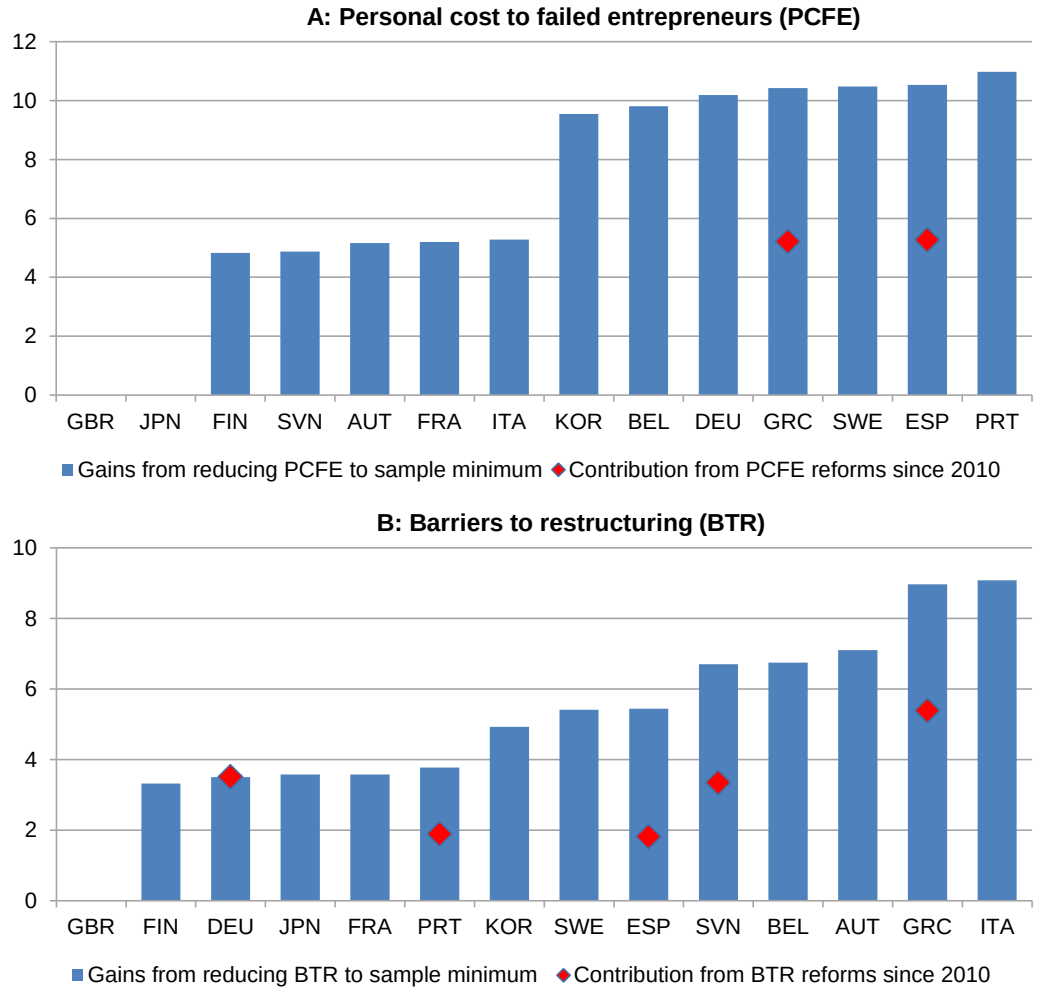
47. Using the most conservative coefficient estimates (Table B1), we apply the methodology outlined in Appendix C to calculate the average effects of reforming insolvency regimes on zombie shares.

18 Interestingly, the size of the coefficients on personal cost to failed entrepreneurs and barriers to restructuring rises significantly when we also control for other policies (see Columns 5 and 6, Table B2).

According to this approach, the potential reduction in zombie congestion associated with policy reform will be highest in countries where the personal cost to failed entrepreneurs and barriers to restructuring is most stringent and those that are more specialised in industries with the highest exposure to the policy. The bars in Figure 8 show the estimated average reduction in the zombie capital share (measured in 2013) associated with lowering the personal cost to failed entrepreneurs and barriers to restructuring from their 2010 levels to the sample minimum in 2010 (i.e. to the United Kingdom values). In turn, the diamonds quantify the potential reduction in the zombie capital share due to recent reforms to insolvency regimes between 2010 and 2016.

Figure 8. How much could reforms to insolvency regimes reduce aggregate zombie congestion?

Reduction in zombie capital share associated with reforming insolvency regimes; percentage difference



Notes: Zombie shares refer to the share of industry capital sunk in zombie firms, defined as firms aged ≥ 10 years and with an interest coverage ratio<1 over three consecutive years. The blue bars show the estimated average reduction in the zombie capital share (measured in 2013) associated with lowering the personal cost to failed entrepreneurs and barriers to restructuring from their 2010 levels to the sample minimum in 2010 (i.e. to the United Kingdom values). The red diamonds exist for countries which have reformed their insolvency regimes between 2010 and 2016 and quantify the potential reduction in the zombie capital share from these reforms. This is calculated as the blue bars (as defined above) *minus* the estimated reduction in the zombie capital share associated with reducing each insolvency indicator from their 2016 levels to the sample minimum in 2016. These calculations are based on the coefficients from Table B1 and the methodology outlined in Appendix C.

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

48. In Italy and Greece, for example, reducing barriers to restructuring to the sample minimum is associated with an estimated 9 percentage point reduction in zombie congestion (Figure 8, Panel B), which

accounts for around one-half and one-third of the zombie capital share in Italy and Greece respectively (Figure 2, Panel B). In Greece, however, significant reform efforts since 2010 have the potential to deliver almost two-thirds of these estimated gains, which augurs well for productivity performance in Greece in the period ahead. A similar story applies to Spain, where insolvency reforms since 2010 could potentially account for one-half and one-third of the estimated gains from reducing personal cost to failed entrepreneurs and barriers to restructuring from their 2010 levels to the sample minimum. Finally, a reduction in barriers to restructuring in Portugal since 2010 holds out the prospect for a modest reduction in the zombie capital share, but more substantial inroads will largely depend on reforms to address the high personal cost to entrepreneurial failure. Given the relatively strong assumptions underlying this approach to obtain average effects from the difference-in-difference estimator, these estimates should not be taken as precise estimates of potential gains. Instead, the point is that there are likely to be material gains from reforming insolvency regimes in many countries.

4.2.3 Extensions and robustness

49. Well-designed insolvency regimes might be associated with a lower zombie capital share to the extent that they facilitate the market exit of zombie firms, effectively restructure zombie firms back to good financial health or reduce the likelihood that firms which encounter an adverse shock become zombies. To shed further light on the potential channels at play, Appendix D studies transitions in the status of zombie and non-zombie firms between 2010 and 2013 with a view to better understand the contribution of insolvency regimes to the corporate restructuring channel. In a sample of continuing firms, we find that higher barriers to restructuring – particularly an inability of creditors to initiate restructuring (Column 3) – are associated with a disproportionately lower likelihood that zombie firms return to better financial health and non-zombie firms escape the regression to zombie status, in high firm turnover industries than in other industries. Put differently, effective corporate restructuring in industries with naturally higher firm turnover will be relatively more likely in countries with insolvency regimes that exhibit lower barriers to restructuring than in other countries. From this perspective, cross-country differences in zombie congestion may emerge because insolvency regimes in some countries are more successful at restructuring weak firms than in others.

50. Besides the aforementioned features of insolvency regimes, Panel C of Table 2 and related policy experiments in Panels H and I of Figure B1 show that a number of other policy factors are associated with a high zombie capital share, including stringent product market regulations affecting firm entry and weak rule of law. For example, stronger rule of law – which is likely to proxy for the extent of judicial efficiency – plays a significant role: improving the rule of law to the best practice level would be associated with a reduction in the zombie capital share differential between high and low- exposed industries of more than 3 percentage points in Greece (see Figure B1, Panel H).

51. The estimates in Table B2 of Appendix B demonstrate that the results linking insolvency regimes to the zombie capital share are generally robust to the inclusion of other policy variables, such as administrative burdens on start-ups, employment protection legislation and the rule of law. This is not particularly surprising, given that the new OECD insolvency indicators are weakly correlated with other structural variables – such as those that proxy for market regulations, and financial market development, legal and corporate governance – with correlation coefficients typically at or below 0.2-0.3 in absolute value terms.

52. The baseline results for *Insol-12*, personal cost to failed entrepreneurs and barriers to restructuring are broadly robust to: *i*) dropping one country at a time from the sample;[19] *ii*) re-estimation

19. In this exercise, Administrative Burdens on Start-ups becomes marginally insignificant when the United Kingdom is excluded.

using the STATA robust regression routine, which re-weights OLS estimation to place less weight on extreme values; *iii*) using insolvency regime indicators for 2016, which may be subject to less measurement error than the retrospective 2010 indicators; *iv*) excluding firms which are part of a multinational group (MNE) from the sample (Table B3);[20] *v*) using alternative definitions to identify zombie firms (see Table B4), such as 15 year age cut-off to define old incumbents (instead of 10 years), a 5 year persistence windows to calculate the interest coverage ratio less than one (instead of 3 years) and attempts to replicate the subsidised bank credit zombie measure outlined in Caballero et al (2008); and *vi*) the application of SDBS resampling weights in the construction of the zombie capital shares to address representativeness issues (see Table B5).

