Working Paper Series

No 143

Fear the Walking Dead? Zombie Firms in the Euro Area and Their Effect on Healthy Firms' Credit Conditions

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Abstract. Zombie firms may adversely impact healthy firms through several transmission channels. Besides real spillover effects on productivity or investment, zombies may also cause negative financial spillover effects, where zombies receive credit at more favourable conditions than healthy firms. We investigate characteristics of zombie firms in the euro area and whether they cause spillovers on healthy firms' credit conditions, focusing on two variables: new credit and interest rates. Contrary to existing findings, our results indicate that zombie firms pay higher interest rates and receive less new credit than healthy firms. The spillover effect of zombie firms on healthy firms' new credit is not significant. For interest rates, the spillover effect is even reversed: Zombie existence significantly lowers healthy firms' interest rates. Zombie firms across the euro area are smaller, less profitable, and more leveraged with lower credit quality than healthy firms. Yet, they do not seem to pose significant negative externalities on the credit conditions of healthy firms. Novel loan-by-loan data from the European credit registry (AnaCredit) allows our analysis to be over a broad set of countries and firms, on a new level of granularity. This may explain the divergence of our findings from the existing literature.

Keywords: *zombie firms, financial spillovers, interest rates, new credit, financial stability*
JEL: E43, E44, E51, G21, G32

1 Introduction

For over a decade, zombie firms have been an important topic both in policy and academic discussions. Coined in the seminal paper by Caballero et al. (2008), the zombie term was first used for firms in the stagnating Japanese economy of the 1990s. Zombie firms are corporates that still operate, even though they are no longer profitable. In Europe, zombie firms became an issue especially in the aftermath of the global financial crisis (GFC) 2008 and the subsequent European sovereign debt crisis. In the context of the COVID-19 pandemic, this discussion has been reinvigorated. Critics raised the concern that expansive monetary and fiscal policies not only support healthy firms facing liquidity constraints, but also allow zombie firms to avoid bankruptcy. Zombie firms are a relevant policy issue for at least two reasons (ECB Podcast, 2021). First, their existence may raise concerns for the financial stability of the banking system. Should a large number of zombies fail, for instance because vital fiscal support measures are being phased out, or because interest rates rise, this could endanger their creditors. Second, zombie firms withhold resources (capital, workers etc.) from healthy firms that may use them more efficiently. Thus, the existence of zombie firms can adversely impact healthy firms through spillover effects.

A large part of the zombie literature investigates these spillover effects. Most studies focus on "real" spillovers from zombies to healthy firms in terms of employment, investment, productivity, and profit margins (Acharya et al., 2019, 2022; Adalet McGowan et al., 2018; Banerjee and Hofmann, 2018, 2020; Farinha et al., 2018; Caballero et al., 2008; Schivardi et al., 2021). One transmission channel for these real spillovers are "financial" spillovers, based on the assumption that zombie firms receive credit at more favourable conditions than healthy firms. The idea is that the existence of zombie firms deteriorates credit conditions and access to capital for healthy firms; see for instance Farinha et al. (2018). Yet, only a handful of these studies attempt to verify this assumption, so that Andrews and Petroulakis (2019) call financial spillovers an "understudied channel" (p. 3).

This paper investigates the financial spillovers from zombie to healthy firms in the euro area between Q3 2018 and Q4 2021, focusing on two variables: new credit and interest rates. To that end, we use an OLS panel regression set-up with different fixed effects specifications, which is standard in the literature. As a data source we employ the European Central Bank's (ECB) novel "Analytical Credit Datasets" (AnaCredit), which provide granular loan-by-loan data for all credit extended to non-natural persons in the euro area that exceeds €25,000, and match it with firm balance sheet data from Orbis (Bureau van Dijk). In short, we do not find financial spillovers to be a straightforward channel through which zombie firms adversely affect healthy firms. Regarding new credit, healthy firms receive significantly more new credit than zombie firms and there is no negative spillover effect: Healthy firms in banks with a higher share of loans held by zombie firms (bank zombie share) do not receive significantly less new credit than healthy firms in banks with a lower zombie share. Regarding interest rates, zombie firms in general are found to pay higher interest rates than healthy firms. The only exception are firms with a particularly bad credit rating (C or worse). Yet, also concerning interest rates, there is no negative spillover effect. On the contrary, our results indicate that an increased presence of zombie firms in a bank significantly decreases healthy firms' interest rates, regardless of the firm's credit rating. This finding contrasts with the prevailing view in the literature that the existence of zombie firms adversely affects healthy firms' credit conditions. We review the four papers that examine financial spillovers below.

