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Firm Performance, Business Supports and Zombification over the Pandemic

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**Firm Performance, Business Supports and Zombification over the Pandemic
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Adapted from Statistics Canada. Did the COVID-19 pandemic zombify the economy? A look at zombie firms. *Economic and Social Reports*. (2025). This does not constitute an endorsement by Statistics Canada of this product.

ABSTRACT: Did the COVID-19 pandemic zombify the economy? Commentators have pointed to the pandemic and related business support measures potentially fueling zombification. Using administrative data covering the universe of Canadian firms, we find a broad-based decline in the share of zombie firms across industries relative to pre-pandemic levels. Whereas business support measures kept firms alive and operating as non-zombie firms, the decline in the zombie firm share was caused by would-be zombie firms exiting, indicative of the pandemic's cleansing effects. As a consequence, while aggregate labour productivity worsened in Canada over the pandemic, it was not driven by zombie firms.

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1 Introduction

Zombie firms are businesses that persistently perform poorly over time without exiting, and their share in the economy has been rising over time across many countries.¹ They negatively impact economic growth as they tend to be unproductive and compete with other healthy firms for scarce resources. For Canada, while the share of zombie firms was falling leading up to the pandemic, these firms were becoming less productive over time, were negatively impacting healthy firms, and were increasingly lowering aggregate productivity by upwards of five percent in 2019 (Amundsen et al., 2023).

Commentators on the COVID-19 pandemic have spurred concern that further zombification may have occurred. The experience of the pandemic is unique from previous downturns because of the unprecedented amount of support offered to businesses (IMF 2020a, 2020b, 2020c).² The OECD (2020, 2021), the G30 (2020) and the EBRD (2022) noted that the scale and swift implementation of pandemic-related measures had the potential to accelerate zombification and constrain the post-pandemic recovery. Canada presents a good benchmark for this scenario given the widespread implementation of supports, such as the Canada Emergency Wage Subsidy (CEWS), the Canada Emergency Commercial Rent Assistance (CECRA), the Canada Emergency Rent Subsidy (CERS), and the Canada Emergency Business Account (CEBA). These programs had wide uptake and impacted over a million business recipients (Hoffarth and Lin, 2023).

Evidence at the aggregate level shows that labour productivity in the business sector in Canada has been declining since 2020,³ and this has prompted growing interest in understanding the role of different contributing factors.⁴ One factor is the potential long-term effects of the economic downturn. Barlevy (2002) argues that recessions can have a sully effect whereby worker-firm match quality declines, for example due to lower labour mobility, leading to greater misallocation. Alternatively, in the spirit of Schumpeter (1939, 1942), Caballero and Hammour

¹ See Peek and Rosengren (2005), Hoshi (2006), Caballero et al. (2008), Giannetti and Simonov (2013), Kwon et al. (2015), Storz et al. (2017), Banerjee and Hofmann (2018), Acharya et al. (2019), Kulkarni et al. (2019), De Martiis and Peter (2021), El Ghouli et al. (2021), Favara et al. (2021), Hu and Varas (2021), Acharya et al. (2022), Banerjee and Hofmann (2022), Becker and Ivashina (2022), Brunner et al. (2022), Jordà et al. (2022), Schivardi et al. (2022), Albuquerque and Mao (2023), Álvarez et al. (2023), Bittner et al. (2023), Bonfim et al. (2023), De Martiis et al. (2023), Havemeister and Horn (2023), Acharya et al. (2024), Altman et al. (2024), De Jonghe et al. (2024), Faria-e-Castro et al. (2024), Favara et al. (2024), Rocheteau (2024), Tuuli (2024), and Yamada et al. (2025).

² See Gourinchas et al. (2020), Laeven et al. (2020), Zoller-Rydzek and Keller (2020), Cirera et al. (2021), Gourinchas et al. (2021a), Lalinsky and Pál (2021), Battersby et al. (2022), Chundakkadan et al. (2022), Dörr et al. (2022), Piette and Tielens (2022), Altavilla et al. (2023), Di Nola et al. (2023), Franco et al. (2023), and Acosta-Henao et al. (2024).

³ Statistics Canada. Table 36-10-0480-01. Labour productivity and related measures by business sector industry and by non-commercial activity consistent with the industry accounts. Accessed on August 5, 2024.

⁴ See Wang (2021), Haun and Sargent (2023), Devakos et al. (2024), and Doyle et al. (Forthcoming).

(1994, 1996) argue that downturns can have a cleansing effect on the economy, whereby the least productive firms exit, and their resources are made available to more productive firms. On net, it is an empirical question about which mechanism dominates. Haltiwanger et al. (2021) found that in previous recessions in the United States, the cleansing effect dominates at first but then the sully effect takes over and lasts longer.

This paper explores the contributing factors to lower aggregate labour productivity by focusing on whether this was related to the prevalence of zombie firms, whether this was related to the uptake of business support programs, and whether this was related to lower firm performance. The paper is the first to evaluate the pandemic's impact on zombie firms using administrative data up to 2022 covering the universe of firms. We contribute to the literature by building on past papers that have explored the zombie firm phenomenon among pre-pandemic firms, or listed/surveyed firms, or the early stages of the pandemic. The paper is most closely related to two streams in the literature that find alternative results: i) those that show business supports may not have been well targeted and zombification may have risen (Albuquerque and Iyer, 2024; Banerjee et al., 2024; Seo et al., 2024; Makabe and Yagi, 2024; Hong et al., 2022; Hoshi et al., 2023; Honda et al., 2023; Morikawa, 2023; Kozeniauskas et al., 2022); and ii) those that show business supports did not go to pre-pandemic zombie or weak firms and cleansing effects were present (Akarsu et al., 2024; Banerjee and Ćirjaković, 2024; Pelosi et al., 2021; Bighelli et al., 2022; Lalinsky et al., 2024; Gourinchas et al., 2021b; Harasztosi et al., 2022; Konings et al., 2023; Davies et al., 2023; Cros et al., 2021; Bloom et al., 2023; Muzi et al., 2023; Leung and Liu, 2022).

As various zombie firm definitions exist in the literature, we focus on the one described in McGowan et al. (2018), who define zombie firms as having earnings before interest and taxes less than their interest payments (interest coverage ratio less than one) for three consecutive years and as being at least 10 years old. This definition has been well utilized in the literature, and represents poorly performing mature firms that do not exit. Its three-year requirement aligns with the pandemic's impact in 2020 for new zombie firms in 2022. While the earnings-based requirement is affected by the uptake of the business support programs, since these programs were typically recorded as subsidies and grants under total revenue, the programs had mostly concluded by end-2021, and thus the dynamics for zombification are only partially affected, while those for productivity are not affected in 2022.⁵ However to compensate, we focus the analysis on three-year transitions, comparing the transition of zombie and non-zombie firms between

⁵ There remains some ambiguity on whether the uptake of support mechanically increases earnings. For example, the CEWS was a partial wage subsidy for firms which required them to maintain their employees. In cases where the pandemic's shock was severe, earnings in a counterfactual scenario may have been higher by laying off workers.

Unlike the other support measures, the CEBA provided an interest-free loan and allowed firms to pay back the amount without penalty up to 2024. For firms with an outstanding balance during the pandemic, this would imply lower interest payments compared to the alternative of obtaining credit through other means.

2019 to 2022 to three-year transitions in the past. Also, as a robustness check, we calculate the zombie shares with five alternative definitions to ensure our results are not being driven by the specific measure. These include the McGowan et al. (2018) definition but augmented with the consecutive years criteria set to two years; the McGowan et al. (2018) definition but augmented to require the interest coverage ratio to be greater than one for two consecutive years to exit zombification; the McGowan et al. (2018) definition but augmented for three non-consecutive years to allow for firms to temporarily cease operations; the Albuquerque and Iyer (2024) definition, where for two consecutive years the interest coverage ratio is below one, the leverage ratio is above the median firm in the industry, the real sales growth is negative, and one of the three indicators must be reversed for two consecutive years to exit zombification; and the Storz et al. (2017) definition, where for two consecutive years the return on assets is negative, earnings is low relative to debt, and net investment is zero or negative. We find across all specifications, the share of zombie firms declines over the pandemic, providing support that the decline is robust and persistent.⁶

Our findings are as follows. i) The zombie firm share declined over the pandemic, and this was broad-based across industries. ii) Zombie and non-zombie firms were more likely to exit over the pandemic, and the decline in the zombie firm share was due to the exit of non-zombie firms that traditionally would have entered zombie status. iii) The main factor behind the higher firm exits and fewer transitioning non-zombie firms was the industry and aggregate shocks of the pandemic, representative of cleansing effects. iv) Pandemic-related business support measures helped firms to survive and remain/transition into non-zombie status. v) Firm productivity declined over the pandemic, and the primary factor for the deterioration in aggregate labour productivity was the within-firm contribution of non-zombie firms, with zombie firms having a limited contribution and firms that received support having a positive contribution.

Taken together, the results show that zombie firms did not proliferate, and government support programs did not contribute to them. In fact, the opposite was true. Firms that received support became healthier, had a lower probability of exit, and contributed positively to changes in aggregate labour productivity. This highlights the important role of government supports going forward to address future economic shocks. Broad, but targeted, support measures can be a useful tool without compromising the traditional cleansing effects that encourage creative destruction.

⁶ The zombie share results for the first three augmented definitions are provided in Figure A1, Figure A2 and Figure A3 in the Appendix, while the results for the Albuquerque and Iyer (2024) definition are provided in Figure 1b and the results for the Storz et al. (2017) definition are provided in Figure 1c.

2 Related Literature

Two strands of the literature have found mixed evidence on whether the pandemic and related business support measures helped to propagate or cleanse zombie and weak firms.

