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**Article**

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# When companies don't die: Analyzing zombie firms in a low interest rate environment

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We examine whether low interest rates foster non-viable firms in Europe by analyzing two classes of firms: zombies and distressed. Controlling for the business cycle and recession periods, we find a significantly negative effect of short-term rates on the likelihood of being a zombie, while no effect for distressed firms is detected. A decrease in inflation and a lower state of the business cycle is associated with a rise in both zombies and distressed firms. Examining a non-conventional monetary policy program, we find no evidence of credit misallocation. Therefore, concurring monetary and macroeconomic phenomena likely explain the presence of non-viable firms, although with dissimilarities between zombies and distressed firms.

*Key words:* zombie firms, distressed firms, monetary policy, business cycle  
*JEL codes:* D22, E32, E43, E52, G33

## 1 Introduction

With the COVID-19 pandemic, a series of government measures put into place to support struggling businesses might have allowed otherwise insolvent borrowers to remain alive. Following the pandemic containment measures, a reduction in the number of bankruptcies was recorded in Europe.<sup>2</sup> The crisis highlights the importance of monitoring and analyzing the presence of non-viable firms kept afloat by public support schemes and bank lending activities (LAEVEN et al., 2020).

The rising numbers of zombie firms (BANERJEE and HOFMANN, 2022) have been associated with excessive levels of corporate debt (JORDÀ et al., 2022), lax monetary policies (ACHARYA et al., 2019), low interest rates (BANERJEE and HOFMANN, 2018), and erroneous bank lending behaviors (CABALLERO et al. 2008).

We contribute to the literature by using the Compustat Global Fundamentals database to examine the link between monetary policy and non-viable listed firms in eight European countries. We thereby investigate the link between short-term interest rates and non-viable firm status in general as well as in relation to a specific policy measure, that is, the reaction of non-viable firms following the announcement of the ECB's Corporate Sector Purchase Program (CSPP). To complement a silent literature, we expand our analysis to capture not only zombie

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<sup>2</sup> Source: Eurostat (<https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20201104-2>).

firms but also distressed firms, in order to observe potential differences in their reactions.

Since the implementation of monetary policy measures coincides with recession periods, we augment our analysis by considering two business cycle indicators – GDP growth and the composite leading indicator (CLI)<sup>3</sup> – to examine their impact on the status of non-viable firms. We complement this empirical analysis by highlighting the effect of specific recession events capturing three economic downturns – the dot-com bubble, the Global Financial Crisis, and the Debt Crisis<sup>4</sup> – to understand the distinctive effects on non-viable firms' status.

Considering the impact of monetary policy, proxied by the short-term interest rate, our results indicate a negative and significant effect of short-term rates on the likelihood of being classified as a zombie firm, supporting the argument that low interest rates could constitute a favorable environment for zombie firms' survival (BANERJEE and HOFMANN, 2018). This result, however, is not confirmed for the class of distressed firms. This might be explained by the unique features of zombie firms as insolvent borrowers kept alive by subsidized bank credit (CABALLERO et al., 2008; HOSHI, 2006). The results of the examination of the announcement of the CSPP show a significant decrease in zombie and distressed firm status following the announcement of the program. However, at the same time, we find no evidence of misallocation of subsidies to zombies and distressed firms within this specific program.

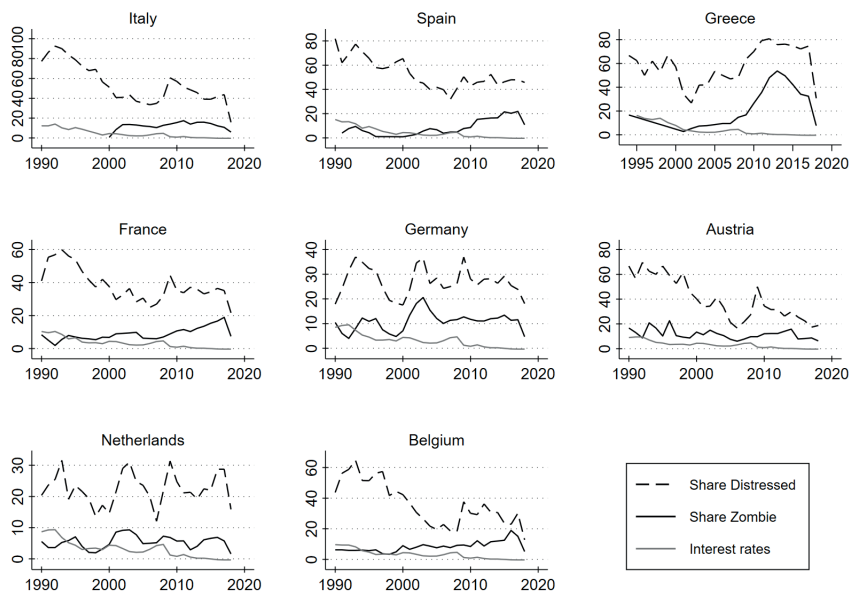
Our results based on the Consumer Price Index (CPI), as an inflation measure, and the business cycle measures indicate that an increase in inflation decreases the likelihood of zombie and distressed firm status, consistent with earlier work (Bhamra et al., 2018; Acharya et al., 2023). We also document a negative and highly significant effect of GDP growth on zombie and distressed firm status. Finally, the results suggest that the probability of zombie status is significantly positively affected by recession periods following the burst of the dot-com bubble, the Global Financial Crisis, and the Debt Crisis.

