Productivity, Zombie Firms and Exit Barriers in Portugal

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Abstract

Productivity growth is slowing in OECD countries, coupled with increased misallocation of resources. A recent strand of literature focuses on the role of non-viable firms "zombie firms" to explain these developments. Using a rich firm-level dataset for Portugal, we explore the role played by zombies in firm dynamics and the misallocation of labour and capital. We confirm the results on the high presence of zombie firms, which are significantly less productive than their healthy counterparts and drag down aggregate productivity. Higher zombie presence is associated with lower growth of viable firms, stifling intra-sectoral capital reallocation. Portugal has shown one of the largest reductions in barriers to exit and restructuring of all OECD countries and is therefore particularly suited for an assessment of the extensive margin effects of these policy changes. We show that a reduction in exit and restructuring barriers promotes a more effective exit channel and fosters the restructuring of the most productive zombies. The results highlight the role of public policy in addressing zombies' prevalence, fostering a more efficient resource allocation, and promoting productivity growth.

Introduction

The last decades have seen enormous progress in information and communication technologies, increased participation of firms in global value chains and a better educated workforce (Peña-López, 2017; Jack and Lewis, 2009). These developments can be seen everywhere but, as aggregate productivity statistics show, global productivity growth is slowing. The "productivity paradox" has raised a debate on the underlying reason. Prominent explanations

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include structural headwinds, the mismeasurement of productivity and fundamental differences between current and past innovations (Adler *et al.*, 2017; Gordon, 2017). Yet, these factors mostly consider headline aggregate productivity numbers and hide possible sectoral heterogeneity.

Firm-level data add an interesting perspective to this discussion: productivity growth has not slowed down for all firms. The most productive (those at the frontier) continue to grow. Meanwhile, the other firms (the "laggards") have stagnated, contributing to a growing performance gap vis-à-vis the frontier (Adalet McGowan *et al.*, 2018; Andrews *et al.*, 2016). Portugal is no exception to this divergence (Chart 1). This pattern is surprising for at least two reasons. First, models of competitive diffusion would predict laggard companies to adopt frontier technology, become more productive and catch-up or, second, in line with the process of creative destruction, forced to exit (Andrews *et al.*, 2016).

On the diffusion models, the literature points to a breakdown of technological diffusion mechanisms, translating into "winner takes it all" dynamics — where one or a few firms dominate the market. Firms below the technological frontier are no longer able to learn from top-performers and therefore cannot catch-up and grow (Autor *et al.*, 2017; De Loecker *et al.*, 2020; Grullon *et al.*, 2019; Blonigen and Pierce, 2016; Reich, 2016; Krugman, 2015).

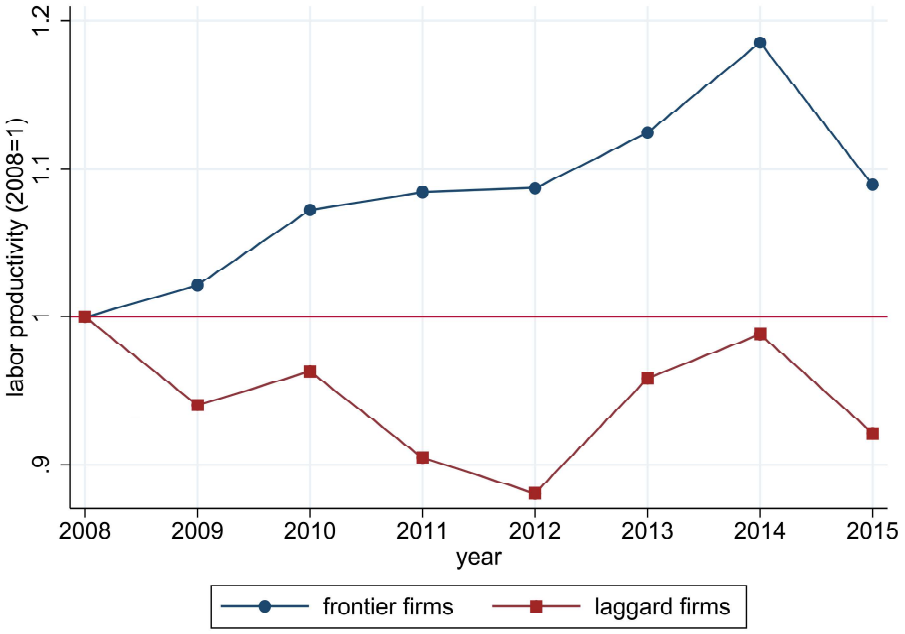
On the predictions of Schumpeterian creative destruction, an increasing body of research uncovers rising capital and labour misallocation, in particular within industries, being a major driver of the productivity slowdown (Cette *et al.*, 2016; García-Santana *et al.*, 2016; Gopinath *et al.*, 2017; ECB, 2017; Lenzu and Manaresi, 2018; Andrews and Petroulakis, 2017). This trend is visible for Portugal, both across sectors (Reis, 2013; Benigno and Fornaro, 2014) and within sectors (Dias *et al.*, 2016; Gopinath *et al.*, 2017) — with within industry misallocation almost doubling between 1996 and 2011. Increased misallocation is linked with curtailed firm dynamics, where the least productive can remain in the market, capture resources, and thus stifle the entry and growth of viable firms (Criscuolo *et al.*, 2014; Decker *et al.*, 2016).

A recent strand of literature, led by the OECD, links these developments to the emergence of zombie firms (Adalet McGowan *et al.*, 2017a/b, 2018).[2] Institutional bottlenecks create the conditions for non-viable firms to remain in the market as a result of depressed creative destruction.[3] By remaining in the market, despite their low productivity, these persistently weak firms increase productivity dispersion and drag aggregate productivity down. Their negative spillovers on viable laggard firms and potential entrants add to the dispersion. Zombies crowd out available financing and human capital and distort compe-

2 The OECD work builds on work for the Japanese economy (Caballero *et al.*, 2003; Hoshi and Kashyap, 2004; Caballero *et al.*, 2008).

3 Recent research also highlights the role of the banking sector for zombie prevalence, promoting resource misallocation and curbing productivity growth (Duval *et al.*, 2017; Storz; *et al.*, 2017; Acharya *et al.*, 2019; Schivardi *et al.*, 2017; Blattner *et al.*, 2018).

Chart 1: Labour Productivity Developments in Portugal, 2008-2015 – Frontier vs. Laggard Firms



Source: Authors' own computations based on firm-level data from IES.
Notes: Labour productivity defined as gross value added per worked hour. Frontier firms are the top 10 per cent most productive companies in each two-digit sector (non-financial and non-farming 2-digit NACE Rev. 2) in each year. Indices are computed at industry level and averaged across industries.

tition in product and input markets, by depressing prices, inflating market wages and reducing the market share available for viable firms to invest and grow (Caballero *et al.*, 2008; Adalet McGowan *et al.*, 2018; Schivardi *et al.*, 2017).