The only existing two studies primarily focusing on financial variables analyse spillovers on the province and sector level in China. Yu et al. (2021) find that increasing the zombie share in an industry by one percentage point increases healthy firms' debt financing cost by 0.051 p.p. Using an instrumental variable, the adverse impact on debt financing cost increases to 14.8 p.p. Similarly,Wang and Zhu (2021) find that zombie firms crowd out financing opportunities for healthy firms and increase healthy firms' financial constraints.

As a sub-section of their analysis, Acharya et al. (2019) examine interest rates in five euro area countries between 2009 and 2015. They find that a one percentage point increase in the industry zombie share significantly increases interest rates of healthy firms in this industry by 2.4 p.p. Finally, Andrews and Petroulakis (2019) investigate whether zombie firms crowd out healthy firms' credit in four euro area countries from 2009 to 2013. The authors use a credit availability measure from the SAFE survey, asking firms whether they have more difficulties to obtain loans or credit lines from banks compared to the previous six months. A one percentage point increase in the zombie share decreases their measure of credit availability significantly by -0.0053 (maximum at 3). Given the small number of studies and the modest magnitude of some of the effects, a further investigation of financial spillovers seems worthwhile.

Turning to real spillovers, Acharya et al. (2019) name two main avenues of transmission: Distorted competition and a loan supply shift to zombie firms, which the authors argue will increase healthy firms' interest rates. Thus, financial spillovers from zombie firms to healthy firms' credit conditions are one channel of transmission for real spillovers. While our results cannot confirm the adverse loan supply shift conjectured by Acharya et al. (2019), real spillovers can still be transmitted via the second channel, namely distorted competition. Competition on the sector level could be distorted as zombie firms survive economic shocks that would have usually led to their exit. Thus, they deter entry of more productive firms into the market, leading to adverse real spillovers for healthy firms. In line with the model by

Caballero et al. (2008), empirical studies on real spillovers find that healthy firms in sectors with higher zombie prevalence have lower employment growth, investment, and productivity than healthy firms in sectors with fewer zombies (Acharya et al., 2019, 2022; Adalet McGowan et al., 2018; Banerjee and Hofmann, 2018, 2020; Farinha et al., 2018; Caballero et al., 2008; Schivardi et al., 2021).[1] While our paper relates closely to these studies and uses a similar methodological approach, we focus on financial, not real spillovers, which also entails employing different dependent variables.

Besides real and financial spillovers to healthy firms, an important question is: Why do zombie firms exist in the first place and how do they survive, given their non-viability? This question is addressed in a second strand of the zombie literature that investigates the creation of zombie firms and whether banks keep them alive with cheap credit (evergreening).[2] There are three main theoretical motives for banks to "evergreen" their loans: (i) Extending credit to non-viable firms prevents banks from realizing losses through the firms' default. (ii) Regulation and public measures meant to support undercapitalized banks can incentivize risk shifting to weaker firms as losses are partly covered (Acharya et al., 2022). (iii) Banks could extend cheap credit to non-viable firms to not ruin the firms' reputation as a condition for market-based financing. In line with these motives, undercapitalized banks are indeed found to have higher proportions of zombie loans (for instance, Storz et al. (2017), Acharya et al. (2021), Bittner et al. (2021), Schivardi et al. (2021)). While these papers analyse which bank characteristics favor zombie lending, this paper examines the consequence of it.

