Economic and Social Reports

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by Alexander Amundsen, Amélie Lafrance-Cooke and Danny Leung

Release date: March 22, 2023

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Zombie firms in Canada

by Alexander Amundsen, Amélie Lafrance-Cooke and Danny Leung

Abstract

The literature shows that zombie firms can lower aggregate productivity, impede reallocation and constrain the growth of healthy firms. In Canada and other advanced economies, the share of zombie firms has been rising over the past few decades, with recent studies showing that the share in Canada could potentially be the highest in the world. However, these studies of the Canadian context are based only on publicly traded Canadian firms. This paper presents new evidence on zombification using Canadian-controlled private corporations and publicly traded firms. The paper finds that the zombie share among all firms is considerably lower and diverging in trend. However, a number of notable results show that zombies are increasingly showing up in the mining, quarrying, and oil and gas extraction sector; they are accounting for more resources over time; their performance and productivity are worsening; they are negatively impacting the productivity and growth of healthy firms; and they are increasingly lowering aggregate productivity by a sizable margin.

Authors

Alexander Amundsen is with the Department of Finance Canada, and Amélie Lafrance-Cooke and Danny Leung are with the Economic Analysis Division at Statistics Canada.

Acknowledgements

Disclaimer

The views expressed in the paper do not reflect, in any way, the views of the Department of Finance Canada.

Introduction

There are various signs that the process of creative destruction is slowing across advanced economies. These signs include an aggregate productivity slowdown, where aggregate productivity growth rates have declined (Ollivaud et al. [2016] for the Organisation for Economic Co-operation and Development [OECD] and Sharpe and Tsang [2018] for Canada); an increasing productivity dispersion between the most productive and the least productive firms (Andrews et al. [2016] globally and Gu [2019] for Canada); an increasing misallocation of capital between firms with high and low marginal products of capital (Gopinath et al. [2017] for southern Europe and Chen and Tombe [2020] for Canada); and a decline in the firm entry and exit rate, representing reduced business dynamism (Decker et al. [2014] for the United States and MacDonald [2014] for Canada).

These trends imply an increasing significance of weak firms that do not exit the market, which the literature has coined as zombie firms. Zombie firms, or zombies, are businesses that perform poorly over a long period of time without exiting, and their share has been rising over time across many advanced economies (McGowan et al., 2017b; Banerjee and Hofmann, 2018; Banerjee and Hofmann, 2020). They have been found to be less productive, be more leveraged, make lower investments, reduce industry and aggregate productivity, and hurt the growth prospects of healthy firms within the same industries (Hoshi, 2006 Caballero et al., 2008; McGowan et al., 2017b; Banerjee and Hofmann, 2018; Acharya et al., 2019; Acharya et al., 2020; Banerjee and Hofmann, 2020; Carreira et al., 2022).

For Canada, research has been conducted concerning zombie firms. Deloitte (2018) uses data from the Toronto Stock Exchange (TSX) and the TSX Venture Exchange (TSXV) to find that 16% of firms could be considered zombies. Banerjee and Hofmann (2020) use data from Worldscope to find that Canada has the highest zombie share (around 30%) across 14 OECD countries. They suggest that the commodity sector may be a contributing factor for Canada, as zombies tend to be found in commodity-related sectors across countries. Using data from Compustat, Grieder and Ortega (2020) find that, between 1980 and 2018, the proportion of zombies rose from around 3% to around 25%. They show that two-thirds of Canadian zombies were in industries exposed to commodity prices, with 75% of these firms in metal, coal and mineral mining; 10% in oil and gas extraction; and the remaining 15% in other commodity-related sectors. Also using Compustat, De Martiis et al. (2021) find an increasing share of zombies over time, though at levels lower than in the United States. Grieder et al. (2021) present results from Compustat up to the fourth quarter of 2020 that show a general upward trend in the zombie share over time, with a recent decline in the fourth quarter of 2020. Using both Compustat and Worldscope, Altman et al. (2021) find that Canada has the highest zombie share (around 32%) across 20 countries. They emphasize that this high share correlates with Canada's share of small enterprises, of which Canada also has the highest share (around 76% of firms) across countries.

These results imply that Canada may be a poor performer in terms of its number of zombies, with the highest zombie share when compared with other advanced economies. However, each of these studies has relied on data using only Canadian publicly traded firms. Their samples exclude Canadian-controlled private corporations, which make up over 99% of all firms in Canada. Consequently, their results reflect a fraction of the Canadian economy,[1] and this fraction is heavily weighted towards firms in the commodity sector.[2] Studies have suggested that the zombie share may be lower among private firms, with Favara et al. (2021) finding that the zombie share among private U.S. firms is half as large as among publicly traded U.S. firms, at 5% and 10%, respectively.

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1. In the present study's dataset, publicly traded firms make up roughly 0.2% of counts, 11% of payroll, 20% of capital and 16% of value added.
2. Between 2006 and 2016, Canadian mining, quarrying, and oil and gas extraction firms made up 57% of Canadian headquartered firms in Compustat (Grieder and Lipsitz, 2018), while over the same period, Canadian mining, quarrying, and oil and gas extraction firms made up less than 1% of Canadian private sector employer firms (Statistics Canada, 2021).

This paper extends the analysis of zombie firms in Canada to privately held corporations. This is the first paper to consider two types of firms – publicly traded and privately held incorporated firms- by using one of the most comprehensive datasets yet to analyze zombie firms.[3] This study uses the National Accounts Longitudinal Microdata File (NALMF) from Statistics Canada, which includes all private and publicly traded firms that file a corporate tax return. The sample is made up of roughly 15 million observations between 2000 and 2019, allowing for a thorough analysis of the zombie situation in Canada. The study uses new empirical methods to take advantage of the sample size, such as conducting some analysis at the three-digit North American Industry Classification System (NAICS) level, tracking zombie firms over a long period and measuring the aggregate impact of zombie firms. The majority of the results have not been estimated for Canada before, so this paper provides new information on the characteristics of Canadian zombie firms. Because private firms are included, the dataset allows for the first cross-country comparison between Canada and other OECD countries that are based on the ORBIS database used by the OECD.[4]

The central findings are that the zombie share among all firms (5% to 7%) was substantially lower than among publicly traded firms (18% to 36%), and while the share of zombies among all firms declined after 2011, the share of zombies among publicly traded firms steadily increased. This divergence shows that zombification is a different phenomenon across these two types of firms and highlights the importance of including private firms in zombie firm analysis. Compared with other OECD countries, Canada is not the worst zombie offender in the world and lies in the middle instead. However, there is room for improvement when compared with G7 countries such as Great Britain and France.

The remainder of the paper is organized as follows: Section 2 discusses the related literature; Section 3 describes the data and definitions; Section 4 presents the empirical results; Section 5 describes some results from a robustness check without firms from the mining, quarrying and oil and gas extraction sector; and Section 6 concludes.

Literature review

The origin of zombie firms came from studies that analyzed the Japanese macroeconomic stagnation in the 1990s. Weak and insolvent firms were being kept alive by Japanese banks. This took the form of forbearance, where the banks maintained and extended their terms of credit to not realize non-performing loans on their balance sheets (Peek and Rosengren, 2005; Hoshi, 2006; Caballero et al., 2008). Kwon et al. (2015) estimate that annual aggregate productivity growth in Japan would have been 1% higher had these banks not conducted zombie lending.[5]

The issue of zombie firms was renewed throughout the mid-2010s as the European sovereign debt crisis unfolded. Studies pointed out that similar zombification was occurring, with banks helping to prop up weak firms in the aftermath of the 2008 financial crisis (Acharya et al., 2019). Several papers, such as those by Schivardi et al. (2017), Storz et al. (2017), Blattner et al. (2019), and Andrews and Petroulakis (2019), connected the presence of weak banks to zombie firms in Europe, mainly through poor bank health or stringent capital requirements that led to perverse incentives for maintaining lending relationships to zombies.

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3. Studies such as those by Nurmi et al. (2020) and Carreira et al. (2022) use administrative data for Finland and Portugal, respectively. This study is most closely related to theirs in terms of data comprehensiveness, though Canada has the advantage of having a much larger population of firms.
4. The ORBIS database provides data on private and publicly traded firms across OECD countries. However, ORBIS's coverage varies across countries and is known to under-represent small firms (Bajgar et al., 2020).
5. Kwon et al. (2015) show that Japan experienced a negative labour reallocation effect during the crisis, so labour reallocation between firms lowered aggregate productivity growth, with zombies accounting for almost the entirety of this.