This article uses a set of comprehensive firm-level data for Portugal, a country with weak aggregate productivity growth (Alves, 2017), covering all firms from 2006 to 2015, we contribute to the literature on the role of zombie firms in explaining resource misallocation, by reinforcing the evidence on negative spillovers on healthy firms (intensive margin). Furthermore, we provide novel evidence on the role of policy barriers on the extensive margin. Portugal, as one of the OECD countries with the largest decrease in exit and restructuring barriers in recent years (Chart 2), provides a quasi-natural experiment to understand the institutional drivers of zombie prevalence. Studying zombie spillovers in a country that underwent a deep crisis brings additional insights into the literature as externalities may be higher, given the more restricted supply of credit, amplifying the crowding-out effect. The coverage of our database, which includes all Portuguese firms, is an improvement vis-à-vis studies that focus only on listed firms. It solves the possible selection bias in cross-country studies that use samples where specific industries and smaller, younger firms are underrepresented. The results for Portugal are relevant for a number of countries, as

the increased misallocation is a widespread phenomenon, and the zombies' characteristics and prevalence display cross-country regularities (Adalet McGowan *et al.*, 2018).

We confirm the results in the literature on the high presence of zombie firms. Zombies are significantly less productive than their healthy counterparts, increase productivity dispersion and drag aggregate productivity down. While there is evidence of positive selection within zombies, with the most productive restructuring and the least productive exiting, we also find that zombies' productivity threshold for exit is much lower than that of viable firms, allowing zombies to stay in the market, distort competition and capture resources. This curbs the growth of viable firms, in particular the most productive, harming within industry resource reallocation. We show that a reduction in exit and restructuring barriers promotes a more effective exit channel, disproportionately facilitating the exit of non-viable firms, and fostering the restructuring of the most productive within zombies. Our results highlight the role of public policy in promoting an improved resource allocation within sectors and thereby unlock productivity growth.

The remainder of the article is organized as follows. Section 2 reviews the literature on zombie firms, including a discussion on the quantitative criteria to define a zombie. Section 3 elaborates on the rich set of data used in the analysis, and Section 4 takes stock of the characteristics of zombie firms and their dynamics. The empirical framework for assessing the impact of zombie congestion on non-zombie firms and the impact of policy-induced barriers on zombies' exit and restructuring is developed in Section 5, where we also present and discuss the results. Section 6 concludes, discussing avenues for future work and possible policy complementarities.

Literature Review on Zombie Firms

A Prior on the Definition of Zombies

In economic terms, a zombie is a non-viable firm that would exit or, where feasible, restructure in a competitive market. The literature offers different definitions to operationalize this concept (Adalet McGowan *et al.*, 2018).

Caballero *et al.* (2008) consider a firm to be a zombie if it receives financial help from its creditors to survive, despite poor profitability. In practice, the authors compare the interest rate paid by the firm to a reference interest rate, that of the highest-quality borrowers. Those firms with a negative interest rate gap receive subsidized credit and thus are classified as zombies. The method is very data demanding, implying detailed knowledge of each firm's debt distribution.

Other authors rely on the operating characteristics of the firm. Storz *et al.* (2017) classify a firm as a zombie if it shows a negative return on assets and negative net investment for two consecutive years and a debt-servicing capacity (EBITDA to total financial debt) lower than 5 per cent. Schivardi *et al.* (2017) combine two criteria: return on assets below the cost of capital for the safest borrowers (three-year average) and financial debt over assets above 40 per cent (also testing alternative thresholds). Bank of Korea (2013) classifies a firm

as a zombie if the operating income (EBIT) is lower than interest expenses for at least three consecutive years. Building on this definition, the OECD add the age criterion that firms need to be older than ten years, to avoid erroneously classifying start-ups as zombies (Adalet McGowan *et al.*, 2018).

In this article, we follow the OECD definition. We use a simplified EBIT measure to address an accounting standard change in the dataset (see Section 2.1). The three-year criterion is essential in addressing the pro-cyclicality concerns on the zombie status (also addressed with the sectoral-time fixed effects included in the regressions that follow). Given the severity of the crisis that impacted Portugal, we also test for a more stringent time criteria, imposing five years. Moreover, to have a more symmetric measure on the non-zombie status, we compute an alternative specification where firms, once declared zombies, can only become non-zombies after three periods of interest coverage ratios higher than one. On the criticism that the analysis omits firms which exit the market before completing ten years, it should be noted that the objective is not to focus on unhealthy firms, but on unhealthy firms that endure in the market. That is the very definition of a zombie firm.

In any case, it is not likely that the results depend critically on the criteria chosen as they are broadly consistent. By computing a simplified version of Caballero *et al.* (2008) methodology, Adalet McGowan *et al.* (2018) show a positive and significant correlation with their definition. Storz *et al.* (2017) and Schivardi *et al.* (2017) replicate their results using the interest coverage ratio criteria followed by the OECD, with limited impact on the results. Adalet McGowan *et al.* (2018) also test for different variations of their criteria, again with no major changes. These results highlight that more important than the level of zombie congestion — which is different for different criteria — what matters are the dynamics of zombie prevalence across time and sectors.

Existing Results on Zombie Firms

Historically, the academic analysis of zombie firms originated with the Japanese macroeconomic stagnation in the 1990s (Hoshi and Kashyap, 2004; Caballero *et al.*, 2008), but there are even earlier references (Kane, 1989). Caballero *et al.* (2008) argue that zombies in the Japanese economy reduce market prices, increase market wages and congest markets, reducing profits, discouraging entry and investment, and limiting viable firms' expansion. The authors show a sharp increase in zombie prevalence in the early 1990s, stabilizing at high levels from the mid-1990s to 2002, the end year of their sample. By relying on a reduced form model of spillovers of zombie congestion, the authors show that a higher share of capital sunk in zombie firms reduces the growth differential of healthy firms vis-à-vis zombies.

Building on this work, a series of OECD papers analyze the zombie phenomenon for a sample of OECD countries over the period 2003 to 2013. Adalet McGowan *et al.* (2018) show that the share of total employment and capital stock accounted for by zombie firms, as well as the share of zombie firms in the total firm population, has risen in several OECD countries. This in-

crease, coupled with the fact that zombies, on average, own more capital and employ more workers than non-zombies, translates into high shares of resources sunk in non-viable firms.

