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Consequences of Zombie Businesses: Australia's Experience

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Joel Bowman
Arndt-Corden Department of Economics, Crawford School of Public Policy, ANU
Centre for Applied Macroeconomic Analysis, ANU

Abstract

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Keywords

Zombie Firms, Labour Productivity, Firm Dynamics, Resource Allocation

JEL Classification

D24, E22, G33, J24, L25

Address for correspondence:

(E) cama.admin@anu.edu.au

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[‡] Arndt-Corden Department of Economics, Crawford School of Public Policy, Australian National University, Email: joel.bowman@anu.edu.au

1. Introduction

The provision of large-scale policy support in response to the COVID-19 pandemic has increased debate surrounding the risks of zombie firms. Existing literature have highlighted that zombie firms are a concern as they tend to hinder productivity growth by crowding out resources and impeding the efficient allocation of resources more broadly (McGowan, Andrews et al. 2018). While previous studies have used various definitions of zombies, most have generally classified a business as a zombie if they are unable to meet their interest expense using their current profits for several years. The prevalence of zombie firms has also increased in advanced economies in recent decades alongside a slowdown in productivity growth (Banerjee and Hofmann 2020).

Zombie firms are kept alive when their owners and associated creditors find the expected benefits in keeping the business alive exceeds the benefits of liquidation. This normally entails an expectation that business conditions will improve. The decision by creditors to keep zombie firms alive may also be influenced by structural factors. For example, creditors may be more inclined to lend to zombies if insolvency regimes are inefficient (McGowan, Andrews et al. 2017), accommodative monetary policy (White 2012), if the banking system is in poor financial health (Storz, Koetter et al. 2017) or if there are non-market benefits in keeping the business in operation (Jiang, Li et al. 2017).

Identifying zombie firms is challenging. The commonly used approach in the literature – identifying zombies as firms that struggle to meet their interest expenses from current profits – may classify several different types of firms as zombies. For example, zombie firms may be incumbent businesses that are kept in operation due to non-market reasons. Alternatively, creditors may support zombie firms given expectations that business conditions will improve.

International studies have found sizeable indirect adverse consequences of zombie firms. These conclusions have been reached on studies that have drawn on data from Japan (Caballero, Hoshi et al. 2008), Europe (Hallak, Harasztosi et al. 2018), Portugal (Carreira, Teixeira et al. 2021), Italy (Storz, Koetter et al. 2017), China (Tan, Huang et al. 2016) and cross-country studies more broadly (McGowan, Andrews et al. 2018).

Schivardi, Sette et al. (2020) argue that the existing literature that examines the consequences of zombie firms suffer from a serious identification problem. Examining the consequences of zombie firms is made complicated to the extent that the share of zombies in an industry is correlated with the performance of both zombie and other firms. Further details on the identification problem are discussed in the next section.

The purpose of this paper is to examine three key questions regarding the consequences of zombie firms in Australia. First, does the amount of resources allocated towards zombie firms impede the activity of other firms operating within the same industry? Second, what are the potential adverse channels through which zombie firms may impede the operation of other firms in the Australian context? Third, does the share of resources allocated towards zombie firms impede the business sectors performance at an industry level?

This paper makes several contributions to the literature on the consequences of zombie firms. For example, this paper is the first public study to my knowledge has analysed the consequences of zombie firms using data on Australian businesses. Understanding the trends and consequences of zombie firms could help shed light on one of the potential drivers behind Australia's productivity slowdown over the last decade. Second, the paper uses an alternative criteria to identify zombie companies in light of Schivardi, Sette et al. (2020) zombie identification critique (described more in next section). Third, the analysis in this paper draws on a large firm-level dataset that captures most of the population of businesses operating in Australia. Research into zombie companies has been to date largely limited to the examination of listed companies due to data constraints, which may be problematic as they are unlikely to be representative of the broader business sector.

This paper is organised as follows. Section 2 provides a description of the literature that assesses the consequences of zombie companies. Section 3 describes the key research questions and methods. Section 4 explains the key data used and summary statistics. Section 5 analyses the results. Section 6 examines the robustness of the results. Section 7 extends the baseline model framework to further explore the channels through which zombie companies impact the operations of viable companies. Section 8 discusses the policy implications. Section 9 concludes by explaining the policy implications of this chapter's empirical findings and highlights areas for future research.

2. Literature Review

This section of the chapter has three sub-sections. First, describes the international evidence on the consequences of zombie firms. Second, examines the potential channels through which zombie firms may influence the activity of other firms. Third, explains the identification problem in the existing literature that assesses the consequences of zombie companies.

2.1 International evidence on the consequences of zombie firms

A growing body of literature have highlighted both the direct and indirect adverse consequences of zombie firms.

Cross-country studies using data over the period 2003-13 have found that the productivity of viable businesses have been hindered the greater the amount of resources sunk into zombie firms (McGowan, Andrews et al. 2018). Further, the higher presence of resources allocated towards zombie firms is also associated lower investment and employment growth in a non-zombie firm and capital growth becomes less responsive to business productivity (i.e., undermines allocative efficiency). In turn, the authors suggest that zombie firms may lower countries' productivity growth by constraining business investment and multi-factor productivity growth.

The economic stagnation in Japan is often linked to the widespread practice of Japanese banks continuing to extend credit to insolvent firms (Hoshi and Kashyap 2004) (Hayashi and Prescott 2002). Zombie companies have been found to reduce profits for other viable firm, depress job creation, reduce business investment and have been found to hinder countries' productivity growth (Caballero, Hoshi et al. 2008).

In Europe, the prominence of zombie companies has increased and that the growing prevalence of zombie firms has been found to crowd out employment for non-zombie businesses, especially younger ones (Hallak, Harasztosi et al. 2018). Using a sample of businesses in Portugal, research has found that industries with higher shares of zombies have lower levels of aggregate productivity (Carreira, Teixeira et al. 2021).

In Italy, the impact of zombie firms on the market through the channel of zombie lending was assessed using the level of under capitalisation of banks operating in the market as an

exogenous proxy for zombie lending (Schivardi, Sette et al. 2017). Their econometric strategy helps address concerns that the rise of zombie firms could be a cyclical story as shocks that increase the prevalence of zombie firms can also affect firm performance. They find that under capitalised banks were less likely to cut lending to zombie firms and that credit misallocation increased the failure rate of healthy firms while reducing the failure rate of zombie firms. However, contrary to previous literature, they find that the adverse effects of credit misallocation on the growth of healthier firms and productivity dispersion were negligible. The results suggest the existence of an important counter balancing effects of the survival of zombie firms on viable firms in the short run, such as through reduced unemployment and sustained economic activity.

The problem of zombie companies and their adverse effects is not limited to advanced economics. Within China, zombie firms have also been found to crowd out investment activity of viable firms (Tan, Huang et al. 2016). The large potential gains in resolving zombie firms have been reaffirmed in Lam, Schipke et al. (2017). To an extent, the activities of non-zombie firms appear hindered by large quantities of capital being tied up with zombie firms (Wang and Zhu 2020).

2.2 Channels through which zombies impede the activity of other firms

The literature has identified several channels through which zombie firms may weigh on aggregate activity or productivity (McGowan, Andrews et al. 2018). First, zombie firms may weigh on productivity directly as zombies tend to be less productive (Banerjee and Hofmann 2020). Second, zombie firms could crowd out factors of production for non-zombie firms, which may hinder the growth potential for the most productive businesses. Third, zombie firms may be hinder the efficient resource allocation by preventing non-zombie firms from gaining market share and by increasing the barriers for younger more dynamic firms to replace inefficient incumbent businesses.

The presence of zombie firms may also be symptomatic of the inefficient allocation of factors of production. Previous literature has suggested that weak banks have an incentive to evergreen loans to their impaired borrowers to avoid having to declare outstanding loans non-performing, using data on firms and banks in the euro area periphery countries (Storz, Koetter et al. 2017). The desire for banks to avoid the realisation of losses was found to be a large

supportive factor of zombie companies in Japan. (Peek and Rosengren 2005) (Fukuda, Kasuya et al. 2006). The discipline of bank lending practices was also weakened by cross-shareholdings and the widespread perception that debt was guaranteed by the government (Hanazaki and Horiuchi 2003). In turn, banks continued to lend to insolvent firms with the hope that the borrower would get bailed out by the government in the event of severe repayment difficulties, thereby contributing to the softening of budget constraints of enterprises (Berglöf and Roland 1995). The impact of forbearance lending practices contributed to lower output growth across the euro area following the onset of the sovereign debt crisis in 2011 (Tracey 2019).

