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Kyriakos Andreou [a], Andreas Fousteris [b], Sotirios Kokas [c], Alexandros Kontonikas [*c] and Emmanouil Pyrgiotakis [d]

[a] *PwC (Greece)*
[b] *Department of Business Administration, University of Piraeus*
[c] *Essex Business School, University of Essex*
[d] *Smurfit Graduate Business School, University College Dublin*

Abstract

This paper examines the prevalence, dynamics, and failure risk of zombie firms in Greece during the post-crisis and post-Covid period, using firm-level Orbis data over the period 2015–2023. Building on the composite zombie classification introduced in PwC (2015), which does not rely mechanically on interest coverage ratios and is well suited to the Greek corporate environment, we document four main findings. First, the share of zombie firms declined substantially over the recovery period, despite a temporary increase during the Covid-19 episode. Second, zombification is predominantly transitory: most zombie firms recover, while a non-negligible fraction remains persistently weak or exits the market. Third, using a Cox proportional hazards model, we show that zombie status is associated with a hazard of firm failure approximately 2.7 times higher, even after controlling for standard firm-level characteristics. Fourth, we document pronounced heterogeneity across firm size, with zombie incidence and failure risk particularly elevated among micro firms. The results highlight zombification as a distinct firm state associated with materially higher failure risk.

Keywords: Greek non-financial corporations, zombies, survival, Cox model.

[*] Corresponding author: Alexandros Kontonikas, Professor in Finance, Essex Business School, University of Essex, Wivenhoe Park, Colchester, CO4 3SQ, United Kingdom; E-mail: a.kontonikas@essex.ac.uk.

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1. Introduction

Following the sovereign debt crisis, the Greek economy underwent a prolonged period of adjustment characterised by deleveraging, weak investment, and subdued productivity growth. More recently, macroeconomic conditions have improved, supported by stronger export performance, a buoyant tourism sector, and large-scale EU funding through the Recovery and Resilience Facility (RRF), which is expected to accelerate the green and digital transitions. Improvements in banking-sector balance sheets, including the resolution of non-performing loans and rising deposit funding, have enhanced banks' capacity to extend credit, while the digital transformation of the public sector has contributed to a more business-friendly environment. Despite these developments, structural challenges persist. Investment remains low relative to European peers, regulatory and judicial inefficiencies continue to weigh on business activity, and access to external finance remains particularly constrained for smaller firms, which rely heavily on internal funds to finance investment and growth (Bank of Greece, 2023). During the Covid-19 crisis, extensive fiscal and financial support prevented a sharp deterioration in corporate financial health and a surge in firm failures (IMF, 2021) but may also have contributed to the prolonged survival of financially weak firms. This motivates a closer examination of the persistence and exit risk of zombie firms in the post-Covid period.

In this paper, we examine the prevalence, dynamics, and failure risk of zombie firms in Greece during the post-crisis and post-Covid period. We build on the composite zombie classification approach introduced in PwC (2015), which emphasises persistent unprofitability, poor performance, and weak debt sustainability and which does not rely mechanically on interest coverage ratios. This approach is particularly well suited to the Greek corporate ecosystem, which is characterised by low leverage among the median firm and a large share of micro and small enterprises (Vettas et al., 2019; Gatopoulos et al., 2024). Our analysis is organised around four related research questions. First, what are the key characteristics of Greek firms during the recovery period, and which features systematically distinguish zombie firms from healthier firms? Second, how has the prevalence of zombie firms evolved over time in the aftermath of the sovereign debt and Covid-19 crises? Third, what is the relationship between zombie status and firm failure, once standard firm-level fundamentals are taken into account? Fourth, to what extent do zombie prevalence and failure risk vary across firms of different sizes and sectoral classification? Addressing these questions allows us to link the negative externalities associated with zombification to firm-level exit risk and to assess how corporate fragility and resilience differ across segments of the Greek corporate ecosystem.

Using a large panel of non-financial firms from Orbis over the period 2015–2023, we provide a comprehensive empirical characterisation of zombie firms across time, sectors, and firm size classes. The initial sample consists of 31,561 firms. After applying standard data-quality and sample-selection filters, the final dataset comprises approximately 125,000 firm-year observations, covering firms of various sizes and sectors. The firms in our sample account for roughly 75% of total corporate turnover in Greece, indicating broad coverage of

economic activity. We document the evolution of zombie prevalence, examine the persistence of zombification over time, and analyse exit paths by distinguishing between recovery, continued zombification, and firm failure. To quantify exit risk in a rigorous manner, we embed zombie status within a Cox proportional hazards framework and condition on a rich set of firm-level characteristics, including size, leverage, profitability, liquidity, and age, which are standard determinants of firm survival in the literature (Guariglia et al., 2016; Baumöhl et al., 2019).

Our empirical analysis yields four main findings, corresponding to the research questions outlined above. First, we show that a "typical" Greek firm during the recovery period is characterised by relatively low leverage, adequate liquidity, and modest profitability. Zombie firms differ systematically from healthier firms: they are smaller in terms of turnover, less profitable, more leveraged, less solvent, less liquid, and older, indicating substantially greater financial fragility. The profitability gap between zombie and non-zombie firms is large and persistent, widening further following the Covid-19 shock.

Second, we document a marked decline in the prevalence and persistence of zombie firms over time. The aggregate share of zombie firms falls steadily over the recovery period and, by the end of the sample, declines to below 5%, despite a temporary increase during the Covid-19 episode. Zombification is predominantly a transitory state rather than a permanent condition. Cohort analysis shows that persistence rates decline sharply over time: only 1% of firms first classified as zombies in 2015 remain in zombie status by 2023, with similarly low persistence observed for later cohorts. Looking at zombie outcomes more broadly, around two-thirds (66%) of zombie firms recover and return to financial health, while 20% remain trapped in zombie status and 14% eventually fail and exit the market.

Third, zombie status is associated with a substantially higher risk of failure. Estimates from a Cox proportional hazards framework indicate that this association corresponds to a hazard of firm failure approximately 2.7 times higher than that of non-zombie firms, even after conditioning on standard firm-level characteristics such as size, leverage, profitability, liquidity, and age. Fourth, we document pronounced heterogeneity across firm size and sectors. Micro firms exhibit the highest vulnerability, with zombie shares averaging 8.1% over 2015–2023 and substantially higher failure rates, reaching 3.26% in 2021, more than three times higher than for larger firms. At the same time, sectoral patterns reveal important differences in zombie incidence. The total number of zombie firms declined by 68% by 2023, while relative to the 2020 peak the decline exceeds 90%, with Industry, Commerce, and Services accounting for the largest absolute reductions.

Our work is related to two existing strands of the literature. The first strand examines the prevalence, persistence, and economic effects of zombie firms, documenting their adverse implications for investment, productivity, and resource allocation (e.g. Caballero et al., 2008; Adalet McGowan et al., 2018; Andrews and Petroulakis, 2019; Schivardi et al., 2022). A growing body of work applies these ideas to European economies and, more recently, to Greece, highlighting the relevance of zombification in shaping real economic outcomes (PwC, 2015; Gatopoulos et al., 2024). While much of this literature relies on

interest-coverage-based definitions of zombies, we follow the composite balance-sheet-based approach introduced in PwC (2015), which is better suited to the Greek corporate ecosystem characterised by low leverage, a large share of micro and small firms, and heterogeneous accounting practices. In this respect, our analysis complements existing Greece-specific evidence by shifting attention from static outcomes to the dynamics, persistence, and exit risk of zombie firms in the post-crisis and post-Covid period.

The second strand studies firm failure and exit using hazard and discrete-choice models, emphasising the role of firm-level balance-sheet fundamentals in shaping survival prospects (Audretsch and Mahmood, 1995; Görg and Spaliara, 2014; Guariglia et al., 2016; Baumöhl et al., 2019). More recent contributions explicitly link zombification to firm survival, showing that financially weak firms face elevated exit risk in international settings (Banerjee and Hofmann, 2022; Carreira et al., 2022). Closest to our approach, Banerjee and Hofmann (2022) analyse firm survival conditional on zombie status, primarily treating zombification as a conditioning variable interacting with financial conditions. In contrast, we explicitly model zombification as an economically meaningful firm state and show that zombie status itself is associated with a substantially higher hazard of failure, even after controlling for standard determinants of firm survival. By bridging the zombie-firm and firm-failure literatures, our work provides new evidence on how persistent financial weakness shapes corporate exit dynamics and post-crisis adjustment in an economy emerging from multiple large shocks.

2. Data and summary statistics

We collect Greek firm-level data from the Orbis database for the period 2015–2023. Orbis provides information on both listed and private Greek companies, utilizing data sourced from ICAP (Kalemli-Ozcan et al., 2015). ICAP is the largest electronic repository of business information in Greece, offering extensive coverage of key financial (balance sheet and income statement) and demographic characteristics (Gatopoulos et al., 2024). Coverage is significantly higher for larger firms, while micro-firms are underrepresented due to less stringent financial reporting requirements, particularly for sole proprietors, compared to other legal entities such as Société Anonyme (S.A.) and Limited Liability Companies (LLCs).[1] The Orbis/ICAP database is widely used in existing firm-level studies on Greece.[2]

[1] Vettas et al. (2022) compare ICAP's sample of firms to the Hellenic Statistical Authority (ELSTAT) Business Register, demonstrating that ICAP covers, on average, 60% of the Greek economy's turnover between 2005 and 2019. They show that only 2.1% of micro-firms with an annual turnover of less than €0.5 million are covered by ICAP. Coverage improves significantly for larger firms, reaching 25% for firms with a turnover between €0.5–1.5 million, 81.1% for those between €5–50 million, and 89.3% for firms with a turnover exceeding €50 million (Gatopoulos et al., 2024). The IMF (2021) study, which uses Orbis data, also highlights that while the data is broadly representative of the sectoral and size distribution of Greek NFCs, smaller firms are underrepresented.

[2] See, among others, PwC (2015), IMF (2021), Vettas et al. (2019, 2022), Gatopoulos et al. (2024), Genakos et al. (2024) and Piraeus Bank (2024).

The initial sample consists of 31,561 firms**.** We apply several filters, removing approximately half of the firms from the sample. These filters relate to sectoral classification and data availability, with the latter accounting for most of the exclusions. Specifically, since our focus is on non-financial corporations, we exclude firms operating in NACE sectors K (Financial and Insurance Activities) and O (Public Administration and Defence; Compulsory Social Security). This approach aligns with prior studies. Additionally, we exclude sector S (Other Service Activities) due to its unique characteristics.[3] Regarding data availability, firms with their most recent financial statement dated 2014 or earlier are removed. We also exclude firms that lack sufficient data to construct zombie classification measures. After applying the filters, the final dataset includes approximately 125,000 firm-year observations.