The increased zombie prevalence is a widespread phenomenon in OECD countries, particularly among European countries, with a steady decline in interest rate coverage ratios since 2011, despite the low-interest-rate environment (IMF, 2017; Mahtani *et al.*, 2018). The spillover mechanisms detailed in Caballero *et al.* (2008) are corroborated for OECD countries. Within industries, the capital sunk in zombies reduces employment growth and investment for the average non-zombie in relation to zombies, and more so for the most productive firms, harming the process of resource reallocation (Adalet McGowan *et al.*, 2018). The reduced investment by non-zombie firms stifles innovation and technology advances, also depressing within-firm productivity growth (Cooper *et al.*, 1995; Adalet McGowan *et al.*, 2018).

An increasing body of literature deals with the link between the financial sector and the prevalence of zombies. Financial frictions harm the most vulnerable firms — i.e. those with higher rollover risk, higher debt overhang or lower collateral — which are not necessarily the least productive (Duval *et al.* 2017). Also, financial frictions, in particular when exit barriers are high, foster the survival of firms that would otherwise exit the market via bank forbearance to avoid the realization of losses. Weaker firms are associated with weaker banks (Blattner *et al.*, 2019; Storz *et al.*, 2017; Schivardi *et al.*, 2017; Acharya *et al.*, 2019; Arrowsmith *et al.*, 2013). Relationship banking is also a potential factor fostering zombie lending, as zombies are on average older (Peek and Rosengren, 2005). Furthermore, there is again evidence of negative spillovers, as the restricted credit availability reduces the exit of non-viable firms at the expense of healthier firms (Schivardi *et al.*, 2017 and Anderson *et al.*, 2017).

Exit and restructuring barriers play an important role in zombie congestion and for productivity growth.[4] Evidence suggests that better insolvency frameworks are associated with a higher likelihood of zombie restructuring, higher TFP growth for laggards (by providing incentives to experimentation and by allowing for easier structural changes at the firm-level) and reduced zombie congestion (Adalet McGowan *et al.*, 2017a/b). Additionally, they incentives banks to encourage corporate restructuring (Andrews and Petroulakis, 2017). This is particularly relevant given that healthy firms have more difficulties accessing credit in markets with higher zombie prevalence and that improvements in bank health are more likely to reduce zombie congestion when insolvency regimes are of better quality (Andrews and Petroulakis, 2017).

4 Even though there is heterogeneity in zombie presence across countries, potential gains to productivity by improving insolvency regimes are also high for countries which show relatively low levels of zombie congestion (Adalet McGowan *et al.*, 2017a).

Table 1: Descriptive Statistics for Portuguese Firm-Level Data, 2006-2015

Variable	Unit	Mean	Median	Std. Dev.	Min	Max
Revenue Turnover	1000 Euros	1.349	152	27.501	0	9,699,709
GVA	1000 Euros	289	44	4.934	-150.234	1,287,741
Worked Hours Per Year	hour	21.039	6.336	195.607	961	37,989,600
Total Workers	unit	12	4	108	1	23.768
Tangible Assets	1000 Euros	444	22	15.699	0	4,646,097
Intangible Assets	1000 Euros	82	0	8.289	0	2,964,748
EBIT	1000 Euros	39	2	2.315	-379.964	792.503
Interest paid	1000 Euros	25	1	1.229	0	783.815

Source: Authors' own computations based on IES.

Data

Firm-level Data

We rely on a comprehensive set of firm-level data for the period 2006 to 2015, the Informação Empresarial Simplificada (IES) provided by Banco de Portugal. IES covers the entire population of Portuguese firms, including profit and loss and balance sheet data. The data used in this article cover NACE Rev. 2 industry codes 10-83, excluding 64-66.[5] After data treatment, the unbalanced panel dataset includes 343,180 firms and 1,875,545 observations.[6] Table 1 provides descriptive statistics for the firm-level data used in this article.

To apply the zombie classification, we compute the interest coverage ratio as earnings before interest and tax (EBIT) divided by interest expenses. EBIT as reported IES has a break in 2010, because of a change in accounting standards. To overcome this, we compile a simplified EBIT measure — turnover and subsidies to production net of cost of goods sold, services and external supplies, labour costs and depreciation. It excludes financial income due to the difficulties in compiling a consistent time series and thus it is a less stringent zombie definition in comparison with that used by the OECD.

Labour productivity is defined as nominal gross value added (GVA) per hour worked. We calculate nominal GVA as the sum of turnover and operating subsidies, minus cost of goods sold and supplies and external services, following Banco de Portugal (2014). Robustness checks with GVA per worker are also performed. Intangible assets are only included for the robustness checks, given the change in accounting rules and due to measurement issues and (under)reporting of intangibles. To limit the impact of outliers in the regression analysis, we focus on firms with at least three workers and exclude the percentiles 1 and 99 of the dependent variables (capital

5 This restriction excludes either industries that are providing public services (i.e. education and healthcare) as their business models not primarily focus on profit maximization or industries in which the measurement of labour productivity developments is difficult and would bias the results. The following sectors are excluded: agriculture, forestry and fishing; mining and quarrying; financial and insurance activities; public administration and defense, compulsory social security; education; human health services; residential care and social work activities; arts, entertainment and recreation; other services; activities of households as employers; activities of households for own use; and activities of extraterritorial organizations and bodies.

6 See Gouveia and Osterhold (2018) for more information on data treatment.

and employment).

Data on Exit and Restructuring Barriers

To study the link between insolvency regimes and firm dynamics, we use the country-level OECD composite insolvency indicator, ranging from 0 to 1. When the composite indicator is high, i.e. close to 1, the relatively high exit and restructuring costs most likely lead to a delay in the initiation of the insolvency or restructuring process and prolong the duration of the proceedings, incentivizing unviable firms to stay in the market (Adalet McGowan *et al.*, 2017a).[7] The indicator is available for 2010 and 2016 and is a combination of 12 different sub-indicators (Adalet McGowan *et al.*, 2017b). Portugal registered one of the most substantial improvements among OECD countries in recent years (Chart 2). Major changes occurred in 2012, in the context of the 2011-2014 Economic Adjustment Programme. The reforms, inspired by the US insolvency framework (the famous Chapter 11), aimed at fostering the recovery of viable firms and the liquidation of non-viable ones.[8] Based on the dates of these changes, we annualized the OECD indicator in order to build an annual time series capturing exit and restructuring barriers.

Industries with higher natural firm turnover rates, i.e. those with more entry and exit, are more exposed to policy-induced insolvency regime changes than industries with lower turnover rates. Data on industry-level firm turnover rates of the UK and the United States markets, which are relatively unregulated and approximate natural turnover rates, are used to measure the exposure of each industry (Bottasso *et al.*, 2017 and Adalet McGowan *et al.*, 2017b).