On the one hand, a series of papers have found evidence that zombification may have risen, with support measures being inefficiently targeted. Albuquerque and Iyer (2024) found that the zombie share of firms was higher in 2022 compared to 2019 for publicly traded firms in a cross-country analysis, while Banerjee et al. (2024) and Seo et al. (2024) found a similar result for 2023 in several advanced economies and South Korea, respectively. Makabe and Yagi (2024) found that the zombie firm share among small and medium-sized enterprises had risen slightly in Japan in 2022 compared to 2019. Hong et al. (2022) found that zombification rose in Japan in 2020 relative to previous periods, with this partly being driven by lower exit rates. Hoshi et al. (2023) found that firms with low credit scores in 2019 in Japan were more likely to apply for and receive support. Honda et al. (2023) found that Japanese firms classified as zombie firms before the pandemic were more likely to receive assistance, while Morikawa (2023) found that Japanese firms that used supports had lower productivity and wages in the years leading up to the pandemic. Kozeniauskas et al. (2022) found for Portugal that the exit rate of less productive firms did not rise and these firms were more likely to take up support measures.

On the other hand, a series of papers have found alternative results, where supports did not go towards pre-pandemic zombie or weak firms and cleansing effects were present. Akarsu et al. (2024) found a lower zombie share among Turkish firms in 2022 compared to 2019. Pelosi et al. (2021) found that pre-pandemic zombie firms in Italy were less likely to take up pandemic supports than other firms, while Bighelli et al. (2022), Lalinsky et al. (2024) and Banerjee and Ćirjaković (2024) found a similar result in other European countries. Gourinchas et al. (2021b) showed in a cross-country analysis that although business supports were inefficiently targeted, pre-pandemic zombie firms accounted for only two percent of funds disbursed. Harasztosi et al. (2022) found across the European Union that low liquidity firms received more support, and this was not related to worse pre-pandemic characteristics. Konings et al. (2023) found in Flanders that support measures helped firms to avoid exit and had temporarily increased their productivity. Davies et al. (2023) found in the Netherlands that viable firms used pandemic supports more often than unviable ones. Cros et al. (2021) found in France that factors predicting firm failures operated similarly in 2020 than it did in 2019. Bloom et al. (2023) found for the United Kingdom that reductions in within-firm total factor productivity were partially offset by the contraction of less productive firms, while Muzi et al. (2023) showed in a cross-country analysis that less productive firms had a higher probability of closing permanently. Leung and Liu (2022) found for Canada that less productive firms had higher exit rates and there was not a

strong relationship between productivity and the use of supports between October 2020 to March 2021.

In summary of these studies, the proliferation of zombie firms appears to depend on a number of factors. i) Zombification among publicly traded firms shows divergent trends over the pandemic compared to private firms. ii) The results vary across countries, where supports were allocated towards relatively weak firms in Japan versus viable firms in Europe. This may reflect country-specific factors such as the design of the business support programs or the pandemic's heterogenous impact across countries. iii) Several studies have focused on pre-pandemic firms or the early stages of the pandemic. To the best of our knowledge, recent studies exploring zombie firms have not yet explored the pandemic's impact on their dynamics, such as the transitions between zombie, non-zombie and exit status, and how these interact with business support programs. This paper aims to fill this gap by analyzing the entire pandemic period using the universe of firms and linking the results to developments in aggregate labour productivity.

3 Data

The dataset we employ is the National Accounts Longitudinal Microdata File from Statistics Canada. This dataset covers the universe of Canadian firms, and includes all firm sizes, all industries, and both private and publicly traded firms. Its comprehensiveness allows us to accurately measure entry and exit, which will prove useful for evaluating the cleansing effects of the pandemic.

Since the dataset is administrative, it requires some restrictions. We impose: i) firms must have positive payroll; ii) firms must have tax filing periods that span a year; and iii) firms must not belong to the management of companies and enterprises or public administration. In total, these restrictions can be considered lenient, with the sample encompassing over 16 million observations between 2002 to 2022, representing the population of incorporated employer firms in Canada. It is one of the most comprehensive datasets to date in the zombie firm literature.

To evaluate the impact of the business support programs, we link the dataset with program data to identify which firms received the CEWS, CECRA, CERS and CEBA. The CEWS was a subsidy for eligible businesses, charities and non-profits covering salary, wages, certain taxable benefits and fees/commissions of up to 75% of the remuneration paid or a maximum of \$847 per week per employee. The CECRA was a subsidy for eligible businesses, charities and non-profits covering part of the monthly rent payments for commercial property between the months of April and September 2020. The CERS was a subsidy for eligible businesses, charities and non-profits covering real or immovable property that does not generate primarily rental income. The CEWS, CECRA and CERS had revenue eligibility requirements that required revenue to be lower than in pre-pandemic periods. The CEBA was an interest-free loan for eligible businesses and non-profits of up to \$60,000, whereby repaying the loan before the specified due date would result in loan forgiveness of up to \$20,000 (Hoffarth and Lin, 2023).

In terms of dollars received across all programs, the CEWS made up 62.1 percent, the CECRA made up 1.3 percent, the CERS made up 4.8 percent, and the CEBA made up 27.1 percent. In terms of all program recipients, 42.3 percent received the CEWS, 4.2 percent received the CECRA, 21.1 percent received the CERS, and 84.5 percent received the CEBA (Hoffarth and Lin, 2023).⁷ Each of the four programs had concluded by end-2021, while the repayment deadline to maintain the loan forgiveness portion of the CEBA ended in 2024.

While self-selection into the program is a potential concern, we conjecture that once controlling for other firm characteristics, the broad but targeted eligibility requirements towards weaker

⁷ Including incorporated and unincorporated businesses and partnerships.

firms over the pandemic provides some assurance against this issue. This is supported by the results which show that the program supports increased the transition probability into non-zombie status and lowered the probability of exit, both positive outcomes which run counter to the expected outcome of weaker firms.

To evaluate the impact on aggregate labour productivity, we employ the Griliches and Regev (1995) decomposition, which breaks down changes in aggregate labour productivity into contributions from the entry, exit and survival of firms. We adapt the decomposition into zombie and non-zombie firm components to highlight each dynamic. All items are in real terms using a business sector GDP deflator.⁸

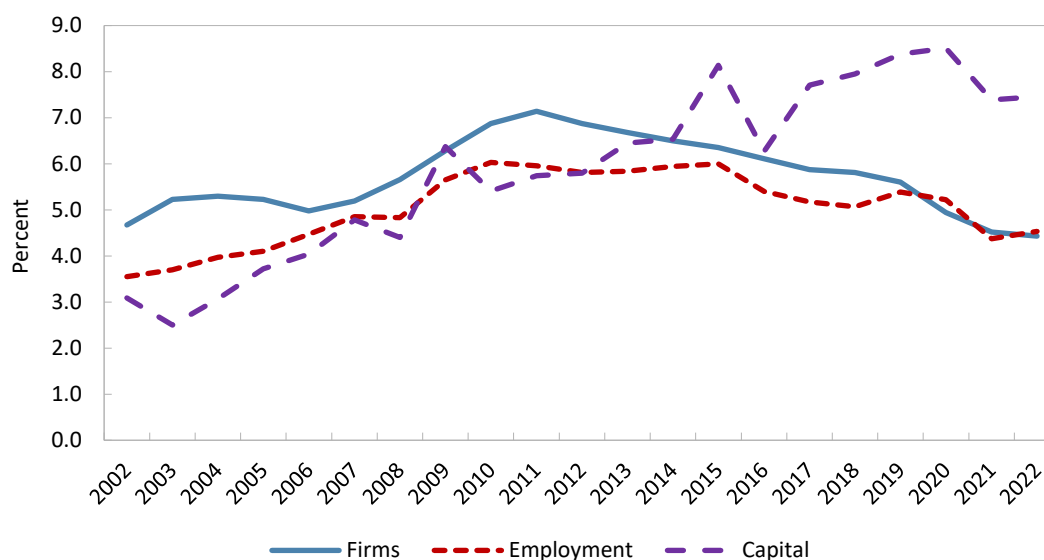
⁸ At the time of writing this paper, industry-level GDP deflators were only available up to 2020.

4 Results

4.1 The zombie firm share declined over the pandemic

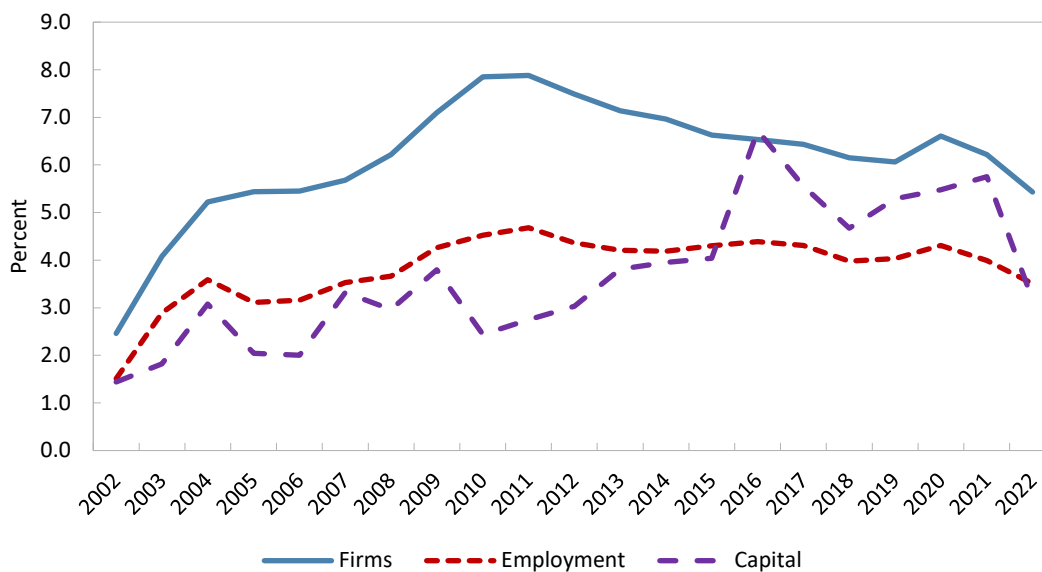
We begin the analysis by examining the prevalence of zombie firms over the pandemic. Since 2002, the share of zombie firms in Canada hovered around five to seven percent, peaked in 2011, and declined after that till 2019. Over the pandemic, Figure 1a shows that the share has continued to decline. Between 2011, 2019 and 2022, the share of zombie firms fell from 7.1 to 5.6 to 4.4 percent, respectively. This decline is accompanied by corresponding declines in the zombie employment shares and zombie capital shares. Between 2019 and 2022, the zombie employment share fell from 5.4 to 4.5 percent, while the zombie capital share fell from 8.4 to 7.5 percent. The capital share, however, remains elevated compared to historical levels. In Figure 1b and Figure 1c, we present the same shares under the Albuquerque and Iyer (2024) and Storz et al. (2017) zombie firm definitions. We find similar dynamics. The share of zombie firms rises and falls historically and over the pandemic falls below pre-pandemic levels. The labour and capital shares also fall or are flat, and their overall levels are lower than the share of zombie firms, highlighting that zombie firms under these definitions are relatively small in size compared to those under McGowan et al. (2018). Overall, the results highlight that the pandemic did not lead to a mass proliferation of zombie firms that might have inhibited the post-pandemic recovery. Given the similarity across definitions, we focus on the McGowan et al. (2018) definition for the remaining analysis.