53. Unreported results include the role of other policies and structural factors that might be expected to be related to zombie shares, for which data are available, but did not yield any significant results. These include: *i*) a number of financial system characteristics (share of non-performing loans to total loans, share of banks that are government or foreign owned), financial markets (ratio of stock market capitalisation and private credit to GDP; debt to equity bias), government loan guarantees to SMEs, governance and accounting standards, contract enforcement, and collective bargaining; and *ii*) potential complementarities between insolvency regimes and judicial systems. However, this does not necessarily imply that there is no role for such complementarities; instead, this ambiguity could reflect data limitations, including the relatively narrow country coverage.

4.3 Insolvency regimes and capital reallocation

4.3.1 Empirical framework

54. If insolvency regimes that delay corporate restructuring increase the resources sunk in zombie firms, than one would expect them to also distort reallocation patterns, given evidence that productivity-enhancing capital reallocation is lower in industries with more zombie congestion (Adalet McGowan et al., 2017; Section 2.1). To test this idea, we augment canonical models of firm dynamics which predict that conditional on firm size, firms with higher MFP grow more quickly (see Foster et al., 2016; Decker et al., 2016).

55. Specifically, we consider a baseline specification for a cross-section of 12 countries for 2013 and 40 industries, based on the following model:

$$\Delta K_{icst} = \alpha + \beta_1 MFP_{icst-1} + \sum_j \beta_2^j MFP_{icst-1} * Insol_c^j * Exp_s + \beta_3 MFP_{icst-1} * C_c + \beta_4 MFP_{icst-1} * S_s + \sum_k \beta_5^k X_{icst-1}^k + \delta_{cs} + \varepsilon_{icst} \quad [2]$$

where ΔK is the change in the real capital stock for firm *i*, in industry *s*, in country *c*, at time *t* (t=2013); *MFP* denotes a measure of firm-level multi-factor productivity (MFP) which is a deviation from the country-industry-year average to control for MFP differences across industries and countries; *Insol* refers to different indicators of the insolvency regime in country *c*, *Exp* refers to industry *s* exposure to policies (in this case, firm turnover rates for the United States) and *X* denotes a vector of firm age and firm size (1-10, 11-19, 20-49, 50-99, 100-249 and 250+) controls. The interaction term between lagged MFP and country fixed effects (C_c) controls for the direct effect of country-level policies and other omitted factors

20. MNEs are identified using global ultimate owner (GUO) controlling at least 50% of the shares in ORBIS ownership links data. A firm is considered as part of an MNE if its GUO is located in another country, or if at least one of the firms controlled by its GUO is located in a foreign country.

on capital reallocation, while the interaction between lagged MFP and industry fixed effects (S_s) controls for average differences across industries in efficiency of reallocation that are common across countries. The model also controls for interacted country and industry fixed effects to control for country-industry-specific shocks and robust standard errors, clustered at the country and industry level (i.e. country*industry).

56. The model predicts that $ß_1>0$ since on average, incumbent firms with higher productivity in one period should have higher growth potential in the following period. But if $Insol^j$ refers to barriers to restructuring for example, then our prior is that $ß_2<0$ since higher barriers to restructuring should disproportionately reduce the efficiency of capital reallocation in industries with higher firm turnover than those with lower firm turnover.

4.3.2 Baseline empirical results

57. Table 3 shows the baseline results from equation (2). The starting point for this model is that more productive firms have higher growth potential and thus should attract more capital (see Table B6). With this in mind, the coefficients in Panel A – e.g. the triple interaction term MFP_{t-1}*Insol*Turnover – are negative and statistically significant. This suggests that when insolvency regimes delay the initiation and increase the length of insolvency proceedings (i.e. higher values of *Insol-12* or *Insol-13*), capital reallocation is disproportionately less productivity-enhancing in highly-exposed industries than in industries with low exposure. In particular, higher barriers to restructuring – largely an inability of creditors to initiate restructuring and an indefinite stay on assets – are associated with a lower ability of more productive firms to attract capital, and thus a less efficient allocation of capital (Panel C). The same is true when there are fewer exemptions protecting the insolvent debtor's assets that are not directly linked to the business and early warning systems (Panel B), although the sub-components – personal cost to failed entrepreneurs and lack of prevention and streamlining – are not statistically significant (Panel B).

Table 3. Capital reallocation and insolvency regimes

Dependent variable: growth in the real capital stock				
Panel A: **Composite insolvency indicators**	**Insol-13**		**Insol-12**	
Insolvency*Lagged MFP*Turnover	-0.02007***		-0.01614***	
	(0.007)		(0.006)	
Number of observations	870,865		890,527	
AdjR2	0.0193		0.0207	
Panel B: **Insolvency indicators**	Personal costs to failed entrepreneurs	*Stringent exemption of assets*	Lack of prevention and streamlining	*Lack of early warning mechanisms*
Insolvency*Lagged MFP*Turnover	-0.00471	-0.00980***	-0.00180	-0.00231**
	(0.004)	(0.003)	(0.003)	(0.001)
Number of observations	890,527	890,527	890,527	890,527
AdjR2	0.0207	0.0208	0.0207	0.0207
Panel C: **Insolvency indicators**	Barriers to restructuring	*Creditors cannot initiate restructuring*	*Indefinite length of stay*	*Priority of new financing*
Insolvency*Lagged MFP*Turnover	-0.01038***	-0.00238***	-0.00260***	0.00010
	(0.003)	(0.001)	(0.001)	(0.001)
Number of observations	890,527	890,527	890,527	890,527
AdjR2	0.0208	0.0207	0.0207	0.0207
Firm age and size controls	YES	YES	YES	YES
Country Dummies*Lagged MFP	YES	YES	YES	YES
Industry Dummies*Lagged MFP	YES	YES	YES	YES
Country*Industry Fixed Effects	YES	YES	YES	YES

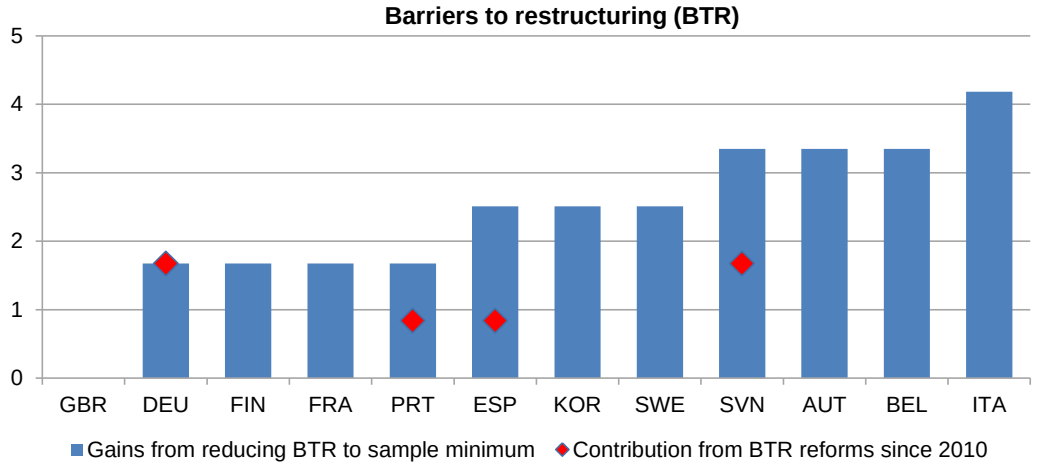
Notes: MFP is the lag of the level of multi-factor productivity estimations based on the Solow-residual, defined as the deviation from country-industry-year mean. Turnover refers to entry and exit rates, for the United States. The regressions include country*industry fixed effects and robust standard errors are clustered by country and industry. Industry refers to 2-digit level detail according to NACE Rev. 1, covering the non-farm non-financial business sector (industry codes 15-74, excluding 65-67). The countries include AUT, BEL, DEU, ESP, FIN, FRA, GBR, ITA, KOR, PRT, SWE and SVN. The insolvency indicators refer to the insolvency regime indicators presented in Section 3.3. While the table presents results for the maximum number of observations for each feature, the results are robust to holding the sample size constant. *** denotes statistical significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

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

58. To calculate the economic magnitude of these results, we evaluate the difference in the efficiency of capital reallocation between a high turnover industry (i.e. at the 75th percentile distribution, such as Construction) and a low turnover (i.e. at the 25th percentile distribution, such as Manufacture of coke, refined petroleum products and nuclear fuel). Assuming a causal relationship, these estimates imply that reducing barriers to restructuring from the high level in Italy to the minimum level in the sample (i.e. the United Kingdom) would imply a reduction in the above differential of around 4 percentage points (Figure 9). In Portugal and Spain, we estimate that recent reforms to barriers to restructuring could raise the efficiency of capital reallocation by 0.8%, while further reforms which closed the remaining gap with best practice could yield additional gains of 0.8% and 1.7% in Portugal and Spain respectively. These estimates are significant in light of the cross-country differences in the efficiency of capital reallocation illustrated in Figure 1, Panel B.

Figure 9. Efficient insolvency regimes can foster productivity-enhancing capital reallocation

Increase in the efficiency of capital reallocation associated with lowering barriers to restructuring; percentage difference between industries with high and low exposure to insolvency regimes



Notes: The blue bars shows the potential gains to productivity-enhancing capital reallocation 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 productivity-enhancing capital reallocation from these reforms. This is calculated as the blue bars (as defined above) *minus* the estimated gains to gains to productivity-enhancing capital reallocation associated with reducing barriers tor restructuring from their 2016 levels to the sample minimum in 2016. The estimates are based on the coefficient estimates from Column 1 of Panel C of Table 3.