The international literature suggests that the mechanisms in place that help reallocate resources towards the most productive businesses may have deteriorated over time. For example, international evidence has pointed to productivity growth being weighed down by rising productivity gaps between global frontier and laggard firms (Andrews, Criscuolo et al. 2015) (Decker, Haltiwanger et al. 2020). The former authors find that productivity gap has been in part driven by stagnating laggard firm productivity. In addition, the exit mechanism of inefficient firms has also weakened as the average productivity of firms on the margin of exit has fallen over time, while the average productivity of entrants relative to viable incumbent firms has risen (Andrews and Saia 2017). This implies less indirect pressure on incumbent firms to boost their productivity and could also reflect rising barriers to entry (Bartelsman, Haltiwanger et al. 2013).

Australia is no exception to these broad productivity trends. Productivity growth in Australia has slowed since the peak of the investment phase of the mining boom in 2012-13. The pace of the productivity slowdown has been smaller compared with other advanced economies, partly due to the expansion of the mining sector (PC 2020). The Productivity Commission has also found that the slowdown has been driven in large part by within industry effects as opposed to across industry effects. Research has also shown a weakening responsiveness of employment growth to firm productivity over the last decade in Australia, which has been a significant drag on aggregate labour productivity growth (Andrews and Hansell 2019). The gap between global frontier and Australian firms has also grown over time, suggesting a slower adoption of cutting-edge technologies (Andrews, Hambur et al. 2022). The persistence of dispersion in industries suggests that improving allocative efficiency and the productivity

growth of low productivity firms can help lift aggregate productivity growth (Campbell, Nguyen et al. 2019).

At face value, the international and domestic literature on productivity trends suggests that the increasing presence of zombie firms may be one possible hypothesis that could help account for the decline in the allocative efficiency of resources and productivity growth over recent decades.

2.3 Identification problem

Schivardi, Sette et al. (2020) argue that the existing literature which examines the consequences of zombie companies suffer from serious identification problem. The identification problem can bias the results towards finding a negative spillover, even if no spillover exits. The problem arises as the share of zombies in an industry is correlated with the performance of both zombie and other firms. The solution to date has largely relied on a regression framework that estimates the spillover effect of non-zombies relative to zombie firm performance given a change in the share of resources allocated towards zombies within an industry. The rationale being that shocks that change the share of zombies in an industry should have the same effect on the average performance of zombies and other firms absent any spillover effects. However, Schivardi, Sette et al. (2020) argue that the identification problem is still evident as the correlation between viable firm performance and zombies is mechanical with no causal meaning, under general conditions for the distribution of firm performance. Or in other words, a negative economic shock could result in the firm distribution shifting to the left. This would increase the share of companies being classified as a zombie whilst simultaneously reducing the performance of viable companies, absent any spillover effects.

The identification problem can also be illustrated in reference to the typical regression framework adopted in the literature. The absolute spillover effect is examined using the following econometric specification:

$$Y_{ist} = \beta_0 + \beta_1 D_{ist}^{NZ} + \beta_2 Z_{st} + \beta_3 D_{ist}^{NZ} * Z_{st} + \delta_s + \delta_t + \varepsilon_{ist} \qquad (1)$$

Where Y is a measure of activity of firm *i* in sector *s* and year *t*, D_{ist}^{NZ} is a dummy equal to one for non-zombie firms, Z_{st} measures the presence of zombies in a sector, δ_s and δ_t are year

and sector dummies and ε_{ist} an error term. The coefficient of interest is β_3. A negative estimate of β_3 is interpreted as evidence of a negative spillovers from zombies to other firms, as the relative performance of healthy firms is more adversely affected by an increasing presence of zombies within an industry.

The literature has recognised some identification challenges with the above econometric specification. This stems from the share of zombies being correlated with shocks that may affect the performance of both zombies and non-zombie firms. For example, a negative demand shock is likely to increase the share of zombies while adversely affecting the performance of healthy firms operating in the same sector. The identification challenge has been previously addressed by specifying a vector of sector-year dummy variables reflected in the following equation.

$$Y_{ist} = \beta_0 + \beta_1 D_{ist}^{NZ} + \beta_3 D_{ist}^{NZ} * Z_{st} + \delta_{st} + w_{ist} \qquad (2)$$

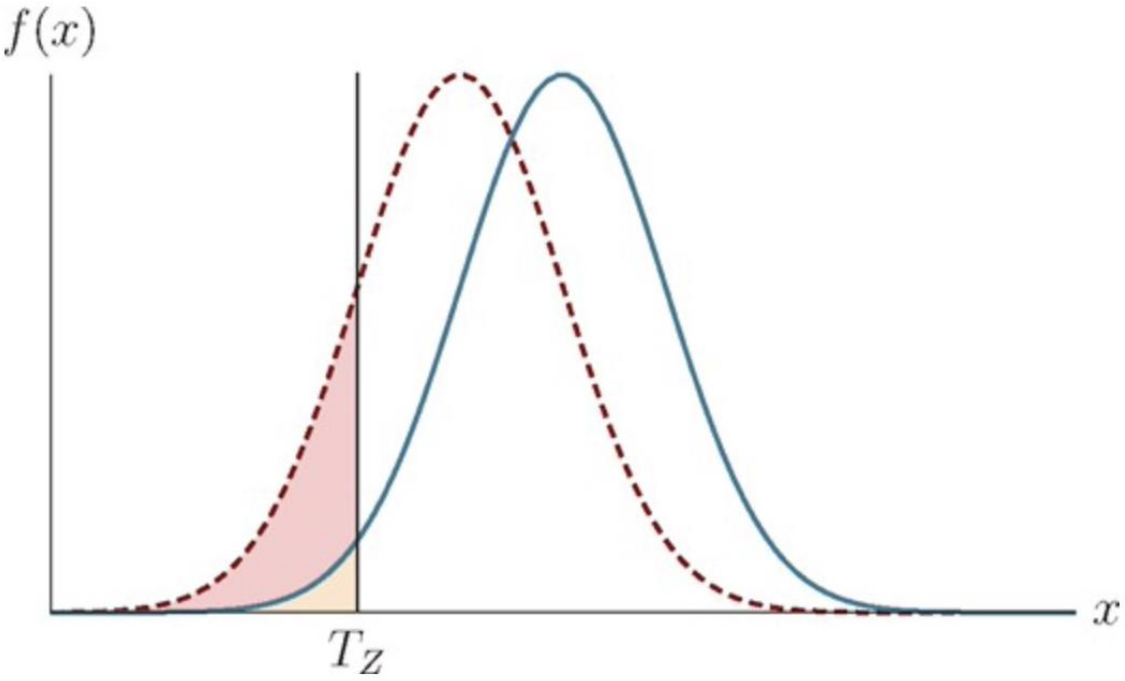
The amended equation estimates only the relative effects of the presence of zombies in an industry on non-zombies relative to zombie firms (β_3). The absolute effect is absorbed by sector-year dummies. A negative β_3 is interpreted as providing evidence of a negative spillover of zombie firms.

Schivardi, Sette et al. (2020) suggests that the use of sector-year dummies is insufficient in overcoming the identification problem. The econometric specification in equation 2 implicitly assumes that in the absence of spillover effects, shocks that change the share of zombies have the same effect on the average performance of zombies and healthy firms. However, this assumption is unlikely to hold and therefore the coefficient β_3 cannot identify the effects of zombies on non-zombies.

The identification problem is illustrated in reference to a hypothetical distribution of firms' performance in a sector. The horizontal axis measures firm quality. Zombie firms are reflected as those below a given threshold (T_Z). Healthy firms are those to the right of T_Z. The empirical framework in equation 2 implicitly assumes that shocks do not impact the difference in the average performance of non-zombie firms and zombie firms absence any spillover effects. Or in other words, the observed variation in $\mu^{NZ} - \mu^{Z}$ is entirely attributed to spillover effects. However, this is unlikely to happen. In the event of a negative shock that

shifts the distribution to the left three things unfold. First, the share of zombie firms increase (i.e. area left of T_Z increase). Second, the conditions means of μ^{NZ} and μ^{Z} likely decline. Third, the difference $\mu^{NZ} - \mu^{Z}$ could also be affected by the distribution of firms' performance, resulting in spurious conclusions. For example, there could be limits to extent to which μ^{Z} can decline before firms drop out of the sample.