Figure 1a. Zombie firm share, McGowan et al. (2018)



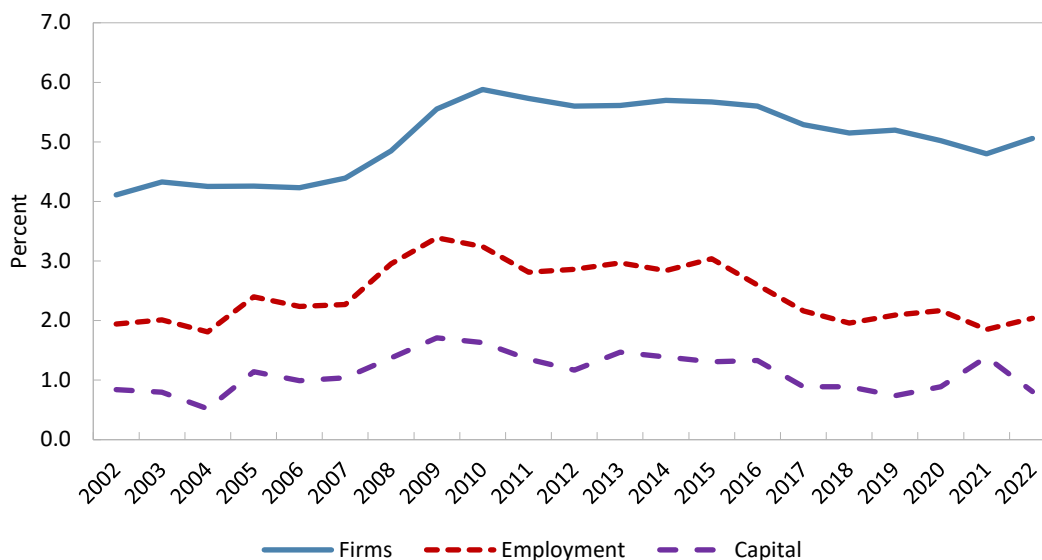
Source: Statistics Canada; authors' calculations using the National Accounts Longitudinal Microdata File.

Figure 1b. Zombie firm share, Albuquerque and Iyer (2024)



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

Figure 1c. Zombie firm share, Storz et al. (2017)



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

The declining prevalence at the aggregate level is reflective of within industry dynamics. Table 1 presents the zombie firm share by industry. Across all industries, there is a decline in the share of zombie firms. The largest percentage point declines occurred in arts, entertainment and recreation (9.0 to 6.0 percent) and retail trade (6.5 to 4.1 percent). Notably, these two sectors were particularly hard-hit during the pandemic as they depended more on face-to-face contact, and thus were relatively affected by the lockdown restrictions. Conversely, in healthcare and social assistance, the zombie firm share declined by only 0.02 percentage points. These changes in the shares point to the pandemic's heterogeneous and uneven impact across sectors.

The results for the zombie employment and capital shares also show declines across most industries. However, there are some exceptions. The employment shares of zombie firms increased in educational services; arts, entertainment and recreation; and transportation and warehousing, while the capital shares increased in transportation and warehousing; arts, entertainment and recreation; health care and social assistance; and accommodation and food services.

The decline in the prevalence of zombie firms but the increase in their employment and capital shares can be explained by: i) surviving zombie firms growing faster than non-zombie firms; ii) the exit of smaller than average zombie firms and the exit of larger than average non-zombie firms; or iii) the replacement of existing zombie firms with non-zombie firms that are larger on average. Of these factors, we find that the transition from non-zombie to zombie status is by far the most important factor since 2019. Although not presented, we investigate counterfactual zombie shares under different scenarios, for example, if only the employment of surviving zombie and non-zombie firms were allowed to change, if only the exit of zombie and non-zombie firms occurred, etc. We find that the transition of large non-zombie firms into zombie status explains the increase in the industry employment and capital shares in 2022. This indicates that over the pandemic, compositional effects occurred, where even though the share of zombie firms declined across industries, the pandemic led to firms of different sizes entering zombie status.

Table 1. Zombie firm share by industry

Industry	Firms			Employment			Capital		
	2002	2019	2022	2002	2019	2022	2002	2019	2022
	Percent								
Agriculture, forestry and fishing and hunting	4.2	5.9	3.8	4.4	5.3	4.3	3.4	4.4	2.5
Mining, quarrying, and oil and gas extraction	5.2	10.6	9.3	5.5	14.9	8.1	4.2	22.2	5.4
Construction	4.5	5.3	4.3	2.9	4.0	2.9	3.5	4.7	3.2
Manufacturing	5.0	7.3	5.6	3.2	5.5	3.5	2.3	2.6	2.3
Wholesale trade	4.8	7.4	5.6	2.7	4.1	3.4	1.4	3.6	2.6
Retail trade	5.0	6.5	4.1	2.5	6.0	2.2	1.8	5.6	2.7
Transportation and warehousing	4.3	4.3	3.4	4.8	6.7	9.6	2.7	20.8	44.9
Information and cultural industries	4.1	7.2	5.7	4.2	10.3	6.5	3.0	8.5	2.0
Finance and insurance	4.5	5.2	4.5	3.1	3.2	1.8	0.9	2.9	1.8
Real estate and rental and leasing	6.6	7.7	6.5	5.8	6.9	5.4	8.2	4.9	4.2
Professional, scientific and technical services	3.4	4.8	4.1	3.5	5.3	5.0	2.9	14.0	7.3
Administrative and support	4.4	5.8	4.9	2.5	4.0	3.0	1.8	3.9	3.3
Educational services	3.8	6.3	6.0	5.2	7.8	13.5	4.6	8.8	1.0
Health care and social assistance	2.6	1.8	1.8	3.7	3.5	3.6	2.4	3.2	4.8
Arts, entertainment and recreation	6.2	9.0	6.0	5.8	10.3	13.6	5.7	10.9	19.0
Accommodation and food services	5.2	6.3	5.7	4.6	5.1	4.9	3.8	4.7	5.7
Other services	6.4	6.9	5.5	5.7	6.0	4.0	7.8	5.0	4.1

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

4.2 Zombie firms were more likely to exit over the pandemic

To evaluate the factors driving the lower zombie firm share, in Table 2, we examine the probability of transitioning between zombie and non-zombie status and exiting the economy. For the average of all three-year transition rates between 2002 and 2019, a zombie firm had a 24.5 percent chance of remaining a zombie firm three years later, a 46.7 percent chance of becoming a non-zombie firm, and a 28.8 percent chance of exiting. By comparison, for the three-year transition period between 2019 and 2022, zombie firms were less likely to remain as zombie firms at 19.3 percent. This decline in persistence is entirely due to a greater exit rate of 34.4 percent since the transition probability from zombie to non-zombie status also fell from 46.7 to 46.4 percent. This shows that compared to historical trends, zombie firms over the pandemic had a lower probability of recovering and a higher probability of exiting the economy.

For non-zombie firms between 2019 and 2022, they also had a lower persistence of remaining as a non-zombie firm, a lower transition probability to becoming a zombie firm, and a higher exit rate compared to historical trends. However, their exit rate did increase less (2.7 percentage points) compared to zombie firms (5.5 percentage points). Taken together, the evidence shows that over the pandemic, cleansing effects were present. Canadian firms were exiting at a greater rate, with zombie firms more so.

Table 2. Three-year transition matrix

	Status in year t+3		
	Non-zombie	Zombie	Exit
	Percent		
Status in year t			
Non-zombie	73.9	5.0	21.2
Zombie	46.7	24.5	28.8
Status in 2019			
Non-zombie	72.8	3.3	23.9
Zombie	46.4	19.3	34.4
	Percentage points		
Difference			
Non-zombie	-1.0	-1.7	2.7
Zombie	-0.3	-5.2	5.5

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

Note: The period between t and t+3 is the average of all three-year transition rates between 2002-2019.

4.3 The declining zombie firm share is due to the exit of would-be zombie firms

Although the most notable difference compared to the pre-pandemic trends is the higher exit rate of zombie firms over the pandemic, this is not the primary factor for the declining zombie firm share. In Table 3, we measure the impact of changing each element of the transition matrix on the share. When the pre-pandemic transitions are applied to the stock of firms in 2019, a share of 6.0 percent is found. This shows that if the transitions remained the same as historically, the zombie firm share would have increased from 5.6 to 6.0 percent between 2019 and 2022, instead of falling to 4.4 percent over the pandemic.