We contribute to the literature on financial spillovers in four main respects. First, our results question the prevailing view that zombies indeed adversely affect healthy firms' credit conditions (Acharya et al., 2019; Andrews and Petroulakis, 2019). Instead, we cannot confirm a straightforward channel of disadvantageous financial spillovers from zombie to healthy firms. Second, to the best of our knowledge, this is the first comprehensive study on zombie

[1] Importantly, Schivardi et al. (2020) and Schivardi et al. (2021) criticise this widely used panel regression approach as the zombie share in a sector might be correlated with unobserved industry-level shocks. If these shocks then affect the performance of healthy, but not zombie firms, this might mechanically lower their employment, investment, or productivity growth, without zombie spillovers being the reason. Whilst most of the mentioned studies only note this critique, Banerjee and Hofmann (2018), Farinha et al. (2018), and Acharya et al. (2020) re-run their regression using an instrumental variable to verify their results, which remain unchanged overall. Due to the differences of our regression set-up including examining at the bank, not the sector level, Schivardi et al.'s critique is less relevant here.

[2] Acharya et al. (2022) group the empirical zombie literature into four thematic strands. Besides the studies on spillover effects and the evergreening literature, the third strand asks whether cheap loans help zombie firms recover. With limited effects on zombies' employment growth, zombie debt and defaults increasing, and lower zombie profitability, these studies find that zombie lending does not improve firm health (for instance, Acharya et al. (2019), Acharya et al. (2021), Nurmi et al. (2020)). The fourth strand of the literature investigates policy instruments to address issues related to zombie lending, such as stricter banking supervision including bank inspections, bank stress testing and bank recapitalisations (for instance, Passalacqua et al. (2021); Farinha et al. (2018); Acharya et al. (2022)).

firms' spillover effects to include all euro area countries, resulting in a strong sample size and potentially more representative results. Third, this paper utilises the new AnaCredit dataset, which introduces a new level of granularity in information on lending to the NFC sector in the euro area.[3] With over 90 loan attributes reported on a quarterly basis, it allows to analyse credit conditions in a more detailed way than previously possible. Fourth, whilst the baseline model is very much in line with those used in the literature, it differs in two important respects: (i) Regressions are run on bank, not sector level, which seems more plausible when considering financial spillovers as explained below. (ii) We focus on different dependent variables, namely interest and new credit that played only a minor role in former studies, if at all. Thus, this paper explores spillovers of zombie to healthy firms from a novel perspective.

The paper is structured as follows. Section 2 presents our data and methodology, in particular the zombie definition we employ. In this section we also introduce our empirical model and hypotheses. Section 3 addresses our main research question on financial spillovers regarding new credit and interest rates. Section 4 concludes.

2 Data and Methodology

2.1 Data

The data we use stem from two sources: Bureau van Dijk's global database (henceforth Orbis) and the ECB's Analytical Credit Datasets (AnaCredit). Orbis is the largest existing firm database and includes information from financial accounts for companies of all sizes in 100 countries. AnaCredit is a granular, credit instrument level database covering practically all bank credit provided in the euro area exceeding €25,000, except for private household debt (European Central Bank, 2022a). Despite a reduced coverage of small firms, Kalemli-Ozcan et al. (2015) show that the sample for European firms in Orbis covers a large part of, and is representative for, the whole European economy in terms of output and employment. In the next subsection 2.2 we briefly analyse yearly observations from an Orbis-only dataset for the 19 euro area countries from 2005-2019, to support the choice and robustness of the Zombie definition that we employ. The dataset presented and used in subsection 2.3 as well as in the main analysis of this paper in section 3, on the other hand, is a joint dataset of the

[3]Initiated in 2011 by the European Central Bank, actual data collection started in September 2018. The purpose of AnaCredit is to monitor the performance of the whole euro area credit market, including all types of credit instruments and as many as 90 credit attributes, allowing for a very detailed analysis of credit exposures on a loan-by-loan basis. For more information on AnaCredit, see section 2.1 and ECB's AnaCredit website at https://www.ecb.europa.eu/stats/money$_{c}redit_{b}anking/anacredit/html/index.en.html$

Orbis and the AnaCredit database for the period between September 2018 and December 2021, that is, 14 quarters. For both datasets we apply certain sample restrictions which are presented in more detail in Appendix A. These either relate to data quality assurance, for instance by eliminating reporting errors, or to the specifics of our two data sources. Importantly, by using AnaCredit data in the main analysis in section 3 we automatically restrict ourselves to firms that use bank credit. The granularity of this dataset is such that one observation uniquely identifies the amount of credit (and all corresponding credit attributes) that a specific firm holds at a specific bank in a specific quarter (i.e. a firm-bank relationship), whereas a debtor can have loans at multiple banks. Table 1 gives an overview of all variables used in our analysis, their definitions and sources.