Until the late 2010s, zombie firms were considered a country-specific or economic-specific phenomenon. The OECD provided the first widespread study of zombie firms, showing that zombies were prevalent and increasing in presence across many OECD countries (McGowan et al., 2017b).[6] This sparked concern from policy makers, as the zombie issue was no longer isolated to specific countries or certain economic periods but was a long-term secular issue with real economic consequences. The OECD showed that zombie firms have lower productivity than healthy firms, implying that aggregate productivity is dragged down by their prevalence. They hoard resources, such as capital, that could be better used in other, healthy firms, contributing to misallocation. They congest input and output markets by competing on credit, wages and output prices that impede the growth of healthy firms within the same industries, implying that zombie firms create negative externalities with their presence.

These results by the OECD have been confirmed in several studies. Banerjee and Hofmann (2018) find that across 14 advanced economies there has been a secular increase in the zombie share of firms across business cycles, ranging on average from around 2% in the 1980s to around 12% in 2016. They show that zombie congestion crowds out the investment and employment growth of healthy firms, and at the country level, a 1% increase in the zombie share reduces aggregate productivity growth by 0.3%. Andrews and Petroulakis (2019) find that zombies compete with healthy firms for credit. The availability of bank loans to healthy firms decreases in industries that have a higher share of capital sunk into zombies. Acharya et al. (2019) find that healthy firms pay higher interest rates, invest less and have lower employment growth in sectors with high zombie congestion than sectors with low zombie congestion. For a 7% increase in the zombie share (the average increase in their sample), healthy firms invest 12.6% less and have 5.6% lower employment growth. Carreira et al. (2022) find that the productivity of zombies has declined at an average annual rate of 1% compared with a 0.5% increase for non-zombies and, at the industry level, a 1% decline in the share of zombies is associated with a 3.1% increase in labour productivity. Banerjee and Hofmann (2020) find that zombie shares have been rising over time across many advanced economies and that zombies are smaller, are more leveraged and invest less, and their performance (profitability, productivity, employment and investment) deteriorates in the years leading up to zombification. After zombification, zombies continue to experience poor performance, and for those that recovered from being a zombie, they underperform firms that were never zombies and face a higher probability of relapsing into zombie status. At the country level, Banerjee and Hofmann (2020) estimate that a 10% increase in the zombie share is associated with a 1% decline in aggregate productivity growth. This constitutes half of the productivity slowdown in their sample.

These issues associated with zombie firms have influenced studies to explore the reasons behind zombification. Five major factors have been suggested in the literature. The first is perverse incentives by banks to protect their balance sheets, e.g., to satisfy capital requirements, leading to excessive forbearance to weak firms (Schivardi et al., 2017; Storz et al., 2017; Blattner et al., 2019; Andrews and Petroulakis, 2019). The second is poorly designed insolvency regimes that create barriers for firms to exit the market or restructure, leading to the survival of unviable firms (McGowan et al., 2017a; Gouveia and Osterhold, 2018; Altman et al., 2021). The third is government support programs, such as direct and tax-based support, that allow weak firms to remain in the market rather than exit it (Nurmi et al., 2020). The fourth is declining interest rates that lower the debt servicing costs of firms, lead to lower incentives to call in non-performing loans and generate a higher risk appetite from creditors (Banerjee and Hofmann, 2018; Bittner et al., 2021; De Martiis and Peter, 2021). The fifth is volatile output prices, such as commodity prices, that result in firms entering zombie status because of fluctuating earnings (Banerjee and Hofmann, 2020; Grieder and Ortega, 2020). These factors have all been suggested as potential reasons behind the zombification of advanced economies, though no single factor has been found to explain the trends in all countries. It is likely that the relative importance of these factors varies, with some factors being more pertinent than others depending on the period and the economic situation.

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6. A notable mention goes to Acharya et al. (2019), who also provided some of the first cross-country evidence of zombification.

In the context of the COVID-19 pandemic, there is a greater need to reallocate resources throughout Canada as sectors adjust to the post-COVID-19 economy. A significant presence of zombie firms could hinder this process, with adverse effects on aggregate productivity. It is therefore important to determine the prevalence and economic consequences of zombie firms in Canada and whether the previous literature for Canada, based on publicly traded firms, is reflective of Canada's zombie situation for private firms.

Data and definitions

This analysis is based on Statistics Canada's NALMF. This administrative dataset covers all unincorporated and incorporated firms in Canada with employees. It spans the period from 2000 to 2019 and includes all industries. Because information on the firm's balance sheet and income statement is required, the study focuses on incorporated firms that have filled out their T2 Corporation Income Tax Return. In this analysis, there are two groups of firms: all firms, which is the sample of private and publicly traded firms, and publicly traded firms.[7]

For this paper, the following conditions are imposed: (1) the sample of firms consists solely of employers that have a positive payroll; (2) firms must have tax filing periods spanning one year[8] (this ensures the observations represent a full year of operation and are comparable with one another); and (3) firms must have reported information about their industry based on the NAICS, excluding management of companies and enterprises (NAICS 55) and public administration (NAICS 91). These conditions are considered lenient, and this is reflected in the final sample. The sample is made up of roughly 15 million observations and represents all incorporated employer firms in Canada.

In the literature, zombie firms are identified by two alternative approaches. The first approach is to create a measure of subsidized credit by comparing the firm's interest rate on debt with a benchmark interest rate (Caballero et al., 2008). Firms are identified as zombies if they receive subsidized credit that allows them to remain in the market and survive. Unfortunately, this measure requires detailed information on the firm's debt structure, which is infeasible in many administrative datasets. This led to the second approach used in the literature, popularized by the OECD (McGowan et al., 2017b), which focuses on creating a measure based on firm performance over time. In this case, zombies are firms that experience persistent financial weakness without exiting.

The zombie definition created by the OECD is used because it has become ubiquitous throughout the literature. It also provides the greatest comparability across countries.[9] Firms are deemed zombies if they have earnings less than their interest payments for 3 consecutive years and are at least 10 years old. They are mature firms that perform poorly over a long period without exiting the market. The definition focuses on mature firms because young firms may have difficulties meeting their interest payments while they are making investments and expanding their operations. The criteria for the interest coverage ratio ensure that these firms are surviving only through asset disposal, equity issuance, fiscal and monetary supports, or debt financing or refinancing.

One concern over the definition is the lack of forward-looking information. Papers such as those by Banerjee and Hofmann (2018), Grieder and Ortega (2020), Banerjee and Hofmann (2020), and Grieder et al. (2021) use a measure that includes expectations of future profitability. This is formulated as the

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7. Publicly traded firms are identified as public corporations under T2 Corporation Income Tax Return Line 040.
8. The firm's filing period represents the length of coverage in the tax filing.
9. Many studies create their own version of the zombie definition, including those for Canada. Although novel, the trade-off is that this makes the results incomparable across countries. Because these studies usually end up conducting a robustness check with the OECD's definition, the results are based on the OECD's definition for maximum comparability.

firm's stock market value divided by the book value (Tobin's q) being less than the industry median. The additional requirement has the advantage of not misidentifying weak firms as zombies if they have high future growth prospects as determined by the market. Unfortunately, the market value of firms is not observable in the NALMF, making this additional requirement infeasible. This underscores a benefit of using datasets based on public financial and market information rather than administrative-based datasets, and the literature finds lower zombie shares when this additional requirement is considered.

For the variables used in the analysis, capital is the after-amortized book value of tangible and intangible assets; the age of a firm is the difference between the current year and the firm's incorporation date; earnings are the net income before taxes, extraordinary items and interest payments; value added is the net income before taxes and extraordinary items plus the payroll and the amortization of tangible and intangible assets; employment is the number of employees; wages are the average annual wages calculated by dividing the payroll by employment; and investment is the net investment in tangible and intangible assets. All variables are deflated by two-digit NAICS industry deflators from Statistics Canada.

Empirical results

Zombie prevalence

First, the prevalence of zombie firms is examined over time. To shed light on the characteristics of zombies in Canada, the incidence of zombification by employment size and age and by investment rate decile and wage decile is presented.

Previous studies on zombie firms in Canada based on publicly traded corporations found that Canada has the highest zombie share among several advanced economies (Banerjee and Hofmann, 2020; Altman et al., 2021). Chart 1 shows that the previous literature reflects their sample composition. The zombie share among all firms (5% to 7%) was substantially lower than among publicly traded firms (18% to 36%). Furthermore, while the share of zombies among all firms has been declining since 2011, the share of zombies among publicly traded firms has steadily increased. This difference highlights how zombification is a fundamentally different phenomenon across private and public firms.[10]

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10. The zombie shares were also calculated using other definitions. Following Grieder and Ortega (2020), a zombie has earnings before interest, taxes, depreciation and amortization that are less than its interest payments for three consecutive years and is older than 10 years. Following Storz et al. (2017), a zombie has a negative return on assets, low earnings relative to debt, and zero or negative investment for two consecutive years. The same patterns over time are observed using these alternative definitions.