To determine which transitions are responsible for the declining zombie firm share, for each transition category, we adjust individually the probability to reflect the actual transitions that occurred between 2019 and 2022. For the remaining transitions in each row, to maintain the sum of probabilities equal to one, we create three scenarios: i) the probability is equally distributed in proportions to the other two transitions; ii) the entire probability is shifted to one of the other

transitions (creating either an upper or lower bound); and iii) the entire probability is shifted to the other transition (creating the corresponding upper or lower bound).⁹

Making the change to the zombie firm exit rate yields a predicted zombie firm share of 5.9 percent, with a lower bound of 5.7 percent and an upper bound of 6.0 percent. This is far from the 4.4 percent of actual zombie firms in 2022. This small downward impact is due to zombie firms making up a small fraction of firms in the population, and so changes in their transitions are not influential.

Looking across the results in Table 3, the most prominent factor in accounting for the decline in the zombie firm share in 2022 is the lower transition probability of non-zombie to zombie status. The bounds on the share in this case range from 4.5 to 4.6 percent. Given the size of the non-zombie firm population, a small change in their transition rates have a large impact on the zombie firm share. This lower transition into zombie status correspondingly implies either their transition into non-zombie status or their exit is responsible for the change in the share. When the higher exit rate of non-zombie firms is simulated, we find only in the case when the transition into zombie status is decreased does it lower the share to 3.7 percent. In other words, the zombie firm share declined over the pandemic because of the exit of non-zombie firms that traditionally would have entered zombie status. This indicates that over the pandemic, non-zombie firms that were impacted essentially skipped over zombification and directly exited the economy.

⁹ For example, in the first scenario, the impact of the increase in the zombie exit rate over the pandemic is assessed by increasing the zombie to exit probability by 5.5 percentage points in the transition matrix, and then decreasing the zombie to zombie and zombie to non-zombie transitions proportionately so that the probabilities sum to one. In the second and third scenario, the entire weight is shifted to either decreasing the zombie to zombie probability, or the zombie to non-zombie probability.

Table 3. Predicted zombie firm share in 2022

	<u>Lower</u>	<u>Middle</u>	<u>Upper</u>
		Percent	
Using pre-pandemic transitions		6.0	
Lower non-zombie persistence	6.1	6.2	6.9
Lower non-zombie to zombie	4.5	4.5	4.6
Higher exit of non-zombies	3.7	6.0	6.1
Lower zombie persistence	5.7	5.7	5.7
Lower zombie to non-zombie	6.0	6.0	6.0
Higher exit of zombies	5.7	5.9	6.0
Lower entry		6.1	
Actual zombie share		4.4	

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

Note: In the middle scenario, the change in one element of the transition matrix is offset by proportional increases in the other elements so that the transitional probabilities sum to one. In the lower and upper scenarios, it is assumed that the change in one element of the transition matrix is completely offset by a change in one of the other elements, holding the last element constant. The lower scenario is the offsetting change that produces the lowest zombie share of firms, while the upper scenario produces the highest one.

4.4 The economic conditions led more firms to exit, while the business supports helped firms to survive and operate as non-zombie firms

What factors are responsible for the greater exit of non-zombie firms that lowered the zombie firm share? We begin by exploring whether the uptake of the support programs was concentrated among zombie or non-zombie firms. Table 4 presents the frequency of receiving support in 2019. We find that 58.5 percent of zombie firms in 2019 would receive pandemic-related support, compared to 64.6 percent of non-zombie firms. This higher share among non-zombie firms is also found among the two largest programs, the CEWS and CEBA, and highlights that pre-pandemic zombie firms had a lesser likelihood of receiving support compared to the general population of firms.

Table 4. Share of firms by program

	CEWS		CERS		CECRA		CEBA		Any	
	Zombie	Non-zombie	Zombie	Non-zombie	Zombie	Non-zombie	Zombie	Non-zombie	Zombie	Non-zombie
	Percent									
2019	34.0	37.9	15.4	13.5	8.2	6.6	49.7	54.9	58.5	64.6

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

Note: Firms are identified to be in a program if at any point over the pandemic they received support.

While non-zombie firms had a higher likelihood to receive support, other factors such as firm characteristics and the industry and aggregate shocks of the pandemic may also be important. To determine the impact of the business support programs, we estimate several multinomial logit models on the transition probability into zombie, non-zombie and exit status. We split the analysis into two sets: i) a pandemic period covering the 2019 to 2022 transition; and ii) a pre-pandemic period covering three-year transitions between 2002 to 2019, with the last transition between 2016 to 2019.¹⁰

For the pandemic model, the following regression is estimated in 2022 for zombie and non-zombie firms in 2019:

$$\ln \frac{P(Y_{it} = m)}{P(Y_{it} = \text{non-zombie})} = \alpha_m + \sum_{k=1}^K \beta_{mk} X_{kit-3} + \gamma_m S_{it} + \delta_m D_{it} + \theta_m S_{it} D_{it} + \sum_{j=1}^J \mu_{mj} \text{Ind}_{jt}, \quad (1)$$

where Y_{it} is the status of firm i at time t with non-zombie status as the reference category, P is the probability, m is either exit or zombie status, X_{kit-3} are different firm characteristics k (return on assets, debt-to-asset ratio, productivity, employment), S_{it} is a dummy if the firm used any of the main business support programs (CEWS, CECRA, CERS and CEBA), D_{it} is a demand shock faced by the firm (the percentage change in the revenue of the firm's three-digit NAICS industry omitting the firm itself from the calculation),¹¹ and Ind_{jt} are industry dummies at the two-digit NAICS level j . The estimated coefficients are used to produce counterfactual scenarios on the transition rates due to differences in firm characteristics, the presence of business supports, or the impact of the industry and macroeconomic conditions over the pandemic.

For the pre-pandemic model, we start by investigating the explanatory power of the firm characteristics in explaining the pre-pandemic transitions and those over the pandemic. The model excludes the business supports and includes a set of year dummies, $Year_\tau$ for each year τ with base year equal to 2002, to account for the pre-pandemic transitions being pooled together:

$$\ln \frac{P(Y_{it} = m)}{P(Y_{it} = \text{non-zombie})} = \alpha_m + \sum_{k=1}^K \beta_{mk} X_{kit-3} + \delta_m D_{it} + \sum_{j=1}^J \mu_{mj} \text{Ind}_{jt} + \sum_{\tau=2003}^{2016} \rho_{m\tau} \text{Year}_\tau. \quad (2)$$

Table 5 presents the predicted transition probabilities of the pre-pandemic model.¹² When the estimated coefficients from (2) in the pre-pandemic period are used to predict the historical probabilities, we closely replicate those in Table 2.¹³ The pre-pandemic coefficients are then

¹⁰ We do not estimate regressions for the 2017 to 2020 transition or the 2018 to 2021 transition to keep the pandemic and pre-pandemic analysis separate.

¹¹ Since a revenue decline was required to qualify for some of the programs, omitting the firm itself from the demand shock calculation avoids collinearity issues.

¹² The coefficient estimates of the models are presented in Table A1 to A4 in the Appendix.

¹³ The slight difference compared to Table 2 is due to the weighting of the average of the transition probabilities across the years. In Table 2, each year gets equal weight, while in Table 5, years with larger firm populations get a larger weight.

applied to the 2019 population of firms to predict the 2019 to 2022 transitions. This informs how the pandemic transitions would have behaved if firms faced the same dynamics (coefficients) as those in the pre-pandemic period, evaluated at their 2019 level of firm characteristics.

Table 5. Predicted transition probabilities – Impact of firm characteristics

	t+3		
	<u>Non-zombie</u>	<u>Zombie</u>	<u>Exit</u>
	Percent		
Non-zombie in pre-pandemic model			
Pre-pandemic characteristics	73.7	4.9	21.3
2019 characteristics	75.8	4.2	20.0
Difference (pp)	2.3	-0.8	-1.5
Zombie in pre-pandemic model			
Pre-pandemic characteristics	46.5	24.4	29.0
2019 characteristics	48.2	23.7	28.1
Difference (pp)	1.8	-0.7	-1.1
Percentage points			
Actual difference in data			
Non-zombie	-1.0	-1.7	2.7
Zombie	-0.3	-5.2	5.5

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

We find that the transition probability to non-zombie status increases, to zombie status decreases, and the exit rate decreases for both zombie and non-zombie firms. This shows that although the firm characteristics in 2019 help to account for some of the decrease in transitioning to zombie status, it cannot explain the lower probability of non-zombie status in 2022 or the higher exit rate found among both zombie and non-zombie firms in 2022 that occur in the actual transitions. Therefore, differences in the firm characteristics in 2019 do not explain the deviation of the transition probabilities between 2019 and 2022 compared to historical trends. This suggests that changes in the model coefficients, the COVID-19 shock, or the presence of business supports are driving the changes in the transitions over the pandemic.

To assess the impact of the business supports on the transition probabilities, the predicted probabilities for each firm in 2022 are estimated using the pandemic model in Table 6. The predicted probabilities are then re-calculated setting the dummy for business supports to zero for all firms. For non-zombie firms, the findings suggest that the presence of supports lowered exit rates by 10.6 percentage points, increased non-zombie persistence by 10.3 percentage points, and increased the non-zombie to zombie probability by 0.3 percentage points. This shows

that the presence of supports mitigated the pandemic's impact on non-zombie firm exit and did it mainly by increasing non-zombie persistence, rather than converting non-zombie firms into zombie ones.