By using turnover rates for the UK and the US, we account for endogeneity issues as the industry-level firm turnover rates in Portugal are dependent on the existing structural policies and, in particular, on the existing insolvency framework.

The industry-level measure of exit and restructuring barriers is computed as:

$$Barriers_{s,t} = InsolvencyFramework_t * NaturalTurnoverRate_s^{uk,us}$$

where the annualized insolvency indicator, $InsolvencyFramework$, is weighted by the proxied *natural* industry turnover rate $NaturalTurnoverRate$ of the UK or, as a robustness check, of the United States.

Zombie Presence and Prevalence

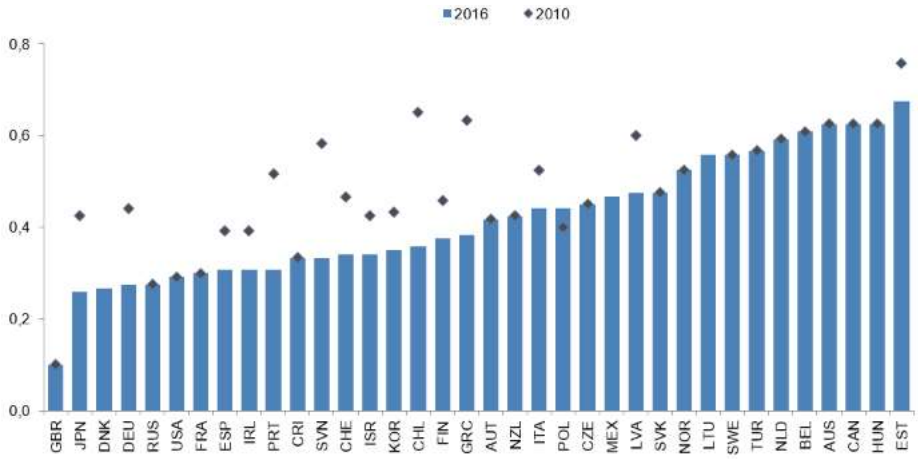
Following Adalet McGowan *et al.* (2018), we define zombie firms as those that are at least ten years old and whose interest coverage ratio is smaller than one

7 The indicator is a de jure measure, focusing on the quality of the framework in each country. Although the OECD also collects some information on outcome measures, it is difficult to build a comparable de facto indicator on a cross-country basis.

8 See Gouveia and Osterhold (2018) for more information on the reforms.

9 Alternative specifications are tested to check robustness.

Chart 2: OECD Indicator on Insolvency Regimes: 2010 and 2016



Source: OECD. Notes: An increase in the composite indicator most likely leads to a delay in the initiation of the insolvency or restructuring process and prolong the duration of the proceedings.

for at least three consecutive years.[9] This section provides an overview of the patterns of zombie prevalence over time and of the characteristics of zombie firms.[10]

Our data show a positive correlation between size and labour productivity in all but four 2-digits sectors (from a total of 63 sectors) — hinting that, within each sector, the most productive firms are able to grow. However, there are also signs of increased intra-sectoral misallocation, with increases in the within-sector interquartile range and standard deviation of labour productivity, suggesting problems at the exit margin. An analysis of zombie firm patterns confirms this. Zombies are more likely to leave the market, with an average exit rate of 13.3 per cent (10.7 per cent for non-zombies; 7.9 per cent if one considers those in the same age bracket as zombies, i.e. 10 years or more). Yet, zombie firms that exit have a labour productivity around 100 per cent below the average productivity in the sector (which means that they have around zero labor productivity), while the average non-zombie leaving the market is 30 per cent below average. Conversely, while the average non-zombie that remains in the market is 9 per cent more productive than the sectoral average, for zombies the deviation is negative (-50 per cent).

While the zombie status is quite persistent, with more than two-thirds of zombies remaining zombies in the subsequent two years, there is also evidence of positive market selection within zombies, with the less productive exiting and the most productive restructuring.[11] However, these positive market forces do not hold across zombies and non-zombies. Zombies remain in the market even if they are half as productive as the average firm in their indus-

10 Data are available as of 2006; hence the zombie classification can be applied from 2008 onwards, the first year in which a firm could possibly trespass the "three consecutive years" condition.

11 Firms that restructure are defined as those that were zombies in t_{-1} and managed to become non-zombies in t and remain healthy in t_{+1}.

try. In general, while firms that exit are, on average, less productive than those that stay (in relation to the sectoral average), the labour productivity deviation threshold for exit is much more lenient for zombies.

From this analysis, one expects zombie firms to be rather prevalent in the economy.[12] Overall, zombies represented around 6.5 per cent of all Portuguese firms in 2008, increasing steadily to 8.5 per cent in 2013. This pattern is similar to that of other countries, such as Spain, Belgium and Italy (Adalet McGowan *et al.*, 2018). Since 2013, the relative number of zombies decreased to close to 6 per cent in 2015. These figures are, however, poor measures of zombie prevalence. As illustrated in Table 2, zombie firms are not only less productive than their healthier counterparts (average deviation towards the 2-digits sectoral mean), but they are also larger — in terms of employment, turnover and assets — and older.[13]

Thus, zombies' economic relevance is better ascertained with measures of capital and labour sunk — i.e., the share of resources that they capture. Given substantial sectoral heterogeneity (as also described by Caballero *et al.*, 2008), Chart 3 presents sunk resources aggregated by main sector of activity, comparing the evolution from 2013 (where the share of zombies in the overall economy reached its maximum) to 2015 (the most recent period). The chart shows that capital is more flexible, with more variation over time than labour.[14] Overall, results of the descriptive analysis are consistent with OECD findings, pointing at cross-country regularities. Zombie firms are on average larger — in terms of employment, turnover and assets — and significantly less productive than their healthy counterparts. Furthermore, there is evidence of distortions at the exit margin, as zombies remain in the market and absorb a significant part of capital and labour, with differences across industries.