Chart 1
Zombie share among all firms and publicly traded firms, 2002 to 2019

percent
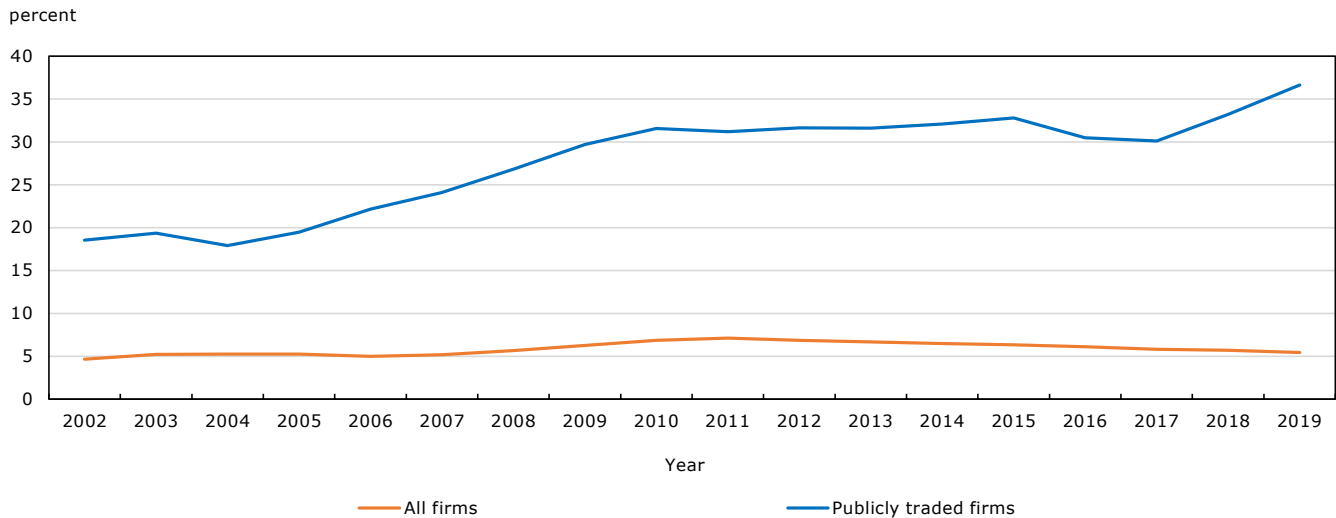
Note: This chart presents the zombie share as defined by the Organisation for Economic Co-operation and Development (McGowan et al., 2017b).
Source: Statistics Canada; authors' calculations using the National Accounts Longitudinal Microdata File.

Table 1 presents the share of zombie firms in each sector for all and publicly traded firms. In 2019, there were zombie firms in all industries, but certain industries stood out. The two industries with the highest share of zombies in 2019 were mining, quarrying, and oil and gas extraction (10.6%) and arts, entertainment and recreation (9.1%). Other sectors, such as wholesale trade (7.0%), information and cultural industries (7.4%), and real estate and rental and leasing (7.8%), were also on the high end. Although there was a high rate of zombie firms within mining, quarrying, and oil and gas extraction, the sector accounted for a very small share of zombies overall, at 1.7% in 2019. This contrasts with publicly traded firms, in which mining, quarrying, and oil and gas extraction zombies accounted for 60.2% of publicly traded zombies, suggesting that listed status was strongly related to zombification in that sector. This may result from structural factors, such as lower listing requirements in the TSXV that are geared towards small firms in the mining, quarrying, and oil and gas extraction sector that may be prone to becoming zombies (Carpentier and Suret, 2011; Carpentier and Suret, 2012). Alternatively, the ability to raise new equity from the exchanges may allow companies to remain zombies for longer, before they become profitable or exit the marketplace.

Table 1

Zombie share of firms by industry for all and publicly traded firms

Industry	All firms			Publicly traded firms
	2002	**2011**	**2019**	**2019**
	percent			
Agriculture, forestry, fishing and hunting	4.1	6.6	5.8	0.0
Mining, quarrying, and oil and gas extraction	5.0	7.8	10.6	49.1
Utilities	4.1	4.9	5.1	14.3
Construction	4.5	5.8	5.3	40.0
Manufacturing	5.0	10.4	6.9	30.4
Wholesale trade	4.8	8.5	7.0	26.7
Retail trade	5.0	8.3	6.3	25.0
Transportation and warehousing	4.3	5.4	4.2	15.4
Information and cultural industries	4.1	8.8	7.4	36.4
Finance and insurance	4.6	7.0	5.2	19.5
Real estate and rental and leasing	6.7	9.1	7.8	10.3
Professional, scientific and technical services	3.4	5.5	4.6	43.8
Administrative and support, waste management and remediation services	4.4	6.9	5.8	21.7
Educational services	3.9	7.9	6.2	0.0
Health care and social assistance	2.6	3.5	1.8	13.3
Arts, entertainment and recreation	6.3	11.3	9.1	20.0
Accommodation and food services	5.2	8.6	6.1	0.0
Other services (except public administration)	6.4	9.3	6.9	16.7
Overall	**4.7**	**7.1**	**5.5**	**36.6**

Notes: This table presents the zombie share of firms within each two-digit North American Industry Classification System sector. Zombies are defined as per the Organisation for Economic Co-operation and Development (McGowan et al., 2017b).
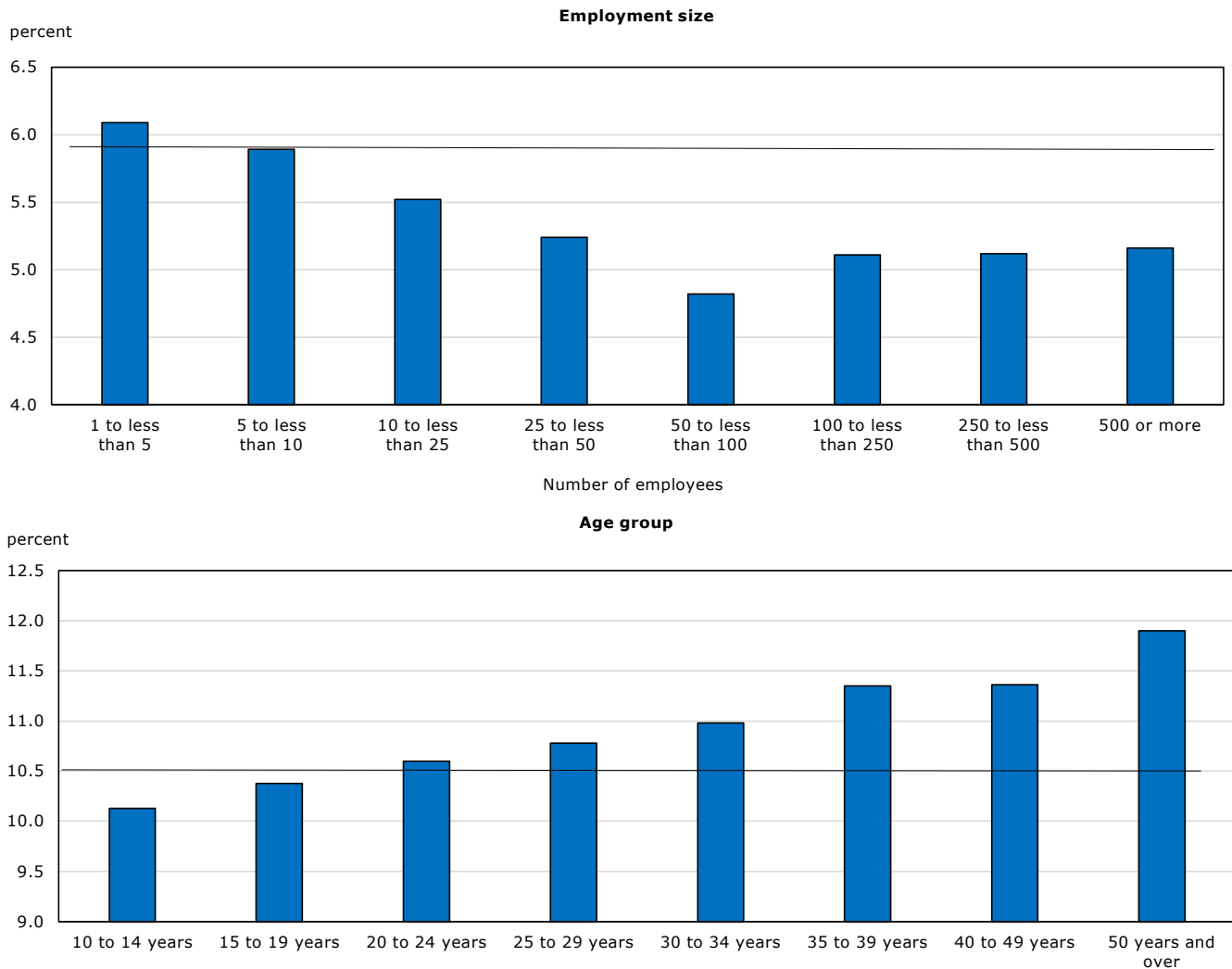**Source:** Statistics Canada, authors' calculations using the National Accounts Longitudinal Microdata File.