As a next step, we map the NACE sectors to seven broader categories of economic activity based on PwC (2021), utilizing NACE 4-digit classification codes and manual matching. This classification enables us to benchmark our results against findings from a recent PwC study that examines the response of Greek firms to the pandemic. The sampled Greek companies are categorized into the following seven sectors: *Industry*, which includes both heavy and light industries, food and beverage production, pharmaceuticals, and energy companies (petroleum refining and renewable energy); *Commerce*, comprising retail and wholesale commerce, fuel retail, and food and beverage trade; *Services*, consisting of enterprises providing services to other companies, along with entertainment, IT, and transportation; *Investment companies*, consisting of firms specializing in leasing and real estate services; *Tourism*, which includes hotel companies, travel agencies, car rental businesses, and cruise enterprises; *Infrastructure*, encompassing telecommunications service providers and utility companies; and *Construction*, consisting of companies involved in building-related activities.[4]

Table 2 presents descriptive statistics for key firm characteristics, while Table 1 provides the relevant variable definitions. Based on the median values, total assets amount to €2.9 million, with an annual turnover of €2.2 million. Earnings Before Interest and Taxes (EBIT) are €127 thousand, reflecting a profitability ratio (EBIT/turnover) of 5%. The leverage ratio, calculated as total debt (short-term and long-term) over total assets, is 12%, while the solvency ratio (equity to total assets) stands at 39%. These figures highlight a relatively high share of non-debt liabilities and are consistent with the fact that Greek firms rely heavily on internal funds to finance investment (Bank of Greece, 2023). In terms of liquidity, the current ratio (current assets to current liabilities) is 145%. Additionally, the median firm has an age

[3] The removal of NACE sectors K and O from the sample is consistent with PwC (2015), Gatopoulos et al. (2024) and Piraeus Bank (2024). Concerning the removal of sector S, it is motivated by the following facts. It contributes the smallest number of firm-year observations to the raw data sample (0.4% of total). At the same time, it exhibits very low turnover and profitability and includes firms that are characterised by lack of consistent, detailed financial reporting, which potentially compromises the reliability and comparability of data. In any case, in unreported results (available upon request) we find that the key conclusions from our analysis remain unaffected to its inclusion.

[4] For robustness, we have conducted our analysis using the NACE sectors. Our inferences are qualitatively similar (results available upon request).

of 19 years. These features are consistent with findings from previous studies on Greek firms.[5] The data suggest that the "typical" Greek firm has relatively low leverage and adequate liquidity, but profitability is modest.

Macro-finance environment

The low leverage of Greek firms is not surprising, given that business lending by Greek banks only began to strengthen during the latter part of the 2015–2023 sample period. Despite the improvement in the economic climate, reflected in the rising Economic Sentiment Index (Figure 1, Panel A), and a decline in sovereign risk, banks were primarily focused on reducing their NPLs (Figure 1, Panel B).[6] This phenomenon is known as a "creditless recovery" and typically follows episodes of banking crises. Financial intermediation slows significantly until banks' balance sheets are cleansed. The efforts of Greek banks yielded significant results, with business NPLs dropping below 10% by April 2022, an important development for strengthening banking stability. The sharp decline in the NPL ratio underscores the success of the "Hercules" programme, which provided government guarantees to NPL securitisations. Since 2022, business lending growth has accelerated, despite the ECB's tighter monetary policy, which substantially increased borrowing costs (Figure 1, Panel C). New monthly business lending flows averaged €1.7 billion between 2022 and 2024, compared with €0.8 billion between 2015 and 2021. At the same time, growth in lending to SMEs was comparatively weaker (Figure 1, Panel D).

3. Zombies and firm failure: definitions and stylised facts

3.1 Zombies

The literature on zombie firms offers several alternative definitions, ranging from low profitability and high leverage to the receipt of subsidised credit. Each definition has its advantages and disadvantages, but they all share the common objective of identifying firms that exhibit persistent financial weakness. Among these approaches, metrics based on the interest coverage ratio (ICR) are particularly popular. These metrics assume that the firm has established a borrowing relationship (e.g. with a bank) and that its profits are insufficient to cover the related interest payments. An inherent limitation of such measures is that they exclude firms with zero debt, as these firms do not have interest payments, making the ICR

[5] For example, Chortareas et al. (2024) report median solvency ratio and turnover of 39.6% and €2.3 million, respectively, using the Bank of Greece's (CBSO) database over the period 2019-2021. The analysis of ICAP's data for 2022 by Piraeus (2024) shows a median current ratio of 141% and an EBITDA margin of 8.6%. In IMF (2021), the median leverage ratio is 10% over the period 2009-2018, while the median age is 16 years (Orbis data).

[6] Following the pandemic, Greek economic sentiment experienced significant improvement. Between December 2020 and December 2023, the Greek sentiment index increased by 12%, while the Eurozone's remained static. The sentiment index is produced by Eurostat and is based on questionnaires assessing factors related to the current economic situation and future developments.

metric inapplicable. If debt is non-zero but relatively small, interest expenses are likely to be low, potentially making the ICR less accurate in identifying financial weakness. Moreover, the ICR criterion faces problems in the presence of subsidised credit, especially when interest rates are "low for long".

We build upon the work of PwC (2015) to develop a zombie classification measure that differs from commonly used ICR-based metrics. A firm is classified as a zombie if it meets all of the following conditions: compound annual growth rate of turnover below −5% (three-year window); return on capital employed below 0% (three-year window mean); and net debt-to-EBITDA above 5, or EBITDA below zero (three-year window mean). Effectively, the PwC measure adopts a combination approach, with the key distinction that it does not rely on the ICR but instead on poor performance and either high debt or negative profits.[7] This is particularly important given that the median Greek firm has relatively low leverage. The PwC measure appears better suited to capture the idiosyncratic characteristics of the Greek corporate ecosystem.

For robustness, and to benchmark our findings to the extant literature, we also use two ICR-based measures. The baseline ICR metric follows De Jonghe et al. (2024). It assigns zombie status if all following conditions are met: 3-year Accumulated Recurring Cash Flows (EBITDA plus Financial Revenues) < 3-year Accumulated Interest Expenses; Recurring Cash Flows fail to cover Interest Expenses in a minimum of two of the three individual years; and Age ≥ 10 years. The alternative ICR-based measure classifies a firm as zombie when ICR < 1 for 3 consecutive years, where ICR = EBIT / Financial Expenses; and Age ≥ 10 years. This measure, proposed by Adalet McGowan et al. (2018), is often used in the literature, including a recent study for Greece (Gatopoulos et al., 2024).[8]

Table 3 presents stylized facts about the characteristics of Greek zombie firms, comparing them to non-zombies based on the PwC metric. Zombie firms are smaller (in terms of turnover), non-profitable, more leveraged, less solvent, less liquid, and older than non-zombies. Focusing on the median, turnover for zombie firms declines by 70%, from €2.7 million (non-zombies) to €0.8 million (zombies). Additionally, zombie firms have negative EBIT and net income, with their profitability ratio falling to -15%. The leverage ratio more than doubles (from 13% to 27%), while both the solvency and liquidity ratios decrease (by 15% and 35%, respectively). Zombie firms are 3 years older than non-zombies (22 years

[7] The PwC approach is conceptually consistent with the zombie definition in Schivardi et al., (2022) Carreira et al. (2022) and Havemeister and Horn (2023) which includes firm performance and leverage metrics. Moreover, the use of negative sales growth is in line with Albuquerque and Iyer (2024).

[8] Adalet McGowan et al. (2018) point out that the age restriction intends to account for the fact that it may be difficult to distinguish zombie firms from young innovative start-ups only based on the ICR. Banerjee and Hofmann (2022) argue that the age restriction has a potential drawback since it rules out the possibility that a young firm can be a zombie. To address this issue, they add the requirement that the firm also has a low future profit growth potential as reflected in a relatively low Tobin's q. On the other hand, Andrews and Petroulakis (2019) remove the age requirement. Several other studies employ iterations of the ICR-based measure. For example, Rodano and Sette (2019) emphasize the use of EBITDA, as opposed to EBIT, when calculating the ICR.

compared to 19).[9] Finally, the volatility of firm characteristics, as measured by the median absolute deviation, is generally higher among zombie firms.[10]

Figure 2 shows the evolution of zombie firms share relative to the total number of firms each year. Using either the baseline zombie classification approach (based on conditions met over a 3-year window) or a less restrictive approach (using 1-year window), the zombie share declines over time. They both reach the lowest point in the sample by 2023, less than 5%. The findings highlight the impact of the Covid-19 crisis, as evidenced by the strong increase in the zombie share between 2019 and 2020.[11]

Figure 3 reveals that, in addition to the overall decline in the zombie share, its persistence has also declined over time. Persistence is measured as the proportion of firms that remain classified as zombies in the current year relative to the number of zombies in the previous year.[12] By 2023, zombie persistence reaches minimum. Table 4 presents the persistence rates (in percentage) of zombie firms by year-cohort. They are computed as the ratio of the number of remaining zombie firms to the number of zombie firms in the year in which they became zombies (having 100 as the base year). On average, 42% of 2015-cohort zombie firms remain in the same status one year after having been flagged as zombie. However, this number decreases significantly to 10% after three years, meaning that only 10% of these firms continue to struggle three years later. By 2021, only 1% of the 2015 zombies remain in that status. Thus, our findings suggest that zombification is predominantly a transitory state rather than a permanent condition.

The average zombie share increases as firm size decreases: 8.1% for micro-firms (annual turnover below €2 million), 2.3% for SMEs (€2–50 million), and 1.3% for large firms (above €50 million).[13] Figure 4 illustrates the distribution of zombie shares across firm size categories over time. The share of zombie micro-firms exhibits pronounced volatility, rising sharply in 2020 before declining rapidly in the post-pandemic period, indicating that smaller

[9] These findings align with previous international studies as well as the PwC (2015) study on Greece. For instance, PwC (2015) analyzes data from 2008 to 2013, focusing on large firms with an annual turnover exceeding €10 million. The study shows that the EBITDA margin of Greek zombie firms is -16%, compared to 8% for "star" firms. It also reveals that zombie firms have higher leverage and lower equity relative to their assets. Regarding international studies, Havermeister and Horn (2023) report a median leverage ratio of 36% and a median age of 24 years for European zombie firms, which matches our findings for Greece in Table 3 based on the ICR definition. Similarly, Schivardi et al. (2020) analyze Italian data during the Covid-19 crisis and demonstrate that the median zombie firm has lower turnover, less equity and liquid assets, and higher debt. Banerjee and Hofmann (2022) and Carreira et al. (2022) show that zombie firms tend to be smaller/more leveraged using OECD-wide and Portuguese datasets.

[10] The trend of inferior firm fundamentals for zombie firms remains largely consistent when using the ICR-based measure. See Table A1 in the Appendix.