Empirical Framework

As shown above, zombie firms are less productive than their non-zombie counterparts and account for a non-negligible part of capital and labour, providing evidence of misallocation of resources towards non-viable firms. It is thus important to understand the possible adverse effects of zombie congestion on healthy firms' growth. We explore the sectoral asymmetries to analyze the consequences of zombie congestion on intra-sectoral resource allocation (intensive margin) and, also, to assess the role

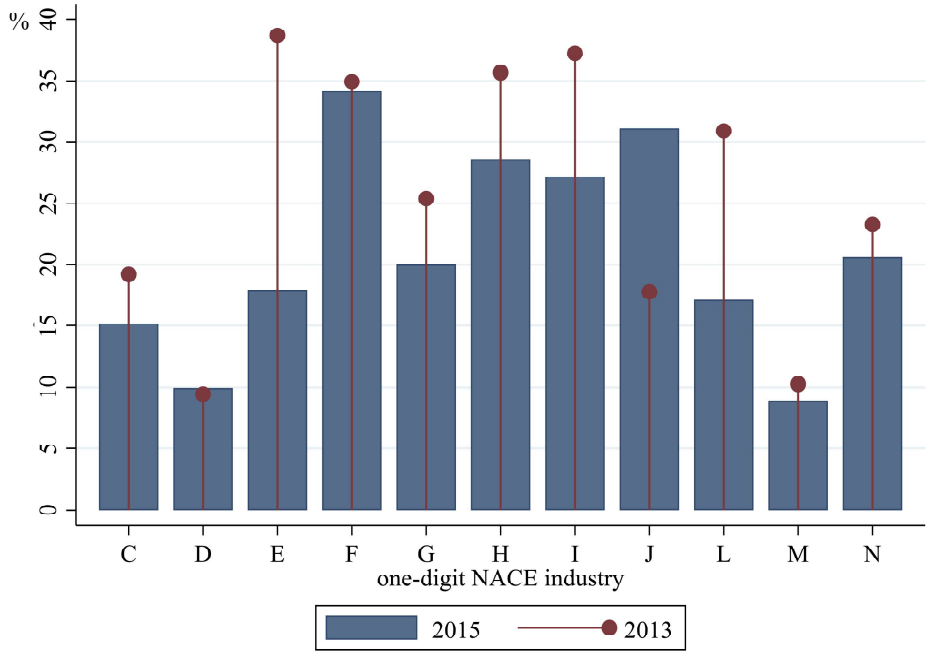
12 Note that a direct comparison with other studies is difficult as the universe of firms considered does not coincide and the quantitative measures to define zombies vary. For these reasons, a qualitative comparison of dynamics is more appropriate than a direct comparison of levels.

13 These characteristics make it easier for them to obtain access to credit, as they have more collateral, in the form of tangible assets, and are more likely to have longer relations with banks. Gopinath *et al.* (2017) find that capital is allocated to firms with higher net worth, not necessarily the more productive. Being larger in terms of employment also implies high social costs from failure, which, as argued by Adalet McGowan *et al.* (2018), may make them more likely to receive government subsidies or support in order to limit potential employment losses, in particular during recessions.

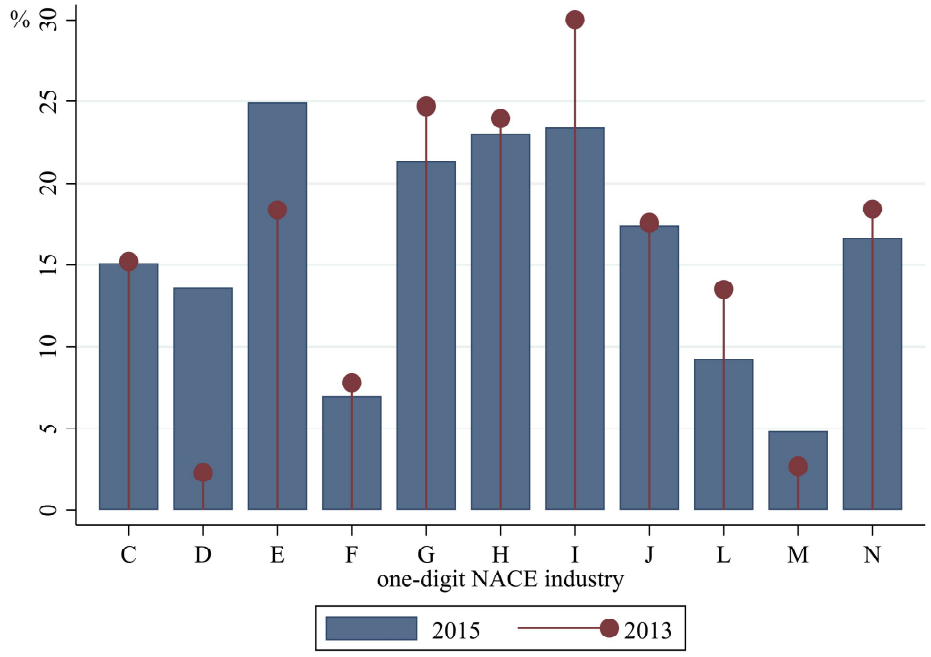
14 As explained before, the level varies with the use of more or less stringent zombie definitions. Therefore, the analytical focus should be on the time dynamics and the sectoral differences, which are broadly robust to the zombie definition.

Chart 3: Share of Labour and Tangible Assets Sunk in Zombie Firms, Industry Level

Panel A: Tangible Sunk Capital



Panel B: Sunk Labour



Source: Authors' own computations based on IES.
Note: For presentational purposes, we aggregate data at the CAE letter code level. In the analytical part, we use the more detailed 2-digits breakdown. Industries, with weights based on 2015 turnover: C - Manufacturing (27 per cent); D - Electricity, gas, steam and air conditioning supply (4 per cent); E - Water supply, sewerage, waste management and remediation activities (1 per cent); F - Construction (5 per cent); G - Wholesale and retail trade, repair of motor vehicles and motorcycles (43 per cent); H - Transportation and storage (5 per cent); I - Accommodation and food service activities (3 per cent); J - ICT (5 per cent); L - Real estate activities (1 per cent); M - Professional, scientific and technical activities (3 per cent); N - Administrative and support service activities (3 per cent).

Table 2: Comparison of the Average Zombie and Non-Zombie Firms

Variable	Unit	Zombie	Non-Zombie
Total Workers	unit	23	15
Turnover	1000 euros	3.168	1.871
Tangible Assets	1000 euros	1.418	546
Intangible Assets	1000 euros	191	136
Firm Age	years	24	22
Labour Prod Deviation	%	-57	19
No. of Observations	-	111.527	662.328

Source: Authors' own computations based on IES.

Notes: In this table, the non-zombie population is restricted to firms older than 10 years in order to allow for a meaningful comparison with the data on zombies (which by definition are older than 10 years). Labor productivity is defined as gross value added per hour worked, Labor Prod deviation as deviation from the sectoral average.

of policy-induced barriers in hampering the exit or restructuring of zombies (extensive margin).