Table 1 also presents the zombie share by industry for 2002 and 2011 for all firms. The zombie shares of many industries followed the overall trend of peaking around 2011, followed by a decline. A notable exception was the mining, quarrying, and oil and gas extraction sector, where the zombie share experienced a large increase over time. It increased during the 2008 financial crisis and again during the 2015 oil price shock. From its relatively moderate level of 5.0% in 2002, it has more than doubled to reach the top of the sample at 10.6% in 2019. The zombie share in arts, entertainment and recreation has remained consistently at or near the top of the sample, suggesting that zombification in this sector is a secular long-term issue.

Chart 2 presents the zombie share by employment size and age group for all firms from 2002 to 2019. The highest rate of zombification was for firms with one to five employees (6.1%). The zombie share fell with firm size to 4.8% for firms with 50 to less than 100 employees, and then rose again to 5.2% for firms with 500 employees or more. Given that most firms had one to less than five employees, most zombie firms were small. However, because the spread in the share of zombies between firms with 1 to less than 5 employees and those with 500 employees or more was minor (at less than 1 percentage point), the consequences of zombies cannot be dismissed as a small-firm issue in Canada, as there is a sizable share of larger zombie firms in the economy.

Regarding zombie shares by age, the prevalence of zombies increased with firm age. As in the case of firm size, the spread between the categories was not large. The zombie share for firms between 10 and 14 years of age was 10.1% compared with 11.9% for firms 50 years or older. Of course, zombie firms are defined as mature, although even conditional on age, zombies were older on average (21.5 years) than mature non-zombie firms (21.0 years). Overall, micro firms and older firms were more likely to be zombies.
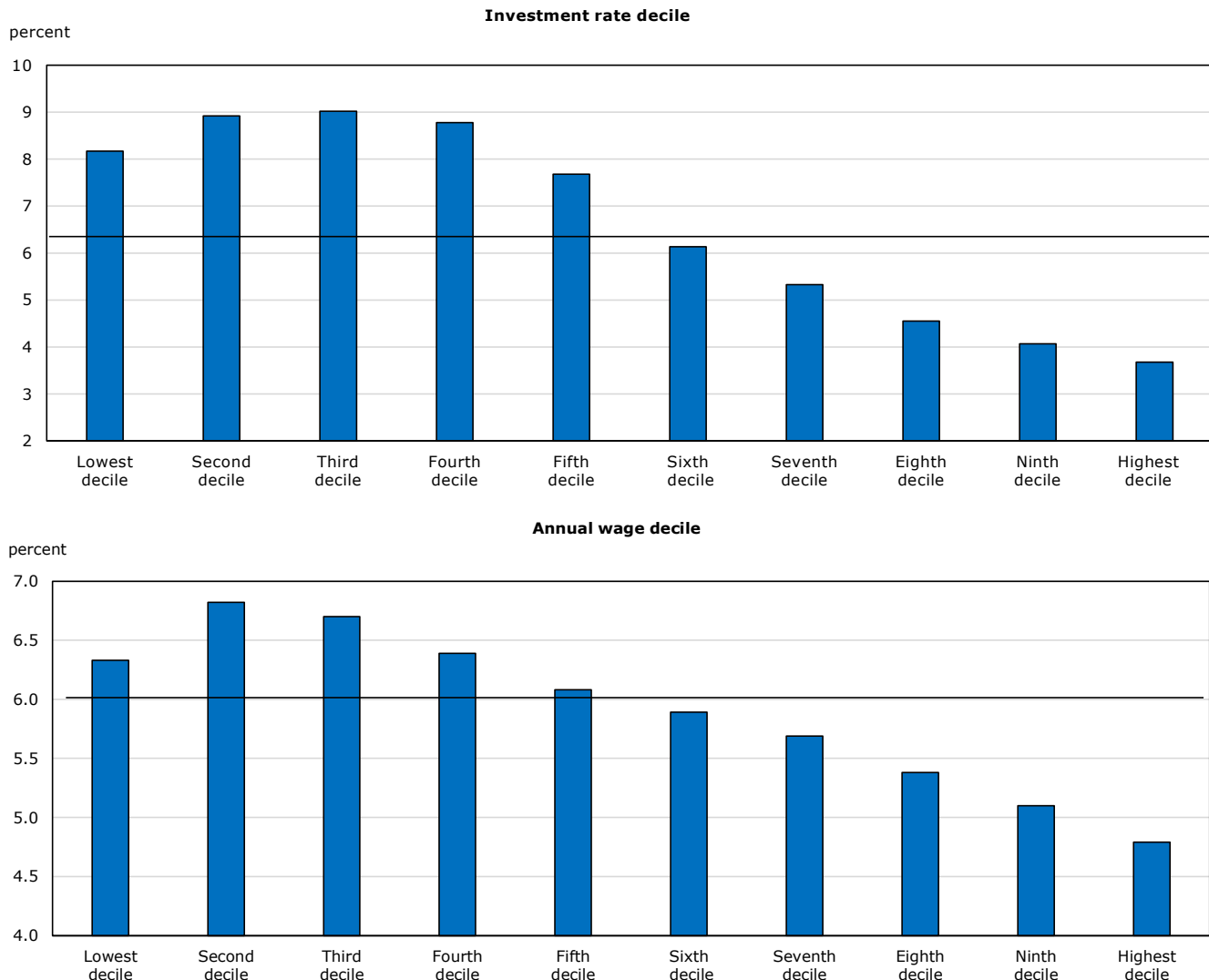
Chart 2
Zombie share by employment size and age, 2002 to 2019

Employment size

Age group

Notes: Horizontal lines refer to the average scale. This chart presents the zombie share by employment size (number of employees) and age (years). Zombies are defined as per the Organisation for Economic Co-operation and Development (McGowan et al., 2017b).
Source: Statistics Canada, authors' calculations using the National Accounts Longitudinal Microdata File.

In Chart 3, the zombie shares by investment rate decile and wage decile are presented after controlling for industry and year differences. The results show that zombie firms tended to exist at the bottom of the investment rate and wage distribution, where they invested less and paid lower wages than healthy firms in their industry. Therefore, zombie firms may be partially contributing to Canada's long-term trends of lagging business investment and stagnating wages (Robson, 2019; Robson and Wu, 2021; Robson and Bafale, 2022; Williams, 2021; Greenspon et al., 2021; Sharpe and Ashwell, 2021).

Chart 3
Zombie share by investment rate decile and wage decile, 2002 to 2019

Investment rate decile

percent

Annual wage decile

percent

Notes: Horizontal lines refer to the average scale. This chart presents the zombie share among investment rate and wage deciles. Each variable is standardized by the three-digit North American Industry Classification System industry and year. Zombies are defined as per the Organisation for Economic Co-operation and Development (McGowan et al., 2017b).
Source: Statistics Canada, authors' calculations using the National Accounts Longitudinal Microdata File.

At the international level, Canada's zombie share appears to be moderate, although Canada compares poorly with several advanced economies. With a zombie share of 6.7% among all firms in 2013, it ranked lower than countries such as Greece (16.0%), Spain (10.3%), Belgium (8.8%) and Japan (7.6%), but higher than other advanced economies such as Italy (5.8%), Great Britain (3.9%), Sweden (3.9%), Korea (3.0%), Finland (2.6%) and France (2.0%).[11] This comparison underlines the true extent of the zombie situation in Canada. Once private firms are considered, Canada's share is no longer the highest in the world and ranks roughly in the middle. However, as the following sections show, zombie firms likely imposed more significant costs on Canada's economy than the moderate level of their share would suggest.