Overall, this study suggests that zombies and distressed firms exhibit a different reaction to a low interest rate environment, and that this monetary policy alone is likely not the main driver of non-viable firms' survival. Rather, concurring phenomena related to the business cycle and inflation expectations can explain the presence of non-viable firms.

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3 The CLI is an indicator designed to provide early signals of turning points in business cycles showing fluctuations of the economic activity around its long-term potential level (OECD, 2020).

4 Dot-com bubble refers to the years 2000-2001, Global Financial Crisis to 2008-2009, and Debt Crisis to 2011-2012.

**Figure 1:** Zombie firms, distressed firms, and short-term interest rates

*Note:* The graph plots the shares of zombie firms, black line, of distressed firms, dashed line, and short-term interest rates, gray line. We define zombie firms following BANERJEE and HOFMANN (2018) and distressed firms following ALTMAN (1968). The short-term interest rates are used as a measure of the European single monetary policy and are based on three-month money market rates.

*Source:* Authors' projections on Compustat Global and OECD data.

## 2 Measuring non-viable firms

We use Compustat Global to collect financial and market data on active and inactive publicly traded companies. We restrict the sample to a set of European countries for which coverage is optimal and match Thomson Reuters Datastream firm ratings with Compustat firm-level data to identify a treatment and control group before the announcement of the ECB's Corporate Sector Purchase Program.

We remove observations with missing company unique identifiers or missing information on fiscal year and drop all firm-year duplicates. To mitigate the effect of outliers, we winsorize variables at the 1st and 99th percentiles year-by-year. At the industry level, we use the GIC group based on the global industry classification standard (GICS) developed by the S&P Dow Jones Indices and the MSCI to identify 22 industries. We exclude companies in the utilities, financial, insurance, and banking industries (ACHARYA et al., 2019; 2023). The final sample

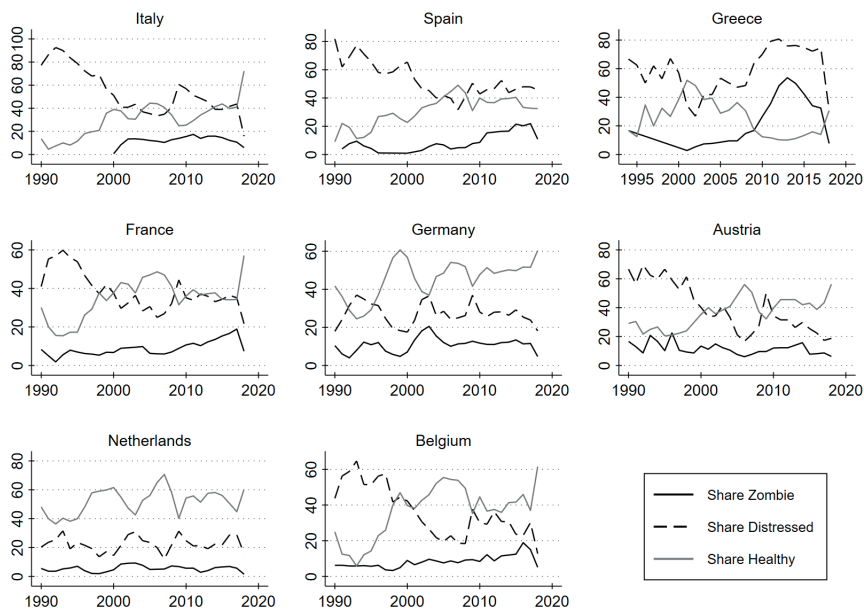
consists of listed firms from eight European countries – Italy, Spain, Greece, France, Germany, Austria, the Netherlands, and Belgium – over the period 1990–2018.

Considering interest rates, inflation, and business cycle indicators, we use data on short-term and long-term interest rates, inflation, and the CLI from the OECD and real GDP growth from the World Bank.

Following BANERJEE and HOFMANN (2018; 2022), we define a zombie firm as an unproductive firm that is unable to cover its debt servicing costs from its current profits over an extended period of time. In line with this definition, BANERJEE and HOFMANN (2018) classify a firm as zombie if its interest coverage ratio is below one for three consecutive years and its Tobin's  $q$  is below median within the sector and year.

To capture non-viable firms beyond the classification of zombie firms, we extend our analysis to distressed firms following the corporate finance literature on firm default. The measure used to identify distressed firms follows Altman (1968) Z-score, which represents a proxy for bankruptcy risk. A Z-score greater than 2.99 signals financial soundness, a score below 1.81 indicates financial distress, and a score between 1.81 and 2.99 represents the gray area.