Figure 1: The Effect of a Common Shock on Zombies and Non-zombies



Source: Schivardi, Sette et al. (2020)

3. Research Questions and Methods

Considering the identification challenges highlighted above, this chapter uses an alternative framework to identify zombie companies. The commonly used approach in the literature identifies zombies as firms that struggle to meet their interest expense from current profits for several consecutive years. This paper classifies a firm as a zombie if it has an average interest coverage ratio (ICR) that falls within the bottom 20 per cent of their industry over a three-year period. The ICR is the ratio of earnings before interest and taxes (EBIT) to interest expenses. Young businesses that are less than three years old are not classified as a zombie.[1] The use of the 20 per cent ICR threshold is arbitrary but was selected as the share of firms classified under this definition is similar to the broad zombie definition at the aggregate level.

[1] The exclusion of start-up firms is common given that it can take some time for new businesses to become profitable.

The broad zombie definition classifies a firm as a zombie if its ICR over a three-year period is less than one.

The proportion of businesses classified as zombies is fairly constant but does vary marginally depending on the entry and exit of younger firms as well as the small changes in the proportion of businesses taking on debt. This reflects younger firms being excluded from the 20^{th} percentile average interest coverage ratio (ICR) criteria. Further, firms with no debt are excluded from being included in the ICR criterion as they have no reported interest expenses.

Using a relative measure rather than absolute criteria to define a zombie firm has two key advantages. First, a relative definition is one avenue to limit the identification problem described above; it is less clear that the share of resources allocated towards zombie firms and the performance of non-zombie businesses would mechanically move together in response to an economic shock. Second, a relative definition can help reduce the conflation between resource allocation and corporate debt overhang effects.[2] However, the use of a relative definition makes it less clear what the general characteristics of a zombie firm are given that not all businesses would have difficulty meeting their interest expenses from current profits. Two alternative zombie definitions are also used as a robustness check. First, I apply a 10^{th} percentile ICR threshold. Second, I adopt a broad zombie definition.

The spillover of zombie firms is assessed by examining how the performance of other firms varies according to the share of full-time equivalent employees that are allocated towards zombie firms within each industry. My prior is that it is the proportion of resources that are allocated to zombie firms that matter for non-zombie firms rather than the share of businesses that meet the zombie definition.

The spillover effects of zombie firms on other firms operating within the industry are assessed in three main ways. First, I assess the correlation between the amount of labour allocated to zombie firms and the activity of other businesses operating within the same industry. Second, I analyse whether the spillover effect of zombie firms differ according to

[2] The corporate debt overhang effects refer to the process of more firms being classified as a zombie as a by-product of corporate debt levels rising. For details on the impact of corporate debt overhang and the macroeconomy see Jorda, O., M. Kornejew, M. Schularick and A. M.Taylor (2020). Zombies at Large? Corporate Debt Overhang and the Macroeconomy. NBER Working Paper, NBER.

firm and industry level factors to better understand the nature of the estimated spillover effects. Third, I examine whether the share of labour allocated to zombie firms impedes the allocative efficiency of resources. Further details on each of these methods are provided below.

3.1 Spillover effects of zombies on the activity of non-zombie businesses

The spillover effect of zombie firms on the activity of other firms is assessed using the following framework:

$$\mathrm{Y_{ist}} = \beta ZSHARE_{st} + \lambda CONTROLS_{IND_{st}} + \phi CONTROLS_{FIRM_{ist}} + \delta_i + \delta_t + \varepsilon_{ist} \qquad (3)$$

where, $\mathrm{Y_{ist}}$ is the measure of non-zombie firm activity growth (output, employment, labour productivity, capex) for non-zombie firm *i* in industry *s* and in year *t*. ZSHARE is the share of employment allocated to zombie firms within the non-zombie firms' industry. CONTROLS includes industry and firm level controls. Industry controls includes debtor share and GVA growth, which help control for factors that may influence both the share resources sunk into zombies in an industry and the performance of non-zombie firms. Firm level controls include sales growth, size (lagged of log sales) and age. I include firm-level fixed effects to capture systematic differences across businesses and year fixed effects to capture macroeconomic conditions. All variables are in real terms, whereby nominal variables are deflated using industry-level deflators. Standard errors are clustered at the industry level.

The coefficient of interest is β. If zombies adversely affect the performance of non-zombies than a negative coefficient on the zombie share variable should be expected. This adverse spillover could reflect zombie firms crowding out market share/resources available for other firms.

The framework above estimates the absolute spillover effect rather than the relative spillover effect as is commonly adopted in the literature. I have chosen to use a simplified econometric specification as concerns surrounding the correlation between the performance of non-zombie firms and the share of zombies in an industry is mitigated using a relative zombie definition. Further, the framework can be readily expanded to assess factors that may alter the size of the spillover effects, as described below.

3.2 Factors that alter the size of the spillover effects

The baseline model is also extended to assess whether the estimated spillover effects of zombie firms differ according to three different firm/industry characteristics. In particular, the baseline model is extended as follows:

$$Y_{ist} = \beta ZSHARE_{st} + \theta ZSHARE \times EXT_{ist} + \rho EXT_{ist} + \lambda CONTROLS_{IND_{st}} + \phi CONTROLS_{FIRM_{ist}} + \delta_i + \delta_t + \varepsilon_{ist} \quad (4)$$

where EXT is the extension measure that includes whether a viable business has any debt, the age of non-zombie firms and whether viable companies are operating in a high or low level of market concentration.[3] Each of the EXT terms are estimated separately. This extension can help shed light on the potential mechanisms through which zombie firms impact the operations of non-zombie firms.

For example, the literature has highlighted that the adverse spillover effects of zombie firms may be propagated by crowding out credit and creating additional entry barriers. If these channels were prevalence than the estimated spillover effect is likely to be larger for non-zombie firms that are reliant on credit (i.e. has debt). Further, if zombie firms were creating entry barriers one would expect young firms would be disproportionately affected.

A less explored channel is whether the spillover effect is likely to vary depending on the degree of market concentration of an industry. My prior is that the spillover effect is likely to be larger for industries that are less concentrated if the mechanism reflects inefficient businesses being kept in operation due to non-market reasons. The rationale being that creditors' incentives to support inefficient businesses are lower when zombie businesses operate in competitive markets, as resources can shift more readily towards productive businesses. Alternatively, the spillover effect is likely to be larger in industries that are more concentrated if the mechanism reflects a subset of businesses in their investment phase being classified as a zombie, and hence are more readily able to draw resources from other firms in their industry.

[3] A high market concentration is defined as industries who's estimated Herfindahl-Hirschman Index (HHI) is within the top half of all industries. This measure is time varying.

3.3 Zombie firms and the allocative efficiency of resources

Zombie firms could potentially hinder economic activity by impeding the extent to which resources shift from less to more productive businesses or the extent to which inefficient firms exit. On the other hand, it is also possible that more efficient firms will be able to attract sufficient financial resources and human capital to sustain their business activities even in the presence of many zombies within their industry. To formally examine this, the allocative efficiency of labour and capital for non-zombie businesses is analysed using the framework below:

$$\begin{aligned} \mathrm{I}_{\mathrm{ist}} - I_{st}^{median} = \rho(LabourProd_{ist-1} - LabourProd_{st-1}^{median}) + \\ \beta ZSHARE_{st-1} + \gamma(LabourProd_{ist-1} - LabourProd_{st-1}^{median}) \times \\ ZSHARE_{ist-1} + \lambda CONTROLS_{ist-1} + \delta_i + \delta_t + \varepsilon_{ist} \end{aligned} \quad (5)$$

where, $\mathrm{I}_{\mathrm{ist}}$ measures the growth of employment/capex. $LabourProd_{ist-1}$ is the measure of firms productivity (gross output divided by number of full-time equivalent employees), ZSHARE is the share of employment sunk into zombie firms within each non-zombie firms' industry. The term CONTROLS includes firm level controls such as size and age. The γ is the coefficient of interest. This examines whether the responsiveness of businesses decision to expand on their resources based on past levels of productivity is contingent on the amount of labour allocated to zombie businesses within their industry. If zombie firms impede the allocation efficiency of resources than a negative coefficient on γ would be expected. The model is also extended by replacing the dependent variable ($\mathrm{I}_{\mathrm{ist}} - I_{st}^{median}$) with a binary variable indicating whether a firm exits. This extension assesses whether the share of labour allocated to zombie firms impedes the responsiveness of firm exits to productivity.