The estimated coefficients in the pandemic model are then changed one at a time to those in the pre-pandemic model to see the impact of the differences in the coefficients in explaining the 2019 to 2022 transitions. In the case of the year dummies, the constant term in the pandemic model is replaced with the average of the constant term plus the year coefficients in the pre-pandemic model to provide a secular comparison. The difference in the coefficients on the financial variables, productivity, employment, and demand have relatively minor impacts for non-zombie firms. The largest effects are from the industry and year coefficients. The difference in the industry coefficients capture the industry-specific effects affecting firms, while those from the year coefficients capture the aggregate effect impacting all firms. Unsurprisingly, the worse economic conditions over the pandemic increased the exit rate of non-zombie firms (4.4 percentage points from the industry-specific effects and 7.0 percentage points from the aggregate effect), and decreased non-zombie persistence (4.7 percentage points from the industry-specific effects and 4.4 percentage points from the aggregate effect). The aggregate effect also lowered the transition probability from non-zombie to zombie status. These results reveal that the industry and aggregate shocks caused more firms to exit rather than remain as non-zombie firms or transition into zombie status. The presence of business supports mitigated this aspect, but the overall net effect resulted in firms exiting the economy. We do not find evidence that the pandemic nor the uptake of business supports led to a propagation of zombie firms.

Table 6. Predicted transition probabilities – Impact of supports and model coefficients

	t+3		
	Non-zombie	Zombie	Exit
	Percent		
Non-zombie in pandemic model			
(a) 2019 characteristics	72.8	3.3	23.9
(b) 2019 characteristics assuming no business supports	62.5	3.0	34.5
(c) Pre-pandemic coefficient on return on assets	72.9	3.3	23.8
(d) Pre-pandemic coefficient on debt-to-asset ratio	72.9	3.1	24.0
(e) Pre-pandemic coefficient on productivity	72.5	3.3	24.2
(f) Pre-pandemic coefficient on employment	72.8	3.3	23.9
(g) Pre-pandemic coefficient on demand	72.8	3.3	23.9
(h) Pre-pandemic coefficient on industry	77.5	3.0	19.5
(i) Pre-pandemic coefficient on year	77.2	5.9	16.9
Percentage points			
Difference			
(a) - (b)	10.3	0.3	-10.6
(a) - (c)	-0.1	0.0	0.1
(a) - (d)	-0.1	0.2	-0.1
(a) - (e)	0.3	0.0	-0.3
(a) - (f)	0.0	0.0	0.0
(a) - (g)	0.0	0.0	0.0
(a) - (h)	-4.7	0.3	4.4
(a) - (i)	-4.4	-2.6	7.0
Actual difference in data			
Non-zombie	-1.0	-1.7	2.7
Percent			
Zombie in pandemic model			
(a) 2019 characteristics	46.4	19.3	34.4
(b) 2019 characteristics assuming no business supports	35.0	18.4	46.6
(c) Pre-pandemic coefficient on return on assets	45.3	18.3	36.4
(d) Pre-pandemic coefficient on debt-to-asset ratio	47.2	19.3	33.5
(e) Pre-pandemic coefficient on productivity	46.7	19.5	33.9
(f) Pre-pandemic coefficient on employment	46.0	19.2	34.8
(g) Pre-pandemic coefficient on demand	46.5	19.2	34.3
(h) Pre-pandemic coefficient on industry	54.2	19.0	26.7
(i) Pre-pandemic coefficient on year	48.6	25.2	26.3
Percentage points			
Difference			
(a) - (b)	11.4	0.9	-12.3
(a) - (c)	1.1	1.0	-2.1
(a) - (d)	-0.8	0.0	0.9
(a) - (e)	-0.3	-0.2	0.5
(a) - (f)	0.3	0.1	-0.4
(a) - (g)	-0.1	0.1	0.1
(a) - (h)	-7.9	0.2	7.6
(a) - (i)	-2.2	-5.9	8.1
Actual difference in data			
Zombie	-0.3	-5.2	5.5

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

The bottom half of Table 6 shows a similar analysis for zombie firms. As in the case of non-zombie firms, deteriorating economic conditions captured by the change in the coefficients on the industry and year dummies increased zombie firm exits, decreased zombie persistence, and decreased zombie firms transitioning into non-zombie status. The uptake of business supports helped zombie firms to convert into non-zombie ones and helped lower their exit, with a minor increase in zombie persistence at 0.9 percentage points. The zombie to non-zombie transition was 10.1 percentage points lower due to the worse economic conditions (the sum of the industry and aggregate effects), but the business supports offset this by 11.4 percentage points. Overall, the evidence points to the pandemic increasing the probability of zombie firm exit, while business supports helped zombie firms to recover into non-zombie ones. Both are consistent with zombification declining over the pandemic.

4.5 The productivity of firms deteriorated over the pandemic

Although the share of zombie firms declined over the pandemic, its contribution to the change in aggregate labour productivity remains ambiguous. The higher exit rate found among zombie and non-zombie firms may have increased aggregate productivity if their average productivity is lower than surviving firms. Alternatively, firms themselves even in the presence of business supports may have suffered from lower productivity due to the pandemic's industry and macroeconomic conditions.

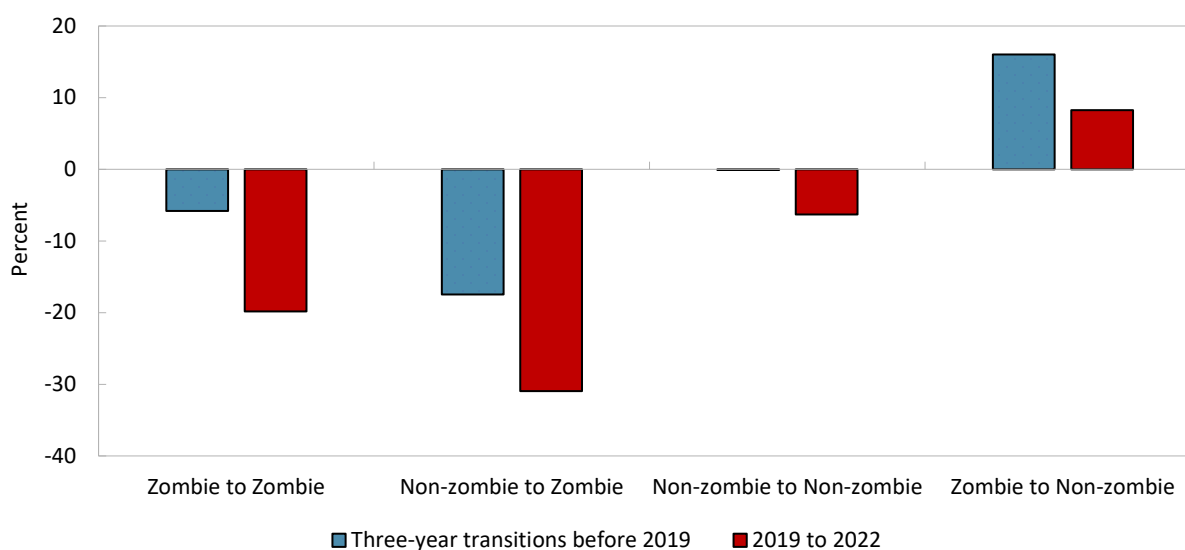
Figure 2 presents the change in average firm labour productivity (real total revenue per employee) by transition category. We find that over the pandemic, firm productivity declined across most categories, with the most pronounced change for firms entering zombie status. Productivity declined by 31.0 percent for non-zombie firms that became zombie firms, 19.8 percent for zombie firms that maintained their status, and 6.3 percent for non-zombie firms that did not change their status. The exception to these declines is zombie firms that recovered into non-zombie ones, where their productivity increased by 8.3 percent. This increase in productivity when transitioning into non-zombie status provides motivation behind the implementation of the business support measures since Table 6 showed they increase the transition likelihood.¹⁴

The deterioration in productivity is unique to the pandemic period. When compared to the average of all three-year transitions beforehand, the productivity changes were not as severe. Before the pandemic, firms transitioning from zombie to non-zombie status saw an improvement in productivity of 16.0 percent (compared to 8.3 percent), and persistent non-zombie firms saw

¹⁴ Since productivity in 2022 is not directly impacted by the support measures, the higher productivity of transitioning firms provides motivation that this is not a temporary phenomenon where these firms will enter zombification again without the support.

essentially no change (compared to a decline of 6.3 percent). Transitions between zombie to zombie, and non-zombie to zombie, saw declines in productivity at 5.8 percent and 17.5 percent, respectively. These declines are expected given the worsening health of zombie firms over time and zombie firms having lower productivity than non-zombie firms (Amundsen et al., 2023). However, compared to the pandemic period, these historical declines are not as severe. This shows that the pandemic period was unique in driving lower firm productivity.

Figure 2. Change in firm labour productivity by period and transition category



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

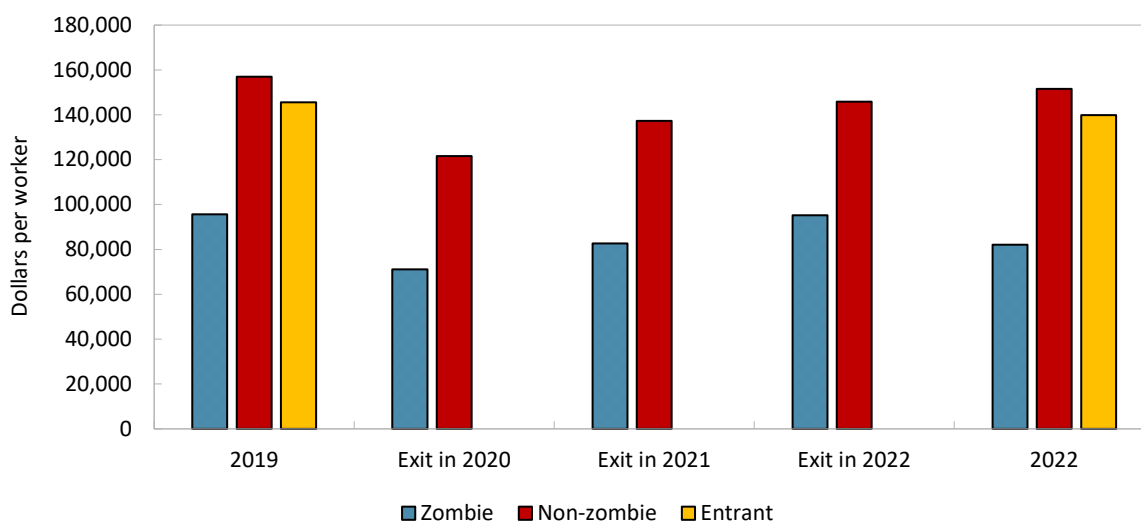
Note: The three-year transitions before 2019 is the average productivity change between year t and $t+3$ within the 2009 to 2019 period.