We monitor firms over the period 1990–2018 and assign them to three categories: zombies, distressed and healthy. A total of 4,499 firms are classified as zombies over this period. Of these, 183 are located in Austria, 169 in Belgium, 1,485 in Germany, 239 in Spain, 1,200 in France, 598 in Greece, 460 in Italy, and 165 in the Netherlands. Figure 2 shows the trend of healthy (gray line), zombies (black line) and distressed (dashed line) firms. The line for distressed firms shows a downward trend, while healthy firms display an upward trend. In our sample, 17,170 firms are classified as healthy (those that are never zombies and with a Z-score above 2.99), while 15,244 are classified as distressed (see Figure 2).

**Figure 2:** Share of zombies, distressed, and healthy firms

*Note:* The graph shows the share of zombies, healthy, and distressed firms by country and year. A firm is classified as zombie if its interest coverage ratio is below one for three consecutive years and its Tobin's  $q$  is below median (BANERJEE and HOFMANN 2018). A firm is classified as healthy if it has never been a zombie and has a Z-score above 2.99 (Altman 1968). Distressed firms are identified following (ALTMAN 1968).

*Source:* Authors' projections on Compustat Global data.

Table 1 reports the descriptive statistics for firm-level variables. Zombie firms fall behind their healthy peers in a number of features: they show higher leverage, higher tangible assets, negative return on equity, and negative profit margins, operating profit and EBIT ICR. They are also smaller and have lower capital and research and development expenditures. Distressed firms report higher leverage and net leverage and higher asset tangibility with respect to the zombie firms, but at the same time they have positive returns on equity, profit margins, operating profit, and EBIT ICR. Distressed firms are also larger in size compared to zombie firms, and have higher capital expenditures. Altogether, we see that zombie firms have specific features that make them differ from other types of firms (DE MARTIIS et al., 2023)

**Table 1:** Statistics on healthy firms, zombies, non-zombies, and distressed firms

	Healthy	Zombie	Non-Zombies	Distressed
Leverage	0.116	0.271	0.199	0.308
Asset Tangibility	0.139	0.175	0.190	0.246
Cash & ST Invest. Ratio	0.125	0.071	0.090	0.064
Return on Equity	0.111	-0.153	0.087	0.032
Profit Margin	0.047	-0.137	0.034	0.007
Operating Profit	0.119	-0.016	0.102	0.066
Capex Ratio	0.036	0.020	0.037	0.031
R&D Ratio	0.037	0.061	0.025	0.018
EBIT ICR	7.787	-3.529	4.320	1.534
Total Assets (Changes)	0.055	-0.070	0.041	0.012
Size Log(Tot. Assets)	4.745	4.201	5.590	6.035

*Note:* The table presents descriptive statistics for healthy, zombies, non-zombies, and distressed firms. Healthy companies are those that are never zombie in the entire period of observation and with a Z-score above 2.99 (ALTMAN 1968). Zombie is a binary variable that takes a value of one if its interest coverage ratio is below one for at least three consecutive years and its Tobin's q is below the median within its sector and year (BANERJEE and HOFMANN 2018). Non-zombies are those equal to zero. Distressed firms are identified using the Z-score measure (ALTMAN 1968). Median values are reported.

*Source:* Authors' calculations on Compustat Global data.

### 3 Monetary policy and non-viable firms

To analyze the effect of monetary policy on the status of non-viable firms, we conduct logistic regressions of zombie and distressed status, respectively, on short-term interest rates, controlling for profit margin, negative income, leverage, and firm size. We then examine the relationship of inflation as well as the effect of the announcement of, and actual participation in, the CSPP on zombie and distressed firm status.

#### 3.1 Interest rates and inflation

Previous studies suggest a negative link between interest rates and zombie status, supporting the rationale that very low interest rates for long allow low-productivity firms to stay in business. The results of logistic regressions including short-term interest rates are presented in Table 2. Regression (1) in Panel A reports the results on zombie firms and shows a negative and significant effect of short-term rates on the probability of zombie status.

**Table 2:** Zombie firms, distressed firms, short-term interest rates, and inflation

<b>Panel A: Zombies</b>	<b>(1)</b>	<b>(2)</b>
Short-Term Interest Rates	-1.007* (0.567)	
Consumer Price Index		-0.192*** (0.043)
Profit Margin	-0.062*** (0.019)	-0.063*** (0.018)
Negative Income	2.309*** (0.070)	2.301*** (0.069)
Leverage 1	2.586*** (0.201)	2.551*** (0.201)
Log(Tot. Assets)	-0.369*** (0.024)	-0.370*** (0.024)
<i>N</i>	25,439	25,439
<i>R</i> <sup>2</sup>	0.317	0.318
<b>Panel B: Distressed</b>	<b>(1)</b>	<b>(2)</b>
Short-Term Interest Rates	-0.143* (0.078)	
Consumer Price Index		-0.112*** (0.033)
Profit Margin	-0.004 (0.008)	-0.005 (0.008)
Negative Income	1.030*** (0.052)	1.021*** (0.052)
Leverage 1	4.006*** (0.198)	4.003*** (0.199)
Log(Tot. Assets)	0.130*** (0.019)	0.219*** (0.019)
Year FE	✓	✓
Industry FE	✓	✓
Country FE	✓	✓
<i>N</i>	25,546	25,546
<i>R</i> <sup>2</sup>	0.182	0.183

*Note:*

The table presents logistic regressions. The dependent variable is a binary variable equal to 1 if a firm is classified as zombie (Panel A) or distressed (Panel B), and 0 otherwise. A firm is classified as zombie following BANERJEE and HOFMANN (2018) and as distressed following ALTMAN (1968). Among the firm controls: profit margin is computed as net income over sales, negative income is an indicator variable that equals one whenever the return on equity is negative, size is the log of total assets, and leverage is the sum of long-term debt and debt in current liabilities divided by total assets. Standard errors clustered at firm-level. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .



We observe a significant negative effect at the 90% confidence level ( $p < 0.1$ ). This result supports the argument that low interest rates potentially extend the evergreening of loans, or at least constitute a favorable environment for zombie firms, corroborating the findings on zombie firms (BANERJEE and HOFMANN, 2018) and low-productivity firms (HAMANO and ZANETTI, 2022).

With respect to the results on distressed status probability in Panel B, we also find a marginally significant negative effect. This result is counter intuitive, as higher interest rates are argued to worsen the debt burden of companies, thereby increasing their likelihood of financial distress. However, when including business cycle-related variables, such as GDP growth, the CLI and recession dummies (see Table 3), the effect becomes insignificant for distressed firms (Regression (4)) but remains significant for zombie firms (Regression (2)).

Turning to the effect of inflation on non-viable firms, the coefficient on the CPI, which is a widely used measure of inflation observed by policy-makers, is negative and significant for distressed and zombie firms (Regression (2) in Panels A and B of Table 2).

The findings suggest that an increase in inflation (CPI) decreases the probability of a firm being classified as non-viable. This relationship is confirmed by the strand of literature examining the link between inflation and equity valuations. BHAMRA et al. (2018) show that corporate defaults spike during times of low inflation and illustrate a strong negative relationship between expected inflation and quarterly corporate defaults in the United States between 1970 and 2016. With respect to zombie-like companies, using firm-level data from a set of European countries over the period 2012–2016, ACHARYA et al. (2023) document that markets that experience an increase in zombie firms subsequently have lower inflation growth compared to markets that have a lower zombie prevalence.

Controlling for business cycles by including GDP growth as well as the CLI, and for recession periods, Table 3 reveals a significant negative link between GDP growth and non-viable status that is more pronounced for zombie firms than for distressed firms. In contrast to distressed firms, zombie firms are also found to be significantly linked to two of the three recession dummies.

**Table 3:** Zombie firms, distressed firms, business cycle indicators, and recession events

	Zombies		Distressed	
	(1)	(2)	(3)	(4)
Composite Leading Indicator	0.078*** (0.025)	0.080** (0.036)	0.032** (0.015)	-0.010 (0.020)
GDP Growth	-0.113*** (0.018)	-0.096*** (0.025)	-0.042*** (0.012)	-0.043** (0.017)
Dot-com Bubble	-1.703*** (0.488)	5.687** (2.816)	0.625*** (0.201)	-0.716 (0.586)
Financial Crisis	-3.481*** (0.774)	1.472 (1.000)	1.321*** (0.306)	-0.405 (0.796)
Debt Crisis	-2.847*** (0.804)	1.700*** (0.600)	1.322*** (0.284)	-0.345 (0.813)
Short-Term Rates	-0.311*** (0.089)	-1.013* (0.613)	0.105*** (0.025)	-0.085 (0.074)
Long-Term Rates	0.049*** (0.015)	0.018 (0.018)	0.076*** (0.016)	0.025 (0.018)
Consumer Price Index	-0.247*** (0.037)	-0.195*** (0.049)	-0.086*** (0.025)	-0.092* (0.036)
Firm Controls		✓		✓
Year FE	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓
Country FE	✓	✓	✓	✓
<i>N</i>	41,833	25,438	41,833	25,545
<i>R</i> <sup>2</sup>	0.072	0.321	0.070	0.184

*Note:* The table presents logistic regressions. The dependent variable is a binary variable equal to 1 if a company is a zombie (Models 1 and 2) or distressed (Models 3 and 4). A company is classified as zombie following BANERJEE and HOFMANN (2018) and as distressed following ALTMAN (1968) Z-score. The Composite Leading Indicator signals turning points in the business cycle. GDP growth refers to real growth rates. Short-term rates relate to 3-month money market rates,<sup>5</sup> while long-term rates refer to government bonds maturing in 10 years. Dot-com bubble (2000-2001), financial crisis (2008-2009), and debt crisis (2011-2012) are dummies for recession events. Standard errors are clustered at firm-level. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Taken together, these findings indicate that zombification is a phenomenon that is aggravated by recession events. However, in contrast to distressed firms, due to the financial assistance they receive from their banking counterparts (CABALLERO et al., 2008), zombies are vulnerable firms that are in financial difficulty for a prolonged period of time. Recessions may very well be the primary cause of firms

5 Source: OECD (<https://doi.org/10.1787/2cc37d77-en>).

becoming overindebted, but they can hardly explain why these companies stay alive despite their inability to cover their debts. Consequently, it is more likely that measures and packages – monetary or otherwise – put in place to ease the burden of the economic crisis allow these firms to stay afloat.