4. Data

The analysis uses firm-level data from the Business Longitudinal Analysis Data Environment (BLADE). The dataset contains administrative tax data for almost the entire population of Australian companies and unincorporated businesses from 2001/02 to 2018/19.[4] Data used in this analysis draws on measures reported from firms' Business Activity Statements (BAS), Business Income Tax (BIT) filings and Pay as You Go (PAYG) summaries. The constructed

[4] Dataset excludes government related business entities and those businesses operating in the finance industry. Businesses with revenue less than $10,000 are excluded. Firm level variables are winsorised at the 1 per cent level. Other key data cleaning assumptions are outlined in the appendix.

dataset also combines BAS data with data on the date of firm formation, which I use to calculate the age of each business. The unbalanced panel dataset is well suited to study the impact of zombie firms as it has a much larger coverage of the business sector compared with other studies that usually have their analysis restricted to listed companies.

This paper has made three key assumptions when cleaning the data. First, businesses in the finance or government-related industries are excluded, as this chapter focuses on privately owned non-financial businesses. Second, micro-sized businesses with annual revenue of less than $10,000 are excluded, as their dynamics are likely to be different compared with larger-sized businesses that employ people and to limit the potential impact of inactive businesses. Third, all continuous firm-level variables are winsorized at the bottom and top one percentile to limit the impact of outlier businesses. An outline of the key variables used in this chapter is provided in the appendix (Table A1).

The share of employment sunk into zombie companies has been stable under the baseline definition since the mid-2000s while the proportion of firms classified as a zombie has declined (in part owing to the increase in new business entrants) (Graph 1). Meanwhile the share of employment sunk into zombie firms and the share of firms classified as a zombie under the broad definition has declined over the same period. The decline in the number of zombies under the baseline and broad definition has been broad based across industries.

Graph1

Zombie Firms

Proportion

*Defined as firm whose interest coverage ratio over a three-year period falls within the bottom 20 percent of their 4-digit ANZSIC industry

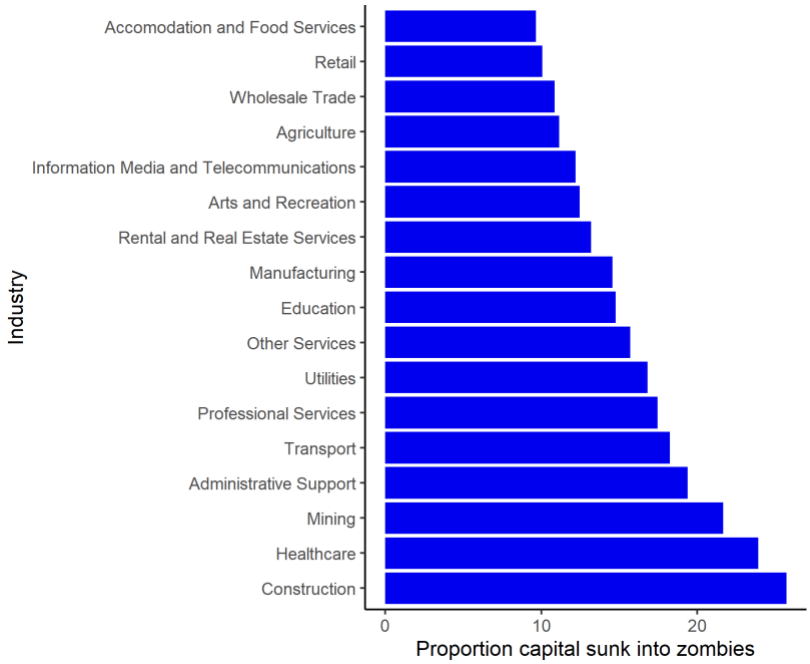
**Defined as firms whose interest coverage ratio over a three-year period is less than one

***Number of full-time equivalent employees

Sources: ABS BLADE data; Author's calculations

Across industries the share of employment sunk into zombie companies is highest for those in the construction, health care and mining industries (Graph 2). The share of employment allocated towards zombies is lowest for those in the accommodation and food services, retail and wholesale trade. In general, industries that tend to be more capital intensive have a higher concentration of labour allocated towards zombie firms.

Graph 2: Employment Sunk into Zombie Companies by Industry Division



Sources: ABS: Author's calculations

Summary statistics from the data used in the firm-level regressions is provided in Table 1. Note that in each of the firm-level regressions, businesses with missing observations are removed. All activity measures are deflated using industry deflators derived from the ABS's Annual National Accounts release. The interesting thing to note is that employment growth is unchanged for a large portion of firms between years, which may make identification challenging. Real capex growth is also negative, reflecting the lumpy nature of capex expenditure (firms typically only increase capex every three to five years) and the impact of depreciation.

Table 1: Summary Statistics
DESCRIPTIVE STATISTICS

Statistic	N	Mean	St. Dev.	Pctl(25)	Pctl(75)
Firm-level					
Output	13,114,811	0.01	0.67	-0.30	0.33
Employment	18,605,324	-0.001	0.30	0.00	0.00
Productivity	13,114,811	0.01	0.70	-0.32	0.34
Capex	9,668,201	-0.06	0.97	-0.30	0.15
Revenue	18,605,324	0.003	0.51	-0.19	0.20
Size	13,114,811	-1.43	1.42	-2.43	-0.59
Age	13,114,811	7.91	4.86	4	11
Agesq	13,114,811	86.19	97.80	16	121
Industry-level					
Employment Sunk Zombies	6,899	0.11	0.04	0.09	0.14
Industry output	6,899	-0.05	0.33	-0.06	0.07
Share of debt	6,899	0.62	0.09	0.57	0.67

Source: ABS; Author's calculations

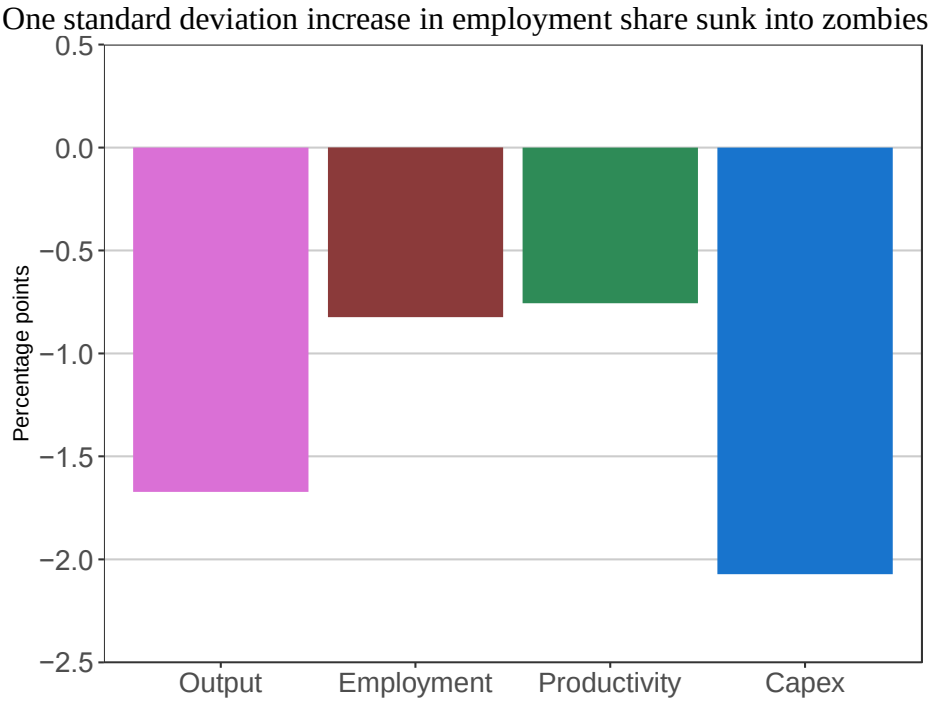
5. Results

The results on the potential spillover effects of zombies on the activity of viable firms and allocative efficiency are examined below. All data cleaning and econometrics are conducted using R Studio.