2.2 Zombie definition

A key question in the zombie literature is how to define "zombies". The challenge is to identify firms that are no longer viable but still active, as opposed to firms that are only temporarily underperforming or still in the growth phase like start-ups. In the literature, there exist numerous zombie definitions, which can be grouped into two broad categories: One the one hand, definitions building on firm performance measures *and* the receipt of subsidised credit as measured by favourable interest rates; one the other hand, definitions that only rely on firm performance indicators to identify zombie firms.

This paper will, as a baseline definition, follow the performance-based zombie identification approach. More specifically, we follow the definition by Storz et al. (2017), which is also used by Andrews and Petroulakis (2019) and Falagiarda et al. (2021). Accordingly, firms are identified as zombies when, for two consecutive years,

i. their return on assets is negative, measured as the ratio of net income to total assets,

ii. their net investments are negative, measured as the net total change in fixed assets year-on-year, and

iii. their debt servicing capacity is lower than 5%, measured as EBITDA divided by total financial debt (long-term debt plus loans).

All three criteria need to hold at the same time. There is a number of arguments for why we use this zombie definition instead of the numerous alternative zombie definitions in the literature.

First, this definition relies on more than one criterion, so only firms are captured that perform weakly in several dimensions. Criterion (i) of our baseline definition is a measure of firm profitability. Criterion (ii) ensures that young, growing firms with strong investments,

Table 1. Variables, definitions and sources

Variable	Definition	Source
Total assets	Sum of firm's debt and equity	Orbis
Return on assets (ROA)	Net income of a firm divided by total assets of that firm	Orbis
Net investment	Net total change in fixed assets year on year	Orbis
Debt servicing capacity	EBITDA divided by total financial debt, calculated as the sum of loans and long-term debt	Orbis
Interest coverage ratio	EBIT (or EBITDA) divided by amount of company's interest expense during a certain period	Orbis
Firm age	Number of years since firm was founded	Orbis
Number of employees	Number of employees in a firm, proxy for firm size	Orbis
Average employment growth	Over two periods: Computed as the net increase between the current period t and the previous period t-1 plus the net increase between t-1 and t-2, divided by 2	Orbis
Leverage	Sum of loans and long-term debt over total assets	Orbis
EBITDA over total assets	EBITDA (earnings before interest, taxes, depreciation and amortisation) divided by total assets	Orbis
EBIT	Earnings before interest and taxes	Orbis
EU firm size	Firm size calculated according to EU classification based on number of employees and turnover or total assets, can be micro, small, medium or large	Orbis
Not_zombie dummy	Equal to one if a firm is "healthy", i.e. the firm does not fulfill our zombie criteria: negative ROA, negative net investments, and a debt servicing capacity below 5% for two consecutive years	Orbis
Asset-weighted zombie share	Total assets held by all zombie firms in an economy or sector at a specific time divided by total assets held by all firms in that economy or sector at that time	Orbis
Outstanding nominal amount (ONA)	Nominal amount of the loan less the amount of the loan that has already been repaid	AnaCredit
Bank zombie share	ONA held by all zombie firms at a bank at a specific time divided by total ONA held by all firms at that bank at that time	Orbis-AnaCredit
Interest rate	Annualised aggregated interest rate charged on an instrument at a specific reference date, effective cost of the credit instrument	AnaCredit
New credit	Sum of ONA of a new loan given to the firm by a specific bank in a specific quarter, new credit is identified where inception date equals reference date	AnaCredit
Probability of default	The counterparty's probability of default over one year, determined in accordance with Articles 160, 163, 179 and 180 of Regulation (EU) No 575/2013.	AnaCredit
Default status	Equal to one if an instrument is declared to be in default, equal to zero if it is not in default	AnaCredit
Performing status	Equal to one if an instrument is declared to be non-performing, equal to zero if it is performing	AnaCredit
Impairment status	Credit quality indicator under the IFRS framework or the GAAP framework*	AnaCredit