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11. The results for the other OECD countries are taken from McGowan et al. (2017b). These results are derived from ORBIS, which differs in firm coverage and sample selection from the sample for Canada. Therefore, the difference in shares between Canada and the other OECD countries may be dependent on sample specification. The zombie definition follows that of McGowan et al. (2017b) for all countries presented.

Zombie persistence

The previous section found that zombie firms accounted for 5% to 7% of all firms in Canada from 2002 to 2019. While the share of zombies was relatively stable, it is unclear whether the population of zombies changes significantly over time, with some firms entering zombie status and others leaving it from year to year. This section examines the persistence of zombification.

Zombification was a highly persistent process, implying that zombie firms remained in this state for many periods. From 2002 to 2019, 85% of zombie firms experienced a single spell of being a zombie (a period of consecutive zombie years), while 14% experienced two spells, and a small percentage, around 1%, experienced more than two spells. This suggests that it was relatively rare to exit and re-enter zombie status.

The high persistence is confirmed by the evidence on the probability of firms transitioning to and from zombie status. The probability of a healthy, non-zombie firm becoming a zombie between any two years from 2002 to 2019 was relatively low, at 3.0%. However, once a firm became a zombie, there was a 30.9% chance of the firm transitioning back to non-zombie status, with a zombie firm in one year remaining a zombie firm in the following year 69.1% of the time.

The transition probabilities are not state dependent. It could be that the longer a firm remains as a zombie, the less likely it is to regain healthy status. Indeed, for each year a firm remained as a zombie, the probability of it staying as a zombie increased by roughly 2 percentage points. For example, a zombie firm had a 69.1% probability of remaining as a zombie in any year. After two consecutive years of being a zombie, the probability increased to 71.7%. After 3 consecutive years, the probability increased to 74.3%, and, finally, after 10 consecutive years of being a zombie, the probability of remaining as a zombie was 86.3%.

Because of the volatility and uncertainty of market demand, some firms may occasionally fall into zombie status. However, this analysis suggests that zombification is generally a long-term issue. Most zombie firms remain as zombie firms for many years.

Zombie performance

Although the previous sections have shown that the number of zombie firms has declined since 2011, the economic implications of zombie firms for the economy were unclear. Even if the prevalence of zombies is decreasing, their performance relative to non-zombies could be worsening or the amount of productive resources being used by zombie firms could be increasing. To the extent that zombies compete with non-zombies for scarce resources, healthy firms could be impacted by zombie prevalence. This section explores these issues.

Being a zombie firm means that earnings relative to interest payments are weak, but has this changed over time? Table 2 shows that the average interest payments for zombie firms declined from 2002 to 2019. By 2019, average interest payments were 77% of those in 2002. This decline is consistent with falling interest rates over the period. Despite this, the interest coverage ratio (earnings relative to interest payments) for zombie firms fell by 89%. This reflects the deterioration of earnings; median earnings dropped by 67% from 2002 to 2019. Median earnings did not drop because zombie firms were smaller. Sizable declines are observed for median earnings even when scaled by capital, payroll and sales. In fact, the declines were even greater when firm size is considered. This suggests that zombie firms in 2019 were larger than zombie firms in 2002. Table 2 also indicates that on average they became older over time.

In contrast, healthy firms showed an improvement in their earnings over the period. Whereas median earnings for zombie firms fell by 67%, median earnings for healthy firms rose by 77%. Healthy firms also benefited from lower interest rates, where the interest payments for healthy firms declined by more than those for zombie firms (31% for healthy firms compared with 23% for zombie firms). Because of the increase in earnings and the decline in interest payments, the average interest coverage ratio for healthy firms saw growth of 159%.

Table 2

Characteristics of zombie and healthy firms, 2002, 2011 and 2019
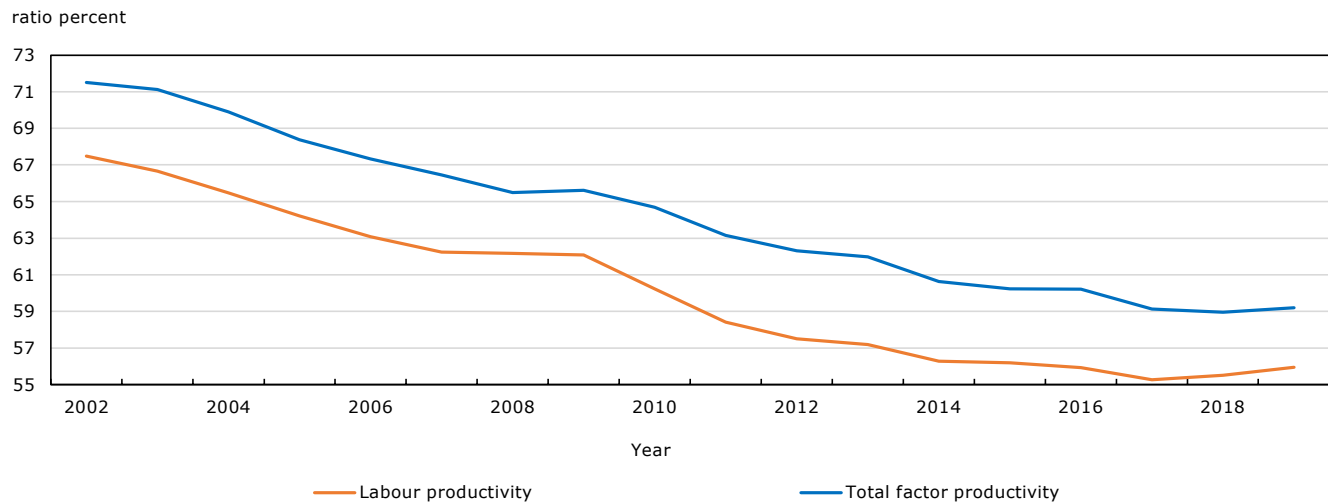
	Zombie firms			Healthy firms		
	2002	**2011**	**2019**	**2002**	**2011**	**2019**
	index (2002 = 1.00)					
All industries						
Mean age	1.00	1.13	1.20	1.00	1.31	1.39
Median interest payments	1.00	0.95	0.77	1.00	0.81	0.69
Median interest coverage ratio	1.00	0.51	0.11	1.00	1.85	2.59
Median earnings	1.00	0.36	0.33	1.00	1.45	1.77
Median earnings/capital	1.00	0.44	-0.08	1.00	1.59	2.57
Median earnings/payroll	1.00	0.33	0.04	1.00	1.50	1.90
Median earnings/sales	1.00	0.39	-0.17	1.00	1.58	2.14
All industries except mining, quarrying, and oil and gas extraction						
Mean age	1.00	1.13	1.21	1.00	1.31	1.39
Median interest payments	1.00	0.95	0.77	1.00	0.82	0.70
Median interest coverage ratio	1.00	0.51	0.11	1.00	1.84	2.60
Median earnings	1.00	0.36	0.33	1.00	1.46	1.78
Median earnings/capital	1.00	0.41	-0.08	1.00	1.59	2.57
Median earnings/payroll	1.00	0.31	0.08	1.00	1.49	1.90
Median earnings/sales	1.00	0.39	-0.17	1.00	1.57	2.15

Notes: This table presents the indexed value of the average age, earnings, interest payments and interest coverage ratio of firms. The average for age is the mean, while the average for the other variables is the median. Zombies are defined as per the Organisation for Economic Co-operation and Development (McGowan et al., 2017b).
Source: Statistics Canada, authors' calculations using the National Accounts Longitudinal Microdata File.

The decline in the health of zombies was also reflected in their productivity performance. Chart 4 presents the average productivity of zombie firms relative to healthy firms. Labour productivity and total factor productivity were lower for zombie firms and declining. Zombies were roughly 70% as productive as healthy firms in 2002, but that ratio has declined to roughly 55% to 60% in 2019.

Chart 4
Productivity of zombie firms relative to healthy firms, 2002 to 2019

ratio percent

Notes: This chart presents the average productivity of zombie firms relative to healthy firms. Labour productivity is ln(Value added/Payroll). Total factor productivity is ln(Value added) - *KS**lnCapital - *LS**lnPayroll, where *LS* = Sum(Payroll)/Sum(Value-added) for each sector *S* (three-digit North American Industry Classification System) and *KS* = 1 - *LS*. Zombies are defined as per the Organisation for Economic Co-operation and Development (McGowan et al., 2017b).
Source: Statistics Canada, authors' calculations using the National Accounts Longitudinal Microdata File.