Although one factor that can affect aggregate labour productivity is the productivity of surviving firms, another is the impact of firm entry and exit. In Figure 3, we present the average productivity of zombie, non-zombie and entering firms in 2019, the 2019 productivity level for those that exited in 2020/2021/2022, and the 2022 productivity level. On average, zombie firms were only 61 percent as productive as non-zombie firms in 2019. By year of exit, the figure shows that the least productive firms exited first during the pandemic. Those that exited in 2020 had the lowest levels of productivity in 2019, and that rises as the pandemic carries over into 2021 and 2022. This suggests that the availability of business supports did not prevent the weakest firms from exiting early in the pandemic.

Entrants in 2019 and 2022 had lower productivity than non-zombie firms in the same years. This highlights that entrants are relatively unproductive in their first years of operation and that they contribute to lower aggregate labour productivity. Between the two years, the productivity level

of entrants declined, which also occurs for zombie and non-zombie firms, matching the broad-based decline from Figure 2. Although not analyzed here, the lower productivity of entrants does not necessarily imply entrants are harming aggregate productivity growth since it is well known that entrants display up-or-out dynamics, where conditional on survival, they positively impact aggregate productivity (Haltiwanger, 2012).

Figure 3. Firm labour productivity



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

Note: For 2019, exit in 2020, exit in 2021, and exit in 2022, the 2019 level of labour productivity is shown. For 2022, the 2022 level of labour productivity is shown. Entrants are defined as firms active in year t but inactive in year $t-3$.

4.6 Zombie firms are not responsible for the decline in aggregate labour productivity over the pandemic

To evaluate whether zombie firms had an impact on aggregate labour productivity, we turn to the decomposition proposed by Griliches and Regev (1995), which breaks down changes in aggregate productivity into changes in firm size, firm productivity, entry and exit. We modify their decomposition by separating the components into non-zombie and zombie firm elements to highlight each dynamic. The change in aggregate labour productivity is decomposed into:

$$\Delta P_t = \sum_{i \in C} \bar{s}_i \Delta p_{it} + \sum_{i \in C} \Delta s_{it} (\bar{p}_i - \bar{P}) + \sum_{i \in N} s_{it} (p_{it} - \bar{P}) - \sum_{i \in X} s_{it-k} (p_{it-k} - \bar{P}), \quad (3)$$

where ΔP_t is the change in aggregate labour productivity between periods t and $t - k$. The first term in the decomposition is the within-firm component that captures for each firm i the change in productivity Δp_{it} for those that continued C between t and $t - k$, weighted by \bar{s}_i . The variable s_i is the firm employment share and the bar on top signifies it is the average across t and $t - k$. The first term will be split between continuing non-zombie and continuing zombie firms based

on their status in year t . The second term is the between-firm component. It captures the impact of the reallocation of labour between continuing firms Δs_{it} that have average productivity \bar{p}_i above the average aggregate level \bar{P} , from firms that have average productivity below the average aggregate level. This term will be split between continuing non-zombie and continuing zombie firms based on their status in year t . The third term is the contribution of firm entry. The contribution of entrants N is negative if their productivity is lower than that of the average aggregate level. The fourth term is the contribution of exiting firms X . If exiters have productivity that is below the average aggregate level, then their contribution is positive. The fourth term will be split by exiting non-zombie and exiting zombie firms based on their status in year $t - k$.¹⁵

Table 7 presents the results of the decomposition for the pandemic period and the average of all three-year transitions in the pre-pandemic period since 2009.¹⁶ Aggregate labour productivity in the business sector (real total revenue per employee) decreased by \$9299 between 2019 and 2022. This change was the result of large changes in the various components that net each other. Negative contributions came from the decline in the productivity of continuing firms (-\$8015), which was made up of continuing non-zombie firms (-\$6668) and zombie firms (-\$1348). Continuing firms that switched from zombie to non-zombie status made a positive contribution to productivity (\$1104), while continuing firms that switched from non-zombie to zombie status made a negative contribution (-\$1167).

The reallocation between continuing firms contributed positively to productivity (\$1009). This shows that over the pandemic, employment in firms that had above average productivity grew relative to those with below average productivity. Non-zombie firms made up the majority of this component (\$656), with zombie firms making up the remainder (\$353). Both non-zombie and zombie firms saw declines in the between-firm contribution compared to historical levels, which suggests that reallocation over the pandemic, although still positive, did not occur at the same degree as it did in the past.

The exit of firms made a positive contribution to productivity (\$8118), which is consistent with exiting firms being less productive than the average. This is comprised of exiting non-zombie firms (\$6553) and exiting zombie firms (\$1565). The exit of zombie firms contributed disproportionately compared to their share in the economy, which is reflective of them having lower productivity than exiting non-zombie firms. Compared to previous periods, the exit of firms made a larger positive contribution to productivity over the pandemic.

¹⁵ In Griliches and Regev (1995), they interpreted the third and fourth terms together, treating entering and exiting firms as replacing one another. We separate each item.

¹⁶ We focus on the post-2009 period since aggregate labour productivity was growing in Canada over this time.

The entry of firms made a negative contribution to the change in productivity (-\$10411), highlighting that entrants are on average less productive than incumbents. Although the entry rate in 2022 was lower than in previous years,¹⁷ the contribution was more negative than in the past due to the lower productivity of entrants in 2022 relative to the average aggregate level.

Combining the contributions of entry and exit together, we can see that each contribution offsets one another, with net entry contributing negatively to changes in aggregate labour productivity (-\$2293). This is in contrast to past periods where net entry contributed positively (\$2661), and highlights that entrants over the pandemic were uniquely unproductive. However, looking across the results in Table 7, this net entry component, as well as the between-firm component, is dwarfed by changes in the within-firm component, particularly that from non-zombie firms (\$3989 to -\$6668). Although zombie firms contribute disproportionately to the change in productivity compared to their presence in the economy, their contributions are relatively small and have not materially changed from historical levels. It is the within-firm contribution of non-zombie firms that is the primary factor. Accordingly, zombie firms played a limited role for changes in aggregate labour productivity over the pandemic.

Table 7 also presents the decomposition split up between firms that received support over the pandemic and those that did not. While the supports kept firms alive and operating as non-zombie firms, they may also have generated inefficiencies in the economy. In contrary to this concern, we find evidence that the support measures are associated with increases in aggregate labour productivity. Productivity increased by \$6295 for those that received support versus a decline of \$5183 for those that did not. This increase is broad-based across the different transition categories, with the relative contributions higher in the within-firm, between-firm and exit components. The exception is the within-firm contribution of firms transitioning between zombie to non-zombie status, where the contribution is higher for firms without support, but the magnitude is small. The higher contribution found among exiting firms that received support versus those that did not (\$6703 versus \$1415) highlights that these firms had lower productivity than the average aggregate level, and this implies that creative destruction continued to function among support receiving firms. Similarly, the positive value for the between-firm component (\$1753) highlights that reallocation occurred towards productive support receiving firms, while misallocation occurred among those that did not receive support (-\$743). Taken together, the evidence shows that the pandemic-related measures are associated with higher aggregate labour productivity without compromising the forces of creative destruction.

¹⁷ In 2022, the three-year entry rate was 23.5 percent, versus an average of 27.1 percent between 2009-2019.

Table 7. Decomposition of the change in aggregate labour productivity

	Average of contributions across every four-year period between 2009 and 2019	2019 to 2022		
		Dollars per worker		
			Any support	No support
Total	9,780	-9,299	6,295	-15,593
Subtotal (excl. Entry)			6,295	-5,183
Within	3,102	-8,015	-2,161	-5,855
Non-zombie firms	3,989	-6,668		
Non-zombie to Non-zombie	2,923	-7,772	-2,009	-5,762
Zombie to Non-zombie	1,066	1,104	380	724
Zombie firms	-887	-1,348		
Zombie to Zombie	-70	-180	-79	-101
Non-zombie to Zombie	-818	-1,167	-452	-715
Between	4,018	1,009	1,753	-743
Non-zombie firms	3,511	656		
Non-zombie to Non-zombie	3,332	552	1,235	-683
Zombie to Non-zombie	178	104	226	-122
Zombie firms	507	353		
Zombie to Zombie	195	174	111	63
Non-zombie to Zombie	312	179	181	-2
Exit	7,801	8,118	6,703	1,415
Exit of non-zombie firms	6,067	6,553	5,709	844
Exit of zombie firms	1,734	1,565	994	571
Entry	-5,140	-10,411		-10,411
Net entry	2,661	-2,293		