5.1 Spillover effects of zombies on the activity of non-zombie businesses

The firm level results suggest that an increase share of labour sunk into zombie firms has a negative spillover effect on the activity of other businesses operating within the same industry (Table 2) (Graph 3). This is apparent when firm-level performance is measured using viable firms' output, employment, productivity and capex growth. The spillover effect on real labour productivity is only statistically significant at the 10 per cent level. The results are economically significant. A one standard deviation increase in employment sunk into zombie companies reduces viable firms output growth by 1.7 percentage points (mean of one per cent in my sample), employment growth by 0.8 percentage points (mean of 0.0 per cent), productivity growth by 0.8 percentage points (mean of one per cent) and capex growth by 2.07 percentage points (mean -6 percentage points). The direction of the effects are robust to alternative zombie definitions, although the size of the coefficients vary (Table A2–A4).

Graph 3
Zombie Spillover Impact on Viable Firms Activity*



*Defined as firm whose interest coverage ratio over a three-year period falls within the bottom 20 percent of their 4-digit ANZSIC industry. Employment measure as a proportion of full-time equivalent employees. Viable firm activity measured in real growth terms.

Sources: ABS BLADE data; Author's calculations

Table 2: Baseline Firm-level Results

RESULTS - BASELINE

	Output	Employment	Productivity	Capex
	(1)	(2)	(3)	(4)

Zombie employment share	-0.418***	-0.206***	-0.189*	-0.518***
	(0.121)	(0.035)	(0.107)	(0.152)
Debtor share	-0.010	-0.070**	0.038	-0.254*
	(0.097)	(0.028)	(0.089)	(0.130)
Industry GVA growth	0.115***	-0.009***	0.111***	0.012
	(0.028)	(0.003)	(0.027)	(0.015)
Size	-0.486***	-0.003***	-0.436***	0.042***
	(0.010)	(0.001)	(0.013)	(0.004)
Age				
	(0.000)	(0.000)	(0.000)	(0.000)
Age squared	0.001***	0.000***	0.000***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Sales growth		0.121***		0.251***
		(0.010)		(0.019)
Observations	13,114,550	18,605,005	13,114,550	9,668,162
R^2	0.307	0.181	0.256	0.224
Adjusted R^2	0.128	-0.002	0.063	0.042
Residual Std. Error	0.629 (df = 10420973)	0.305 (df = 15204733)	0.675 (df = 10420973)	0.945 (df = 7833389)

Notes: ***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.
Standard errors are clustered by ANZSIC industry level and reported in the parenthesis. Firm and time fixed effects are included by not reported. Regressions estimated on sample of non-zombie firms. Continuous variables winsorised.

Sources: ABS; Author's calculations

5.2 Factors that alter the size of the spillover effects

The spillover effect does not differ for viable companies with or without debt (Table A7). This suggests that the adverse spillover effect of zombie companies may not be propagated through the credit channel. The spillover effect across most measures of activity does not differ across firm age (Table A8). The exception is labour productivity, whereby the spillover effect of zombie firms is higher for older firms. These results do not support the notion that zombie firms' spillover effect is propagated by imposing additional barriers to entry.

The spillover effect of zombie firms is higher for those operating in less concentrated industries (Table A9). This result provides indirect evidence against the notion that the spillover effect of zombie firms is propagated by inefficient businesses being kept in operation due to non-market reasons. It is possible that the higher spillover in less concentrated industries arises because a subset of businesses in their investment phase are classified as zombies, and these firms are more readily able to draw resources from other firms in less concentrated industries. The results are economically significant. A one standard deviation increase in employment sunk into zombie companies reduces viable firms output growth by 2.2 percentage points for firms operating in low concentration industries and this effect is lowered to 0.3 percentage points for firms operating in high concentration industries.

The spillover results by market concentration are robust to the use of alternative zombie definitions, including the broad zombie definition and applying a 10^{th} percentile ICR threshold. While the incidence of zombie firms is similar under the baseline definition (largely by construction), the incidence of zombie firms is lower for those in less concentrated industries using the broad zombie definition. This may reflect zombie firms being more prevalent in investment-intensive industries, which tend to be more concentrated. Alternatively, zombie firms may be weeded out through competitive pressures to a greater degree in less concentrated industries.

5.3 Zombie firms and the allocative efficiency of resources

The empirical results do not support the hypothesis that zombie firms adversely impact the allocative efficiency of labour and capital and does not reduce the responsiveness of business exits to productivity (Table 3). The interaction term is only statistically significant in the case of employment growth but does not have the expected negative sign. As such, the results imply that an increase in the share of resources allocated to zombie firms increases the extent to which employment growth is responsive to past levels of productivity.

The results are sensitive to the zombie definition used. The use of the broad zombie definition implies that zombie firms impede the allocative efficiency of labour, capital and business exits (Table A5). However, this definition is subject to the same identification critique discussed earlier. Using a zombie definition that is less susceptible to this problem suggests that a high zombie share in an industry does not necessarily impede the allocative efficiency of resources.

Table 3: Baseline Allocative Efficiency Results
ALLOCATIVE EFFICIENCY - BASELINE

	Employment growth (1)	Capex growth (2)	Exit (3)
Log productivity	0.014	0.007*	-0.012***
	(0.009)	(0.004)	(0.002)
Zombie employment share	-0.143***	-0.195	0.079
	(0.041)	(0.120)	(0.058)
Size	-0.456***	-0.004**	-0.028**
	(0.005)	(0.002)	(0.001)
Age			
	(0.000)	(0.000)	(0.000)
Age squared	-0.000***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)
Log productivity x zombie employment share	0.150**	-0.032	0.004
	(0.067)	(0.032)	(0.019)
Observations	11,708,156	6,289,877	11,688,295
R^2	0.405	0.241	0.449
Adjusted R^2	0.262	0.049	0.317
Residual Std. Error	0.266 (df = 9447724)	0.841 (df = 5019962)	0.222 (df = 9429412)

Notes: ***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.
Standard errors are clustered by ANZSIC industry level and reported in the parenthesis. Firm and time fixed effects are included by not reported. Regressions estimated on sample of non-zombie firms. Continuous variables winsorised.

Sources: ABS; Author's calculations

6. Extensions

This section of the paper extends the baseline results in two main ways. The first adopts a different econometric specification to assess the spillover effect of zombie firms on the

activity of non-zombie businesses. The second assesses whether there is evidence of adverse effects of zombie firms at the industry level.

6.1 Alternative econometric specification

The baseline results are extended by assessing the spillover effects of zombie firms under an alternative econometric specification. More specifically, the spillover effect is assessed using similar framework to that in the existing literature as reflected in the following equation:

$$Y_{ist} = \beta_0 + \beta_1 D_{ist}^{NZ} + \beta_3 D_{ist}^{NZ} * Z_{st} + \delta_{st} + w_{ist} \qquad (6)$$

where Y is a measure of activity of firm *i* in sector *s* and year *t*, D_{ist}^{NZ} is a dummy equal to one for nonzombie firms, Z_{st} measures the presence of zombies in a sector, δ_{st} is a vector of sector-year dummy variables. The equation estimates only the relative effects of the presence of zombies in an industry on non-zombies relative to zombie firms (β_3). The absolute effect is absorbed by sector-year dummies. A negative β_3 is interpreted as providing evidence of a negative spillover of zombie firms.

The extended framework can help overcome some of the identification challenges that may arise from the share of zombie firms being possibly correlated with shocks that affect the performance of both zombies and non-zombie firms. However, this alternative framework may be also subject to its own identification problems as discussed in the literature review section of the paper.

The relative spillover effect is not statistically significant across most measures of firm-level activity at the five per cent level (Table A10). The exception is for capex whereby an increase share of zombies in an industry has a larger adverse impact on firm-level capex growth for non-zombie firms compared with zombie businesses. The results cast doubt over the extent to which the strong spillover effect estimated under the baseline definition may reflect identification challenges.

I have also extended the baseline model by removing the non-zombie firms' contribution to the share of employment allocated to zombie businesses within an industry measure. The amendment can help reduce potential endogeneity concerns. The baseline results are robust to this alternative industry share metric.