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

4.3.3 Extensions and robustness

59. These results are broadly robust to a range of robustness tests, including the application of SDBS re-sampling weights to address potential representativeness issues (Table B7) and alternative MFP definitions, such as that based on the Wooldridge (2009) methodology (Table B8). In both cases, the sub-components personal cost to failed entrepreneurs and lack of prevention and streamlining become statistically significant, while a lack of priority given to new financing over unsecured creditors is also associated with a disproportionately lower allocative efficiency in exposed industries relative to other industries.

5. Conclusion

60. This paper exploits cross-country data to explore the potential link between the design features of insolvency regimes and two sources of labour productivity weakness: the survival of "zombie" firms and capital misallocation. According to indicators assembled from a recent OECD policy questionnaire, the design features of insolvency regimes vary significantly across countries, which imply considerable differences in the personal costs associated with entrepreneurial failure, barriers to corporate restructuring and the availability of prevention and streamlining tools across countries. The empirical results suggest 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. A range of other policies are also relevant to the exit margin, with the zombie capital share positively correlated with weaker rule of law and more stringent product market regulations. 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 rising capital misallocation and the increasing survival of low productivity firms have contributed to the productivity slowdown.

61. Since the new OECD indicators of insolvency regimes capture the different policy design features that influence exit costs, they can be used to give specific and prioritised policy recommendations on insolvency regime reform. In this regard, an effective time to discharge, allowing creditors to initiate restructuring and the presence of early warning mechanisms consistently emerge as important policy levers to reduce zombie congestion and promote more efficient capital allocation. There is also scope to grant more exemptions protecting the insolvent debtor's assets that are not directly linked to the business, establish an effective length of stay on assets and grant priority to new financing over unsecured creditors, although these results are less robust across specifications. Other features of insolvency regimes might also be important to boost productivity growth, but identification of the effect of these other features is constrained by the fact that firm level data is only available for a small sample of countries. Thus, we should not rule out the possibility that countries which are far from best practice with respect to the other design features could still realise productivity gains from reforming other features of insolvency regimes.

62. Future research efforts will be organised around three main areas. First, while this paper has focused on market selection and reallocation, the next step is to evaluate the broader links between insolvency regimes and aggregate productivity growth, by exploring other relevant channels, particularly 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., 2014). A key question for research is to what extent the various policy levers underlying the OECD insolvency regime indicator can also affect these margins of aggregate productivity growth.

63. Second, it is likely that financial sector health is related to the operation of the exit margin. Indeed, banks' reluctance or lack of incentives to deal with non-performing loans and realise losses on their balance sheets that may arise from corporate insolvencies, may lead to "evergreening" of the loans of insolvent/zombie firms (i.e. bank forbearance). This may be particularly relevant to the extent that the current low interest rate environment increases the incentives for banks to bet on the resurrection of failing firms (White, 2012). In this regard, work is underway to link our firm level productivity database to external bank balance sheet databases, in order to analyse the connection between zombie firms and distressed banks, and how this relationship is conditioned by insolvency regimes (Andrews and Petroulakis, 2017).

64. Finally, if the productivity gains from insolvency reforms are significant, then it becomes important to consider the political feasibility of such reforms. At a first glance, the political obstacles to insolvency regime reform may be lower than for other types of structural reforms (i.e. product and labour market deregulation) to the extent that they are less likely to involve the compression of rents. Accordingly, future research could also explore the political economy of insolvency reform.

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APPENDIX A: INSOLVENCY REGIME INDICATORS

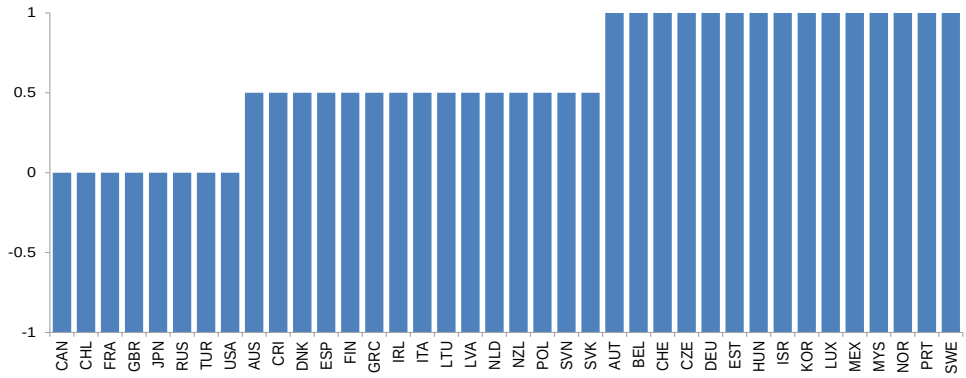
1. In order to ease cross-country comparisons of the indicators, the responses are scaled to take a value between 0 and 1 and are increasing in the extent to which the insolvency regime feature may delay the initiation and resolution of proceedings. All individual features are assigned equal weights to construct the composite indicators. All data refer to 2016.

1. Treatment of failed entrepreneurs

1.1 Time to discharge

2. If discharge is not available, 40 years are allocated as a proxy for the working life of a typical worker following Armour and Cumming (2008). If discharge is available, based on the number of years to discharge, a composite index is created using thresholds, which takes the value 0 if the time to discharge is less than or equal to one year, 0.5 if the time to discharge is between one and three years and 1 if the time to discharge is greater than three years.

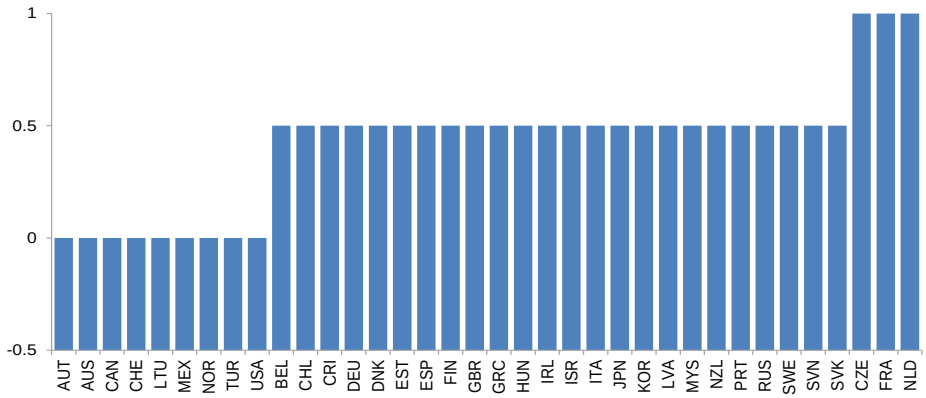
Figure A1. Time to discharge



1.2 Exemptions

3. The indicator takes the value 0 if exemptions (pre-bankruptcy assets which are exempted from the bankrupt estate) are more generous than modest personal items and working equipment (e.g. the debtor's house is exempted), 0.5 if exemptions are restricted to only modest personal items (e.g. assets or income required to cover the debtor's subsistence) and working equipment and 1 if exemptions are less generous than modest personal items and working equipment (e.g. the assets or property of the spouse of the debtor can be included in the bankrupt estate).

Figure A2. Exemption of assets



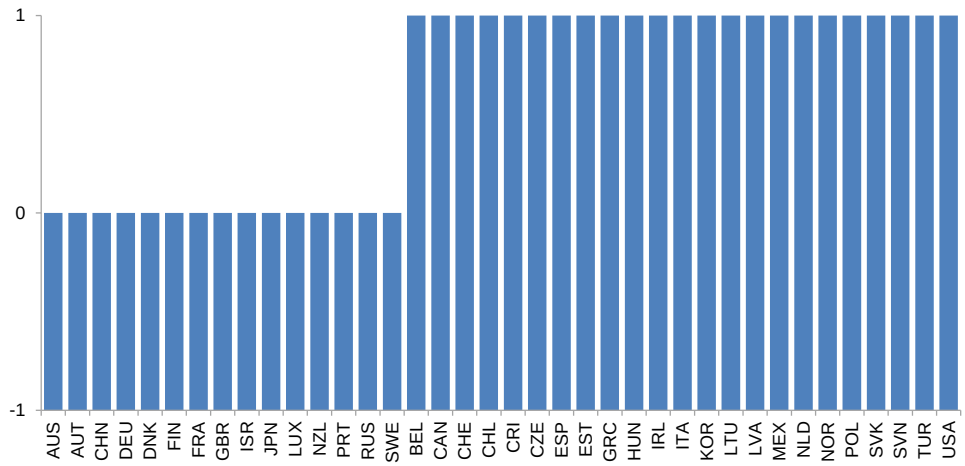
2. Prevention and streamlining

2.1 Early warning mechanisms and pre-insolvency regimes

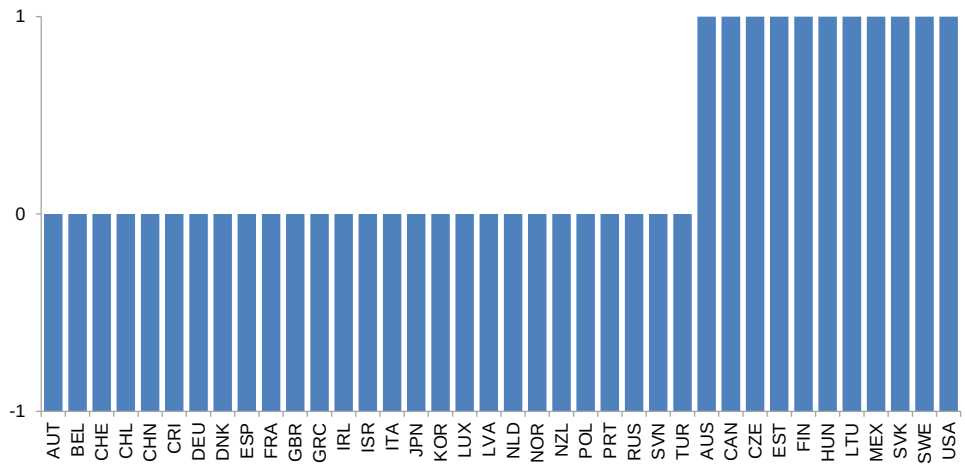
4. The indicator, *early warning mechanisms*, is a dummy variable equal to 0 if countries have early warning mechanisms (e.g. on-line self-test, training) in place and 1 otherwise. The indicator, *pre-insolvency regimes*, is a dummy variable equal to 0 if pre-insolvency regimes exist and 1 otherwise.