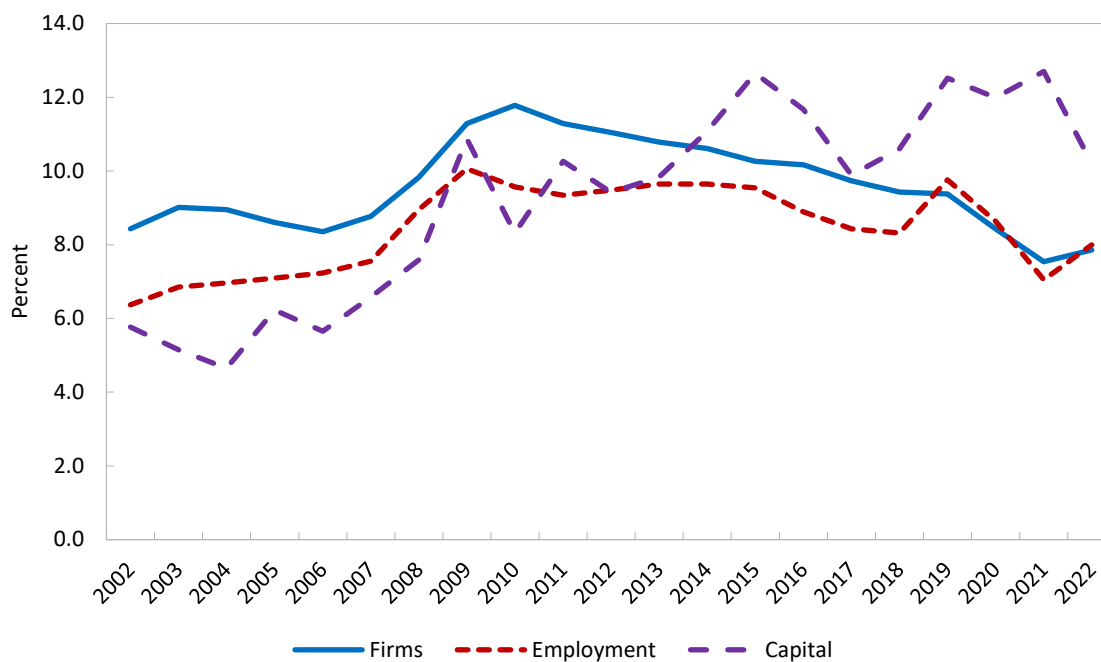
Source: Statistics Canada; authors' calculations using the National Accounts Longitudinal Microdata File.

5 Conclusion

The pandemic called for an urgent and broad policy response to keep economies afloat and prevent businesses from failing. However, this had the risk of zombifying the economy. This paper shows that despite the existence of substantial support to businesses during the pandemic, it did not result in a widespread increase in zombie firms, and in fact, declines in their prevalence occurred across industries. Both zombie and non-zombie firms displayed greater exit probabilities compared to historical trends, and the main contributor to these higher exits were the systemic industry and aggregate shocks representative of the pandemic's cleansing effects. In contrast, business support programs kept firms alive and operating as non-zombie firms, and led some zombie firms to recover. These dynamics cumulate in zombie firms having a limited contribution to developments in aggregate labour productivity seen in Canada over the pandemic. Conversely, firms that received support made a positive contribution.

6 Appendix

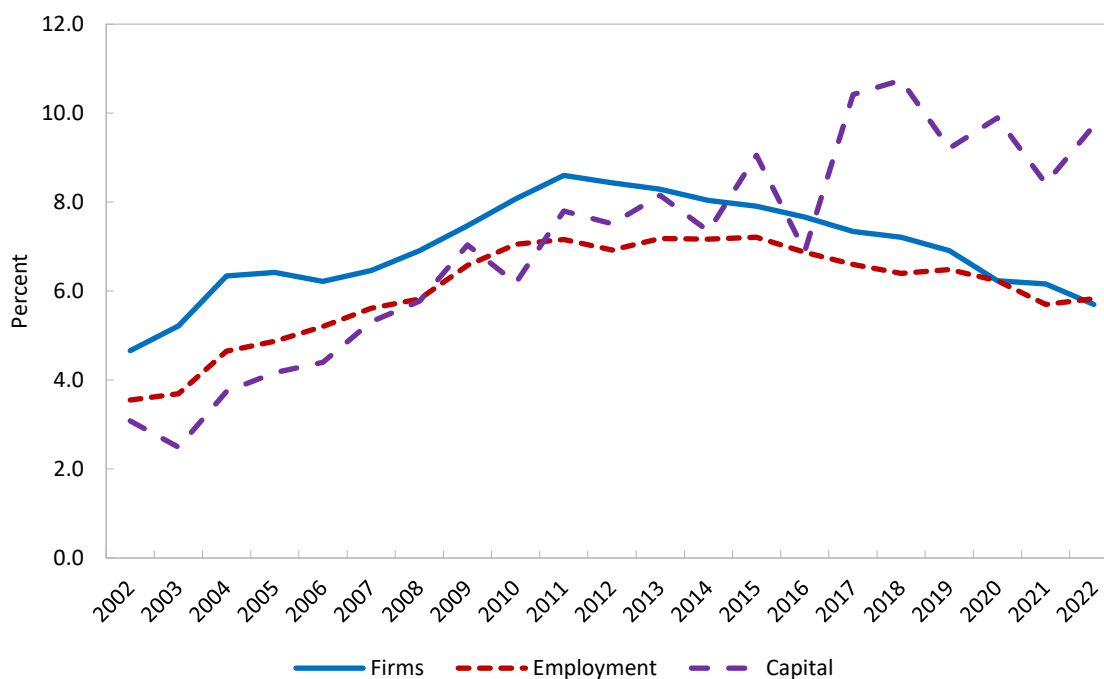
6.1 Figure A1. Zombie firm share with adjusted two-year consecutive definition



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

Note: The adjusted McGowan et al. (2018) zombie firm definition requires firms to have earnings before interest and taxes less than their interest payments for two consecutive years and be at least 10 years old.

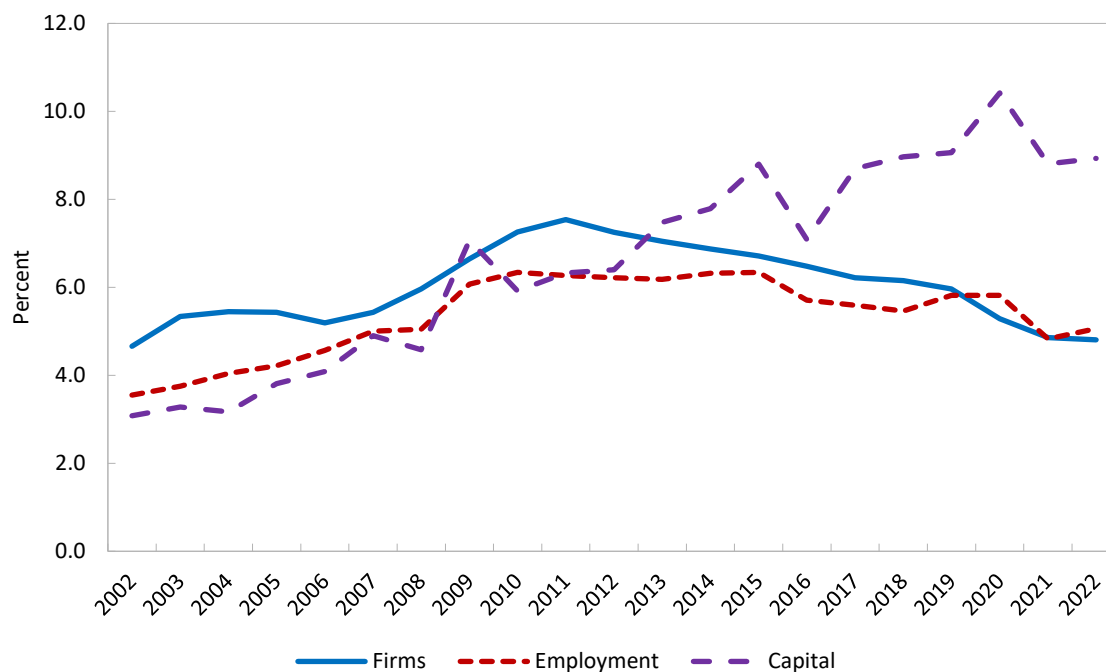
6.2 Figure A2. Zombie firm share with adjusted two-year exit definition



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

Note: The adjusted McGowan et al. (2018) zombie firm definition requires firms to have earnings before interest and taxes less than their interest payments for three consecutive years, be at least 10 years old, and have an interest coverage ratio greater than one for two consecutive years to exit zombification.

6.3 Figure A3. Zombie firm share with adjusted non-consecutive definition



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

Note: The adjusted McGowan et al. (2018) zombie firm definition requires firms to have earnings before interest and taxes less than their interest payments for three non-consecutive years and be at least 10 years old.