[11] The ICR methodology also identifies a low point in the zombie share by 2023, but it doesn't clearly identify the impact of the Pandemic (see Figure A1 in the Appendix).

[12] Zombie persistence is higher when using the ICR measure, indicating that firms remain in zombie state for longer with that classification. See Figure A2 in the Appendix.

[13] The findings on the impact of firm size on the zombie share align with previous studies (Banerjee and Hofmann, 2022; Carreira et al., 2022; Gatopoulos et al., 2024).

firms are particularly sensitive to adverse macroeconomic conditions. By 2023, zombie shares across all size groups reach their lowest levels in the sample.

There is also significant heterogeneity across sectors, as shown in Figure 5. Zombie shares vary across industries, reflecting differences in firm composition and exposure to economic shocks. *Investment Companies* exhibit the highest zombie share, followed by *Construction*. In absolute terms, [14] Figure 6 shows that *Industry*, *Commerce*, and *Services* account for the largest number of zombie firms throughout the period, which is expected given the large number of firms operating in these sectors.[15]

Sectoral dynamics over time point to a broad-based improvement in corporate health. *Tourism* experiences a pronounced increase in zombification during the pandemic, followed by a rapid rebound once restrictions were lifted. Relative to 2015, the total number of zombie firms declines by 68% by 2023, while almost all sectors record reductions in the absolute number of zombie firms of more than 50%. The steepest declines are observed in *Commerce* (–77%) and *Tourism* (–75%), with *Industry* and *Services* also exhibiting substantial reductions.

Finally, Figure 7 plots the profitability ratio of zombies vs. non-zombies over time. The profitability gap between zombies and healthier firms is large and persistent, widening notably since the Covid-19 crisis. Specifically, the gap increases from 18% (2015-2019 average) to 26% (2020-2023).

3.2 Firm failure

We classify firms as failed based on their Orbis status, in line with Beaver et al. (2024) and Cathcart et al. (2020), among others. Specifically, a firm is classified as failed if it is recorded under any of the following statuses: *Active (insolvency proceedings)*, *Bankruptcy*, *Dissolved*, *Dissolved (liquidation)*, *In liquidation*, or *Inactive (no precision)*. In addition, we assign failed status to firms that are reported as active in Orbis at the time of data retrieval (October 2024) but whose most recent financial statement dates to 2021 or earlier, based on the *Last Available Year* variable. Regarding the timing of firm exits, we assume that failure occurs in the last year in which the firm published financial statements. Given the nature of the data, we conduct the failure analysis up to 2021 and exclude the years 2022–2023, as the reliability of failure classification declines substantially for more recent years.[16]

[14] The corresponding results based on the alternative ICR-based zombie definitions are reported in the Appendix. In particular, Figures A3 and A4 show that the size and sectoral patterns of zombie prevalence remain qualitatively similar when zombification is defined using interest-coverage-based measures.

[15] Industry, Commerce and Services are the dominant sectors in the Greek corporate economy. They represent 83% of total turnover, 73% of EBIT, 51% of Capital Employed and 54% of corporate debt.

[16] Due to reporting issues in Orbis, the additional filter is applied to address the fact that that there is a non-negligible number of firms showing as active, even though they produced their last financial statement before the end of the sample period. Reclassifying firms that issued their last financial statement until 2021 as inactive reduces the number of active firm-years by 9,490 observations, representing an 8% decline relative to the case that the filter is not applied.

Over the period 2015–2021, the average failure rate across all firms is 2.44%, while the average failure rate among zombie firms is higher, at 3.97%.[17] The influence of firm size on failure rates mirrors its effect on zombie prevalence, with micro-firms exhibiting the highest vulnerability. In particular, the average failure rate for micro-firms (3.26%) is approximately 3.5 times higher than that for large firms (0.91%). These patterns suggest a close link between firm fragility, zombification, and exit risk, which we formally examine in the subsequent econometric analysis.

4. Zombies and firm failure: Cox model and results

To examine the determinants of firm's survival, we estimate a proportional hazard model (Cox, 1972). The model specifies the hazard function *h*, reflecting the risk of firm *i* failing at time *t* as follows:

$$h(t, X_i) = h_0(t)\exp(\beta X_i + \gamma Z_i) \quad (1)$$

where *h* denotes the conditional hazard rate, representing the probability of failure conditional on surviving up to year *t* and on the covariates, while $h_0(t)$ denotes the baseline hazard rate. The set of covariates (X_i) includes the firm's natural log of total assets, the leverage ratio, the profitability ratio, the liquidity ratio and the natural log of age. Moreover, following Banerjee and Hofmann (2022) we include a dummy variable reflecting the zombie status of the firm (Z_i = 1 if the firm is classified as zombie and 0 otherwise). The model also includes sector fixed effects to account for time-invariant industry trends and year fixed effects to capture time trends. Table 5 presents the estimation results. Columns 1 to 5 introduce each of the five covariates individually, while column 6 includes all covariates together In column 7, we add the PwC-based zombie status dummy to assess its effect on firm survival. To address the influence of extreme values, column 8 applies winsorization to all continuous variables at the 1st and 99th percentiles.

The results indicate that firm-level fundamentals significantly influence the hazard rate. All covariates in the extended models have the expected signs based on theory and previous empirical evidence. Higher total assets, profitability, and age significantly reduce the hazard of failure, while higher leverage increases it. Although the coefficient on the liquidity ratio is negative, as anticipated, its effect is statistically insignificant. Thus, firms that are larger, more profitable, less leveraged, and older face a lower risk of failure (or, equivalently, a higher probability of survival).[18] Winsorising notably amplifies the magnitude

[17] The overall average rate is comparable to the figures reported by Genakos et al. (2024) for Greece over a similar timeframe. It is also consistent with average failure rates found in Baumöhl et al. (2019) for 15 European countries (2007–2015) and in Görg and Spaliara (2014) for France and the UK (1998–2005).

[18] This finding aligns with international evidence reported by Banerjee and Hofmann (2022). Regarding the other firm-level variables, our results in Table 5 are consistent with previous evidence for Greece by Vettas et al. (2019) and Genakos et al. (2024) concerning the negative (positive) influence of firm size and age (leverage) on the hazard rate. For related international evidence see e.g. Audretsch and Mahmood (1995), Görg and

of the coefficients for both the profitability and leverage ratios but does not alter the main conclusions. Beyond the effects of firm-level fundamentals, zombie status (measured contemporaneously with the hazard) is associated with a significantly higher hazard rate compared with non-zombie firms.[19] The inclusion of zombie status in Column 7 materially improves model fit, as reflected in the higher (less negative) log-likelihood relative to Column 6, and the zombie coefficient remains strongly statistically significant. This indicates that the composite zombie classification contains incremental predictive information beyond conventional determinants of firm survival, conditional on the included controls. The improvement in model fit suggests that zombie status is not merely a mechanical restatement of leverage or profitability but captures persistent fragility that is not fully summarised by individual balance-sheet ratios.

The results in Column 7 reveal that being classified as a zombie is associated with a hazard ratio of approximately 2.7 ($= e^{0.975}$). This implies that, conditional on firm characteristics, zombie status is associated with a hazard of failure approximately three times higher than that of non-zombie firms, highlighting the economically significant link between zombification and firm survival prospects. [20]

Table 6 presents the results of various sensitivity checks. In Column 1, the PwC zombie-status dummy is replaced with the baseline ICR measure. Column 2 applies a firm-failure definition that excludes the additional criterion related to data availability. In Column 3, total assets are replaced with sales as a size proxy. Column 4 substitutes the leverage ratio with the solvency ratio. Column 5 includes a dummy variable indicating whether the firm is publicly listed. In Column 6, fixed effects based on the firm's legal form are added. Column 7 reports the results from a logit estimation.[21] The key conclusions remain robust across all these checks. [22]

Spaliara (2014), Guariglia et al. (2016), Baumöhl et al. (2019) and Banerjee and Hofmann (2022. For a theoretical analysis see e.g. Clementi and Hopenhayn (2006).

[19] Zombie status should be interpreted as a composite indicator of firm fragility rather than as an exogenous causal treatment. Accordingly, the estimated coefficients capture conditional associations between zombie status and the hazard of firm failure, rather than causal effects. To reinforce temporal ordering, we also estimate specifications in which zombie status is lagged by one year; the results, which are qualitatively unchanged, are available upon request.

[20] We test the proportional hazards assumption using Schoenfeld residuals. The results indicate some deviation from proportional hazards in the baseline specification, likely reflecting firm heterogeneity and structural changes during the Covid period. Allowing the effect of zombie status to vary with time does not yield a statistically significant time-varying component, while the baseline effect remains robust, indicating a strong link between zombie status and firm failure. These results are available upon request.

[21] To save space and maintain focus on the link between zombies and firm failure, in Table 6 we only present the coefficient of the zombie dummy. Its effect is strongly significant in all cases.

[22] Failure is defined based on Orbis status and the timing of the last available financial statement. As a final robustness check, we also estimate specifications using an alternative failure definition based solely on Orbis status categories, without applying the additional data-availability filter. The results concerning the link between zombie status and failure, available upon request, remain qualitatively unchanged.

Figure 8 shows the estimated coefficient of each statistically significant sectoral FE. The conditional risk of firm failure is, on average, higher in *Investment Companies* and *Tourism*, and lower in *Industry* and *Commerce*. The findings in Figure 8 highlight the important role of sectoral heterogeneity from the perspective of conditional hazard rates.

5. Conclusions

This paper examines the Greek corporate landscape during the recovery from the sovereign debt crisis and the Covid-19 pandemic, with a focus on the dynamics and consequences of zombie firms. Using firm-level Orbis data over 2015–2023 and a composite zombie classification tailored to the Greek corporate environment, we analyse firm characteristics, the evolution and persistence of zombification, and its relationship with firm failure.

Our findings point to four main conclusions. First, Greek firms during the recovery period are characterised by relatively low leverage and adequate liquidity but modest profitability, while zombie firms display systematically weaker balance-sheet positions, including higher leverage, lower liquidity and solvency, and persistent non-profitability. Second, the prevalence of zombie firms has declined markedly over time, falling below 5% by the end of the sample. Zombification is predominantly a transitory state: most zombie firms recover, while a smaller fraction remains persistently weak or exits the market. Third, zombie status is associated with substantially higher failure risk. Estimates from a Cox proportional hazards model indicate that zombie status is associated with a hazard of firm failure approximately 2.7 times higher than that of non-zombie firms, even after controlling for standard firm-level fundamentals. Fourth, there is pronounced heterogeneity across firm size and sectors, with micro firms exhibiting substantially higher zombie incidence and failure rates than larger firms, alongside persistent differences in zombie prevalence across sectors.