Figure A3. Preventative measures

Panel A: Early warning mechanisms



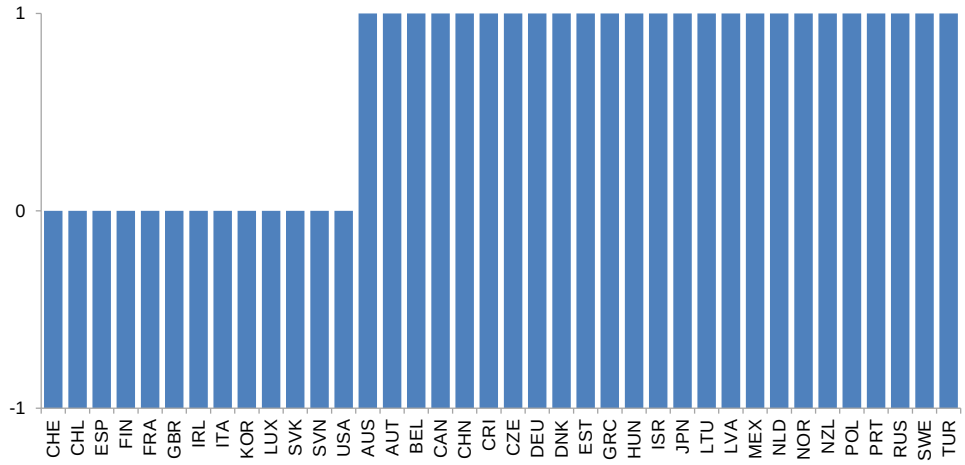
Panel B: Pre-insolvency regimes



2.2 Special insolvency procedures for SMEs

5. This indicator is a dummy variable, which takes the value 0 if special insolvency procedures exist for SMEs and 1 otherwise.

Figure A4. Special procedures for SMEs

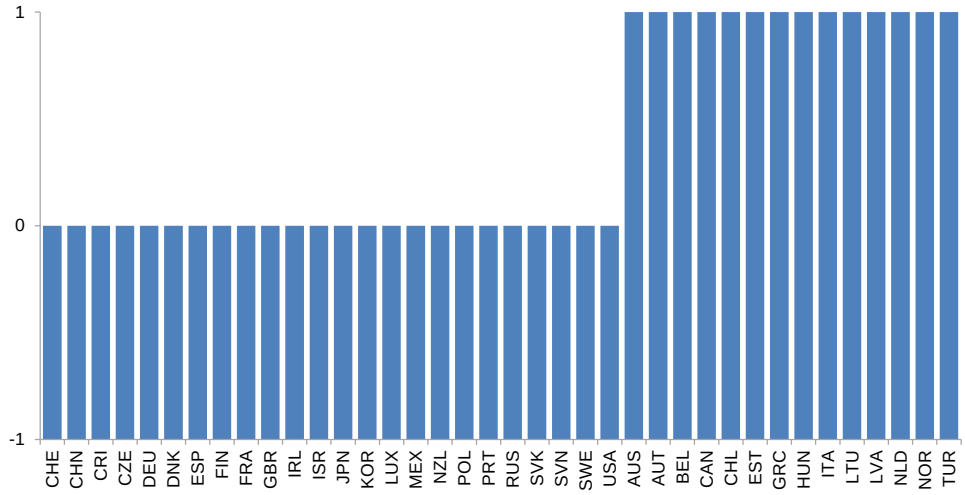


3. Restructuring tools

3.1 Creditors' ability to initiate restructuring

6. This indicator is a dummy variable equal to 0 if creditors can initiate both liquidation and restructuring and 1 if creditors can initiate only liquidation.

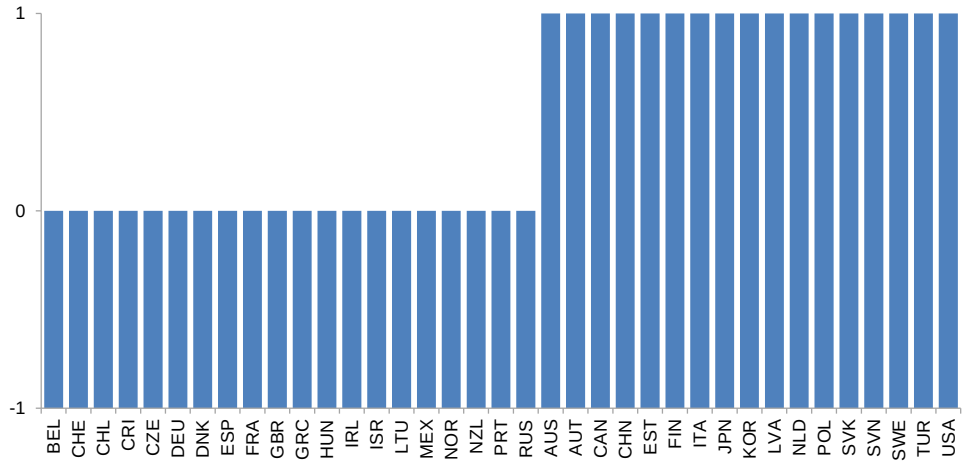
Figure A5. Initiation of restructuring by creditors



3.2 Availability and length of stay on assets in restructuring

7. All countries in the sample have the option of a stay on assets in restructuring. This indicator is a dummy variable equal to 0 if the length of stay has a limit and 1 if the length of stay is indefinite.

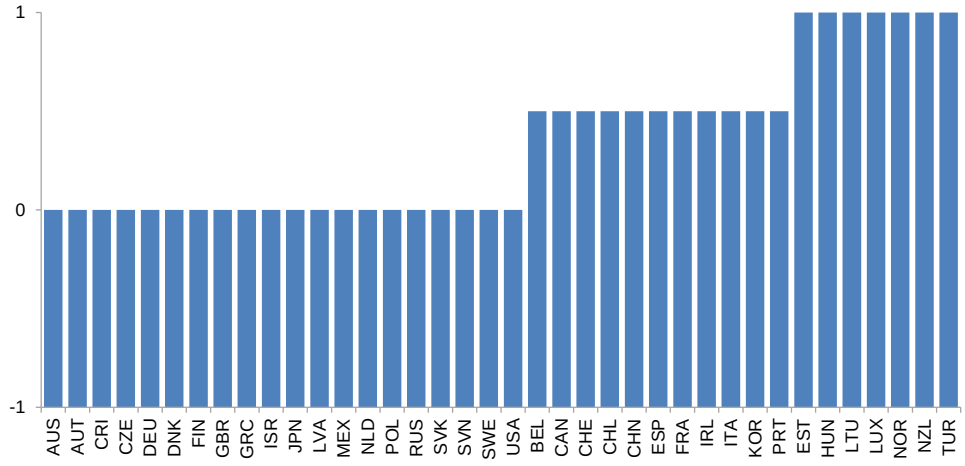
Figure A6. Length of stay on assets in restructuring



3.3 Possibility and priority of new financing

8. This indicator is equal to 0 if the new financing has priority over only unsecured creditors; 0.5 if the priority of new financing has priority over both secured and unsecured creditors; and 1 if new financing has no priority.

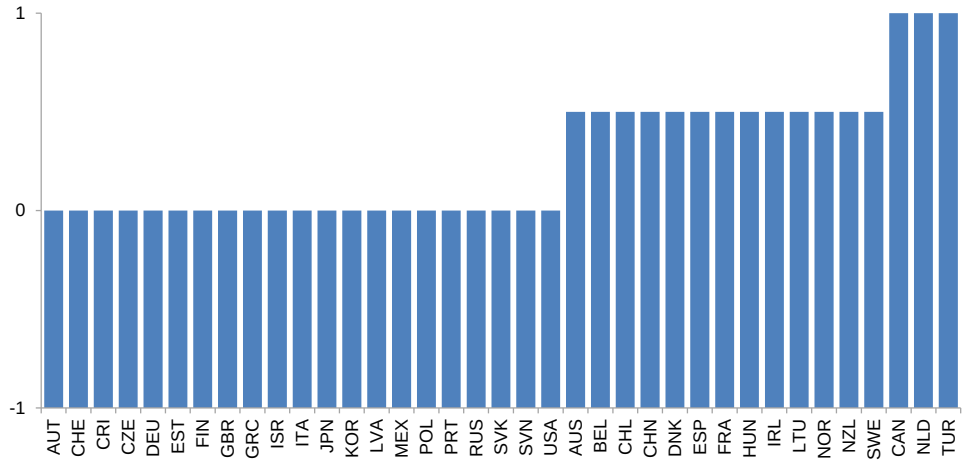
Figure A7. Possibility and priority of new financing



3.4 Possibility to "cram-down" on dissenting creditors

9. This indicator takes the value 0 if there is cram-down, with the provision that dissenting creditors receive as much under restructuring as in liquidation; 0.5 if cram-down exists in the absence of this provision; and 1 if there is no cram-down.