* *Notes:* The following impairment categories apply. IFRS Stage 1: Instrument is not impaired and its credit risk has not increased significantly since initial recognition. IFRS Stage 2: Instrument is not impaired, but it has had a significant increase in credit risk since initial recognition. IFRS Stage 3: Instrument is credit impaired in accordance with IFRS 9 or IFRS 9-consistent national GAAPs. GAAP impaired: Instrument is subject to impairment and specific loss allowances are raised in accordance with an accounting standard other than IFRS 9.

such as Tesla, are not necessarily classified as zombies. Criterion (iii) identifies highly indebted companies. The 5%-threshold of criterion (iii) is chosen because the median interest rate that firms pay on their debt is 5%, such that a debt servicing capacity of 5% implies an interest coverage ratio of 1 (Storz et al., 2017).

Second, while some key papers like Caballero et al. (2008), Acharya et al. (2019), Acharya et al. (2020), and Acharya et al. (2022) advocate the first category of definitions, which include the receipt of subsidised credit, this approach has several drawbacks.[4] Importantly, it might be difficult to distinguish between subsidised zombie credit and favourable financing conditions to support viable firms during economic crises like the global financial crisis (GFC) or the COVID-19 crisis (Schivardi et al., 2020). This is especially true in the low-interest rate environment that prevailed since the ECB deposit facility rate declined to 0.00% in 2012 and the main refinancing rate reached 0.00% in March 2016 (European Central Bank, 2022b). In this low-rate environment, lower-than-average interest rates given to zombie firms would have to be close to zero or negative. At this level, subsidised credit to zombie firms is even harder to single out. Similarly, government support during the COVID-19 crisis makes it difficult to differentiate zombie credit and credit at favourable conditions to support healthy firms throughout the pandemic. Another drawback is that subsidised credit rates might have reasons other than preventing a firm from becoming insolvent, namely long-standing bank-client relations or high-quality collateral (Banerjee and Hofmann, 2018).

A third argument for using the zombie definition by Storz et al. (2017) is that it allows firms to recover, which should be accurately captured to not overestimate zombie shares in the economy (Nurmi et al., 2020). To gauge the importance of recovery for our data, we calculate the probability of remaining a zombie for the baseline and some alternative definitions in Appendix C. The results show that our baseline definition exhibits the lowest probability of remaining a zombie, being very close to Nurmi et al. (2020), who adapt their definition exactly to tackle this concern. Further robustness and cross-checks applying alternative zombie definitions are presented in section 3.3. Overall, the zombie shares computed with our definition as well as the regression results, despite some minor qualifications, are robust to alternative definitions, such that our conclusions hold.

To put our baseline zombie definition to a first test and to explore the evolution of zombie firms in the euro area using this measure, also against established findings in the literature, we now briefly look at Orbis data for the 19 euro area countries from 2005-2019. Before 2005, there exist far less observations across countries, while financial accounts data for 2020 onwards at the time of writing of this paper was not yet available for all firms due to the reporting time lag. The resulting Orbis sample with the restrictions proclaimed

[4] The authors argue that the existence of zombie firms crucially relies on banks giving them cheap credit, s.t. this would be a defining factor. To measure subsidized credit Acharya et al. (2022), for example, estimate the difference between the firm's interest expense and the median interest expense of AA-rated firms in their sample, which has to be negative for firms to be defined as zombies.

in the Appendix A comprises over 18 million observations. We compute asset-weighted zombie shares on the country and sector level in two steps. First, each firm in each year of observation is classified as either healthy (Not_zombie = 1) or as a zombie (Not_zombie = 0) according to the definition above; namely when, for the current and the previous period, (i) returns on assets were negative, and (ii) net investments were negative, and (iii) the debt-servicing capacity was below 5%. Second, the share of zombie over total firms in the sample is calculated and weighted by their assets for each country and sector.[5]