6.4 Table A1. Multinomial logit coefficients – Status in 2022, non-zombie firms in 2019

Regressors	Zombie in 2022			Exit in 2022		
	Coefficient	Std. Error	p-value	Coefficient	Std. Error	p-value
Return on assets	-0.94	0.01	0.00	-0.28	0.01	0.00
Debt-to-asset ratio	0.09	0.01	0.00	0.19	0.00	0.00
Productivity	0.00	0.00	0.00	0.00	0.00	0.00
Employment	0.00	0.00	0.47	0.00	0.00	0.22
Support	-0.11	0.01	0.00	-0.91	0.01	0.00
Demand	0.00	0.00	0.57	0.00	0.00	0.07
Demand*Support	0.00	0.00	0.99	0.00	0.00	0.26
Utilities	0.94	0.06	0.00	0.85	0.03	0.00
Mining, quarrying, and oil and gas extraction	0.60	0.21	0.01	0.63	0.10	0.00
Construction	0.39	0.04	0.00	0.62	0.02	0.00
Manufacturing	0.50	0.04	0.00	0.51	0.02	0.00
Wholesale trade	0.53	0.04	0.00	0.59	0.02	0.00
Retail trade	0.24	0.04	0.00	0.73	0.02	0.00
Transportation and warehousing	0.20	0.04	0.00	0.78	0.02	0.00
Information and cultural industries	0.59	0.06	0.00	0.78	0.03	0.00
Finance and insurance	0.29	0.05	0.00	0.69	0.02	0.00
Real estate and rental and leasing	0.69	0.04	0.00	0.71	0.02	0.00
Professional, scientific and technical services	0.34	0.04	0.00	0.74	0.02	0.00
Administrative and support	0.46	0.04	0.00	0.70	0.02	0.00
Educational services	0.68	0.06	0.00	0.78	0.03	0.00
Health care and social assistance	-0.36	0.04	0.00	0.30	0.02	0.00
Arts, entertainment and recreation	0.56	0.05	0.00	0.80	0.03	0.00
Accommodation and food services	0.58	0.04	0.00	0.98	0.02	0.00
Other services	0.54	0.04	0.00	0.60	0.02	0.00
Constant	-3.22	0.03	0.00	-1.27	0.01	0.00

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

Note: Base outcome is non-zombie status. Omitted industry is agriculture, forestry and fishing and hunting.

6.5 Table A2. Multinomial logit coefficients – Status in 2022, zombie firms in 2019

Regressors	Zombie in 2022			Exit in 2022		
	Coefficient	Std. Error	p-value	Coefficient	Std. Error	p-value
Return on assets	-0.14	0.04	0.00	-0.72	0.03	0.00
Debt-to-asset ratio	0.04	0.01	0.00	0.04	0.01	0.00
Productivity	0.00	0.00	0.00	0.00	0.00	0.00
Employment	0.00	0.00	0.09	0.00	0.00	0.00
Support	-0.37	0.03	0.00	-1.08	0.02	0.00
Demand	0.06	0.02	0.01	0.06	0.02	0.01
Demand*Support	-0.09	0.03	0.00	-0.06	0.02	0.01
Utilities	1.11	0.11	0.00	0.85	0.10	0.00
Mining, quarrying, and oil and gas extraction	0.70	0.45	0.13	0.97	0.38	0.01
Construction	0.27	0.07	0.00	0.51	0.06	0.00
Manufacturing	0.52	0.08	0.00	0.66	0.07	0.00
Wholesale trade	0.63	0.08	0.00	0.84	0.07	0.00
Retail trade	0.43	0.07	0.00	0.90	0.06	0.00
Transportation and warehousing	0.31	0.08	0.00	0.48	0.07	0.00
Information and cultural industries	0.40	0.11	0.00	0.51	0.10	0.00
Finance and insurance	0.68	0.09	0.00	0.43	0.08	0.00
Real estate and rental and leasing	0.85	0.07	0.00	0.43	0.07	0.00
Professional, scientific and technical services	0.52	0.07	0.00	0.51	0.06	0.00
Administrative and support	0.37	0.09	0.00	0.63	0.07	0.00
Educational services	0.11	0.13	0.40	0.40	0.11	0.00
Health care and social assistance	0.54	0.09	0.00	0.58	0.08	0.00
Arts, entertainment and recreation	0.19	0.10	0.07	0.57	0.09	0.00
Accommodation and food services	0.59	0.08	0.00	1.12	0.07	0.00
Other services	0.32	0.07	0.00	0.60	0.06	0.00
Constant	-1.20	0.06	0.00	-0.51	0.05	0.00

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

Note: Base outcome is non-zombie status. Omitted industry is agriculture, forestry and fishing and hunting.

6.6 Table A3. Multinomial logit coefficients – Status in year t, non-zombie firms in year t-3 before 2019

Regressors	Zombie in t			Exit in t		
	Coefficient	Std. Error	p-value	Coefficient	Std. Error	p-value
Return on assets	-1.08	0.00	0.00	-0.39	0.00	0.00
Debt-to-asset ratio	0.01	0.00	0.00	0.19	0.00	0.00
Productivity	0.00	0.00	0.00	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Demand	0.00	0.00	0.05	0.00	0.00	0.01
Utilities	0.44	0.02	0.00	0.79	0.01	0.00
Mining, quarrying, and oil and gas extraction	0.06	0.06	0.28	0.55	0.03	0.00
Construction	0.13	0.01	0.00	0.28	0.00	0.00
Manufacturing	0.44	0.01	0.00	0.20	0.01	0.00
Wholesale trade	0.42	0.01	0.00	0.31	0.01	0.00
Retail trade	0.34	0.01	0.00	0.37	0.00	0.00
Transportation and warehousing	0.09	0.01	0.00	0.35	0.01	0.00
Information and cultural industries	0.43	0.01	0.00	0.65	0.01	0.00
Finance and insurance	0.06	0.01	0.00	0.62	0.01	0.00
Real estate and rental and leasing	0.44	0.01	0.00	0.59	0.01	0.00
Professional, scientific and technical services	0.05	0.01	0.00	0.58	0.00	0.00
Administrative and support	0.18	0.01	0.00	0.34	0.01	0.00
Educational services	0.30	0.01	0.00	0.39	0.01	0.00
Health care and social assistance	-0.41	0.01	0.00	-0.01	0.01	0.14
Arts, entertainment and recreation	0.57	0.01	0.00	0.40	0.01	0.00
Accommodation and food services	0.21	0.01	0.00	0.46	0.00	0.00
Other services	0.38	0.01	0.00	0.26	0.00	0.00
Constant	-2.83	0.01	0.00	-1.77	0.01	0.00
Year 2003	-0.07	0.01	0.00	-0.02	0.00	0.00
Year 2004	-0.07	0.01	0.00	0.05	0.00	0.00
Year 2005	-0.02	0.01	0.01	0.10	0.00	0.00
Year 2006	0.08	0.01	0.00	0.12	0.00	0.00
Year 2007	0.22	0.01	0.00	0.11	0.00	0.00
Year 2008	0.31	0.01	0.00	0.05	0.00	0.00
Year 2009	0.25	0.01	0.00	0.00	0.00	0.39
Year 2010	0.23	0.01	0.00	-0.03	0.00	0.00
Year 2011	0.20	0.01	0.00	-0.03	0.00	0.00
Year 2012	0.19	0.01	0.00	-0.02	0.00	0.00
Year 2013	0.15	0.01	0.00	0.05	0.00	0.00
Year 2014	0.13	0.01	0.00	0.16	0.00	0.00
Year 2015	0.12	0.01	0.00	0.18	0.00	0.00
Year 2016	0.09	0.01	0.00	0.19	0.00	0.00

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

Note: Base outcome is non-zombie status. Omitted industry is agriculture, forestry and fishing and hunting. Omitted year is 2002.

6.7 Table A4. Multinomial logit coefficients – Status in year t, zombie firms in year t-3 before 2019

Regressors	Zombie in t			Exit in t		
	Coefficient	Std. Error	p-value	Coefficient	Std. Error	p-value
Return on assets	-0.06	0.01	0.00	-1.00	0.01	0.00
Debt-to-asset ratio	0.04	0.00	0.00	0.00	0.00	0.04
Productivity	0.00	0.00	0.00	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Demand	0.00	0.00	0.27	0.00	0.00	0.48
Utilities	1.06	0.03	0.00	0.78	0.03	0.00
Mining, quarrying, and oil and gas extraction	0.00	0.13	0.97	-0.15	0.12	0.23
Construction	-0.08	0.02	0.00	0.00	0.02	0.92
Manufacturing	0.26	0.02	0.00	0.19	0.02	0.00
Wholesale trade	0.42	0.02	0.00	0.35	0.02	0.00
Retail trade	0.42	0.02	0.00	0.43	0.02	0.00
Transportation and warehousing	0.00	0.02	0.84	0.07	0.02	0.00
Information and cultural industries	0.30	0.03	0.00	0.14	0.03	0.00
Finance and insurance	0.44	0.02	0.00	0.38	0.02	0.00
Real estate and rental and leasing	0.63	0.02	0.00	0.20	0.02	0.00
Professional, scientific and technical services	0.29	0.02	0.00	0.14	0.02	0.00
Administrative and support	0.17	0.02	0.00	0.04	0.02	0.04
Educational services	0.13	0.03	0.00	0.04	0.03	0.17
Health care and social assistance	0.06	0.02	0.01	-0.06	0.02	0.01
Arts, entertainment and recreation	0.52	0.02	0.00	0.04	0.02	0.10
Accommodation and food services	0.40	0.02	0.00	0.27	0.02	0.00
Other services	0.20	0.02	0.00	-0.02	0.02	0.22
Constant	-1.05	0.02	0.00	-0.97	0.02	0.00
Year 2003	-0.04	0.02	0.03	0.00	0.02	0.91
Year 2004	-0.03	0.02	0.19	0.07	0.02	0.00
Year 2005	0.02	0.02	0.44	0.13	0.02	0.00
Year 2006	0.12	0.02	0.00	0.17	0.02	0.00
Year 2007	0.16	0.02	0.00	0.16	0.02	0.00
Year 2008	0.14	0.02	0.00	0.10	0.02	0.00
Year 2009	0.09	0.02	0.00	0.01	0.02	0.68
Year 2010	0.10	0.02	0.00	0.02	0.02	0.21
Year 2011	0.08	0.02	0.00	0.00	0.02	0.97
Year 2012	0.07	0.02	0.00	0.01	0.02	0.69
Year 2013	0.04	0.02	0.03	0.01	0.02	0.54
Year 2014	0.02	0.02	0.37	0.20	0.02	0.00
Year 2015	0.06	0.02	0.00	0.27	0.02	0.00
Year 2016	0.11	0.02	0.00	0.32	0.02	0.00

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

Note: Base outcome is non-zombie status. Omitted industry is agriculture, forestry and fishing and hunting. Omitted year is 2002.

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