Intensive Margin

Following the specification in Caballero *et al.* (2008) and Adalet McGowan *et al.* (2018), we test whether zombies entail negative spillover effects, e.g. by competing for investment, on viable firms' labour or capital growth. We rely on panel data from 2006 to 2015 to estimate a reduced-form equation on the impact of zombie sectoral congestion on investment and employment growth of the average non-zombie firm in that sector:

$$\begin{aligned}\delta Y_{i,s,t} = \beta_0 + \ & \beta_1 nonzombie_{i,s,t} \\ & + \beta_2 nonzombie_{i,s,t} * RS_{s,t} \\ & + \beta_3 firmcontrols_{i,s,t-1} \\ & + FE_{s,t} + \epsilon_{i,s,t} \quad (1)\end{aligned}$$

where δY denotes capital or employment growth of firm i in a 2-digit industry s in year t, defined as the log difference in tangible assets or in total workers from one year to the other. The dummy *nonzombie* takes the value 1 for non-zombie firms and 0 otherwise. RS is a measure of industry resources sunk in zombie firms, which, depending on the specification, is measured either as KS or LS, taking values between 0 and 1. KS represents the share of tangible assets of zombie firms as a fraction of total tangible assets of all firms in each 2-digit sector. LS denotes the share of total workers employed in zombie firms as a fraction of all workers employed in the sector. Firm controls may include the age of the firm, workers and workers squared (to account for non-linear effects of size) and the turnover growth, as a proxy of growth opportunities. We include interacted two-digit industry-year fixed effects to control for sectoral shocks (as they impact both resources sunk and firm growth) and robust standard errors clustered by industry-year (Adalet McGowan *et al.*, 2018). Firm fixed effects are not suitable in this analytical framework, as zombie status is persistent (Caballero *et al.*, 2008).

The fixed effects structure implies that the absolute effect of resources sunk cannot be estimated, as it is absorbed by the sectoral-year dummy structure. Therefore,

β_2 captures the effect on the average non-zombie in deviation from the effect on zombies. A negative β_2 implies that more resources sunk in zombie firms, representing higher misallocation of capital and labour, adversely affects the *relative* performance of non-zombie firms.

Table 3 presents the estimation results of equation 1 for capital and employment growth. The interaction term is always negative for capital growth, meaning that an increase in resources (capital and labour) sunk in zombie firms is associated with lower investments of the typical healthy firm within a sector. As an illustration, these results mean that the capital growth differential between a non-zombie and a zombie is 0.9 percentage points lower in the textile industry (capital sunk close to 20 per cent) vis-à-vis the consulting sector (capital sunk of around 10 per cent). These findings have implications for aggregate productivity growth given that rising capital misallocation has been found of to be one of the key explanations drivers of the slowdown (Adalet McGowan *et al.*, 2018, Gopinath *et al.*, 2017).

There is, however, no effect on relative employment growth for the average non-zombie. This may reflect the flexibility of capital vis-à-vis labour, as employment is unchanged from one year to the other in more than 50 per cent of the observations (0.4 per cent for the case of capital). These results are consistent with those in Caballero *et al.* (2008). Adalet McGowan *et al.* (2018) find negative spillovers on employment growth, but much smaller than those on investment.

The discussion so far focused on the average firm. Moreover, it is important to understand how zombie prevalence affects the most productive firms within each sector. In Gouveia and Osterhold (2018), we show that the capital stock sunk in non-viable firms is associated with impeded reallocation of resources towards the most productive, both in terms of capital and employment growth.

Extensive Margin

Distorted market competition and resource misallocation can enable a prolonged survival of unviable firms. From a public policy perspective, it is important to understand the role of exit and restructuring barriers in mediating firm dynamics. Well-designed insolvency regimes may promote productivity growth through various channels (Adalet McGowan *et al.*, 2017b). First, by fostering the exit of unviable firms, they promote virtuous market selection, also freeing up resources that are otherwise sunk in zombies. Second, by facilitating the restructuring of viable firms, they spur within-firm growth. Third, they promote firm entry and bolder business projects, by not excessively penalizing failure and by reducing zombie congestion.

To assess the first channel, we develop a differences-in-differences specification à la Rajan and Zingales (1998) that allows us to test for the role of insolvency regimes in mediating exit. Our identification strategy relies on the assumption that industries more exposed to exit and restructuring barriers (the treatment group) are more affected by changes in those policies in comparison with less exposed industries (control group):

Table 3: Zombie Congestion and Capital and Employment Growth (Equation 1)

	(1) dlncapital	(2) dlncapital	(3) dlncapital	(4) dlncapital	(1) dlnemp	(2) dlnemp	(3) dlnemp	(4) dlnemp
nonzombie	0.076***	0.065***	0.066***	0.053***	0.040***	0.031***	0.041***	0.031***
	(0.005)	(0.005)	(0.006)	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)
KS∗nonzombie	-0.084***	-0.089***			0.007	0.003		
	(0.022)	(0.022)			(0.014)	(0.012)		
LS∗nonzombie			-0.060**	-0.056**			0.005	0.008
			(0.028)	(0.027)			(0.016)	(0.013)
Industry-Year FE	yes	yes	yes	yes	yes	yes	yes	yes
firm-level controls:								
Age and size	yes	yes	yes	yes	yes	yes	yes	yes
Turnover growth	no	yes	no	yes	no	yes	no	yes
Observations	702,667	702,667	702,667	702,667	701,299	701,299	701,299	701,299
Adjusted R^2	0.020	0.036	0.020	0.036	0.067	0.129	0.067	0.129

Source: Authors' own computations.

Note: Standard errors in parentheses. * p < .10, ** p < .05, *** p < .01.

$$Exit_{i,s,t} = \beta_0 + \beta_1 Z_{i,s,t-1} + \beta_2 Z_{i,s,t-1} * Insolvency_{t-1} * Exposure_s + \beta_3 Firmcontrols_{i,s,t-1} + FE_{s,t} + \epsilon_{i,s,t} \quad (2)$$

where $Exit$ is a dummy variable, indicating whether a firm i exits ($Exit = 1$) or stays in the market ($Exit = 0$) in year t.[15] The variable $Insolvency$ denotes a measure of the height of barriers to exit imposed by the insolvency regime in year t and $Exposure$ is measured by the natural turnover rate of each 2-digit industry s (see Section 3.2 for details). The dummy Z takes the value 1 for zombie firms, 0 otherwise. Firm controls may include age, number of workers and number of workers squared, firm turnover growth, and relative labour productivity vis-à-vis the sectoral-year average. Two digits sectoral-year fixed effects are included, and robust standard errors are clustered at the sectoral-year level. A negative, β_2 implies that lower barriers to exit increase the exit rate of zombie vis-à-vis non-zombies in sectors more exposed to those barriers, contributing to an improved resource allocation.