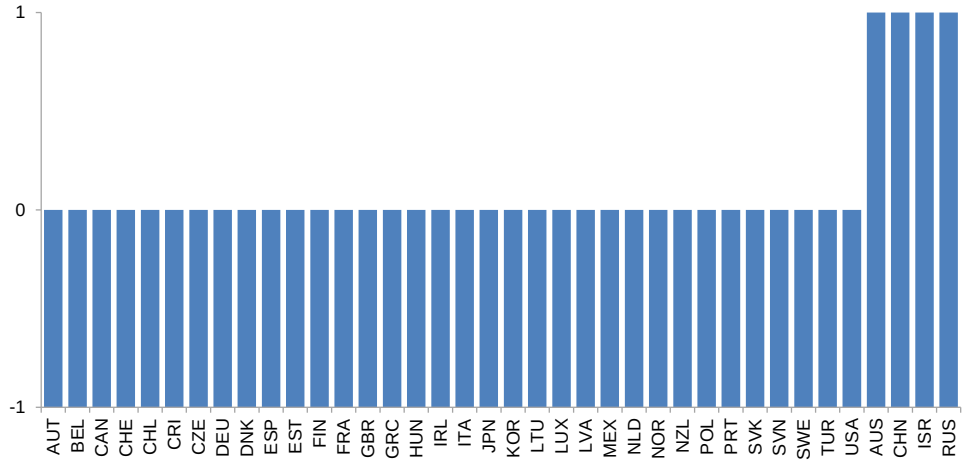
Figure A8. Possibility to "cram-down" on dissenting creditors



3.5 Treatment of management during restructuring

10. This indicator takes the value 0 if management is not dismissed during the restructuring process and 1 if management is dismissed.

Figure A9. Dismissal of management during restructuring

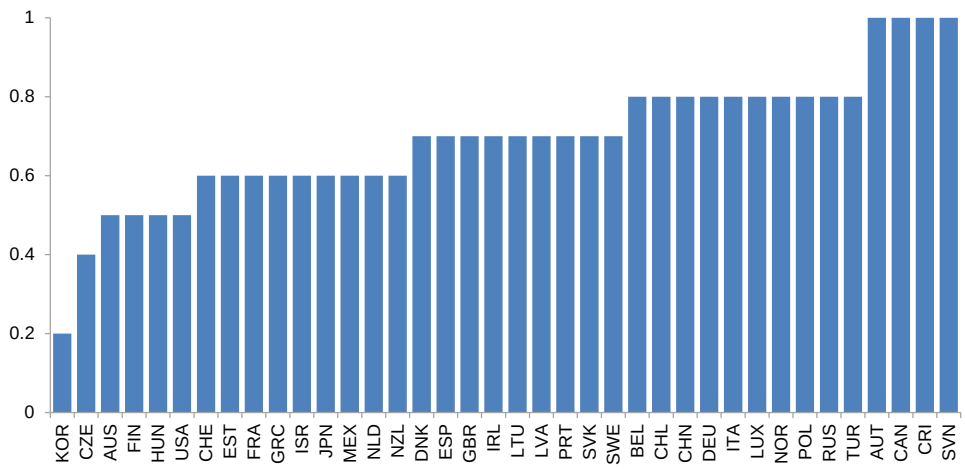


4. Other factors

4.1 Degree of court involvement

11. The questionnaire asks if courts are involved in the different stages of both liquidation and restructuring processes (i.e. the launch of the insolvency procedure, appointment of an insolvency practitioner, voting on a restructuring plan by creditors, confirmation and declaration of the restructuring plan as binding or enforceable and other stages). The indicator adds the number of stages for restructuring (ranging from 0 to 5) and number of stages for liquidation (ranging from 0 to 5), and then rescales the values to be between 0 and 1.

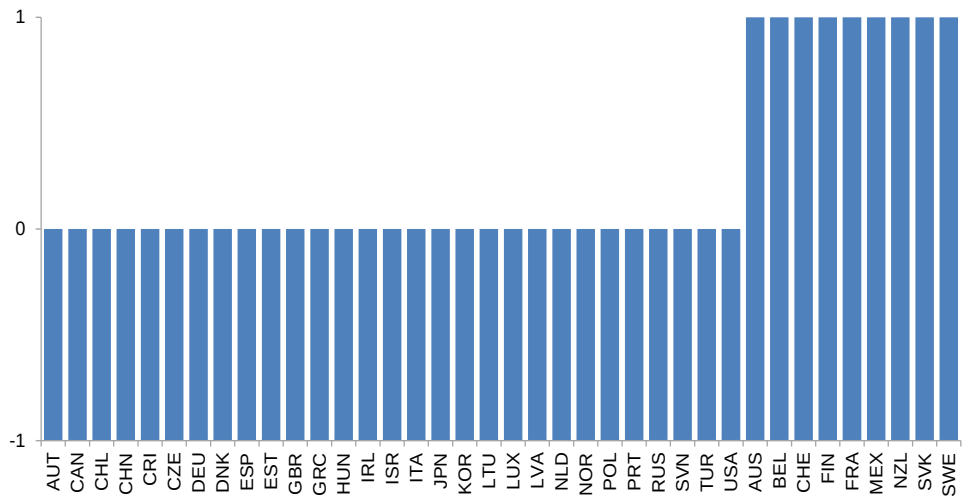
Figure A10. Degree of court involvement



4.2 Distinction between honest and fraudulent bankrupts

12. The indicator takes the value 0 if there is a distinction between the treatment of honest and fraudulent entrepreneurs in the insolvency process (e.g. a fraudulent entrepreneur may be ineligible for debt write-off or discharge from debt) and 1 otherwise.

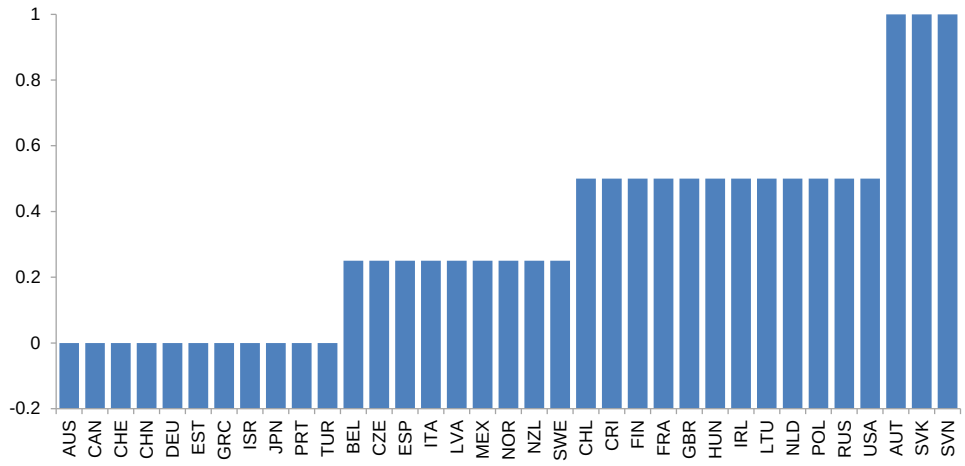
Figure A11. The distinction between honest and fraudulent bankrupts



4.3 Rights of employees

13. First, a combined employee rights indicator is defined as equal to 0 if there are no restrictions on the ability to dismiss employees upon the initiation of insolvency proceedings and it is possible to renegotiate collective dismissal agreements with employees; 1 if there are no restrictions on the ability to dismiss employees upon the initiation of insolvency proceedings but it is not possible to renegotiate collective dismissal agreements with employees or if there are restrictions on the ability to dismiss employees upon the initiation of insolvency proceedings but it is possible to renegotiate collective dismissal agreements with employees; and 2 if there are restrictions on the ability to dismiss employees upon the initiation of insolvency proceedings and it is not possible to renegotiate collective dismissal agreements with employees. This indicator is constructed separately for liquidation and restructuring. Finally, the two are summed and rescaled to be between 0 and 1.