### 3.2 Non-conventional monetary policy

To gain more insights into the direct and indirect effects of monetary policy, we analyze a specific non-conventional monetary policy program, namely, the Corporate Sector Purchase Program, which forms part of the ECB's Asset Purchase Program. Its objective was to ease the financing conditions in the real economy and consists of purchases of investment-grade euro-denominated bonds implemented by the Eurosystem (DE SANTIS et al., 2018).

Between June 2016 and December 2018, the Eurosystem conducted net purchases of corporate sector bonds under the CSPP. Outright purchases of investment-grade bonds were implemented by six Eurosystem national central banks: the Bank of Belgium, Deutsche Bundesbank, the Bank of Spain, the Bank of France, the Bank of Finland, and the Bank of Italy. Summaries of the requirements to qualify for the purchases are given in GROSSE-RUESCHKAMP et al. (2019) and DE SANTIS et al. (2018).

The CSPP was announced in March 2016 and the purchases started in June 2016. We use the *announcement* of the CSPP, in a difference-in-differences (DiD) framework, as a signal to examine the reaction of non-viable firm status, both zombie and distressed, in a sample of eight European countries. In the vein of GROSSE-RUESCHKAMP et al. (2019), we base our analysis on the eligibility of the investment-grade euro-denominated bonds prior to the announcement of the CSPP. Our treatment group is composed of public companies that have an investment-grade rating, while the control group is composed of non-eligible public companies (i.e., those firms that are non-investment grade rated).

We conduct a DiD analysis by running the following model:

$$\begin{aligned}
 Pr(Status_{it} = 1) &= \beta_1 Post\ CSPP_t + \beta_2 Treated_i \\
 &+ \beta_3 Post\ CSPP \times Treated_{it} + \beta_4 X'_{it} \\
 &+ \theta_h + \rho_c + \gamma_j + \varepsilon_{it}
 \end{aligned} \tag{1}$$

where  $Status_{it}$  is the probability of company  $i$  in year  $t$  being a zombie or distressed;  $Post\ CSPP_t$  is an indicator variable that is equal to one whenever the fiscal year is after 2016 (i.e., after the announcement of the CSPP) and zero otherwise;  $Treated_i$  is equal to one whenever the company is included in the treatment group as an investment-grade public company and zero otherwise; and  $Post\ CSPP \times Treated_{it}$  is the difference-in-difference estimator capturing the treatment effect for company  $i$  in year  $t$ . The matrix  $X$  captures firm-specific characteristics such as size, leverage, and profitability. The latter enter the regression with one year lag. Industry fixed effects,  $\theta_h$ , country fixed effects,  $\rho_c$ , and year fixed effects,  $\gamma_j$  are included in all specifications.

**Table 4:** CSPP effects on zombies and distressed firms

<b>Panel A: Zombies</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
Post CSPP×Treated	-1.766*** (0.448)	-1.717*** (0.498)	-1.717*** (0.498)	0.291 (0.501)
Post CSPP			-1.224*** (0.232)	-1.317*** (0.230)
Treated				-2.085*** (0.338)
$N$	41,965	25,439	25,439	25,439
$R^2$	0.058	0.280	0.280	0.288
<b>Panel B: Distressed</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
Post CSPP×Treated	0.500*** (0.172)	0.458*** (0.190)	0.458*** (0.190)	-0.040 (0.158)
Post CSPP			-1.107*** (0.409)	-0.950** (0.411)
Treated				0.528*** (0.160)
Firm controls		✓	✓	✓
Year FE	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓
Country FE	✓	✓	✓	✓
$N$	41,965	25,546	25,546	25,546
$R^2$	0.067	0.174	0.174	0.177

Note:

The table presents DiD regressions. The dependent variable is a binary variable that is equal to 1 if a company is classified as zombie (Panel A) or as distressed (Panel B), and 0 otherwise. A company is classified as zombie following BANERJEE and HOFMANN (2018) and distressed following ALTMAN (1968) Z-score measure. The treatment group is composed of public companies that have an investment-grade rating, while the control group is composed of non-eligible public companies that are non-rated. Ratings information are in line with the minimum requirement of credit assessment of credit quality, BBB-/Baa3/BBBL, from at least one agency among Standard & Poor's, Moody's, Fitch Ratings or DBRS. Standard errors clustered at firm-level. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

The results are given in Table 4 and show a significant decrease in distressed and zombie status post-CSPP. However, the DiD estimator turns insignificant when we include the Treatment and Post-Treatment dummies. Consequently, we do not observe a significant effect of this specific program on zombie and distressed status, which might also be interpreted as no evidence of misallocation of credit towards zombie firms within the CSPP.

#### 4 Conclusion

Focusing on two categories of non-viable firms – zombies and distressed – in eight European countries, this study examines whether the concurrence of low interest rates, a lower state of the business cycle, and recession periods might explain the presence of non-viable firms.