Figure 1 plots asset-weighted zombie shares for selected euro area countries from 2005 to 2019. For all countries except Portugal, the prevalence of zombie firms was small before the global financial crisis hit in 2008, with shares below 2%. The graph illustrates the course of the crisis, with Greece and Ireland impacted early and hard, whilst other countries were more adversely affected only by the subsequent European sovereign debt crisis (Godby and Anderson, 2016). The so-called "GIIPS countries" (Greece, Ireland, Italy, Portugal and Spain) that suffered disproportionately from these two crises exhibit higher zombie shares than the remaining countries. For example, short after the height of the European debt crisis in 2013, the euro area average zombie share was 2.2%, whilst the GIIPS countries' average was 4.7%. These findings are in line with the existing literature (see for instance Acharya et al. (2019), (Pelosi et al., 2021), Storz et al. (2017)).[6] Note that the rise in zombie shares is not due to a decrease in the total number of firms, which for most countries stays rather stable.

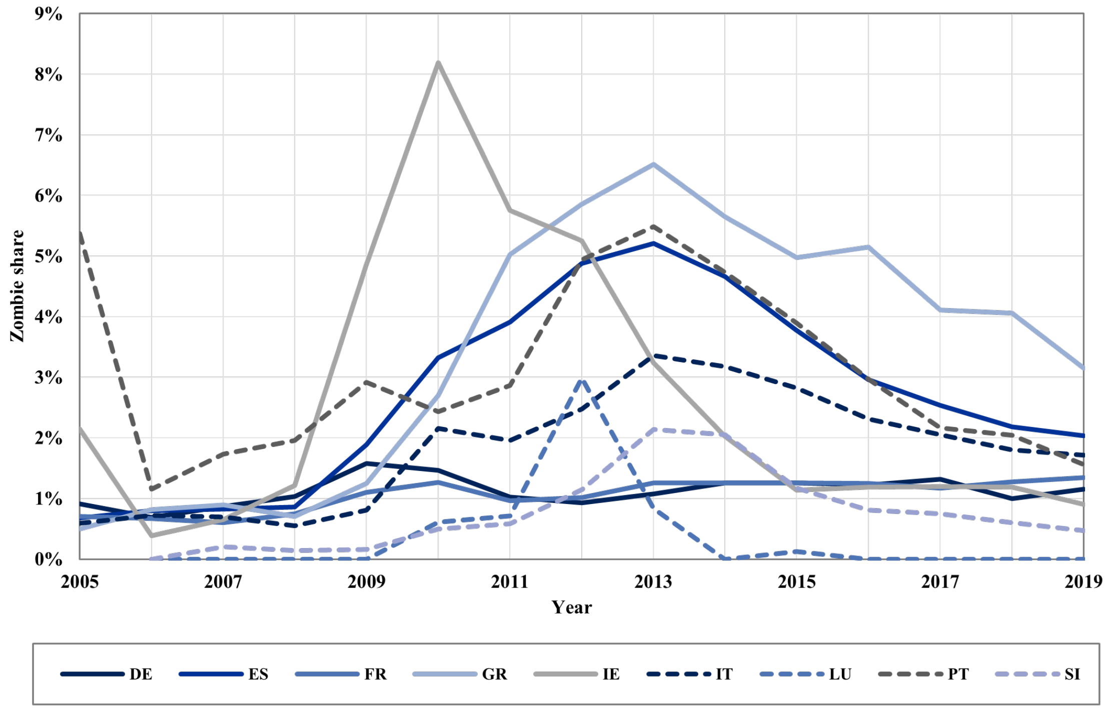
The zombie shares in all countries remained elevated after the global financial crisis. This phenomenon is well-known in the literature too, see e.g., Banerjee and Hofmann (2020).[7] Economic crises favour the creation of zombies in three ways (Acharya et al., 2020): They increase the probability of firm defaults or deteriorate firm credit quality, thus produce higher economic fallout from non-performing loans, and trigger policy measures like government