Taken together, these findings highlight differences between temporary financial distress and persistent weakness when assessing corporate resilience in the post-crisis period. While aggregate zombification has declined significantly, a non-negligible group of firms remains financially fragile, particularly among smaller firms. More broadly, the results highlight zombification as a distinct firm state with materially higher failure risk, contributing to a deeper understanding of firm exit dynamics in economies emerging from prolonged crises and large-scale policy interventions. Our evidence suggests that firm size and balance-sheet strength play a central role in post-crisis resilience, with implications for how recovery dynamics differ across segments of the corporate sector.

References

Acharya, V.V., Crosignani, M., Eisert, T. and Eufinger, C., 2024. Zombie credit and (dis-) inflation: Evidence from Europe. Journal of Finance, 79(3), pp.1883-1929.

Adalet McGowan, M., Andrews, D. and Millot, V., 2018. The walking dead? Zombie firms and productivity performance in OECD countries. Economic Policy, 33(96), pp.685-736.

Albuquerque, B. and Iyer, R., 2024. The rise of the walking dead: Zombie firms around the world. Journal of International Economics, 152, p.104019.

Andrews, D. and Petroulakis, F., 2019. Breaking the shackles: Zombie firms, weak banks and depressed restructuring in Europe. ECB Working Paper (No. 2240).

Audretsch, D.B. and Mahmood, T., 1995. New firm survival: new results using a hazard function. Review of Economics and Statistics, 77(1), pp.97-103.

Banerjee, R. and Hofmann, B., 2022. Corporate zombies: Anatomy and life cycle. Economic Policy, 37(112), pp.757-803.

Bank of Greece, 2023. Speech by Governor Y. Stournaras: The role of SMEs in the Greek economy. 22 September 2023.

Bank of Greece, 2024. Monetary Policy Report 2023-2024. June 2024.

Baumöhl, E., Iwasaki, I. and Kočenda, E., 2019. Institutions and determinants of firm survival in European emerging markets. Journal of Corporate Finance, 58, pp.431-453.

Beaver, W.H., Cascino, S., Correia, M. and McNichols, M.F., 2024. Bankruptcy in groups. Review of Accounting Studies, 29(4), pp.3449-3496.

Caballero, R.J., Hoshi, T. and Kashyap, A.K., 2008. Zombie lending and depressed restructuring in Japan. American Economic Review, 98(5), pp.1943-1977.

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

Cathcart, L., Dufour, A., Rossi, L. and Varotto, S., 2020. The differential impact of leverage on the default risk of small and large firms. Journal of Corporate Finance, 60, p.101541.

Chortareas, G., Katsafados, A.G., Pelagidis, T. and Prassa, C., 2024. Credit risk modelling within the euro area in the Covid-19 period: evidence from an ICAS framework. International Journal of Finance and Economics.

Clementi, G.L. and Hopenhayn, H.A., 2006. A theory of financing constraints and firm dynamics. Quarterly Journal of Economics, 121(1), pp.229-265.

Cox, D.R., 1972. Regression models and life-tables. Journal of the Royal Statistical Society: Series B (Methodological), 34(2), pp.187-202.

De Jonghe, O., Mulier, K. and Samarin, I., 2024. Bank specialization and zombie lending. Management Science.

European Commission, 2024. In-depth review 2024: Greece. Institutional Paper (No. 281).

Fukuda, S.I. and Nakamura, J.I., 2011. Why did 'zombie' firms recover in Japan?. The World Economy, 34(7), pp.1124-1137.

Gatopoulos, G., Louka, A., Peppas, K. and Vettas, N., 2024. Benefits for the Greek economy from resolving bad loans and zombie firms. Bank of Greece Economic Bulletin (July 2024).

Genakos, C., Kaplanis, I., Tagaraki, M.T. and Tsakanikas, A., 2023. Firm resilience and growth during the economics crisis: Lessons from the Greek depression. Hellenic Observatory Discussion Papers (No. 186).

Görg, H. and Spaliara, M.E., 2014. Financial health, exports and firm survival: Evidence from UK and French firms. Economica, 81(323), pp.419-444.

Gourinchas, P.O., Kalemli-Özcan, Ş., Penciakova, V. and Sander, N., 2020. Covid-19 and SME failures. National Bureau of Economic Research Working Paper (No. 27877).

Guariglia, A., Spaliara, M.E. and Tsoukas, S., 2016. To what extent does the interest burden affect firm survival? Evidence from a panel of UK firms during the recent financial crisis. Oxford Bulletin of Economics and Statistics, 78(4), pp.576-594.

Havemeister, L.K. and Horn, K., 2023. Fear the walking dead? Zombie firms in the euro area and their effect on healthy firms' credit conditions. ESRB Working Paper Series (No. 143).

IMF, 2021. Corporate vulnerabilities in the wake of Covid-19. Greece: Selected issues. International Monetary Fund Country Report (No. 21/155).

Kalemli-Ozcan, S., Sorensen, B., Villegas-Sanchez, C., Volosovych, V. and Yesiltas, S., 2015. How to construct nationally representative firm level data from the Orbis global database. NBER Working Paper (No. 21558).

OECD, 2024. Economic Surveys: Greece (December 2024).

Piraeus Bank, 2024. Enterprise rating system (December 2024).

PwC, 2015. Stars and zombies: Greek corporates coming out of the crisis. Executive Summary (September 2015).

PwC, 2019. 10 years of crisis: Smaller but unreformed corporate economy. Executive Summary (April 2019).

PwC, 2021. The response of the Greek companies to the pandemic. Report (2021).

Rodano, G. and Sette, E., 2019. Zombie firms in Italy: a critical assessment. Bank of Italy Occasional Paper (No. 483).

Schivardi, F., Sette, E. and Tabellini, G., 2020. Identifying the real effects of zombie lending. The Review of Corporate Finance Studies, 9(3), pp.569-592.

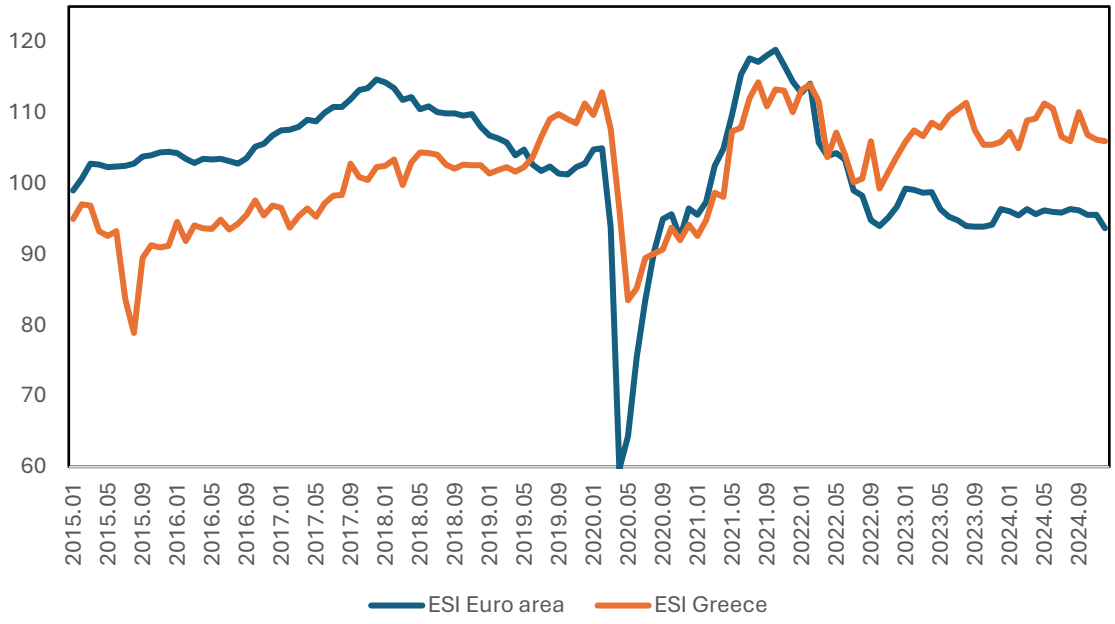
Schivardi, F., Sette, E. and Tabellini, G., 2022. Credit misallocation during the European financial crisis. The Economic Journal, 132(641), pp.391-423.

Vettas, N., Velavanioti, E., Peppas, K. and Vasileiadis, M., 2019. The evolution of new firm's characteristics in Greece before and during the economic adjustment programmes. Bank of Greece Economic Bulletin (December 2019).

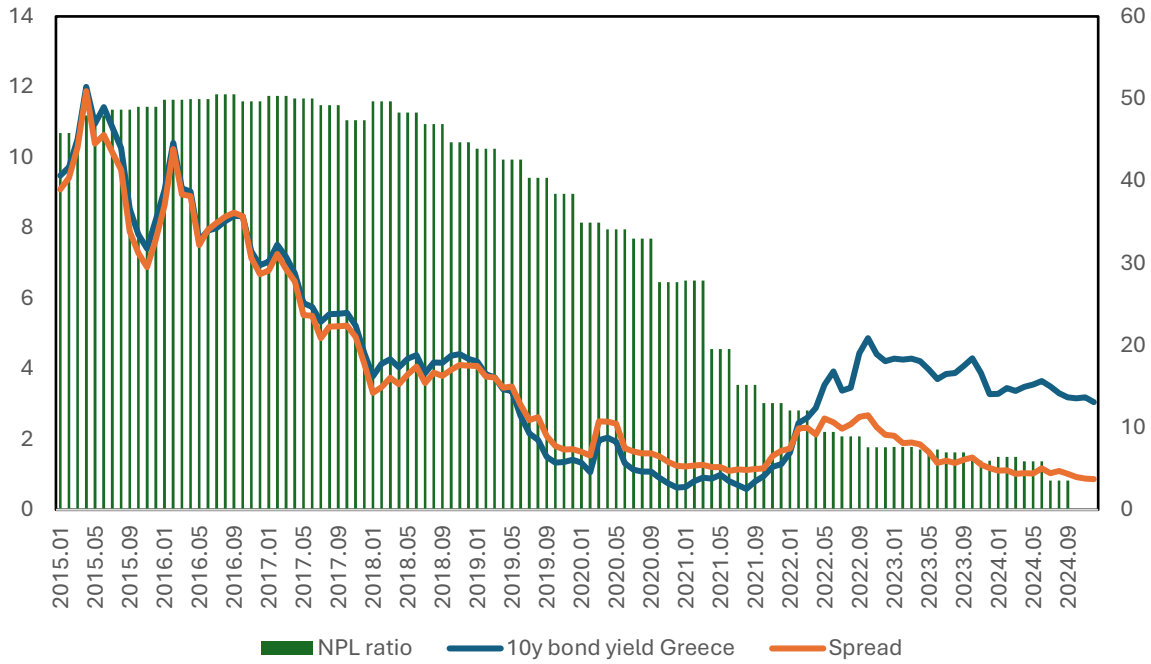
Vettas, N., Louka, A., Peppas, K., Pountouraki, Y. and Vasileiadis, M., 2022. Trends in total factor productivity in Greece and its determinants during the period 2005-2019. Bank of Greece Economic Bulletin (December 2022).