The empirical analysis validates the argument that long-lasting lower rates could be a breeding ground for zombie firms in particular. At the same time, exploiting the announcement of a non-conventional monetary policy program, we find no clear evidence of credit misallocation to non-viable firms. We find a significant decrease in zombie and distressed firm status following the announcement of the program. These effects suggest that in the presence of financial market imperfections, only viable firms are able to respond to lower borrowing costs and increase their capital stock. A direct effect of specific policies, or economic variables, on the zombie share is challenging to identify, however, as zombie firms are classified based on their persistent non-profitability. Further research could therefore focus on the time series dynamics.

Overall, the results underscore that in a low interest rate environment, the prevalence of zombie firms tends to increase, but this trend is not entirely driven by accommodative monetary policy measures. In periods of low inflation during recessions, lenders tend to support otherwise insolvent borrowers more.

This indirect effect, with the existence of offsetting channels, suggests new ways in which persistent low rates can affect the status of non-viable firms. The weight of such concurring factors, together with the separation of zombie firms from other non-viable firms such as distressed firms, should be considered by policy-makers when monitoring the dynamics of zombie firms during and after crisis periods, and when designing policies that, indirectly, target firms in need of support.

## References

- ACHARYA, VIRAL V., MATTEO CROSIGNANI, TIM EISERT, and CHRISTIAN EUFINGER (2023), Zombie credit and (dis-)inflation: Evidence from Europe, forthcoming in *Journal of Finance*.
- ACHARYA, VIRAL V., TIM EISERT, CHRISTIAN EUFINGER, and CHRISTIAN HIRSCH (2019), Whatever it takes: The real effects of unconventional monetary policy, *The Review of Financial Studies* 32 (9), pp. 3366–3411.
- ALTMAN, EDWARD I. (1968), Financial ratios, discriminant analysis and the prediction of corporate bankruptcy, *The Journal of Finance* 23 (4), pp. 589–609.
- BANERJEE, RYAN and BORIS HOFMANN (2018), The rise of zombie firms: causes and consequences, *BIS Quarterly Review*, September.
- BANERJEE, RYAN and BORIS HOFMANN (2022), Corporate zombies: Anatomy and life cycle, *Economic Policy* 31 (112), pp. 757–803.
- BHAMRA, HARJOAT S., CHRISTIAN DORION, ALEXANDRE JEANNERET, and MICHAEL WEBER (2018), Low inflation: High default risk and high equity valuations, NBER Working Paper No. 25317.
- CABALLERO, RICARDO J., TAKEO HOSHI, and ANIL K. KASHYAP (2008), Zombie lending and depressed restructuring in Japan, *American Economic Review* 98 (5), pp. 1943–1977.
- DE MARTIIS, ANGELA, THOMAS HEIL, and FRANZISKA PETER (2023), Are you a Zombie Firm? An Early Warning System Based on Machine Learning Methods, available at SSRN (<https://ssrn.com/abstract=3625473> or <http://dx.doi.org/10.2139/ssrn.3625473>).
- DE SANTIS, ROBERTO A., ANDRÉ GEIS, AISTE JUSKAITE, and LIA VAZ CRUZ (2018), The impact of the corporate sector purchase programme on corporate bond markets and the financing of euro area non-financial corporations, *ECB Economic Bulletin* 3 (4), pp. 66–84.
- GROSSE-RUESCHKAMP, BENJAMIN, SASCHA STEFFEN, and DANIEL STREITZ (2019), A capital structure channel of monetary policy, *Journal of Financial Economics* 133 (2), pp. 357–378.
- HAMANO, MASASHIGE, and FRANCESCO ZANETTI (2022), Monetary policy, firm heterogeneity, and product variety, *European Economic Review* 144, 104089.
- HOSHI, TAKEO (2006), Economics of the living dead, *Japanese Economic Review* 57 (1), pp. 30–49.
- JORDÀ, ÒSCAR, MARTIN KORNEJEW, MORITZ SCHULARICK, and ALAN M. TAYLOR (2022), Zombies at large? Corporate debt overhang and the macroeconomy, *Review of Financial Studies* 35 (10), pp. 4561–4586.
- LAEVEN, LUC, GLENN SCHEPENS, and ISABEL SCHNABEL (2020), Zombification in Europe in times of pandemic, VoxEU.org, October 11.
- OECD – ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (2021) Short-term interest rates (indicator) (<https://doi.org/10.1787/2cc37d77-en>).