[5] Most empirical studies in the zombie literature use such asset-weighted shares to gauge the economic significance of zombie firms (for instance, Acharya et al. (2019), Acharya et al. (2020), Acharya et al. (2022), Andrews and Petroulakis (2019), Banerjee and Hofmann (2018), Banerjee and Hofmann (2020) and Caballero et al. (2008)). The remaining studies use the number of zombie firms divided by the number of total firms in the sample (Storz et al., 2017) or employment-weighted shares (Nurmi et al., 2020). We compute shares both unweighted and weighted by total assets. The difference is marginal, so we use asset-weighted shares in this section, as they are more common in the literature. Note, however, that the asset-weighted zombie share we use here for comparison with the literature differs from the bank zombie share, which we employ in the main analysis, as explained in the next section.

[6] The zombie shares found here are in line with the levels reported by Helmersson et al. (2021), the OECD (Adalet McGowan et al., 2018) and Storz et al. (2017). Yet, they are below the zombie shares of 10-20% that for instance Banerjee and Hofmann (2020), Acharya et al. (2019) or Schivardi et al. (2020) find. We use the same zombie definition as Storz et al. (2017) and Helmersson et al. (2021), but a different one than the other papers. As shown in the robustness checks (section 3.3), this can explain some of the difference.

[7] See Appendix B for a similar comparison on the sector level.

Figure 1. Asset-weighted zombie shares for selected euro area countries, 2005-2019



Notes: This graph shows the percentage share of assets held by zombie firms as defined above in a given country and year and is based on the Orbis-only sample from 2005 to 2019. Yet, we exclude large and listed firms, to allow for a better comparison with Storz et al. (2017). All remaining figures and analysis do include large and listed firms.

guarantees, which incentivizes banks to evergreen loans and shift risks; see section 1.

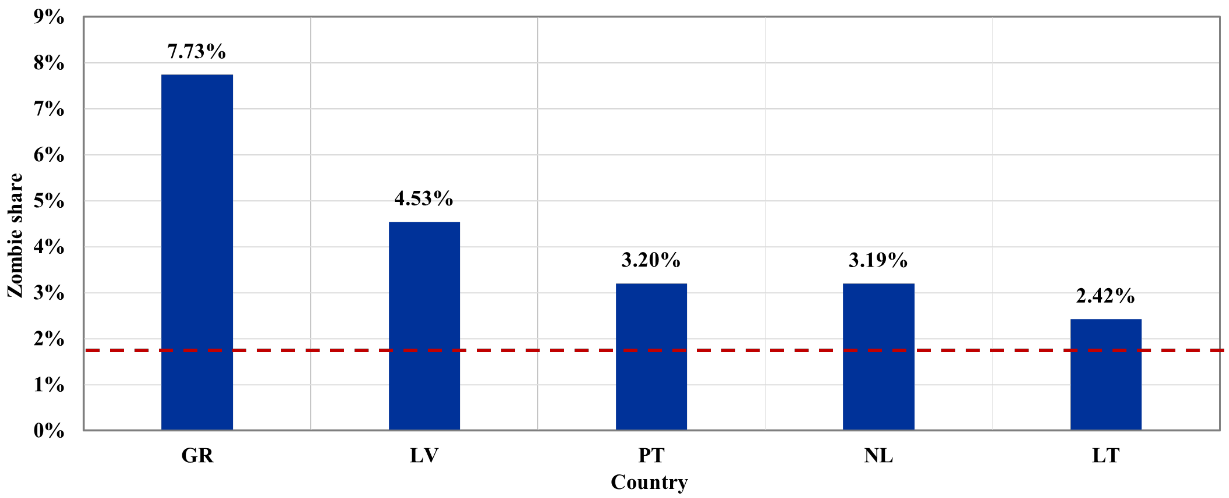
2.3 Zombie firm characteristics and credit conditions