Figure 1: Macro-finance environment

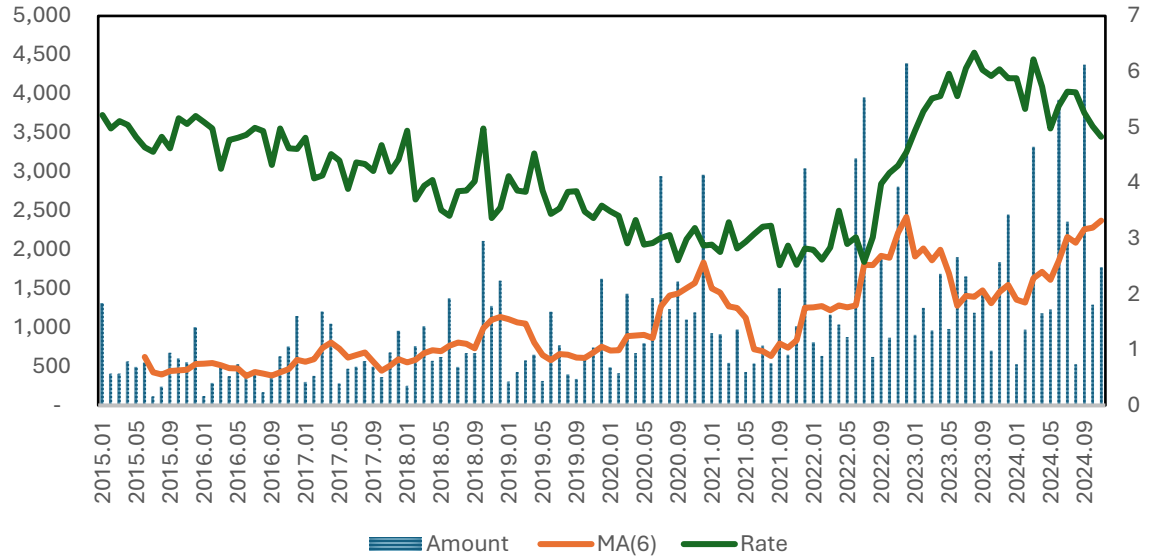
Panel A: Economic sentiment



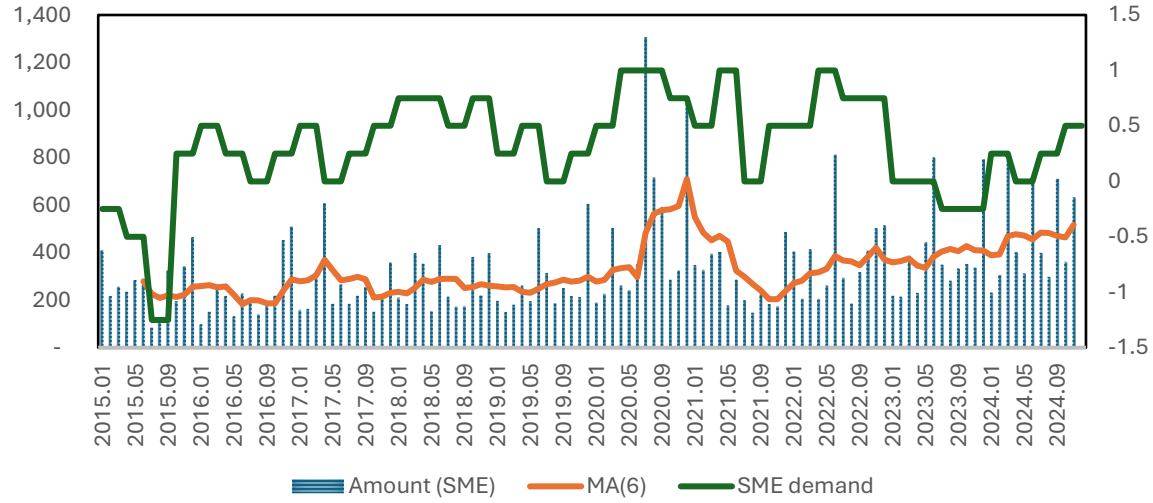
Panel B: Non-performing business loans ratio, government bond yield and spread



Panel C: New business loans (amount and rate)

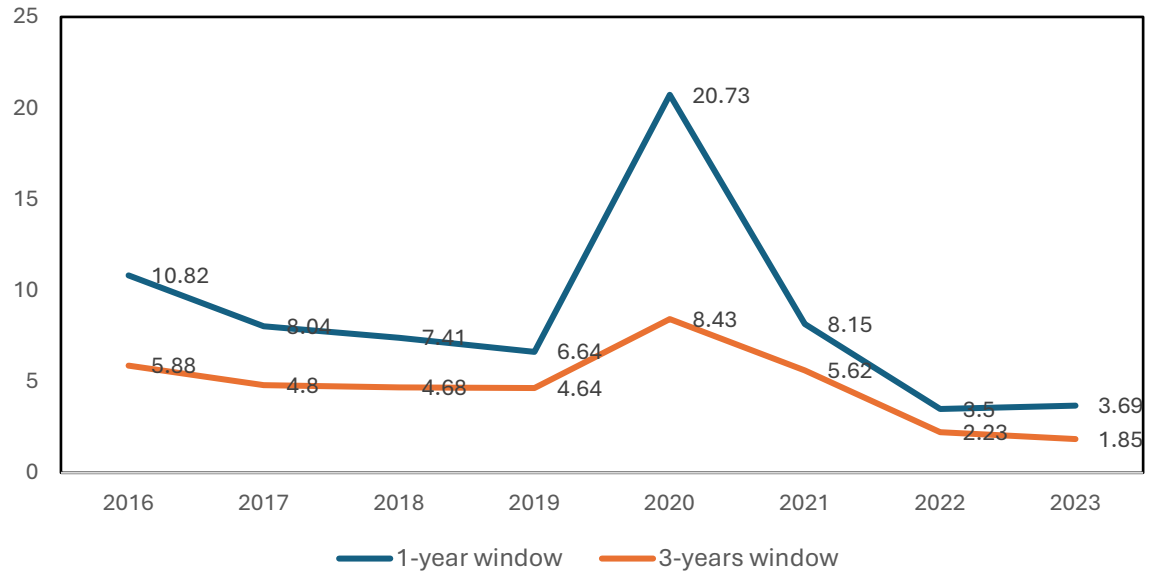


Panel D: New SMEs business loans and demand conditions



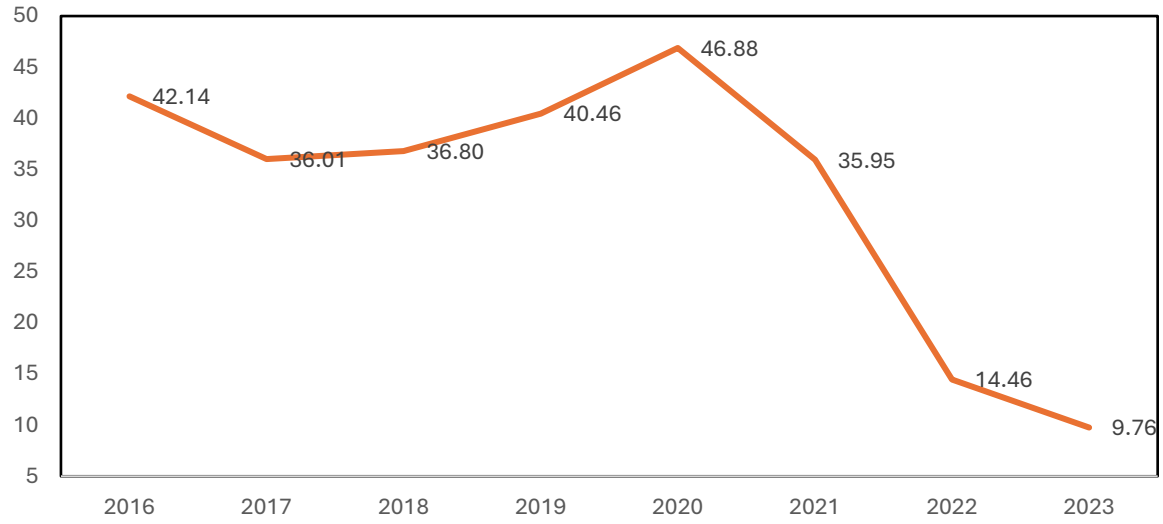
Notes: Figure 1 presents monthly data (2015–2024) for several variables related to the macro-financial landscape. Panel A shows the Economic Sentiment Index (ESI) for Greece and the euro area. Panel B shows the Greek government 10-year bond yield and its spread relative to the Germany (left axis), along with the non-performing business loans as % of total business loans (right axis). Panel C shows the amount (mn euros) and its 6-month moving average (left axis), as well as the interest rate of new loans to Greek non-financial corporations (right axis). Panel D shows the amount (mn euros) of new loans to Greek non-financial corporations of small and medium size and its 6-month moving average (left axis). It also shows the demand of SMEs for loans based on the Bank Lending Survey conducted by the Bank of Greece (right axis). The survey's quarterly data is transformed to monthly frequency and standardised so that 0 implies "no change" while higher (lower) values are associated with higher (lower) demand. Source: Authors' calculations based on data from Eurostat, ECB and Bank of Greece.

Figure 2: Share of zombie firms over time



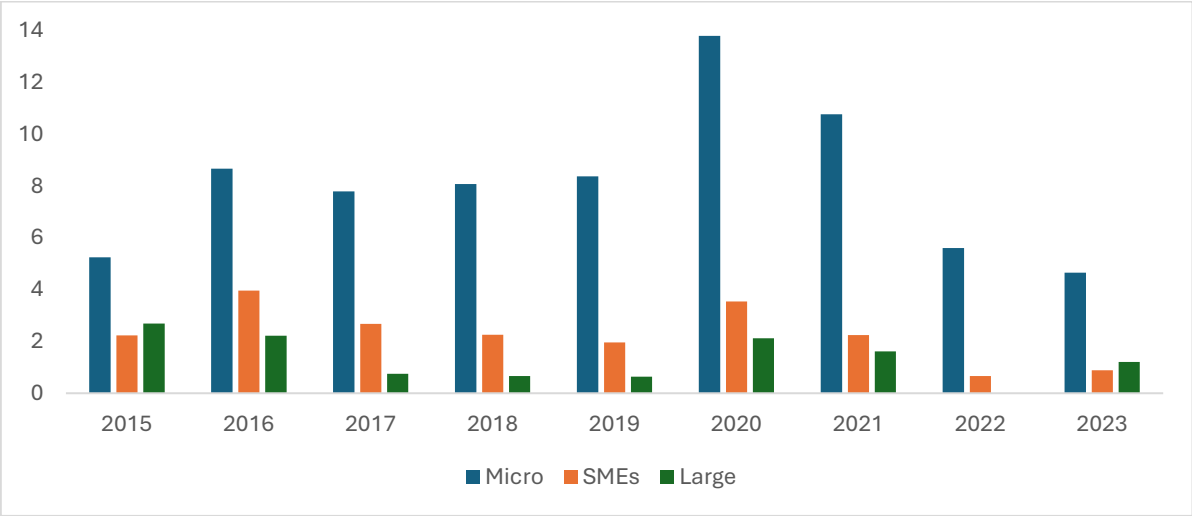
Notes: Figure 2 presents annual data (2015–2023) for the share of Greek zombie firms using the PwC measure which is based on the PwC (2015) study. See Table 1 for more details on the definition of the variables. It plots the number of zombies at year *t* as a share of the total number of firms at *t*. Source: Authors' calculations based on Orbis data.