## Appendix

### A.1 Descriptive statistics

**Table A1:** Firm performance measures

	<b>N</b>	<b>Mean</b>	<b>Median</b>	<b>SD</b>	<b>Min</b>	<b>Max</b>
Leverage 1	42232	0.231	0.205	0.195	0.000	1.659
Leverage 2	42309	0.601	0.604	0.246	0.040	2.532
Net leverage	42231	0.088	0.108	0.293	-0.836	1.462
Asset Tangibility	42302	0.234	0.189	0.198	0.000	0.900
Cash & ST Invest. Ratio	42307	0.144	0.088	0.160	0.000	0.915
Return on Equity	28491	0.016	0.075	2.044	-12.262	150.369
Profit Margin	28257	-0.195	0.027	2.758	-39.624	168.872
Operating Profit	42163	0.076	0.093	0.147	-0.994	0.498
Capex Ratio	34234	0.050	0.035	0.053	-0.064	0.442
Ebit ICR	40543	16.594	3.437	133.935	-969.273	2202.786
Total Assets (Changes)	42259	5.761	0.032	104.988	-1.000	5597.776
Size Log(Tot. Assets)	42327	5.764	5.413	2.656	-0.358	16.278
Size Log(Nr. Employees)	29743	0.291	0.219	2.067	-5.809	5.443

*Note:*

The table reports descriptive statistics of a selection of firm performance measures used to describe zombie, healthy, and distressed firms. Leverage 1 is the sum of long-term debt and debt in current liabilities divided by total assets, leverage 2 is total liabilities over total assets, net leverage is the sum of long-term debt and debt in current liabilities minus cash and short-term investments divided by total assets, asset tangibility is property, plant and equipment divided by total assets, cash & ST investment ratio is cash and short-term investments divided by total assets, roe is net income over common equity, profit margin is computed as net income over sales, operating profit is EBITDA over total assets, capex ratio is capital expenditures over total assets, Ebit ICR is operating income after depreciation over interest expenses, total assets changes is the change in total assets, size is either the log of total assets or log of number of employees.

**Table A2:** Definition of variables

Variable	Description	Source
Zombies (Banerjee and Hofmann 2018)	ICR<1 for 3 yr. & Tobin's q below median within sector-year	Compustat, Datastream
Distressed (Altman 1968)	$1.2 \times \text{WCap.}/\text{TA} + 1.4 \times \text{RetEam}/\text{TA} + 3.3 \times \text{EBIT}/\text{TA} + 0.6 \times \text{ME}/\text{TL} + \text{Sales}/\text{TA}$	Compustat
Composite Leading Indicator	Composite of a number of indicators that provide indication of the cycle evolution	OECD
GDP Growth	Real GDP Growth (%)	World Bank
Short-Term Rates	Averages of daily rates (%) Three-month money market rates	OECD
Long-Term Rates	Averages of daily rates (%) Government bonds maturing in 10 years	OECD
Consumer Price Index	Annual growth rate (%)	OECD
Post CSPP	= 1 if fiscal year post 2016	Compustat
Treated	= 1 if firm is in treatment group as investment-grade public firm	Compustat, Datastream

*Note:*

The table describes the variables used in the empirical analysis, their respective identification and data sources. "Compustat" is the Standard & Poor's Compustat database. "Datastream" is Thomson Reuters database. "OECD" is the Organization for Economic Cooperation and Development database. "World Bank" is the World Bank's database.



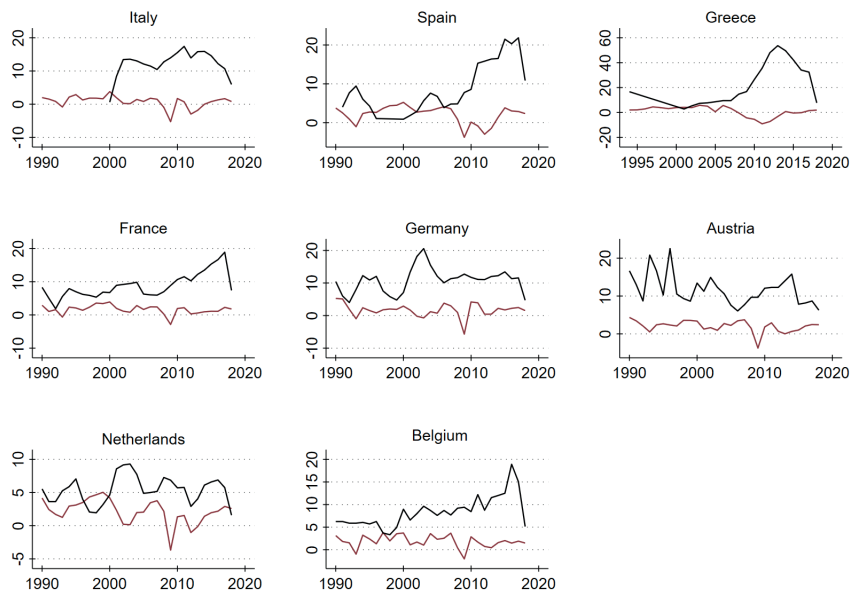
**Table A3:** Zombie firms, distressed firms, and healthy firms by industry