6.2 Industry-level regressions

The analysis is extended to assess whether industries that have a higher amount of labour allocated towards zombie firms is correlated with slower growth in various measures of industry activity. The industry-level regressions are analysed using the following framework:

$$Y_{st} = \beta ZSHARE_{st} + \lambda CONTROLS_{st} + \delta_s + \delta_t + \varepsilon_{st} \quad (7)$$

where, Y_{ist} is the measure of activity for industry *s* in year *t* (e.g. output growth, employment growth, labour productivity, capex growth, entry and exit rates). ZSHARE is the share of employment allocated towards zombie firms within each industry. CONTROLS includes debtor share and sales growth, which help control for factors that drive both the share of resources allocated towards zombies in an industry and the activity of industries. The coefficient of interest is β. If the share of resources allocated towards zombie firms adverse impacts industry activity than the coefficient β is expected to be negative.

The results suggest that having a higher share of labour allocated towards into zombie firms weighs on capex growth and new business entry rates (Table A11). Other metrics of industry activity, such as gross-value-added and employment growth, does not appear to be statistically differ depending on changes in the amount of labour allocated towards zombie firms within an industry.

7. Discussion

The analysis in this paper highlights that a higher proportion of labour allocated towards zombie firms is correlated with weaker activity for non-zombie businesses using data on Australian firms. The size of these adverse spillovers is economically large. These results broadly align with the findings in the literature, which have examined the consequences of zombie firms in a range of other countries. However, comparing the magnitude of the spillovers is made difficult by this paper using an alternative definition of a zombie.

Closer analysis on the consequences of zombie firms' casts doubts over the extent to which the negative correlation between resources allocated to zombie firms and activity of viable businesses is a problem. For example, this paper did not find some of the potential adverse spillover channels of zombie firms that are identified in the existing literature. This includes

zombie firms not being associated with crowding out credit or impeding the allocative efficiency of resources.

The negative spillovers of zombie firms may reflect identification challenges. This includes potential issues regarding the econometric specification, owing in part to the difficulty in finding an exogenous variation in the share of resources allocated to zombie firms and the performance of non-zombie businesses. The extended results using an alternative econometric framework that estimates the relative impact of the share of resources allocated to zombie firms on the activity of non-zombie versus zombie businesses suggests that the results may be sensitive to the choice of econometric framework.

The identification challenges also extend to difficulties in spotting zombie firms. For example, using an interest coverage criterion to identify zombie businesses may classify several different types of firms as zombies. This includes the risk of classifying businesses in their growth phase with a long investment payoff period. This identification challenge may be in part evident by the finding that the estimated spillover effect of zombie firms is larger for viable businesses operating in less concentrated industries. The spillover effect may be higher in less concentrated industries as businesses in their investment phase that are classified as a zombie are more readily able to draw resources and attract market share from other firms. Such channels are likely less concerning for policy makers as they could encapsulate part of the ongoing process of creative destruction.

Collectively, the results in this paper cast doubt over the extent to which zombie firms may be a concern in Australia. This finding is broadly consistent with others that have found the Australian economy performs well at reallocating resources to high productivity firms than in many other OECD countries, possibly reflecting Australia's sound structural policy environment (Andrews and Hansell 2019).

The results of this paper analysed the nature of the zombie problem in Australia prior to the COVID-19 pandemic. The nature of the COVID-19 pandemic and associated policy responses that focused on preserving businesses through programs such as JobKeeper raises several interesting policy-relevant questions. In particular, has the policy support measures delayed the restructuring or exit of unproductive firms and have therefore increased the risk of firm zombification? Analysis to date suggests that job reallocation during the pandemic

has remained connected to firm productivity over 2020 in Australia (Andrews, Hambur et al. 2021). The potential scarring effects of the pandemic on the economy are difficult to predict but associated risks arising from zombification can be assessed as data becomes available.

8. Conclusion

The share of resources allocated to zombie firms is found to correlate with weaker activity amongst other firms operating within the same industry. However, the stable share of labour allocated to zombie firms in Australia since 2003/04 to 2018/19 is reassuring at the aggregate level. These trends suggest zombie firms are unlikely to be a material driver behind the slowdown in Australia's economic activity since the mid-2000s.

Identifying channels through which zombie firms impede the activity of other businesses remains difficult. Closer analysis is unable to detect some of the potential adverse channels through which zombie firms impede the activity of other firms. For example, this paper finds that the share of labour allocated to zombie firms does not impede the allocative efficiency of resources or firm exits. The results provide evidence against the hypothesis that zombie firms weigh on the activity of non-zombie firms by crowding out the availability of credit or by imposing additional barriers to entry. The finding of a larger spillover effect of zombie firms in less concentrated industries may reflect difficulties in identification, or the fact that some firms in their investment phase are zombies and these firms are able to draw market share and resources more readily from other firms operating in the same industry.

There are several avenues for future research. First, the impact of the COVID-19 pandemic and associated business support measures on the zombification of businesses can be assessed in Australia and abroad as data becomes available. Second, the extent to which bank lending to zombie firms crowds out credit available for more viable businesses in Australia could be investigated, pending propriety data on bank loans becoming available to researchers. Third, future research could investigate alternative econometric specifications to assess the consequences of zombie firms. This may involve the use of instrumental variables to help identify the exogenous variation in the share of zombies with respect to aggregate performance shocks, albeit finding a suitable instrument is challenging. Last, an evaluation of policies that help contribute to the mitigation of zombie firms and the amount of resources allocated towards zombie businesses could provide some valuable policy relevant insights.

The adverse consequences of zombie businesses could be a risk to the longer-term economic recovery in Australia and abroad. The results presented in this paper casts doubt over the extent to which zombie firms are a concern in Australia, at least prior to the COVID-19 pandemic.

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10. Appendix

The appendix has four key sections. First, describes the BLADE disclaimer. Second, provides a variable list including details on how they are constructed. Third, outlines the key data

cleaning assumptions. Fourth, provides the regression output of some of the key robustness checks.

10.1 Disclaimer

The following Disclaimer Notice refers to data and graphs sourced from the Australian Bureau of Statistics' BLADE (Business Longitudinal Analysis Data Environment) database. The results of these studies are based, in part, on Australian Business Register (ABR) data supplied by the Registrar to the Australian Bureau of Statistics (ABS) under A New Tax System (Australian Business Number) Act 1999 and tax data supplied by the Australian Taxation Office (ATO) to the ABS under the Taxation Administration Act 1953. These require that such data are only used for the purpose of carrying out functions of the ABS. No individual information collected under the Census and Statistics Act 1905 is provided back to the Registrar or ATO for administrative or regulatory purposes. Any discussion of data limitations or weaknesses is in the context of using the data for statistical purposes, and is not related to the ability of the data to support the ABR or ATO's core operational requirements. Legislative requirements to ensure privacy and secrecy of this data have been followed. Only people authorised under the Australian Bureau of Statistics Act 1975 have been allowed to view data about any particular firm in conducting these analyses. In accordance with the Census and Statistics Act 1905, results have been confidentialised to ensure that they are not likely to enable identification of a particular person or organisation.

10.2 Variable list and key data cleaning assumptions

Table A1

Variable	Mnemonic	Unit of measurement	Construction method
Background			

Firm ID	id	Numeric	Based on business ABN
Average interest-coverage-ratio	ICR average	Percent	EBIT three-year average/interest expense three-year average
Average interest-coverage-ratio threshold	ICR threshold	Percent	Of firms within industry with positive interest expense average; 20th percentile ICR average across by each industry and year
Zombie Definitions			
Baseline	zombie_baseline	Binary	0 but equals 1 for those firms that have an ICR average less than the ICR threshold
10th percentile	zombie_10percenitle	Binary	Same as baseline but a 10th percentile ICR threshold is applied
Broad	Zombie_broad	Binary	0 but equals 1 for those firms with an ICR average less than 1
Industry level			
Industry measure	x_anzsic06	4-digit	Australian and New Zealand Standard Industrial Classification 2006
Debtor share	share_debtor	Binary	Share of firms within an industry that have debt. Firms have debt if their total liabilities less current liabilities is greater than zero.
Real industry GVA growth	Industry_gva	Percent	Industry output growth. Firm and industry output measured as turnover less operating expenses. Deflated using industry deflators derived from Table 5 in the ABS's Annual National Accounts release.
Entry	Entry	Binary	0 but equals 1 for those in which the date equals the minimum date for an individual firm (i.e. captures first time a firm enters the database)
Exit	Exit	Binary	0 but equals 1 for those in which the date is equal to the maximum date for an individual firm (i.e. last date before firm drops out of sample)
Firm level			
Real output growth	dlgva_base	Percent	Gross-value-added measured as turnover less operating expenses. Deflated using industry deflators derived from Table 5 in the ABS's Annual National Accounts release.
Employment growth	dlemp_adj	Percent	Number of full-time equivalent employees plus one given that owners in particularly smaller-sized firms appear to be excluded
Real productivity growth	dlprod	Percent	Real output divided by number of full-time equivalent employees
Real capex growth	dlnoncurrentassets	Percent	Total assets less current assets. Capital stock deflated using implied industry deflators derived from Table 58 in the ABS's Annual National Accounts.
Size	size	Log	Lagged real revenue. Revenue deflated using industry GVA deflators.
Age	Age	Years	Constructed by take the date at a given point of time less the birth date of a firm.
Age squared	Agesq	Years	Age variable squared
Real sales growth	dlrevenue	Percent	Revenue growth deflated using industry GVA deflators.