When compared with other OECD countries, the productivity gap between zombie and healthy firms in Canada appears to be greater. McGowan et al. (2017b) show for a sample of OECD countries (Belgium, Finland, France, Italy, Korea, Spain, Sweden and the United Kingdom) that the labour productivity of zombie firms relative to healthy firms is roughly 80% in 2013, having declined from 88% in 2003.[12] Therefore, while the overall zombie share has been declining since 2011, it masks concerning trends that zombies are performing worse and becoming less productive, dragging down the overall performance of Canada's economy.

The worsening performance at the firm level may not be a significant issue if the overall presence of zombie firms in Canada is shrinking. While the count share has been declining since 2011, zombie firms have been getting larger over time. For instance, the capital share of zombie firms has consistently increased from 2002 to 2019, reaching a historical high of 8.3% in 2019, up from 3.1% in 2002 (data not shown). There has also been an increase in the labour share of zombie firms as measured by employment and payroll. For instance, the labour share as measured by employment increased from 3.6% in 2002 to 5.3% in 2019. These results imply that more capital and labour are being tied up into inefficient firms rather than being used by healthier and more productive businesses, dragging down aggregate productivity.

To understand how zombie firms impact other healthy firms in the economy, a regression linking the performance of healthy firms to the prevalence of zombies in an industry is estimated (Caballero et al., 2008; McGowan et al., 2017b). Table 3 presents estimates from the following regression:

$$Y_{it} = \beta_1 D_{it}^{Healthy} + \beta_2 D_{it}^{Healthy} Share_{jt} + \beta_3 lnPayroll_{it} + \beta_4 lnCapital_{it} + \beta_5 lnAge_{it} + \boldsymbol{S'T} + \varepsilon_{it}, \qquad (1)$$

12. The results from McGowan et al. (2017b) differ from those for Canada in two ways: (1) the labour productivity measure is based on gross output per employee versus the value added per payroll for Canada and (2) the ORBIS dataset, which differs in firm coverage and sample selection from the sample for Canada, is used. Therefore, the productivity results between Canada and the other OECD countries may be dependent on the labour productivity measure and the sample specification.

Where the i subscript represents firms, the j subscript represents industries and the t subscript represents years; the dependent variable Y is either labour productivity, total factor productivity, capital growth or payroll growth; the variable $D^{Healthy}$ is a dummy variable taking the value 1 if the firm is not classified as a zombie; $Share$ is either the industry capital or payroll share of zombies; $Payroll$ is the payroll of the firm; $Capital$ is the capital stock of the firm; Age is the age of the firm; S is a vector of industry dummies at the three-digit NAICS level; and T is a vector of year dummies. Labour productivity is the natural logarithm of value added divided by payroll. Total factor productivity is the natural logarithm of value added minus the weighted capital input (capital share of value added multiplied by the natural logarithm of capital) and minus the weighted labour input (payroll share of value added multiplied by the natural logarithm of the payroll), where the capital and the payroll share sum to 1.

Under this specification, the impact of zombie congestion on the relative performance of healthy firms can be estimated. Notice that by controlling for industry-specific time varying shocks by incorporating, $S'T$, it is not possible to estimate the absolute effect of zombies on healthy firm performance. Therefore, the results should be interpreted in a relative sense, i.e., how the performance of healthy firms changes relative to the performance of zombie firms when zombie congestion increases. Firm size and age are used to control for firm-specific characteristics.

Table 3
Firm-level performance regressions, all firms

Independent variable	Dependent variable							
	Labour productivity	Total factor productivity	Labour productivity	Total factor productivity	Capital growth	Payroll growth	Capital growth	Payroll growth
	coefficient							
$D^{Healthy}$	67.8***	68.0***	...	...	9.054***	11.36***	...	...
$D^{Healthy}$ × capital share (percent)	-0.267**	-0.222*	...	...	-0.0861	-0.136***	...	...
$D^{Healthy}$	...	...	69.0***	69.6***	...	...	9.593***	12.13***
$D^{Healthy}$ × Payroll share (percent)	...	...	-0.498***	-0.508***	...	...	-0.185***	-0.276***
Adjusted R-squared	0.268	0.410	0.268	0.410	0.012	0.030	0.012	0.030
Firm size and age controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

... not applicable

* significantly different from reference category ($p < 0.05$)

** significantly different from reference category ($p < 0.01$)

*** significantly different from reference category ($p < 0.001$)

Note: $D^{Healthy}$ is a dummy variable taking the value 1 if the firm is not classified as a zombie.

Source: Statistics Canada, authors' calculations using the National Accounts Longitudinal Microdata File.

The estimates show that zombie firms lower the productivity, as well as the capital and payroll growth, of healthy firms. Focusing on the estimates of $D^{Healthy}$, which represents a dummy for the healthy firm status, reveals that being a healthy firm implies higher productivity levels and higher growth rates of capital and payroll. This is to be expected. However, this better performance of healthy firms declines as the share of zombie capital, $D^{Healthy}$ multiplied by capital share, or the share of zombie payroll, $D^{Healthy}$ multiplied by payroll share, in an industry increases, representing congestion effects from zombie firms on healthy firms. These may be occurring through competition in input and output markets, as zombie firms would compete with healthy firms on credit, wages and output prices.[13]

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13. Acharya et al. (2020) document how markets with a higher share of zombie firms have higher input costs and lower product prices than markets with lower zombie shares. This is consistent with zombie firms competing on input and output prices with healthy firms.

To provide a sense of the magnitude of these impacts, based on the coefficient estimates, a 1 percentage point increase in the industry capital share of zombies decreases labour productivity, total factor productivity, capital growth and payroll growth of healthy firms by 0.267, 0.222, 0.0861 and 0.136 percentage points, respectively. The same increase in the industry payroll share of zombies decreases these four measures by 0.498, 0.508, 0.185 and 0.276 percentage points, respectively. If the aggregate zombie capital and payroll shares were to drop to zero from their levels of 8.3% and 5.1%, as calculated in 2019, the results imply that labour productivity, total factor productivity, capital growth and payroll growth of healthy firms would improve by 2.2, 1.8, 0.7 and 1.1 percentage points, respectively, for capital and 2.5, 2.6, 0.9 and 1.4 percentage points, respectively, for payroll.[14]

For the payroll share, the congestion effects appear greater in the labour market as the coefficient estimates on the payroll share are roughly twice as negative as those on the capital share, suggesting that labour hoarding by zombie firms is particularly onerous. This result highlights the multiple channels through which zombie firms can negatively impact the economy's overall performance. The literature has often focused on capital hoarding of zombies as a key issue. However, these results show that labour hoarding is likely as important, if not more so. Considering the labour shortages faced by Canada as it recovers from the COVID-19 pandemic, these results suggest that zombie firms may exacerbate labour shortages by hoarding labour away from healthy firms, making it more difficult for healthy firms to compete and grow. On an aggregate scale, this could reduce the economy's ability to recover from adverse shocks when zombie firms and labour shortages are present.

Taken together, the growing zombie presence in terms of capital and payroll shares, the lower and declining firm-level performance of zombie firms, and their negative impact on healthy firms' productivity and growth suggest that zombie firms could have a significant negative impact on aggregate productivity. This is confirmed in Chart 5, which presents the ratio of aggregate productivity between the original sample and one where zombie firms are removed. This is formulated by creating a representative firm in the economy for both samples and measuring aggregate labour productivity and total factor productivity. It is observed that the aggregate impact of zombie firms has been increasing and reached upwards of 5% in 2019, suggesting that eliminating zombie firms in Canada could raise aggregate productivity by roughly 5%. This substantial aggregate productivity loss is driven by these firms not exiting the economy.