Figure A12. Rights of employees



APPENDIX B: BASELINE ESTIMATES – ADDITIONAL RESULTS

Table B1. Insolvency regimes and capital sunk in zombie firms: horserace

Dependent variable: zombie capital shares					
	(1)	(2)	(3)	(4)	(5)
Personal costs to failed entrepreneurs*Turnover	0.01420*** (0.004)			0.01095*** (0.004)	0.01426*** (0.004)
Lack of prevention and streamlining*Turnover		0.00418* (0.002)		0.00095 (0.003)	0.00012 (0.002)
Barriers to restructuring*Turnover			0.01296*** (0.004)	0.00745* (0.004)	0.00879* (0.005)
Number of observations	558	558	558	558	558
AdjR2	0.319	0.306	0.314	0.321	0.320
Administrative burdens on start-ups*Turnover	NO	NO	NO	NO	YES
Rule of Law*Turnover	NO	NO	NO	NO	YES
EPL including CD*Turnover	NO	NO	NO	NO	YES
Country Fixed Effects	YES	YES	YES	YES	YES
Industry Fixed Effects	YES	YES	YES	YES	YES

Notes: Zombie shares refer to the share of industry capital sunk in zombie firms, defined as firms aged ≥ 10 years and with an interest coverage ratio<1 over three consecutive years. 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 are based on 14 countries (AUT, BEL, DEU, ESP, FIN, FRA, GBR, GRC, ITA, JPN, KOR, PRT, SWE and SVN) in 2013. The insolvency indicators refer to the insolvency regime indicators presented in Section 3.3. *** 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: Zombie shares sourced from Adalet McGowan et al. (2017), based on ORBIS Database; insolvency indicators based on the OECD questionnaire on insolvency regimes; Administrative burden on start-ups from OECD, Product Market Regulation (PMR) Database; Rule of law from World Bank, Worldwide Governance Indicators; and Employment Protection Legislation (including collective dismissals) from the OECD Indicators of Employment Protection.

Table B2. Policies and capital sunk in zombie firms: multiple policies

Dependent variable: zombie capital shares						
	Insol-12	Personal costs to failed entrepreneurs	Barriers to restructuring	**Insol-12**	Personal costs to failed entrepreneurs	Barriers to restructuring
Insolvency*Turnover	0.01225* (0.007)	0.01410*** (0.004)	0.01032** (0.005)	0.01325* (0.008)	0.01504*** (0.005)	0.01058* (0.006)
Number of observations	558	558	558	558	558	558
AdjR2	0.313	0.320	0.312	0.312	0.319	0.311
Administrative burdens on start-ups*Turnover	YES	YES	YES	YES	YES	YES
Rule of Law*Turnover	YES	YES	YES	YES	YES	YES
EPL including CD*Turnover	NO	NO	NO	YES	YES	YES
Country Fixed Effects	YES	YES	YES	YES	YES	YES
Industry Fixed Effects	YES	YES	YES	YES	YES	YES

Notes: Zombie shares refer to the share of industry capital sunk in zombie firms, defined as firms aged ≥ 10 years and with an interest coverage ratio<1 over three consecutive years. 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 are based on 14 countries (AUT, BEL, DEU, ESP, FIN, FRA, GBR, GRC, ITA, JPN, KOR, PRT, SWE and SVN) in 2013. The insolvency indicators refer to the insolvency regime indicators presented in Section 3.3. *** 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: Zombie shares sourced from Adalet McGowan et al. (2017), based on ORBIS Database; insolvency indicators based on the OECD questionnaire on insolvency regimes; Administrative burden on start-ups from OECD, Product Market Regulation (PMR) Database; Rule of law from World Bank, Worldwide Governance Indicators; and Employment Protection Legislation (including collective dismissals) from the OECD Indicators of Employment Protection.

Table B3. Insolvency regimes and capital sunk in zombie firms: excluding MNEs

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Dependent variable: zombie capital shares				
Panel A: **Composite insolvency indicators**	**Insol-12**	Personal costs to failed entrepreneurs	Lack of prevention and streamlining	Barriers to restructuring
Insolvency*Turnover	0.01171***	0.00998***	0.00375**	0.00747**
	(0.004)	(0.003)	(0.002)	(0.004)
Number of observations	515	515	515	515
AdjR2	0.350	0.353	0.347	0.347
Panel B: **Individual features**		*Time to discharge*	*Lack of early warning mechanisms*	*Creditors cannot initiate restructuring*
Insolvency*Turnover		0.00335***	0.00271**	0.00121
		(0.001)	(0.001)	(0.001)
Number of observations		515	515	515
AdjR2		0.348	0.348	0.343
Panel C: **Other policies**	Administrative burdens on start-ups	Rule of law	EPL including CD	
Policy*Turnover	0.00363**	-0.00336***	0.00404***	
	(0.001)	(0.001)	(0.001)	
Number of observations	515	515	515	
AdjR2	0.348	0.351	0.350	
Country Fixed Effects	YES	YES	YES	YES
Industry Fixed Effects	YES	YES	YES	YES

Notes: Zombie shares refer to the share of industry capital sunk in zombie firms, defined as firms aged ≥ 10 years and with an interest coverage ratio<1 over three consecutive years. 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). MNEs are identified using global ultimate owner (GUO) controlling at least 50% of the shares in ORBIS ownership links data. A firm is considered as part of an MNE if its GUO is located in another country, or if at least one of the firms controlled by its GUO is located in a foreign country. Sectors with less than twenty (non-MNE) firms are excluded from the sample. The regressions are based on 14 countries (AUT, BEL, DEU, ESP, FIN, FRA, GBR, GRC, ITA, JPN, KOR, PRT, SWE and SVN) in 2013. The insolvency indicators refer to the insolvency regime indicators presented in Section 3.3. *** 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: Zombie shares sourced from Adalet McGowan et al. (2017), based on ORBIS Database; insolvency indicators based on the OECD questionnaire on insolvency regimes.

Table B4. Insolvency regimes and capital sunk in zombie firms: robustness to alternative definition

Zombie capital shares: alternative definitions										
	Panel A: 3 years persistence, Age≥ 15 years					Panel B: 5 years persistence, Age≥ 10 years				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Insol-12*Turnover	0.01170**					0.00913***				
	(0.005)					(0.003)				
Personal costs to failed entrepreneurs*Turnover		0.01175***			0.00953***		0.00745***			0.00566**
		(0.003)			(0.003)		(0.002)			(0.002)
Lack of prevention and streamlining*Turnover			0.00335		0.00091			0.00176		-0.00017
			(0.002)		(0.002)			(0.001)		(0.001)
Barriers to restructuring*Turnover				0.00963***	0.00477				0.00733***	0.00503*
				(0.004)	(0.004)				(0.002)	(0.003)
Number of observations	558	558	558	558	558	558	558	558	558	558
AdjR2	0.288	0.295	0.283	0.288	0.295	0.289	0.291	0.280	0.289	0.292
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
	Panel C: 5 years persistence, Age≥ 15 years					Panel D: Zombie measure based on Caballero et al. (2008)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Insol-12*Turnover	0.00771***					0.01401**				
	(0.003)					(0.007)				
Personal costs to failed entrepreneurs*Turnover		0.00650***			0.00517***		0.00472			0.00304
		(0.002)			(0.002)		(0.005)			(0.006)
Lack of prevention and streamlining*Turnover			0.00147		-0.00009			0.00110		-0.00156
			(0.001)		(0.001)			(0.003)		(0.003)
Barriers to restructuring*Turnover				0.00587***	0.00372*				0.01254**	0.01291*
				(0.002)	(0.002)				(0.006)	(0.007)
Number of observations	558	558	558	558	558	558	558	558	558	558
AdjR2	0.291	0.294	0.283	0.290	0.295	0.683	0.683	0.680	0.685	0.680
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Zombie shares in Panel A, B, C refer to the share of industry capital sunk in zombie firms, defined as firms aged ≥ 10 or 20 years and with an interest coverage ratio<1 over three or five consecutive years. Additional results for other measures using different age (≥ 10, 15, 20 years old) and persistence (3, 4, 5 years) thresholds are available on demand. Zombie shares in Panel D are calculated based on the methodology of Caballero et al. (2008), which defines zombie firms as those whose actual interest payments fall short of an estimated benchmark R* based on firm debt structure and market interest rates. More specifically, $R^*_{i,t} = rs_{t-1}BS_{i,t-1} + \left(\frac{1}{5}\sum_{j=1}^{5} rl_{t-j}\right)BL_{i,t-j}$, where $BS_{i,t}$ is the short-term loans (less than one year) and $BL_{i,t}$ is the long-term debt (more than one year) of firm *i* at the end of year *t*, rs_t is the short-term prime rate and rl_t is the long-term rate at year *t* (see Adalet McGowan et al., 2017). 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 are based on 14 countries (AUT, BEL, DEU, ESP, FIN, FRA, GBR, GRC, ITA, JPN, KOR, PRT, SWE and SVN) in 2013. The insolvency indicators refer to the insolvency regime indicators presented in Section 3.3. OLS regressions are used in Panel A-C and STATA robust regression routine are used in Panel D. *** 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: Zombie shares sourced from Adalet McGowan et al. (2017), based on ORBIS Database; insolvency indicators based on the OECD questionnaire on insolvency regimesInsolvency.