Table 4 presents the results for the exit regression (equation 2), where we indeed find a negative coefficient for β_2, but only when considering a lag of two periods for the insolvency framework. This is not surprising as exit procedures take time to be finalized (and our dependent variable captures the moment when the firm actually exits from the market). To illustrate these results, take the administrative and support services sector, with one of the highest exposures to exit barriers, and the machinery and equipment production industry, one of the least exposed. The reforms introduced since 2012 increase the exit rate differential between zombies and non-zombies by 1.8pp in the most exposed

15 Ideally, one would like to focus on firms that exited due to insolvency procedures and not on all firms that exited the market (for instance, because they merged with another firm). However, we do not have access to a reliable source on the reason for exit.

industry in comparison with the least exposed one. Comparing industries with an exposure differential equivalent to the percentiles 75-25, the increase in the exit rate differential is 0.4pp.

As the $Exit$ dummy is a proxy for the start of the exit procedures, we re-estimate our model with different leads of the dependent variable (e.g. $Exit = 1$ if the firm is no longer in the database in $t + 2$), with no qualitative changes to the results.

Effective insolvency regimes should foster not only the exit of non-viable firms but, according to the second channel presented above, also promote the restructuring of the most productive zombies, where feasible.

To test whether lower exit and restructuring barriers in a certain sector foster the exit of the least productive and the restructuring of the most productive zombies, we again apply a differences-in-differences specification:

$$R_{i,s,t} = \beta_0 + \beta_1 LPdev_{i,s,t-1} + \beta_2 LPdev_{i,s,t-1} * Insolvency_{t-1} * Exposure_s + \beta_3 Firmcontrols_{i,s,t-1} + FE_{s,t} + \epsilon_{i,s,t} \quad (3)$$

where R takes the value 1 if a zombie firm in $t-1$ turns non-zombie in t and stays healthy the period after ($ICR > 1$). $LPdev$ is the per cent deviation of the firm labour productivity in relation to the sectoral-year average. The variable $Insolvency$ denotes a measure of the height of barriers to exit imposed by the insolvency regime in year t and $Exposure$ is measured by the natural turnover rate of each 2-digit industry s (see Section 3.2). Firm-level controls include age, number of workers and number of workers squared and turnover growth. As before, two digits sectoral-year fixed effects are included and robust standard errors are clustered at the sectoral-year level. A negative β_2 implies that lower exit and restructuring barriers promote the restructuring of the most productive zombies in sectors relatively more exposed to those barriers.

Conversely, from the population of zombies, we would expect the least productive firm within each sector to have a higher likelihood of leaving and effective insolvency regimes to foster this positive selection. We thus re-estimate equation 3 with a dummy that takes the value 1 if the zombie leaves the market as the dependent variable. A positive β_2 implies that lower exit and restructuring barriers improve the efficient resource allocation, by strengthening the relationship between lower productivity and higher probability of exit in sectors relatively more exposed to the barriers.

In Table 5, we provide evidence that lower exit and restructuring barriers promote the restructuring of the most productive in sectors relatively more exposed to the policy change, but we fail to find a significant effect for the exit margin (although

Table 4: Exit Rates and Exit Barriers (Equation 2)

	(1) exit	(2) exit	(3) exit	(4) exit	(5) exit	(6) exit	(7) exit	(8) exit
L2.Zombie	0.055***	0.053***	0.054***	0.053***	0.053***	0.051***	0.053***	0.051***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
L2.ZombieXInsolvency XExposureUK	-0.002**		-0.002**		-0.002**		-0.002**	
	0.001		0.001		0.001		0.001	
L2.ZombieXInsolvency XExposureUS		-0.002**		-0.002**		-0.002**		-0.002**
		(0.001)		(0.001)		(0.001)		(0.001)
Industry-Year FE	yes	yes	yes	yes	yes	yes	yes	yes
firm-level controls:								
Age and size	yes	yes	yes	yes	yes	yes	yes	yes
Turnover growth	no	no	yes	yes	no	no	yes	yes
Labour productivity	no	no	no	no	yes	yes	yes	yes
Observations	416,622	415,437	416,622	415,437	396,753	395,717	396,753	395,717
Adjusted R^2	0.013	0.013	0.013	0.013	0.014	0.014	0.014	0.014

Source: Authors' own computations.

Note: Standard errors in parentheses. * p < .10, ** p < .05, *** p < .01.

Table 5: Zombie Dynamics - Exit and Restructuring (Equation 3)

	(1) restructure	(2) restructure	(3) restructure	(4) restructure	(5) exit	(6) exit	(7) exit	(8) exit
L.LabourProd	0.055***	0.054***	0.056***	0.054***	-0.031***	-0.028**	-0.031***	-0.028**
	(0.016)	(0.019)	(0.017)	(0.019)	(0.011)	(0.012)	(0.011)	(0.012)
L.LabourprodXInsolvency XExposureUK	-0.004**		-0.004**		0.002		0.002	
	(0.002)		(0.002)		(0.001)		(0.001)	
L.LaborprodXInsolvency XExposureUS		-0.005**		-0.005**		0.001		0.002
		(0.003)		(0.003)		(0.002)		(0.002)
Industry-Year FE	yes	yes	yes	yes	yes	yes	yes	yes
firm-level controls:								
Age and size	yes	yes	yes	yes	yes	yes	yes	yes
Turnover growth	no	no	yes	yes	no	no	yes	yes
Observations	32,499	32,415	32,499	32,415	33,299	33,222	33,299	33,222
Adjusted R^2	0.019	0.019	0.019	0.019	0.011	0.011	0.011	0.011

Source: Authors' own computations.

Note: Standard errors in parentheses. * p < .10, ** p < .05, *** p < .01.

the sign is the expected one).[16] Again, as an illustration, the results indicate that the reforms introduced since 2012 increase the likelihood of restructuring of a zombie firm 10 per cent more productive than the average in the sector by 0.4pp when comparing the administrative sector, with one of the highest exposures to exit and restructuring barriers, and the machinery and equipment production industry, one of the least

16 The significant effect on restructuring is present already with only one lag of the policy variable, whereas in equation 3 two lags are needed. This may reflect the different nature of exit and restructuring procedures, with the former taking more time than the latter. In any case, we do not find a significant effect of lowering exit barriers on fostering the exit of the least productive zombies within each sector, even when using lags higher than 1. This may relate to the limitations of our exit variable, which may wrongly classify a M&A as an exit. The lack of significance of the coefficient may also be due to the reduced sample size, by considering only the population of zombies and comparing those with different productivity levels within each sector. Using the sub-components of the insolvency indicator does not change the results. This is expected, given the high interrelation among the different sub-policy areas.

exposed.