Chart 5
Aggregate productivity excluding zombie firms relative to aggregate productivity with zombie firms, 2002 to 2019
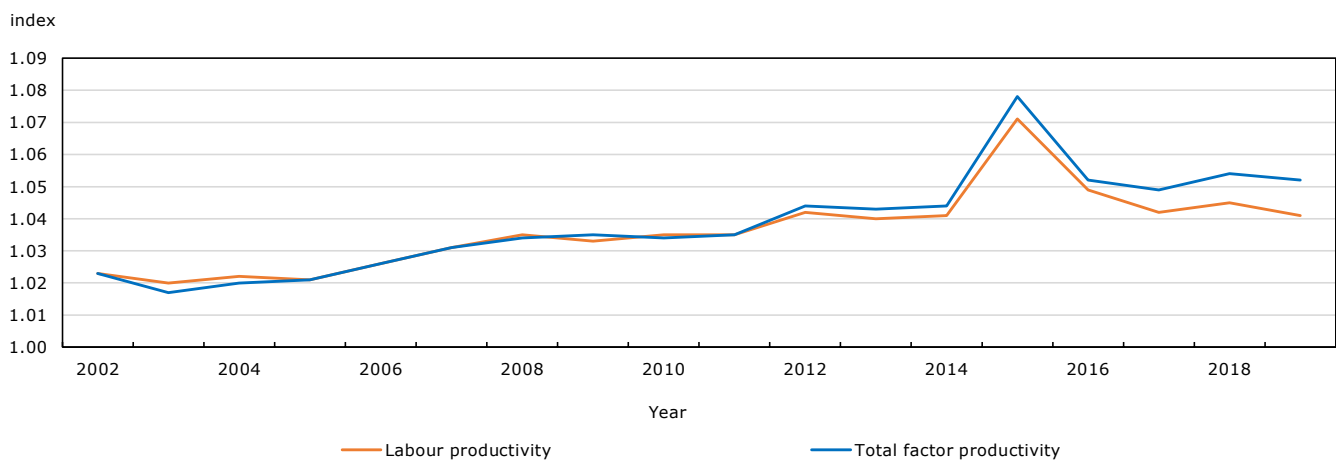
Notes: This chart presents the ratio of aggregate productivity between a sample without zombies and one with zombies. Aggregate labour productivity is ln(Sum(Value-added)/Sum(Payroll)). Aggregate total factor productivity is ln(Sum(Value-added)) - Mean(KS)*ln(Sum(Capital)) - Mean(LS)*ln (Sum(Payroll)), where LS = Sum(Payroll)/Sum(Value-added) for each sector S (three-digit North American Industry Classification System) and KS = 1 - LS. Zombies are defined as per the Organisation for Economic Co-operation and Development (McGowan et al., 2017b).
Source: Statistics Canada, authors' calculations using the National Accounts Longitudinal Microdata File.

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14. These are based on the reduced form estimates, which neglect general equilibrium effects.

Robustness

As shown in Table 1, the mining, quarrying, and oil and gas extraction sector is the one sector where the share of zombie firms is rising over the period, and this is consistent with lower commodity prices in 2011 to 2012 and in 2014 to 2016. Robustness checks were undertaken to examine the extent to which zombie firms in this sector are driving the results presented in the previous sections. To do this, some of the analysis is repeated excluding firms from the mining, quarrying, and oil and gas extraction sector.

First, the performance of zombie and healthy firms, excluding those from the mining, quarrying, and oil and gas extraction sector, is compared. The results are almost identical to those that include the sector. Although zombies benefit from lower interest rates and payments, their earnings deteriorate over the period, as does their interest coverage ratio. In comparison, there is growth in all earnings measures for healthy firms.

Second, assets, liabilities, employment, payroll and capital shares of zombie firms, excluding those from the mining, quarrying, and oil and gas extraction sector, are examined. Unlike the case with the performance measures, there are some larger differences when this sector is excluded. However, the overall findings are unchanged. The importance of zombies in terms of assets, liabilities, employment, payroll and capital still increases over time, but not by as much as when the sector is included. When it comes to assets, liabilities and capital, the increase in the importance of zombie firms is more subdued. By contrast, the increases in the zombie contribution to employment and payroll are comparable, with and without the sector. These findings are consistent with mining, quarrying, and oil and gas extraction being a capital-intensive sector.

To see whether the regression results were sensitive to the inclusion of the mining, quarrying, and oil and gas extraction sector, regression (1) is re-estimated excluding the sector. The coefficient estimates on the interaction between the healthy firm dummy and the share of zombies become more negative, suggesting that zombie firms outside mining, quarrying, and oil and gas extraction hurt the productivity and growth of healthy firms by an even greater magnitude. An increase of 1 percentage point in the capital share of zombies decreases labour productivity, total factor productivity, capital growth and payroll growth of healthy firms by 0.440, 0.386, 0.0966 and 0.134 percentage points, respectively. The same increase in the payroll share of zombies decreases these four measures by 0.673, 0.657, 0.199 and 0.297 percentage points, respectively. The coefficients on the payroll share continue to remain substantially more negative than the capital coefficients, confirming that labour hoarding by zombies is particularly damaging to healthy firms.

Finally, the aggregate impact on productivity without the mining, quarrying, and oil and gas extraction sector is calculated. A positive (though less steep) aggregate impact is found, reaching upwards of 3.8%. Unsurprisingly, the sharp spike in 2015 in Chart 5 disappears, indicating that this spike was because of the 2014 to 2016 oil price shock that predominately hurt firms in mining, quarrying, and oil and gas extraction.

Conclusion

This study finds that the zombie firm share in Canada is much lower than the estimates from the previous literature. The high incidence of zombification found in previous studies was because of a focus on publicly traded corporations. When all firms are considered, the incidence of zombie firms in Canada, at 5% to 7%, falls within the range of that reported for other OECD countries. This does not imply, however, that zombie firms do not have important economic consequences for Canada. While the share of zombies has fallen since 2011, their performance relative to healthy firms has been declining and the resources that they account for have been rising. The latter finding has particular importance because the regression evidence presented in this study shows that the increasing presence of zombies in an industry negatively impacts the productivity and growth of healthy firms.

Zombies were prevalent in all industries, but the share was highest (10.6%) in mining, quarrying, and oil, and gas extraction in 2019. Among publicly traded firms, the zombie share in mining, quarrying, and oil and gas extraction reached upwards of 50%. Both shares have risen substantially over time, roughly doubling since 2002. This suggests that the industry composition of zombie firms is becoming more concentrated in the commodity sector. Zombies were found on average to be older, employ fewer workers, make smaller investments and pay lower wages. The smaller size of zombies might suggest that they do not have aggregate consequences, but zombie firms have been getting larger over time. They have increased their aggregate share of capital and employment from roughly 3.1% and 3.6% in 2002 to 8.3% and 5.3% in 2019, respectively. This shows that zombie firms are increasingly using more resources over time.

When it comes to zombie persistence, zombification is a highly persistent process. Most zombie firms were persistently weak and zombies in the previous period. Around 69.1% of zombie firms remained a zombie from year to year. Noticeably, this transition probability increases each year a firm remained a zombie. By 10 consecutive zombie years, the probability of remaining a zombie increased to 86.3%. This zombification process is characterized by firms staying as zombies in a single spell, with upwards of 85% of zombie firms experiencing a single spell of consecutive zombie years. It is relatively rare to exit and re-enter zombie status. This suggests that firms can become trapped in a perpetual state where they do not exit the market or recover back to health.

Regression techniques developed by Caballero et al. (2008) and McGowan et al. (2017b) were used to estimate the impact of zombie firms on the performance of healthy firms within the same industries. Zombies were found to lower the productivity and growth of healthy firms, suggesting that zombie firms congest input and output markets. This implies that the presence of zombie firms creates negative externalities. Labour hoarding by zombies (as opposed to capital hoarding) is particularly burdensome on healthy firms, indicating that zombies could exacerbate labour shortages. Given the current labour shortages in Canada as it recovers from the COVID-19 pandemic, zombie firms could be undermining the ability of healthy firms to recover. The estimates show that a 1 percentage point increase in the industry capital share of zombies decreased labour productivity, total factor productivity, capital growth and payroll growth of healthy firms by 0.267, 0.222, 0.0861 and 0.136 percentage points, respectively. The same increase in the industry payroll share of zombies decreased these four measures by 0.498, 0.508, 0.185 and 0.276 percentage points, respectively.

In addition to lowering the productivity of other firms, zombies themselves have been performing worse. The performance and productivity of zombie firms relative to healthy firms have declined considerably, with relative productivity declining by roughly 10% since 2002. When compared with other OECD countries, the productivity gap between zombie and healthy firms in Canada appears to be greater, suggesting that Canadian zombie firms were particularly unhealthy. Because these zombies were also hoarding resources, zombie firms were increasingly lowering aggregate productivity in Canada, upwards of 5% in 2019. This is a substantial productivity loss that is driven by these firms not exiting the economy.

The study also shows that the findings are robust to the exclusion of the mining, quarrying, and oil and gas extraction sector. There were large swings in commodity and oil prices in the 2000s and 2010s, and this may have caused businesses in this industry to fall into zombie status temporarily. Given the large, fixed investments in this sector, it may be optimal for these firms to continue operating as zombies in anticipation of a recovery in prices. It would be interesting to study the persistence of zombies in this sector and whether they have exited out of zombie status with the recovery of oil prices in 2022.