Table B5. Insolvency regimes and capital sunk in zombie firms: re-sampling weights

Dependent variable: zombie capital shares				
Panel A: **Composite insolvency indicators**	**Insol-12**	Personal costs to failed entrepreneurs	Lack of prevention and streamlining	Barriers to restructuring
Insolvency*Turnover	0.01222**	0.01258***	0.00327	0.00959**
	(0.006)	(0.004)	(0.003)	(0.004)
Number of observations	548	548	548	548
AdjR2	0.298	0.304	0.293	0.297
Panel B: **Individual features**		*Time to discharge*	*Lack of early warning mechanisms*	*Creditors cannot initiate restructuring*
Insolvency*Turnover		0.00610***	0.00272*	0.00184
		(0.002)	(0.001)	(0.002)
Number of observations		548	548	548
AdjR2		0.307	0.295	0.292
Panel C: **Other policies**	Administrative burdens on start-ups	Rule of law	EPL including CD	
Policy*Turnover	0.00347*	-0.00249*	0.00256	
	(0.002)	(0.001)	(0.002)	
Number of observations	548	548	548	
AdjR2	0.295	0.294	0.293	
Country Fixed Effects	YES	YES	YES	YES
Industry Fixed Effects	YES	YES	YES	YES

Notes: Zombie shares refer to the share of industry capital sunk in zombie firms, defined as firms aged ≥ 10 years and with an interest coverage ratio<1 over three consecutive years. 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). Before constructing the zombie capital shares, re-sampling weights based on the OECD and Eurostat Structural Demographic Business Statistics (SDBS) are applied to the underlying firm level data into to address potential representativeness issues. Sectors with less than twenty (non-MNE) firms are excluded from the sample. The regressions are based on 14 countries (AUT, BEL, DEU, ESP, FIN, FRA, GBR, GRC, ITA, JPN, KOR, PRT, SWE and SVN) in 2013. The insolvency indicators refer to the insolvency regime indicators presented in Section 3.3. *** 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: Zombie shares sourced from Adalet McGowan et al. (2017), based on ORBIS Database; insolvency indicators based on the OECD questionnaire on insolvency regimes.

Table B6. Productivity-enhancing capital reallocation

	(1)	(2)	(3)	(4)
	Cross-section of 12 countries, 2013			
	Panel A		*Panel B: With resampling weights*	
	Solow	Wooldridge	Solow	Wooldridge
$MFP_{i,t-1}$	0.03424***	0.03787***	0.03433***	0.02985***
	(0.005)	(0.003)	(0.006)	(0.007)
Firm Age and Size Controls	YES	YES	YES	YES
Industry*Country Fixed Effects	YES	YES	YES	YES
Observations	890,527	890,527	746,429	746,429
AdjR2	0.0165	0.0126	0.0423	0.0368

Notes: MFP is the lag of the level of multi-factor productivity estimates, defined as the deviation from country-industry-year mean. Turnover refers to entry and exit rates, for the United States. The regressions include country*industry fixed effects and robust standard errors are clustered by country and industry. Industry refers to 2-digit level detail according to NACE Rev. 1, covering the non-farm non-financial business sector (industry codes 15-74, excluding 65-67). In Panel B, re-sampling weights based on the OECD and Eurostat Structural Demographic Business Statistics (SDBS) are applied to address potential representativeness issues; for details of this procedure, see Gal (2013). The countries include AUT, BEL, DEU, ESP, FIN, FRA, GBR, ITA, KOR, PRT, SWE and SVN. The insolvency indicators refer to the insolvency regime indicators presented in Section 3.3. *** denotes statistical significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

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

Table B7. Insolvency regimes and capital reallocation: robustness (1)

SDBS re-sampling weights applied to the baseline model

Panel A: **Composite insolvency indicators**	**Insol-13**	**Insol-12**		
Insolvency*Lagged MFP*Turnover	-0.04547***	-0.04102***		
	(0.012)	(0.011)		
Number of observations	729,679	746,429		
AdjR2	0.0448	0.0500		
Panel B: **Insolvency indicators**	Personal costs to failed entrepreneurs	*Stringent exemption of assets*	Lack of prevention and streamlining	*Lack of early warning mechanisms*
Insolvency*Lagged MFP*Turnover	-0.03087***	-0.00799*	-0.01719***	-0.00996***
	(0.008)	(0.005)	(0.005)	(0.003)
Number of observations	746,429	746,429	746,429	746,429
AdjR2	0.0500	0.0494	0.0498	0.0498
Panel C: **Insolvency indicators**	Barriers to restructuring	*Creditors cannot initiate restructuring*	*Indefinite length of stay*	*Priority of new financing*
Insolvency*Lagged MFP*Turnover	-0.02713***	-0.00456**	-0.00729***	-0.00533***
	(0.007)	(0.002)	(0.002)	(0.002)
Number of observations	746,429	746,429	746,429	746,429
AdjR2	0.0499	0.0494	0.0496	0.0496
Firm age and size controls	YES	YES	YES	YES
Country Dummies*Lagged MFP	YES	YES	YES	YES
Industry Dummies*Lagged MFP	YES	YES	YES	YES
Country*Industry Fixed Effects	YES	YES	YES	YES

Notes: MFP is the lag of the level of multi-factor productivity estimates based on the Solow-residual, defined as the deviation from country-industry-year mean. Turnover refers to entry and exit rates, for the United States. The regressions include country*industry fixed effects and robust standard errors are clustered by country and industry. Industry refers to 2-digit level detail according to NACE Rev. 1, covering the non-farm non-financial business sector (industry codes 15-74, excluding 65-67). Re-sampling weights based on the OECD and Eurostat Structural Demographic Business Statistics (SDBS) are applied to address potential representativeness issues; for details of this procedure, see Gal (2013). The countries include AUT, BEL, DEU, ESP, FIN, FRA, GBR, ITA, KOR, PRT, SWE and SVN. The insolvency indicators refer to the insolvency regime indicators presented in Section 3.3. *** denotes statistical significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

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

Table B8. Insolvency regimes and capital reallocation: robustness (2)

Robsutness to alternative MFP measure

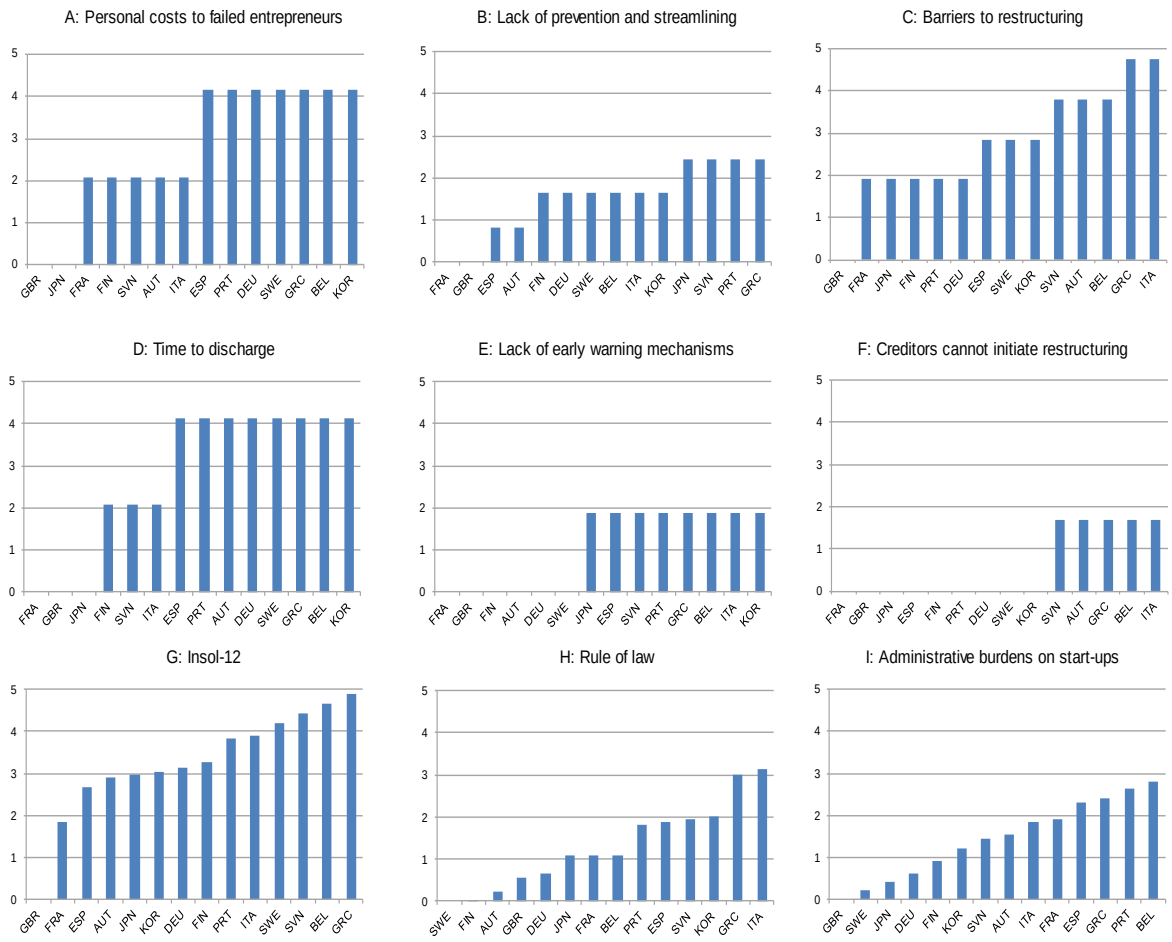
Panel A: **Composite insolvency indicators**	**Insol-13**	**Insol-12**		
Insolvency*Lagged MFP*Turnover	-0.03072***	-0.02866***		
	(0.011)	(0.010)		
Number of observations	729,679	746,429		
AdjR2	0.0361	0.0427		
Panel B: **Insolvency indicators**	Personal costs to failed entrepreneurs	*Stringent exemption of assets*	Lack of prevention and streamlining	*Lack of early warning mechanisms*
Insolvency*Lagged MFP*Turnover	-0.02184***	-0.00376	-0.01282***	-0.00856***
	(0.008)	(0.004)	(0.004)	(0.003)
Number of observations	746,429	746,429	746,429	746,429
AdjR2	0.0427	0.0425	0.0427	0.0427
Panel C: **Insolvency indicators**	Barriers to restructuring	*Creditors cannot initiate restructuring*	*Indefinite length of stay*	*Priority of new financing*
Insolvency*Lagged MFP*Turnover	-0.01913***	-0.00214	-0.00484*	-0.00417***
	(0.006)	(0.002)	(0.002)	(0.001)
Number of observations	746,429	746,429	746,429	746,429
AdjR2	0.0427	0.0425	0.0425	0.0426
Firm age and size controls	YES	YES	YES	YES
Country Dummies*Lagged MFP	YES	YES	YES	YES
Industry Dummies*Lagged MFP	YES	YES	YES	YES
Country*Industry Fixed Effects	YES	YES	YES	YES