	<b>Code</b>	<b>Zombies</b>	<b>Distressed</b>	<b>Healthy</b>
Energy	1010	68	391	417
Materials	1510	364	1,862	1,254
Capital Goods	2010	631	2,837	2,452
Commercial Services	2020	184	632	970
Transportation	2030	176	926	548
Automobiles & Components	2510	58	541	438
Consumer Durables & Apparel	2520	409	1,005	1,445
Hotels, Restaurants & Leisure	2530	128	609	417
Media Services	2540	125	373	377
Retailing	2550	51	97	156
Food and Staples Retailing	3010	5	9	10
Food, Beverage & Tobacco	3020	265	1,222	923
Household & Personal Products	3030	16	86	258
Healthcare	3510	214	599	735
Pharmaceuticals	3520	410	476	895
Real Estate	4040	5	98	41
Software	4510	538	1,130	2,756
Technology	4520	224	551	1,131
Semiconductors Equipment	4530	82	159	389
Telecommunication	5010	123	371	373
Entertainment	5020	277	867	911

*Note:* The table presents descriptive statistics by industry classification. The industry code used refers to the GIC group, Compustat item group, which is based on the global industry classification standard (GICS) and developed by the S&P Dow Jones Indices and the MSCI.

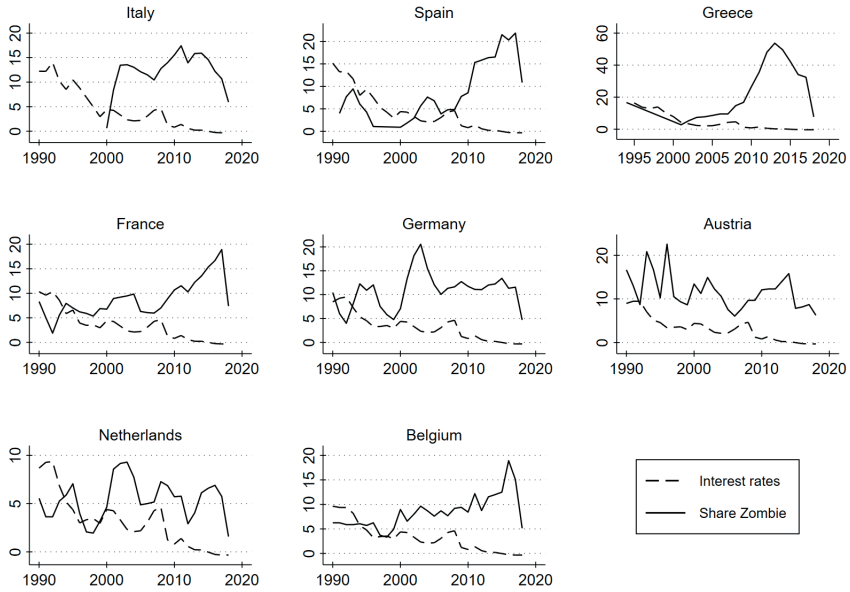
*Source:* Author's calculations on Compustat data.

**Figure A1:** Zombie shares and GDP growth



*Note:* The graph plots the share of zombies (black line) and GDP growth (red line). We identify zombie firms following Banerjee and Hofmann (2018).

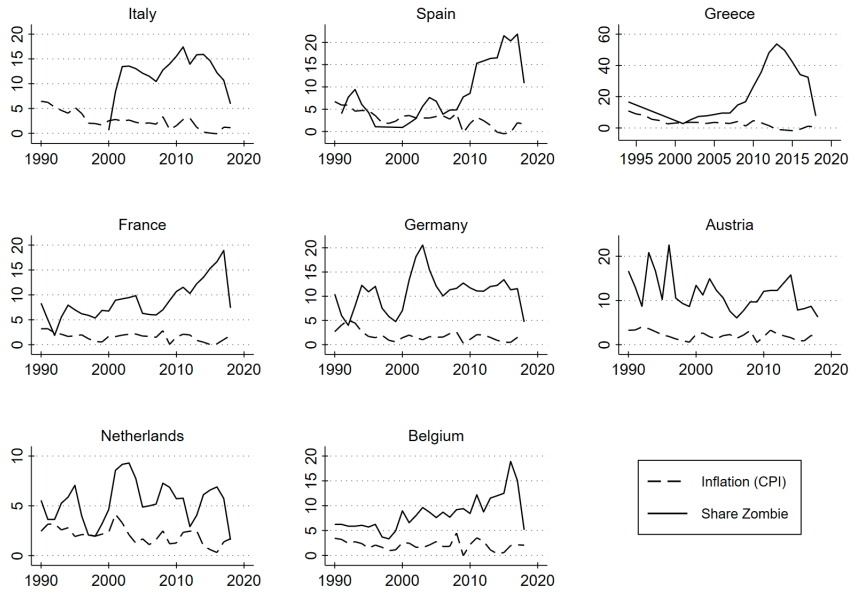
*Source:* Authors' projections on Compustat and World Bank data.

**Figure A2:** Zombie shares and short-term rates

*Note:* This graph plots the share of zombies (black line) and the short-term rates (black dashed line). We identify zombie firms following BANERJEE and HOFMANN (2018).

*Source:* Authors' projections on Compustat and OECD data.

**Figure A3:** Zombie shares and inflation



*Note:* This graph plots the share of zombies (black line) and CPI inflation (CPI) (black dashed line). We identify zombie firms following Banerjee and Hofmann (2018).

*Source:* Authors' projections on Compustat and OECD data.