Note: The industry level measures of output and employment etc are estimated in the same ways as the firm level measures. All growth rate measured as $g = \frac{L_t - L_{t-1}}{0.5 \times (L_t + L_{t-1})}$, which approximates the log changes.
Sources: ABS; Author's calculations

10.3 Key data cleaning assumptions

- Only includes non-financial corporations or households (sisca08 and div)
- Excludes government related enterprises (x_tolo and div)

- Excludes businesses with nominal turnover of less than $10,000 to limit the impact of micro enterprises or those that are inactive.
- Gross value added is reported as missing for firms with nominal revenue less than $10 million from 2017/18, as small businesses were no longer required to report operating expenses.
- Productivity estimates were replaced as missing for those firms that report negative gross value added (can't have negative productivity measures).
- Level of employment sunk into zombie companies winsorized at the one per cent level to limit the impact of outliers when estimating the share of labour sunk into zombie companies.
- All growth variables are winsorized at the bottom and top one per cent to limit the impact of outliers.
- Missing observations for each of the respective regressions are naturally excluded from each regression. This results in differences in the number of observations across model specifications with different dependent variables. Note that the number of observations is less for those involving capex, as data on the capital stock for unincorporated businesses are unavailable.

10.4 Additional Regression Output

Table A2

FIRM-LEVEL RESULTS - 10 PERCENT ZOMBIE CRITERIA

	Output	Employment	Productivity	Capex
	(1)	(2)	(3)	(4)

Zombie employment share	-0.697***	-0.257***	-0.407***	-0.752***
	(0.175)	(0.059)	(0.149)	(0.255)
Debtor share	-0.018	-0.078***	0.036	-0.266**
	(0.095)	(0.028)	(0.085)	(0.124)
Industry GVA growth	0.115***	-0.009***	0.110***	0.011
	(0.028)	(0.003)	(0.027)	(0.014)
Size	-0.480***	-0.002**	-0.428***	0.043***
	(0.010)	(0.001)	(0.012)	(0.004)
Age				
	(0.000)	(0.000)	(0.000)	(0.000)
Age squared	0.001***	0.000***	0.000***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Sales growth		0.125***		0.249***
		(0.010)		(0.019)
Observations	13,747,980	19,681,172	13,747,980	10,514,033
R^2	0.294	0.166	0.242	0.206
Adjusted R^2	0.120	-0.009	0.055	0.036
Residual Std. Error	0.635 (df = 11021458)	0.312 (df = 16260072)	0.683 (df = 11021458)	0.947 (df = 8654931)

Notes: ***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Standard errors are clustered by ANZSIC industry level and reported in the parenthesis. Firm and time fixed effects are included by not reported. Regressions estimated on sample of non-zombie firms. Continuous variables winsorised.

Sources: ABS; Author's calculations

Table A3

RESULTS - BROAD ZOMBIE CRITERIA

	Output	Employment	Productivity	Capex
	(1)	(2)	(3)	(4)
Zombie employment share	-0.194***	-0.133***	-0.051	-0.417***

	(0.074)	(0.021)	(0.062)	(0.081)
Debtor share	-0.017	-0.077***	0.037	-0.268*
	(0.103)	(0.029)	(0.090)	(0.148)
Industry GVA growth	0.113***	-0.009***	0.109***	0.013
	(0.028)	(0.003)	(0.027)	(0.016)
Size	-0.487***	-0.003***	-0.436***	0.043***
	(0.010)	(0.001)	(0.012)	(0.004)
Age				
	(0.000)	(0.000)	(0.000)	(0.000)
Age squared	0.001***	0.000***	0.000***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Sales growth		0.121***		0.260***
		(0.009)		(0.018)
Observations	12,915,602	18,152,875	12,915,602	9,303,291
R^2	0.312	0.187	0.260	0.231
Adjusted R^2	0.132	0.000	0.067	0.043
Residual Std. Error	0.624 (df = 10239313)	0.304 (df = 14761629)	0.670 (df = 10239313)	0.948 (df = 7478702)

Notes: ***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Standard errors are clustered by ANZSIC industry level and reported in the parenthesis. Firm and time fixed effects are included by not reported. Regressions estimated on sample of non-zombie firms. Continuous variables winsorised.

Sources: ABS; Author's calculations

Table A4

RESULTS - WITHOUT BUSINESS ENTERPRISE GROUPS

	Output	Employment	Productivity	Capex
	(1)	(2)	(3)	(4)
Zombie employment share	-0.363***	-0.194***	-0.150	-0.452***
	(0.110)	(0.035)	(0.097)	(0.134)
Debtor share	-0.014	-0.072**	0.035	-0.259**

	(0.098)	(0.028)	(0.089)	(0.132)
Industry GVA growth	0.115***	-0.009***	0.111***	0.012
	(0.028)	(0.003)	(0.027)	(0.015)
Size	-0.486***	-0.003***	-0.436***	0.042***
	(0.010)	(0.001)	(0.013)	(0.004)
Age				
	(0.000)	(0.000)	(0.000)	(0.000)
Age squared	0.001***	0.000***	0.000***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Sales growth		0.121***		0.251***
		(0.010)		(0.019)
Observations	13,115,075	18,607,157	13,115,075	9,669,632
R^2	0.307	0.181	0.256	0.224
Adjusted R^2	0.128	-0.002	0.063	0.042
Residual Std. Error	0.629 (df = 10421421)	0.305 (df = 15206810)	0.675 (df = 10421421)	0.945 (df = 7834802)

Notes: ***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Standard errors are clustered by ANZSIC industry level and reported in the parenthesis. Firm and time fixed effects are included by not reported. Regressions estimated on sample of non-zombie firms. Continuous variables winsorised.

Sources: ABS; Author's calculations

Table A5

ALLOCATIVE EFFICIENCY - BROAD ZOMBIE DEFINITION

	Employment growth (1)	Capex growth (2)	Exit (3)
Log productivity	0.041***	0.010***	-0.018***
	(0.006)	(0.002)	(0.002)
Zombie employment share	-0.103***	-0.032	0.058

	(0.029)	(0.144)	(0.037)
Size	-0.456***	-0.004**	-0.028***
	(0.005)	(0.002)	(0.001)
Age			
	(0.000)	(0.000)	(0.000)
Age squared	-0.000***	0.001***	-0.001***
	(0.000)	(0.000)	(0.000)
Log productivity x zombie employment share	-0.071**	-0.045***	0.048***
	(0.031)	(0.012)	(0.009)
Observations	11,707,275	6,289,721	11,687,417
R^2	0.405	0.241	0.449
Adjusted R^2	0.262	0.049	0.317
Residual Std. Error	0.266 (df = 9446866)	0.841 (df = 5019815)	0.222 (df = 9428557)

Notes: ***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.
Standard errors are clustered by ANZSIC industry level and reported in the parenthesis. Firm and time fixed effects are included by not reported. Regressions estimated on sample of non-zombie firms. Continuous variables winsorised.