The post-2019 period would also be of interest because of the COVID-19 pandemic. During the pandemic, subsidies were provided to firms that were heavily impacted by the effects of the pandemic. These subsidies helped businesses cope, but they could have also extended the life of zombie firms, where these firms would have exited the market in the absence of support. This line of research will be pursued in the future as data for this period become available.

References

Acharya, V. V. Crosignani, M. Eisert, T., & Eufinger, C. (2020). Zombie credit and (dis-)inflation: Evidence from Europe (No. w27158). National Bureau of Economic Research.

Acharya, V. V., Eisert, T., Eufinger, C., & Hirsch, C. (2019). Whatever it takes: The real effects of unconventional monetary policy. The Review of Financial Studies, 32(9):3366–3411.

Altman, E. I., Dai, R., & Wang, W. (2021). Global zombies. Available at SSRN: http://dx.doi.org/10.2139/ssrn.3970332

Andrews, D., Criscuolo, C., & Gal, P. (2016). The global productivity slowdown, technology divergence and public policy: A firm level perspective. Brookings Institution Hutchins Center Working Paper, 24.

Andrews, D. & Petroulakis, F. (2019). Breaking the shackles: Zombie firms, weak banks and depressed restructuring in Europe. Working Paper Series 2240, European Central Bank.

Bajgar, M., Berlingieri, G., Calligaris, S., Criscuolo, C., & Timmis, J. (2020). Coverage and representativeness of Orbis data. OECD Science, Technology and Industry Working Papers, No. 2020/06, OECD Publishing, Paris, https://doi.org/10.1787/c7bdaa03-en.

Banerjee, R., & Hofmann, B. (2018). The rise of zombie firms: Causes and consequences. BIS Quarterly Review September.

Banerjee, R., & Hofmann, B. (2020). Corporate zombies: Anatomy and life cycle. BIS Working Papers.

Bittner, C., Fecht, F., & Georg, C.-P. (2021). Contagious zombies. Discussion Papers 15/2021, Deutsche Bundesbank.

Blattner, L., Farinha, L., & Rebelo, F. (2019). When losses turn into loans: The cost of undercapitalized banks. ECB Working Paper No. 2228, Available at SSRN: http://dx.doi.org/10.2139/ssrn.3366998

Caballero, R. J., Hoshi, T., & Kashyap, A. K. (2008). Zombie lending and depressed restructuring in Japan. American Economic Review, 98(5):1943–77.

Carpentier, C., & Suret, J. M. (2011). The survival and success of Canadian penny stock IPOs. Small Business Economics, 36(1), 101–121.

Carpentier, C., & Suret, J. M. (2012). Entrepreneurial equity financing and securities regulation: An empirical analysis. International Small Business Journal, 30(1), 41–64.

Carreira, C., Teixeira, P., & Nieto-Carrillo, E. (2022). Recovery and exit of zombie firms in Portugal. Small Business Economics, 59(2):491–519.

Chen, Y., & Tombe, T. (2020). The aggregate productivity effect of labour and capital market distortions in Canada. Revision Requested, Canadian Journal of Economics, 2020.

Decker, R., Haltiwanger, J., Jarmin, R., & Miranda, J. (2014). The role of entrepreneurship in US job creation and economic dynamism. Journal of Economic Perspectives, 28(3):3–24.

Deloitte (2018). The infinite organization: Realizing lasting success. https://www2.deloitte.com/content/dam/Deloitte/ca/Documents/fcc/The-infinite-organization-EN-WEB.pdf

De Martiis, A., Heil, T., & Peter, F. J. (2021). Are you a zombie? A supervised learning method to classify unviable firms and identify the determinants. Available at SSRN: http://dx.doi.org/10.2139/ssrn.3625473

De Martiis, A., & Peter, F. J. (2021). When companies don't die: Analyzing zombie and distressed firms in a low interest rate environment. Available at SSRN: http://dx.doi.org/10.2139/ssrn.3890788

Favara, G., Minoiu, C., & Perez-Orive, A. (2021). U.S. zombie firms: How many and how consequential? FEDS Notes 2021-07-30-2, Board of Governors of the Federal Reserve System.

Gopinath, G., Kalemli-Özcan, S., Karabarbounis, L., & Villegas-Sanchez, C. (2017). Capital allocation and productivity in South Europe. The Quarterly Journal of Economics, 132(4):1915–1967.

Gouveia, A. F., & Osterhold, C. (2018). Fear the walking dead: Zombie firms, spillovers and exit barriers. OECD Productivity Working Papers, No. 13, OECD Publishing, Paris, https://doi.org/10.1787/e6c6e51d-en

Greenspon, J., Stansbury, A., & Summers, L. H. (2021). Productivity and Pay in the United States and Canada. International Productivity Monitor, (41), 3–30.

Grieder, T., Khan, M., Ortega, J., & Symmers, C. (2021). COVID-19's impact on the financial health of Canadian businesses: An initial assessment. Bank of Canada. Staff Analytical Note 20218. https://www.bankofcanada.ca/2021/05/staff-analytical-note-2021-8/

Grieder, T., & Lipsitz, M. (2018). Measuring vulnerabilities in the non-financial corporate sector using industry-and firm-level data. Bank of Canada. Staff Analytical Note 2018-17. https://doi.org/10.34989/san-2018-17

Grieder, T., & Ortega, J. (2020). A financial stability analysis of zombie firms in Canada. Bank of Canada. Staff Analytical Note 2020-3. https://doi.org/10.34989/san-2020-3

Gu, W. (2019). Frontier firms, productivity dispersion and aggregate productivity growth in Canada. International Productivity Monitor, (37):96 119.

Hoshi, T. (2006). Economics of the living dead. The Japanese Economic Review, 57(1), 30–49.

Kwon, H. U., Narita, F., & Narita, M. (2015). Resource reallocation and zombie lending in Japan in the 1990s. Review of Economic Dynamics, 18(4):709–732.

MacDonald, R. (2014). Business entry and exit rates in Canada: A 30-year perspective. Economic Insights 11-626-X, No. 038. Statistics Canada.

McGowan, M. A., Andrews, D., & Millot, V. (2017a). Insolvency regimes, zombie firms and capital reallocation. OECD Economics Department Working Papers, No. 1399, OECD Publishing, Paris, https://doi.org/10.1787/5a16beda-en

McGowan, M. A., Andrews, D., & Millot, V. (2017b). The walking dead? Zombie firms and productivity performance in OECD countries. OECD Economics Department Working Papers, No. 1372, OECD Publishing, Paris, https://doi.org/10.1787/180d80ad-en

Nurmi, S., Vanhala, J., & Virén, M. (2020). The life and death of zombies - Evidence from government subsidies to firms. Bank of Finland Research Discussion Paper, (8).

Ollivaud, P., Guillemette, Y., & Turner, D. (2016). Links between weak investment and the slowdown in productivity and potential output growth across the OECD. OECD Economics Department Working Papers, No. 1304, OECD Publishing, Paris, https://doi.org/10.1787/5jlwvz0smq45-en

Peek, J., & Rosengren, E. S. (2005). Unnatural selection: Perverse incentives and the misallocation of credit in Japan. American Economic Review, 95(4):1144–1166.

Robson, W. B. (2019). Thin Capitalization: Weak Business Investment Undermines Canadian Workers. C. D. Howe Institute Commentary, 550.

Robson, W. B., & Bafale, M. (2022). Investment Threatens Canadian Prosperity. C. D. Howe Institute Commentary, 625.

Robson, W. B., & Wu, M. (2021). Declining Vital Signs: Canada's Investment Crisis. C. D. Howe Institute Commentary, 606.

Schivardi, F., Sette, E., & Tabellini, G. (2017). Credit misallocation during the European financial crisis. Bank of Italy Working Paper.

Sharpe, A., & Ashwell, J. (2021). The Evolution of the Productivity-Median Wage Gap in Canada, 1976-2019. International Productivity Monitor, (41), 98–117.

Sharpe, A., & Tsang, J. (2018). The stylized facts about slower productivity growth in Canada. International Productivity Monitor, (35):52–72.

Statistics Canada. (2021). Table 33-10-0164-01, Business dynamics measures, by industry.

Storz, M., Koetter, M., Setzer, R., & Westphal, A. (2017). Do we want these two to tango? On zombie firms and stressed banks in Europe. ECB Working Paper No. 2104, Available at SSRN: http://dx.doi.org/10.2139/ssrn.3052072

Williams, D. M. (2021). Pay and Productivity in Canada: Growing Together, Only Slower than Ever. International Productivity Monitor, (40), 3–26.