Finally, we provide preliminary evidence on entry dynamics. Accounting for the entry channel is particularly challenging, given that it is not possible to estimate the pool of potential entrants. Therefore, we focus on two predictions, one on the quality of the entrants and another on their quantity.

We start by testing whether there is evidence that higher zombie congestion increases the threshold of productivity that a new entrant must surpass, given that zombies increase market wages, reduce market prices and reduce the market share for non-zombies (Caballero *et al.*, 2008). We find that the sectoral mean productivity of new entrants (deviation towards sectoral mean) is positively correlated with the presence of zombies in the sector, measured by sunk capital (controlling for industry and/or time fixed effects; when controlling for sectoral turnover growth the effects become not significant). We do not find an effect for sunk labour.

Lastly, we check whether sectoral entry is hampered by zombie congestion, given the increased productivity threshold and the crowding-out of capital and labour. To do so, we compute the correlation between measures of zombie congestion and sectoral yearly entry rates. As in Schivardi *et al.* (2017), we fail to find any significant results for sunk labour and capital, as well as when controlling for sectoral turnover growth (to control for growth opportunities). However, we do find a negative correlation with the share of zombies in the sector, meaning that industries with a higher number of zombie players display lower entry rates.

Conclusion

There is widespread evidence of resource misallocation across OECD countries harming productivity growth. By making use of a comprehensive set of firm-level data for Portugal, we contribute to the literature on the role of zombie firms in explaining resource misallocation, by reinforcing the evidence on spillovers (intensive margin) and by providing novel evidence on the exit and restructuring channels (extensive margin).

Portugal is a rich case study, as it is one of the OECD countries with the largest drop in exit and restructuring barriers in recent years. It is thus particularly suited for an assessment of the extensive margin effects. Furthermore, given the severity of the crisis that hit the country during the period studied, this research brings additional insights into the literature on zombies' spillovers. While during deep recessions, the opportunity costs of sunk resources are lower, given the limited outside opportunities for reallocation, it is also the time where capital is scarcer and thus where crowding out effects could be stronger. The balance of the two opposing forces is determinant for the outcome. Moreover, by relying on an administrative database covering all Portuguese firms, we improve on the robustness of studies that rely on specific types of firms (e.g. listed firms) or datasets with limited coverage (e.g. covering only larger firms or sectors). The results of this research for Portugal are relevant for other countries that face a rising presence of zombie firms and high policy-induced structural barriers to foster resource allocation and promote a more ef-

fective exit channel.

Overall, we confirm the results in the literature on the high prevalence of zombie firms, being significantly less productive than their healthy counterparts and thus dragging aggregate productivity down. Furthermore, while we find evidence of positive selection within zombies, with the most productive restructuring and the least productive exiting, we also show that the zombies' productivity threshold for exit is much lower than that of non-zombies, allowing them to stay in the market, distorting competition and accounting for a sizable share of existing resources. This curbs the growth of viable firms, harming a more efficient intra-sectoral resource reallocation. We show that a reduction in exit and restructuring barriers promotes a more effective exit channel, disproportionately fostering the exit of non-viable firms, and stimulate the restructuring of the most productive zombies. These results highlight the role of public policy in addressing zombies' presence and thus in promoting productivity growth.

While fostering the exit of the least productive is appealing, one needs to consider the broad implications carefully. In some sectors, zombies employ more than one out of five workers, making zombies responsible for a significant share of employment. Thus, the policy mix must be carefully designed to address and minimize social costs that may arise. This may be particularly important at the regional level.

The reallocation of employment is not only crucial from a social perspective, but it is also determinant for positive potential output effects, as otherwise, the stock of human capital is merely reduced. Therefore, a flexible education system and effective Active Labor Market Policies have a particular role to play (Andrews and Saia, 2017). Going forward, it would be important to understand better the employment dynamics, both in terms of type of contract (permanent versus temporary versus contract work) and level of skills to better inform policymakers.

The same concern holds for capital: in some industries, more than 25 per cent of the sectoral fixed capital is accounted for by zombies. In case they exit the market, can the stock of capital be reallocated to more productive uses? While there is some sectoral evidence that at least part of the stock of capital can be reassigned (see, for example, Australian Productivity Commission, 2015), one can expect a part of this stock to be lost, as it is firm-specific. On improving the allocation of capital flows, there are important complementarities between bank health and good insolvency regimes, as the latter reduce the incentives for evergreening and bank forbearance. In any case, it should be noted that zombies, on average, have more tangible assets to pledge as collateral. If banks' financing criteria focus on the existence of collateral, rather than on the quality of the project or the firm, zombie lending lasts even without evergreening motives.

There is again a role for policy action, in particular as non-collateralizable assets (the intangibles) gain weight in the economy. Public policy may be vital in correcting the asymmetries of information existing in the bank financing market, for instance via well-designed public guarantees systems (Rodrigues *et al.*, 2016; Farinha and Félix, 2015), and in fostering the devel-

opment of alternative financing options, in particular in the context of supranational initiatives, such as the so-called Capital Markets Union in the EU. Future research could provide evidence on the effects of zombies separately on tangible and intangible investment, as our preliminary evidence suggests that the effect is asymmetric.

Effective policy action hinges on a deeper understanding of the nature of zombie firms and how they interact with existing institutional features. Are these zombies inherently unviable, or do they become zombies ex-post due to bad shocks or due to a regulatory setting? While there is evidence that ex-ante heterogeneity across firms is a key determinant of ex-post growth (e.g. Pugsley *et al.*, 2017), it is vital to understand better what those ex-ante factors are and what drives zombie dynamics. Moreover, in particular as the margin of improvement in exit and restructuring barriers decreases, one needs to explore ways to further foster the exit of zombies, the growth of viable incumbents and the entry of dynamic firms (e.g. Haltiwanger *et al.*, 2013). For instance, ensuring a fit for purpose regulatory environment is an important challenge for policymakers, as product market distortions and administrative barriers to entry are also positively associated with higher zombie congestion and lower exit (Adalet McGowan *et al.*, 2017a/b; Monteiro *et al.*, 2017; Aghion *et al.*, 2017).

Concerning aggregate dynamics, while zombie congestion and intra-sectoral reallocation are (increasingly) important, other dynamics concur to explain the productivity slowdown. On top of the more classical discussions on cross-sectoral misallocation, there are also changing dynamics at the other end of the zombie productivity spectrum, i.e. the very high growth firms (the so-called gazelles). They are not only becoming rarer but also less productive (e.g. Pugsley *et al.*, 2017). To different degrees, all these elements, taken together, explain country-level developments. A successful policy agenda must tackle these challenges in a coherent and encompassing manner.

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