Figure 3: Zombie persistence over time



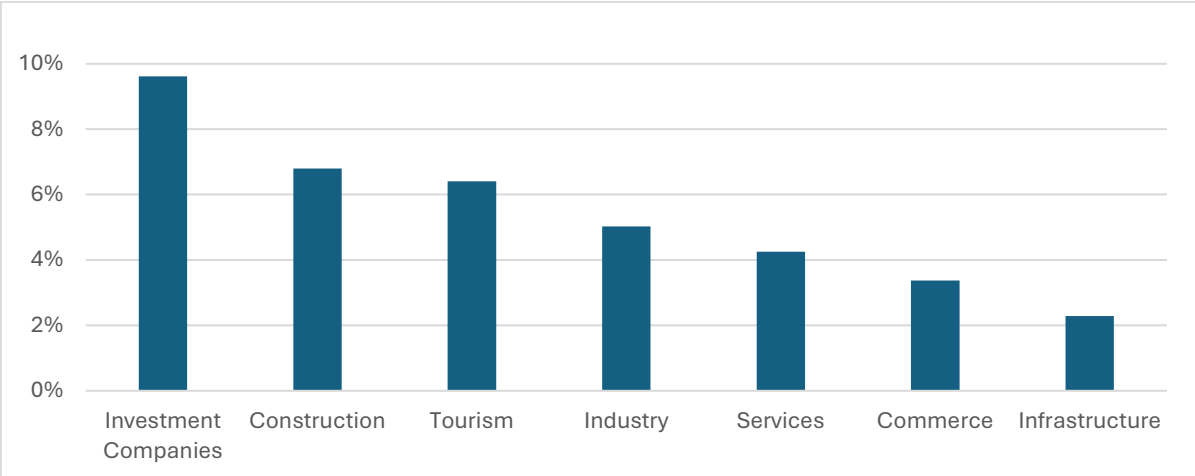
Notes: Figure 3 presents annual data (2015–2023) for the persistence of Greek zombie firms using the PwC measure which is based on the PwC (2015) study. See Table 1 for more details on the definition of the variables. A firm is classified as a persistent zombie at time *t* if it has zombie status both at *t*-1 and *t*. Figure 3 plots the number of persistent zombies at year *t* as a share of the number of zombies at *t*-1. Source: Authors' calculations based on Orbis data.

Figure 4: Share of zombie firms over time and across size



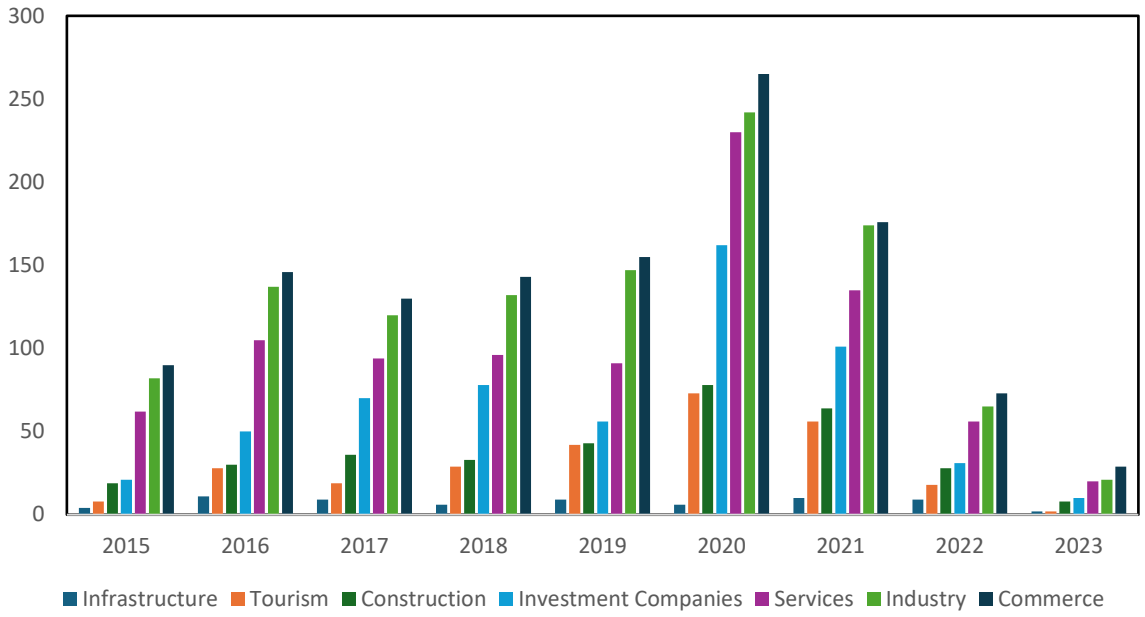
Notes: Figure 4 presents annual data (2015–2023) for the share of Greek zombie firms across different size bins using the PwC measure which is based on the PwC (2015) study. See Table 1 for more details on the definition of the variables. "Micro" firms are those with an annual turnover of less than €2.0 million, while "small and medium-sized" (SME) are those with an annual turnover between €2 million and €50 million, and "large" are those with an annual turnover of more than €50.0 million. Source: Authors' calculations based on Orbis data.

Figure 5: Share of zombie firms across sectors



Notes: Figure 5 presents the average share of Greek zombie firms over the period 2015-2023 across different sectors using the PwC measure which is based on the PwC (2015) study. See Table 1 for more details on the definition of the variables. Sector classification follows PwC (2021) and includes *Industry* (manufacturing, food and beverage production, pharmaceuticals, and energy), *Commerce* (retail, wholesale, and fuel trade), *Services* (business services, entertainment, IT, and transportation), *Investment Companies* (leasing and real estate services), *Tourism* (hotels, travel agencies, car rentals, and cruises), *Infrastructure* (telecommunications and utilities), and *Construction* (building-related activities). Source: Authors' calculations based on Orbis data.

Figure 6: Number of zombie firms over time and across sectors



Notes: Figure 6 presents the number of Greek zombie firms over the period 2015-2023 across different sectors using the PwC measure which is based on the PwC (2015) study. See Table 1 for more details on the definition of the variables. Sector classification follows PwC (2021) and includes *Industry* (manufacturing, food and beverage production, pharmaceuticals, and energy), *Commerce* (retail, wholesale, and fuel trade), *Services* (business services, entertainment, IT, and transportation), *Investment Companies* (leasing and real estate services), *Tourism* (hotels, travel agencies, car rentals, and cruises), *Infrastructure* (telecommunications and utilities), and *Construction* (building-related activities). Source: Authors' calculations based on Orbis data.

Figure 7: Profitability over time across zombies and non-zombies

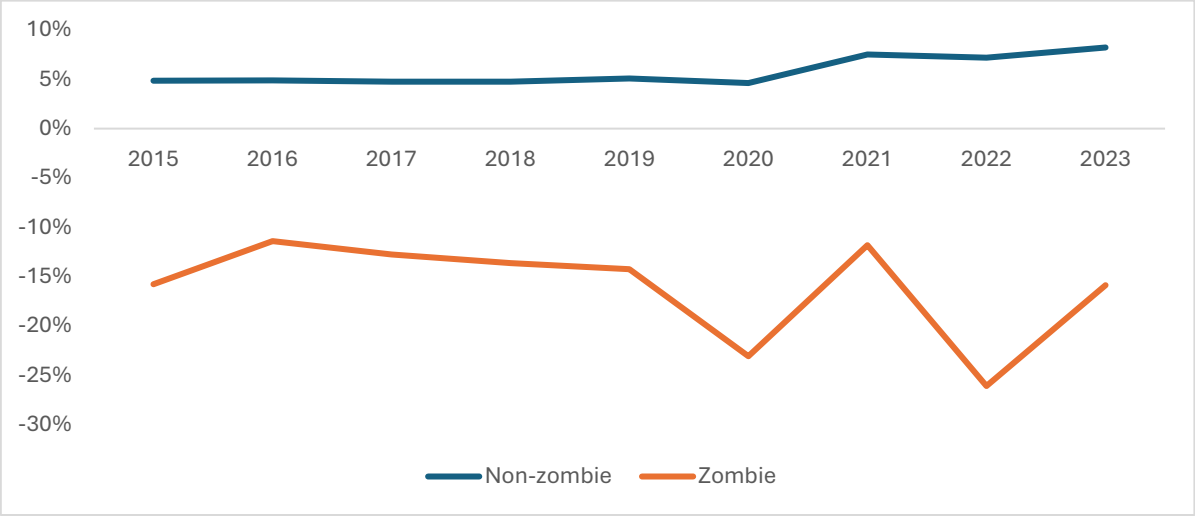
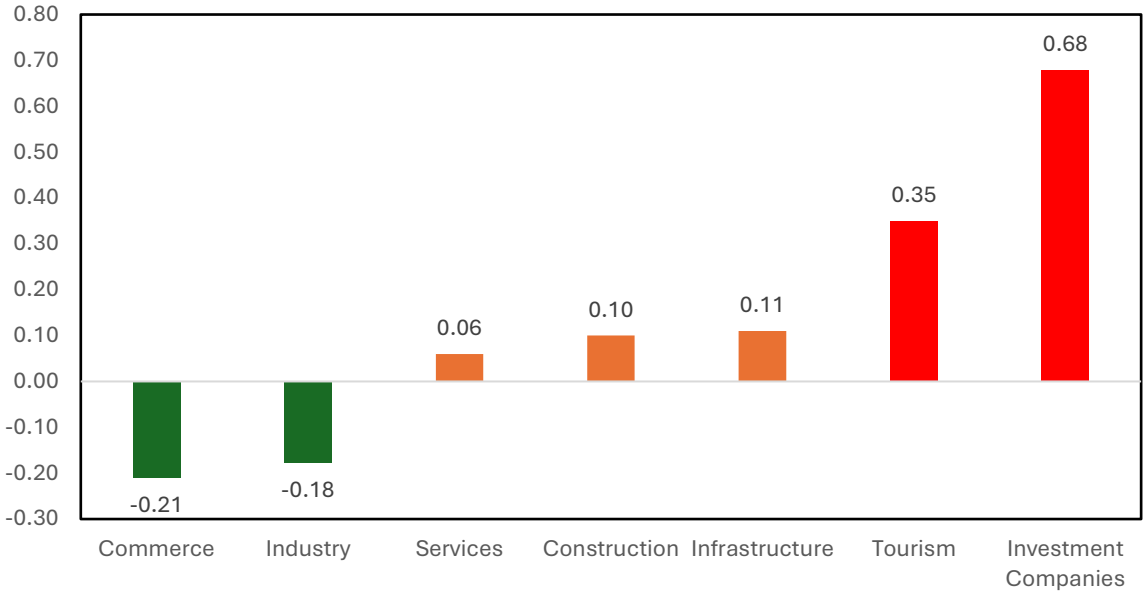


Figure 7 presents the 50th percentile (median) of the profitability ratio of Greek non-zombie and zombie firms for each year over the period 2015-2023 using the PwC measure that is based on the PwC (2015) study. See Table 1 for more details on the definition of the variables. Source: Authors' calculations based on Orbis data.