Sources: ABS; Author's calculations

Table A6

BROAD ZOMBIE CRITERIA - INDUSTRY RESULTS - ZOMBIE EMPLOYMENT SHARE

	GVA	Employment	Productivity	Capex	Entry	Exit
	(1)	(2)	(3)	(4)	(5)	(6)
Zombie employment share	-0.086	-0.093**	0.180*	-0.211***	-0.042**	0.049***
	(0.099)	(0.047)	(0.097)	(0.056)	(0.018)	(0.017)
Debtor share	-0.123	-0.050	-0.022	0.368***	-0.057***	-0.063*

	(0.125)	(0.076)	(0.114)	(0.134)	(0.022)	(0.032)
Sales growth		0.865***		0.790***	0.034***	-0.000
		(0.018)		(0.027)	(0.007)	(0.002)
Observations	7,249	7,273	7,249	7,271	7,273	6,804
R^2	0.496	0.792	0.592	0.528	0.587	0.459
Adjusted R^2	0.459	0.777	0.562	0.493	0.556	0.416
Residual Std. Error	0.236 (df = 6755)	0.077 (df = 6778)	0.190 (df = 6755)	0.138 (df = 6776)	0.036 (df = 6778)	0.029 (df = 6310)

Notes: ***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Standard errors are clustered by ANZSIC industry level and reported in the parenthesis. Industry and time fixed effects are included by not reported.

Sources: ABS; Author's calculations

Table A7

RESULTS - EXTENSION - CREDITOR CHANNEL

	Output (1)	Employment (2)	Productivity (3)	Capex (4)
Zombie employment share	-0.561***	-0.191***	-0.263**	-0.624***
	(0.137)	(0.052)	(0.112)	(0.131)
Has debt	0.033**	0.014**	0.016	0.135***
	(0.015)	(0.006)	(0.011)	(0.019)
Debtor share	-0.136	-0.098***	-0.052	-0.248**
	(0.114)	(0.033)	(0.103)	(0.119)
Industry GVA growth	0.142***	-0.004	0.130***	0.012

	(0.038)	(0.003)	(0.037)	(0.014)
Size	-0.450***	-0.005***	-0.381***	-0.005
	(0.010)	(0.001)	(0.011)	(0.003)
Age				
	(0.000)	(0.000)	(0.000)	(0.000)
Age squared	0.000***	0.000***	0.000	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Sales growth		0.163***		0.156***
		(0.011)		(0.014)
Zombie employment share x has debt	0.173	-0.027	0.157*	0.199
	(0.118)	(0.046)	(0.087)	(0.159)
Observations	6,398,682	9,199,706	6,398,682	8,665,130
R^2	0.318	0.209	0.249	0.311
Adjusted R^2	0.122	0.013	0.033	0.142
Residual Std. Error	0.631 (df = 4971407)	0.359 (df = 7374242)	0.701 (df = 4971407)	0.759 (df = 6960237)

Notes: ***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.
Standard errors are clustered by ANZSIC industry level and reported in the parenthesis. Firm and time fixed effects are included by not reported. Regressions estimated on sample of non-zombie firms. Continuous variables winsorised.

Sources: ABS; Author's calculations

Table A8

RESULTS - EXTENSION - YOUNG FIRMS

	Output	Employment	Productivity	Capex
	(1)	(2)	(3)	(4)
Zombie employment share	0.074	-0.074	0.212	-0.778**
	(0.345)	(0.122)	(0.247)	(0.393)
Age				
	(0.000)	(0.000)	(0.000)	(0.000)
Debtor share	-0.041	-0.083***	0.020	-0.280**
	(0.103)	(0.030)	(0.092)	(0.115)
Industry GVA growth	0.115***	-0.009***	0.111***	0.016
	(0.028)	(0.003)	(0.027)	(0.015)
Size	-0.490***	-0.005***	-0.437***	0.026***

	(0.010)	(0.001)	(0.012)	(0.004)
Sales growth		0.121***		0.257***
		(0.010)		(0.019)
Zombie employment share x age	-0.055*	-0.014	-0.045**	0.029
	(0.032)	(0.013)	(0.022)	(0.029)
Observations	13,114,550	18,605,005	13,114,550	9,668,162
R^2	0.307	0.181	0.256	0.221
Adjusted R^2	0.127	-0.002	0.063	0.039
Residual Std. Error	0.629 (df = 10420973)	0.305 (df = 15204733)	0.675 (df = 10420973)	0.947 (df = 7833389)

Notes: ***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Standard errors are clustered by ANZSIC industry level and reported in the parenthesis. Firm and time fixed effects are included by not reported. Regressions estimated on sample of non-zombie firms. Continuous variables winsorised.

Sources: ABS; Author's calculations

Table A9

RESULTS - EXTENSION - MARKET CONCENTRATION

	Output	Employment	Productivity	Capex
	(1)	(2)	(3)	(4)
Zombie employment share	-0.549***	-0.218***	-0.288**	-0.699***
	(0.158)	(0.040)	(0.139)	(0.207)
High market concentration	-0.065***	-0.002	-0.050***	-0.034
	(0.019)	(0.010)	(0.017)	(0.021)
Debtor share	-0.007	-0.070**	0.040	-0.249*
	(0.096)	(0.028)	(0.088)	(0.129)
Industry GVA growth	0.114***	-0.009***	0.110***	0.016
	(0.028)	(0.003)	(0.027)	(0.017)
Size	-0.486***	-0.003***	-0.436***	0.042***
	(0.010)	(0.001)	(0.013)	(0.004)
Age				

	(0.000)	(0.000)	(0.000)	(0.000)
Age squared	0.001***	0.000***	0.000***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Sales growth		0.121***		0.251***
		(0.010)		(0.019)
Zombie employment share x high market concentration	0.461***	0.044	0.346**	0.572***
	(0.162)	(0.075)	(0.143)	(0.211)
Observations	13,114,550	18,604,956	13,114,550	9,668,138
R^2	0.307	0.181	0.256	0.224
Adjusted R^2	0.128	-0.002	0.063	0.042
Residual Std. Error	0.629 (df = 10420971)	0.305 (df = 15204692)	0.675 (df = 10420971)	0.945 (df = 7833368)

Notes: ***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.
Standard errors are clustered by ANZSIC industry level and reported in the parenthesis. Firm and time fixed effects are included by not reported. Regressions estimated on sample of non-zombie firms. Continuous variables winsorised.

Sources: ABS; Author's calculations

Table A10

RESULTS – EXTENSION: DIFFERENT ECONOMETRIC SPECIFICATION

	Output	Employment	Productivity	Capex
	(1)	(2)	(3)	(4)
Non-zombie	0.070***	0.048***	0.026*	0.146***
	(0.026)	(0.016)	(0.014)	(0.017)
Size	-0.056***	-0.008***	-0.052***	0.016***
	(0.002)	(0.001)	(0.002)	(0.002)
Age	-0.042***	-0.011***	-0.032***	-0.023***
	(0.001)	(0.001)	(0.001)	(0.002)
Age squared	0.002***	0.000***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Non-zombie x Zombie employment share	-0.204	-0.004	-0.206*	-0.328***
	(0.199)	(0.121)	(0.109)	(0.124)
Observations	14,299,334	20,762,683	14,299,334	11,332,290

R^2	0.028	0.014	0.020	0.014
Adjusted R^2	0.027	0.014	0.019	0.014
Residual Std. Error	0.672 (df = 14292425)	0.314 (df = 20755769)	0.701 (df = 14292425)	0.963 (df = 11325380)

Notes: ***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Standard errors are clustered by ANZSIC industry level and reported in the parenthesis. Firm and time fixed effects are included by not reported. Regressions estimated on sample of non-zombie firms. Continuous variables winsorised.

Table A11

RESULTS – EXTENSION: INDUSTRY RESULTS

	GVA	Employment	Productivity	Capex	Entry	Exit
	(1)	(2)	(3)	(4)	(5)	(6)
Zombie employment share	-0.133	-0.086	0.124	-0.273***	-0.095***	-0.005
	(0.111)	(0.068)	(0.098)	(0.098)	(0.034)	(0.031)
Debtor share	-0.111	0.008	-0.083	0.334***	-0.043*	-0.048**
	(0.123)	(0.067)	(0.107)	(0.127)	(0.022)	(0.022)
Sales growth		0.861***		0.791***	0.034***	0.001
		(0.018)		(0.027)	(0.007)	(0.003)
Observations	7,292	7,316	7,292	7,314	7,316	6,844
R^2	0.490	0.787	0.584	0.510	0.577	0.434
Adjusted R^2	0.453	0.772	0.554	0.474	0.546	0.390
Residual Std. Error	0.237 (df = 6798)	0.078 (df = 6821)	0.192 (df = 6798)	0.141 (df = 6819)	0.036 (df = 6821)	0.030 (df = 6350)

Notes: ***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Standard errors are clustered by ANZSIC industry level and reported in the parenthesis. Industry and time fixed effects are included by not reported.

Sources: ABS; Author's calculations