Notes: MFP is the lag of the level of multi-factor productivity estimates based on the Wooldridge (2009) methodology, defined as the deviation from country-industry-year mean. Turnover refers to entry and exit rates, for the United States. The regressions include country*industry fixed effects and robust standard errors are clustered by country and industry. Industry refers to 2-digit level detail according to NACE Rev. 1, covering the non-farm non-financial business sector (industry codes 15-74, excluding 65-67). Re-sampling weights based on the OECD and Eurostat Structural Demographic Business Statistics (SDBS) are applied to address potential representativeness issues; for details of this procedure, see Gal (2013). The countries include AUT, BEL, DEU, ESP, FIN, FRA, GBR, ITA, KOR, PRT, SWE and SVN. The insolvency indicators refer to the insolvency regime indicators presented in Section 3.3. *** denotes statistical significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

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

Figure B1. Zombie capital share and policies

Reduction in zombie capital share associated with reforming policy to best practice level; percentage difference between industries with high and low exposure to the policy



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

APPENDIX C: A METHODOLOGY TO SIMULATE THE IMPACT OF REFORMS

14. Evaluating the potential reduction in zombie shares from hypothetical insolvency regime reform (using the coefficients estimated in Table B3) involves two steps, based on the procedure proposed by Guiso et al. (2004).

15. First, we need to estimate the impact of the reform on the zombie capital share in country *c* and industry *j* ($\Delta \widehat{Zombie\ share}_{jc}^{K}$). This requires multiplying the estimated coefficient $\widehat{\beta_1}$ by the difference in efficiency between best practice and the insolvency regime of the country ($Insol_{BP} - Insol_c$), taking into account industry exposure to regulation:

$$\Delta \widehat{Zombie\ share}_{jc}^{K} = \widehat{\beta_1}\, Exp_j (Insol_{BP} - Insol_c)$$

16. For any given industry *j*, the countries where the industry zombie capital shares are most reduced are those with the largest gap in insolvency regime efficiency ($Insol_{BP} - Insol_c$). For any gap in insolvency regime efficiency, the industries that gain most are those with the highest exposure to regulation (Exp_j). The impact on a country's zombie share will therefore depend both on the extent of the reform and on its industrial specialization.

17. Second, we summarize the benefits of reforming the insolvency regime at the country or industry level computing weighted averages of the expression above. More precisely, the impact of reforming the insolvency regime on the zombie capital share in each country *c* is obtained as:

$$\Delta \widehat{Zombie\ share}_{c}^{K} = \sum_j \left[\frac{K_{jc}}{\sum_j K_{jc}} \widehat{\beta_1}\, Exp_j (Insol_{BP} - Insol_c) \right]$$

where K_{jc} is capital stock in country *c*, industry *j*. Similarly, the impact of reforming the insolvency regime on the zombie capital share in each industry *j* can be computed as:

$$\Delta \widehat{Zombie\ share}_{j}^{K} = \sum_c \left[\frac{K_{jc}}{\sum_c K_{jc}} \widehat{\beta_1}\, Exp_j (Insol_{BP} - Insol_c) \right]$$

18. Two important caveats are in order. First, the validity of this simulation procedure is conditional on a set of very restrictive assumptions, which are discussed in detail by Bassanini et al. (2009). Essentially, we need to assume that insolvency regimes have no, or negligible, aggregate (i.e. country-level) impact on zombie capital shares. If relevant, such effects should of course be taken into account in the simulation of the aggregate impact of the reform. However, its magnitude cannot be estimated in the context of our model due to the presence of country-specific fixed-effects. We also need to assume that the simulated policy would have no relevant consequences on the structure of production, that is, on industry capital shares within a country.[21] The second important caveat when interpreting these exercises is that, being purely cross-sectional, our analysis will be silent as to the time horizon in which the computed gains could materialize.

21. Bassanini et al. (2009) show evidence supporting the second assumption in the case of EPL reforms in OECD countries.

APPENDIX D: INSOLVENCY REGIMES AND CORPORATE RESTRUCTURING

Empirical framework

19. Well-designed insolvency regimes might be associated with a lower zombie capital share to the extent that they facilitate the market exit of zombie firms, effectively restructure zombie firms back to good financial health or reduce the likelihood that firms which encounter an adverse shock become zombies. Given concerns regarding the accurate measurement of firm exit in ORBIS, we study – in a sample of continuing firms – transitions in the status of zombie and non-zombie firms with a view to better understand the contribution of insolvency regimes to the corporate restructuring channel. To this end, we construct a variable *Status*, which equals: 1 if a firm classified as a zombie in 2010 transitions to non-zombie status in 2013 (i.e. it is potentially restructured back to good health); 0 if there is no change in status between 2010 and 2013 (i.e. zombies remain zombies, non-zombies remain non-zombies); and -1 if a firm classified as a non-zombie in 2010 regresses to zombie status in 2013 (potentially due to a lack of timely restructuring).

20. Using this methodology, we estimate the following baseline econometric specification on a cross-section of continuing firms across 13 countries and 40 industries for 2013:[22]

$$Status_{icst} = \alpha + \sum_j \beta_1^j Insol_c^j * Exp_s + \sum_k \beta_2^k Pol_c^k * Exp_s + \sum_k \beta_3^k X_{icst-1}^k + \delta_c + \delta_s + \varepsilon_{icst} \quad [3]$$

where: *Status* refers to changes in the status of the firm from 2010 to 2013, based on the methodology described above. *Insol* refers to different features of the insolvency regime (where j=number of features) in country *c* and *Exp* refers to industry *s* exposure to policies, in this case firm turnover rates for the United States (see Section 4.1.1). X denotes a vector of firm age and firm size (1-10, 11-19, 20-49, 50-99, 100-249 and 250+) controls. We estimate equation (3) via both ordinary least squares (OLS) and an ordered logit, but place more weight on the former since it is difficult to interpret the coefficient on interaction variables in a non-linear setting (Norton et al., 2004). The model includes country and industry fixed effects to control for omitted time-invariant country-specific factors that might affect the probability of a transition in the status of the firm between 2010 and 2013, and common industry-specific technological factors, such as differences in the extent of natural competition across industries. The (robust) standard errors are clustered at the country and industry level (i.e. country*industry). At various times, we also control for the influence of other national level policies (*Pol*).

21. The main parameter of interest is $ß_1$. If $Insol^j$ refers to barriers to restructuring and $ß_1<0$, for example, then higher barriers to restructuring are associated with a lower likelihood that zombie firms subsequently return to better financial health and (more marginal) non-zombie firms avoid turning into zombie firms.

Empirical results

22. Table D1 shows the baseline results from equation (3). The aggregate composite index (*insol-12* in Column 1) is marginally insignificant. However, the estimated negative coefficient in Column 2 suggests that higher barriers to restructuring – particularly an inability of creditors to initiate restructuring (Column 3) – are associated with a disproportionately lower likelihood that zombie firms returns to better financial health and non-zombie firms escape the regression to zombie status, in highly-exposed industries than in low-exposed industries. Put differently, effective corporate restructuring in industries with naturally

22 Austria is excluded from this analysis because very few firms change status between 2010 and 2013.

higher firm turnover will be relatively more likely in countries with insolvency regimes that exhibit lower barriers to restructuring than in other countries.

Table D1. Insolvency regimes and corporate restructuring

Dependent variable: Transition status of firms between 2010 and 2013

	(1)	(2)	(3)
	Insol-12	Barriers to restructuring	*Creditors cannot initiate restructuring*
	Estimation by OLS		
Insolvency*Turnover	-0.00344	-0.00399**	-0.00132*
	(0.003)	(0.002)	(0.001)
	Estimation by Ordered Logit		
Insolvency*Turnover	-0.03783	-0.04463**	-0.01442**
	(0.035)	(0.019)	(0.007)
Country Fixed Effects	YES	YES	YES
Industry Fixed Effects	YES	YES	YES
Observations	787,466	787,466	787,466

Notes: The regressions are based on 13 countries (BEL, DEU, ESP, FIN, FRA, GBR, GRC, ITA, JPN, KOR, PRT, SWE, and SVN) in 2013. 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 insolvency indicators refer to the insolvency regime indicators presented in Section 3.3. *** denotes statistical significance at the 1% level, **significance at the 5% level, * significance at the 10% level. Robust standard errors, clustered by country and industry, are shown in parentheses.

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