Figure 8: Estimates of sectoral classification effect on hazard rates



Notes: Figure 8 presents estimates from Cox proportional hazard model for Greek firms over the period 2015-2021. It shows the estimated coefficient for each sectoral fixed effect. Sector classification follows PwC (2021) and includes *Industry* (manufacturing, food and beverage production, pharmaceuticals, and energy), *Commerce* (retail, wholesale, and fuel trade), *Investment Companies* (leasing and real estate services), and *Tourism* (hotels, travel agencies, car rentals, and cruises). Source: Authors' calculations based on Orbis data.

Table 1: Definition of variables

Variable	Definition	Source
Zombie (PwC)	Zombie status based on the PwC (2015) study. A dummy variable that is equal to 1 if all following conditions are satisfied (and 0 otherwise): (i) Compound Annual Growth Rate of Turnover < -5% (3-year window); (ii) Return on Capital Employed < 0% (3-year window mean); (iii) Net Debt/EBITDA > 5, or EBITDA < 0 (3-year window mean)	Authors' calculations based on Orbis data
Zombie (ICR Alternative)	Zombie status based on the Adalet McGowan et al. (2018) study. A dummy variable that is equal to 1 if all following conditions are satisfied (and 0 otherwise): (i) Interest Coverage Ratio (ICR) < 1 for 3 consecutive years, where ICR = EBIT / Financial Expenses; (ii) Age ≥ 10 years	
Failed	Failed status based on the Beaver at al. (2024) and Cathcart et al. (2020) studies. A dummy variable that is equal to 1 if the firm has any of the following statuses in Orbis (and 0 otherwise): Active (insolvency proceedings); Bankruptcy; Dissolved; Dissolved (liquidation); In liquidation; Inactive (no precision). We also assign failed status to firms that show as active in Orbis, when the data was retrieved (October 2024), but produced their last financial statement until 2021 based on the "Last Available Year" Orbis variable. We assume that firms failed in the last year that they published a financial statement	
Assets	Total Assets = Fixed Assets + Current Assets, expressed in thousands of euros	Orbis
Turnover	Sales, expressed in thousands of euros	Orbis
EBIT	Earnings Before Interest and Taxes, expressed in thousands of euros	Orbis
Net income	P/L for period, expressed in thousands of euros	Orbis
Profitability	EBIT margin = EBIT / Turnover	Authors' calculations based on Orbis data
Short-term debt	Short-term financial debts (e.g. to credit institutions + part of long-term financial debts payable within the year, bonds, etc.), expressed in thousands of euros	Orbis
Long-term debt	Long-term financial debts (e.g. to credit institutions (loans and credits), bonds), expressed in thousands of euros	Orbis
Leverage	Leverage ratio = (Short-term debt + Long-term debt) / Assets	Authors' calculations based on Orbis data
Solvency	Solvency ratio = Equity /Assets	
Liquidity	Current ratio = Current Assets / Current Liabilities	
Age	Current year - incorporation year	
Listed	Listed status. A dummy variable that is equal to 1 if the firm is listed (and 0 otherwise)	

Table 2: Descriptive statistics, all firms

Variable	N	P25	P50	P75	MAD
Assets	125,335	1,362	2,942	7,192	2,001
Turnover	125,792	1,086	2,240	5,455	1,479
EBIT	125,335	17	127	419	152
Net income	125,335	-5	63	260	118
Profitability	122,324	0.01	0.05	0.13	0.05
Short-term debt	125,335	0	40	512	40
Long-term debt	125,335	0	39	719	39
Leverage	125,334	0	0.12	0.35	0.12
Solvency	125,334	0.17	0.39	0.62	0.22
Liquidity	125,785	1.00	1.45	2.44	0.59
Age	124,244	10	19	30	10

Notes: Table 2 presents summary statistics over the period 2015-2023 for key financial characteristics of the sampled Greek firms. Assets, turnover, EBIT, net income and debt are expressed in thousands of euros. See Table 1 for more details on the definition of the variables. N, P25, P50, P75 and MAD represent the number of firm-year observations, 25^{th}, 50^{th} (median), 75^{th} percentile and the median absolute deviation (MAD). Source: Authors' calculations based on Orbis data.

Table 3: Descriptive statistics of zombies and non-zombies

	Non-zombie		Zombie	
	P50	MAD	P50	MAD
Assets	3,391	2,106	3,727	2,067
Turnover	2,698	1,580	817	1,717
EBIT	165	171	-130	265
Net income	84	133	-180	253
Profitability	0.06	0.05	-0.15	0.23
Short-term debt	53	40	102	62
Long-term debt	61	39	186	147
Leverage	0.13	0.12	0.27	0.14
Solvency	0.40	0.22	0.25	0.31
Liquidity	1.48	0.58	1.13	0.73
Age	19	10	22	9

Notes: Table 3 presents summary statistics over the period 2015-2023 for key financial characteristics of the sampled Greek firms across zombie and non-zombie status using the PwC measure which is based on the PwC (2015) study. Assets, turnover, EBIT, net income and debt are expressed in thousands of euros. See Table 1 for more details on the definition of the variables. P50 and MAD represent the 50th (median) percentile and the median absolute deviation (MAD). Source: Authors' calculations based on Orbis data.

Table 4: Persistence rates of zombie firms by year-cohort

Cohort	2015	2016	2017	2018	2019	2020	2021	2022	2023
2015	100	42	20	10	13	14	8	5	1
2016		100	34	13	13	19	13	3	1
2017			100	38	20	20	12	8	2
2018				100	40	24	14	6	3
2019					100	52	21	6	2
2020						100	37	5	1
2021							100	19	3
2022								100	9
2023									100

Table 4 presents the persistence rates (in percentage) of zombie firms by year-cohort. They are computed as the ratio of the number of remaining zombie firms to the number of zombie firms in the year in which they became zombies (having 100 as the base year). Zombie classification uses the PwC methodology which is based on the PwC (2015) study. See Table 1 for more details on the definition of the variables. Source: Authors' calculations based on Orbis data.

Table 5: Survival analysis

	(1)	(3)	(3)	(4)	(5)	(6)	(7)	(8)
Ln(Assets)	-0.162***					-0.154***	-0.153***	-0.199***
	(-8.630)					(-6.746)	(-6.118)	(-7.810)
Leverage		0.188***				0.194***	0.179***	0.688***
		(5.978)				(5.219)	(4.798)	(7.260)
Profitability			-0.000*			-0.000**	-0.000**	-0.176***
			(-1.941)			(-2.183)	(-1.992)	(-4.485)
Liquidity				0.000**		-0.000	-0.000	-0.000
				(2.056)		(-0.358)	(-0.480)	(-0.020)
Ln(Age)					-0.172***	-0.087***	-0.128***	-0.117***
					(-6.831)	(-3.125)	(-3.879)	(-3.609)
Zombie (PwC)							0.975***	0.815***
							(16.078)	(12.992)
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	98,990	98,990	96,814	98,970	97,694	95,527	75,419	75,419
Log Likelihood	-91006	-91115	-86869	-91116	-89229	-84805	-59101	-59015

Notes: Table 5 presents estimates from Cox proportional hazard model for Greek firms over the period 2015-2021. The dependent variable is the hazard of firm failure. A positive coefficient indicates that the risk of firm failing is increasing in that variable. Column 8 uses winsorized data at the 1st and 99th percentiles. N represents the number of firm-year observations. z-statistics (in parentheses) are based on standard errors clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1. See Table 1 for more details on the definition of the variables. Source: Authors' calculations based on Orbis data.

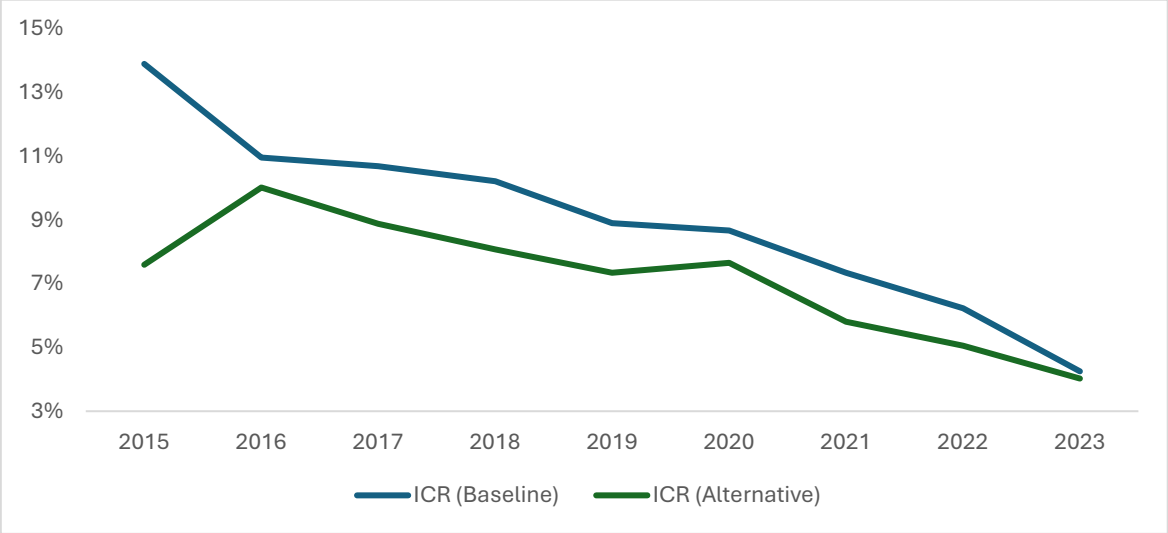
Table 6: Robustness checks and extensions

	(1) ICR	(2) Fail Orbis	(3) Turnover	(4) Solvency	(5) Listed	(6) Legal FE	(7) Logit
Zombie (PwC)		0.983***	0.725***	0.979***	0.984***	1.007***	1.100***
		(16.078)	(11.091)	(16.643)	(16.102)	(15.891)	(13.230)
Zombie (ICR)	0.853***						
	(9.915)						
Ln(Turnover)			-0.215***				
			(-12.203)				
Solvency				-0.034***			
				(-3.651)			
Listed					-1.136		
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Legal FE	No	No	No	No	No	Yes	No
N	50,196	75,419	75,419	76,789	75,419	75,419	75,554
Log Likelihood	-31818	-334	-58937	-61919.7	-59090	-58138	-6797

Notes: Table 6 columns 1-6 present estimates from Cox proportional hazard model for Greek firms over the period 2015-2021. The dependent variable is the hazard of firm failure. A positive coefficient indicates that the risk of firm failing is increasing in that variable. Column 1 replaces the PwC zombie measure with the ICR-based metric. Column 2 uses firm fail definition that is based solely on Orbis fail status without imposing the additional criterion ("Last Available Year" < 2022). Column 3 replaces total assets with turnover. Column 4 uses the solvency ratio instead of the leverage ratio. Column 5 adds the listed status dummy variable. Column 6 adds fixed effects based on the firm's legal form. N represents the number of firm-year observations. z-statistics (in parentheses) are based on standard errors clustered at the firm level. Column 7 presents estimates from Logit model. The dependent variable is a dummy which equals 1 if the firm has failed that year, and 0 otherwise. t-statistics (in parentheses) are based on standard errors clustered at the firm level.*** p<0.01, ** p<0.05, * p<0.1. See Table 1 for more details on the definition of the variables. Source: Authors' calculations based on Orbis data.

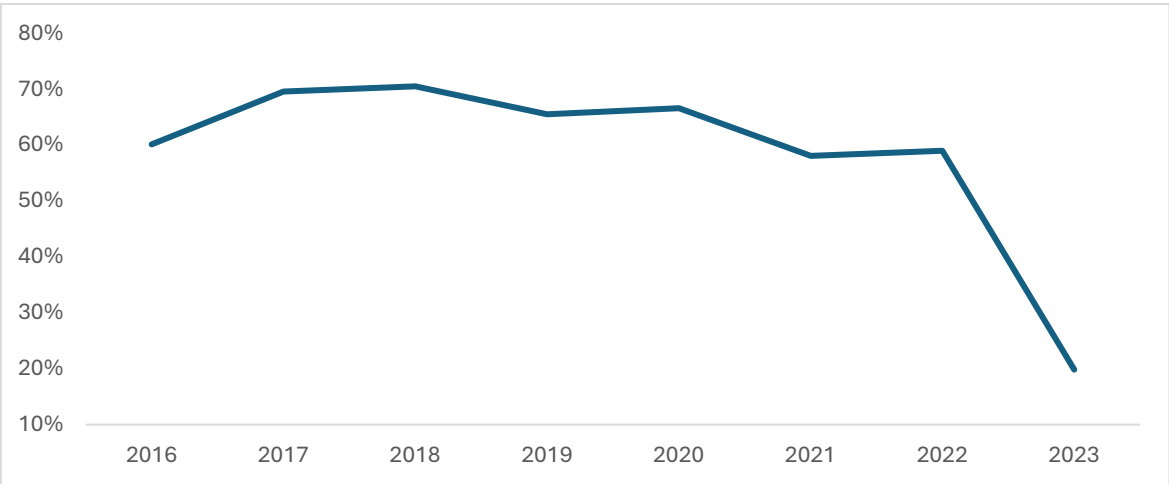
Appendix

Figure A1: Share of zombie firms over time: Alternative ICR measures



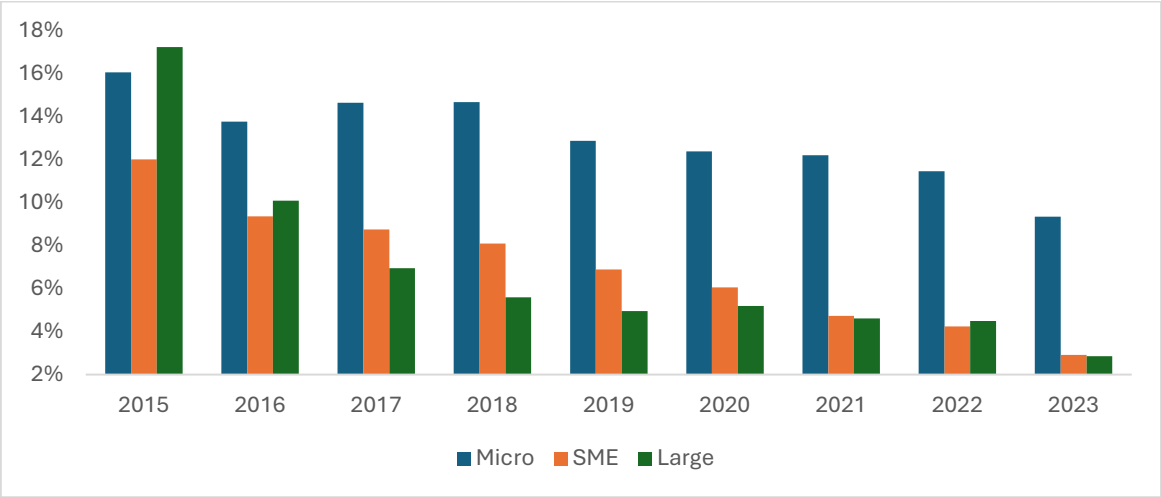
Notes: Figure A1 presents annual data (2015–2023) for the share of Greek zombie firms using two alternative interest coverage (ICR)-based measures; ICR (Baseline) is based on the study by De Jonghe et al. (2024), while ICR (Alternative) is in line with Adalet McGowan et al. (2018). See Table 1 for more details on the definition of the variables. It plots the number of zombies at year *t* as a share of the total number of firms at *t.* Source: Authors' calculations based on Orbis data.

Figure A2: Zombie persistence over time: ICR measure



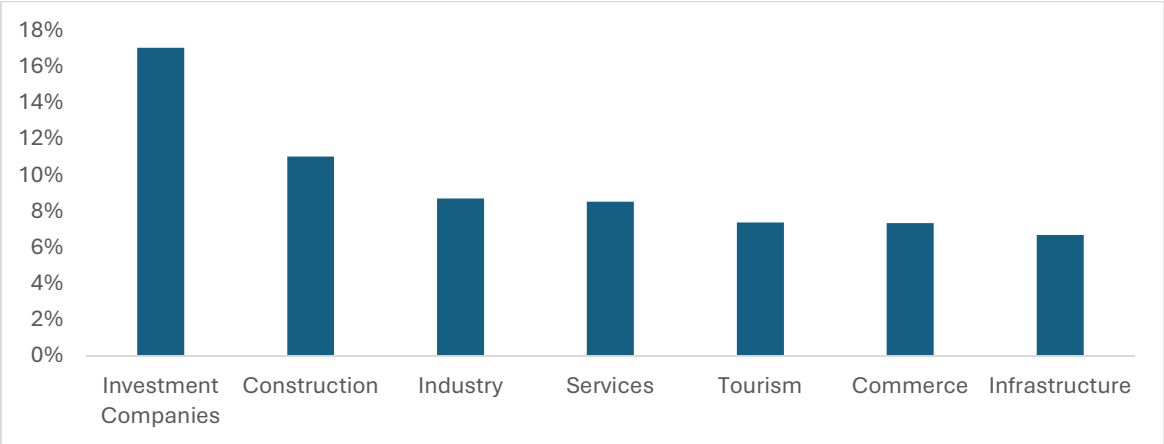
Notes: Figure A2 presents annual data (2015–2023) for the persistence of Greek zombie firms using the Interest coverage (ICR) measure which is based on the study by De Jonghe et al. (2024). See Table 1 for more details on the definition of the variables. A firm is classified as a persistent zombie at time t if it has zombie status both at t-1 and t. Figure 3 plots the number of persistent zombies at year t as a share of the number of zombies at t-1. Source: Authors' calculations based on Orbis data.

Figure A3: Share of zombie firms over time and across size: ICR measure



Notes: Figure A3 presents annual data (2015–2023) for the share of Greek zombie firms across different size bins using the Interest coverage (ICR) measure which is based on the study by De Jonghe et al. (2024). See Table 1 for more details on the definition of the variables. "Micro" firms are those with an annual turnover of less than €2.0 million, while "small and medium-sized" (SME) are those with an annual turnover between €2 million and €50 million, and "large" are those with an annual turnover of more than €50.0 million. Source: Authors' calculations based on Orbis data.

Figure A4: Share of zombie firms across sectors: ICR measure



Notes: Figure A4 presents the average share of Greek zombie firms over the period 2015-2023 across different sectors using the Interest coverage (ICR) measure which is based on the study by De Jonghe et al. (2024). See Table 1 for more details on the definition of the variables. Sector classification follows PwC (2021) and includes *Industry* (manufacturing, food and beverage production, pharmaceuticals, and energy), *Commerce* (retail, wholesale, and fuel trade), *Services* (business services, entertainment, IT, and transportation), *Investment Companies* (leasing and real estate services), *Tourism* (hotels, travel agencies, car rentals, and cruises), *Infrastructure* (telecommunications and utilities), and *Construction* (building-related activities). Source: Authors' calculations based on Orbis data.

Table A1: Descriptive statistics of zombies and non-zombies: ICR measure

	Non-zombie		Zombie	
	P50	**MAD**	**P50**	**MAD**
Assets	4,056	2,156	5,308	2,707
Turnover	3,350	1,735	1,747	1,758
EBIT	229	199	-139	300
Net income	125	151	-250	338
Profitability	0.06	0.05	-0.08	0.14
Short-term debt	92	52	322	282
Long-term debt	108	69	329	290
Leverage	0.14	0.12	0.36	0.23
Solvency	0.43	0.21	0.13	0.34
Liquidity	1.56	0.57	0.94	0.80
Age	21	9	24	7

Notes: Table A1 presents summary statistics over the period 2015-2023 for key financial characteristics of the sampled Greek firms across zombie and non-zombie status using the Interest coverage (ICR) measure which is based on the study by De Jonghe et al. (2024). Assets, turnover, EBIT, net income and debt are expressed in thousands of euros. See Table 1 for more details on the definition of the variables. P50 and MAD represent the 50th (median) percentile and the median absolute deviation (MAD). Source: Authors' calculations based on Orbis data.

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