In this section, we present descriptive statistics for zombie and healthy firms as well as their credit conditions, with a focus on our main variables of study, interest rates and new credit, at the end of the section. To that end, we apply our zombie definition to the matched Orbis-AnaCredit sample as presented above, which we will also use for the main analysis of this paper in section 3. Our sample comprises around 1.16 million distinct firms in total and 15658 zombie firms.[8] To measure the prevalence of zombie firms in our sample and for our analysis, we use the bank zombie share. This corresponds to the outstanding nominal amount of loans held by zombie firms at a certain bank at a specific time, divided by the total outstanding nominal amount of loans held by all firms which are clients of that bank at that

[8]Since Orbis financial accounts data only become available over time, the present analysis is restricted until the financial year 2019. Therefore, in the matched Orbis-AnaCredit sample with its first observation in September 2018 (when the AnaCredit collection was established), all firms that are identified as zombie firms in 2019 via Orbis are assumed to stay zombies over the period of study, which is Q3 2018 to Q4 2021.

time. Compared to the existing literature, this bank-level measure is a novel statistic based on our granular dataset. While the asset-weighted zombie share identifies the prevalence of zombie *firms*, the bank zombie share allows us to identify zombie *loans* at the more granular bank-firm level. Considering that our regression analysis will also be conducted on the bank-firm level, the bank zombie share is a suitable metric for the sake of our question. Using our zombie definition as introduced above, 1.81% of the outstanding nominal amount in loans at an average euro area bank are held by zombie firms; see Figure 2, which portrays the top 5 countries with the highest bank zombie shares in our main sample.[9]

Figure 2. Top 5 bank zombie shares in Orbis-AnaCredit matched sample



Notes: This graph shows the five countries with the highest bank zombie share in our matched Orbis-AnaCredit sample from 2018 Q3 to 2021 Q4. The red dashed line depicts the average bank zombie share across all 19 euro area countries.

Table 2 shows some more descriptive statistics for firms in our main Orbis-AnaCredit sample: The average firm in this sample is 25 years old, has around 280 employees, and is financially well-performing. This is underlined by an average leverage ratio of 28%, as well as a positive mean EBIT and total assets. Looking at credit data, the mean outstanding nominal amount (ONA) of a loan is around €808,000, and the average interest rate paid on a loan is 3.45%.

Table 3 compares financial characteristics of zombies and non-zombies and shows that we do identify firms as zombies that perform significantly worse than the remaining firms for all financial variables included here. First, zombie firms are less profitable than healthy firms. In contrast to healthy firms, both the mean and median EBIT of zombie firms are

[9]To ensure comparability with the literature and our Orbis-only sample, we also compute the asset-weighted zombie share for our matched sample, which averages at 1.4% across the sample, and is highest in Greece at 6.3%; see figure 11 in Appendix D.

Table 2. Descriptive statistics for the matched Orbis-AnaCredit sample

	Mean	Std. dev.	Min	Percentiles 10th	50th	90th	Max	Count
Firm age	24.54	17.76	1.00	7.00	21.00	44.00	905.00	24,997,815
Num. of employees	280.72	4,992.43	0.00	2.00	11.00	109.00	709,720.00	24,997,815
Total assets (Mio)	98.50	2,318.04	0.00	0.23	1.74	26.68	305,891.00	24,997,815
EBIT (Mio)	3.50	104.76	-10,821.00	-0.04	0.05	1.15	15,153.70	24,997,815
Leverage ratio	0.27	0.43	-4.67	0.00	0.24	0.58	332.68	24,997,815
Interest rate (%)	3.45	3.80	-82.40	0.64	2.56	7.08	100.00	24,997,815
ONA (Mio)	0.81	12.77	-113.35	0.00	0.09	1.03	11,438.29	24,918,677
Zombie share (%)	1.89	0.02	0.00	0.01	0.02	0.03	1.00	24,585,257

Notes: This table presents descriptive statistics of the average firm in our matched Orbis-AnaCredit sample, across all 19 euro area countries and across time (from 2018 Q3 to 2021 Q4), after applying the sample restrictions described in Appendix A. Zombie and healthy firms are not distinguished in this table. The table includes the number of observations, mean, standard deviation, minimum and maximum value, as well as the 10th, 50th and 90th percentile for each characteristic.

negative, i.e. zombie firms have negative earnings. Second, zombie firms are more indebted than healthy firms in this sample. Their median leverage ratio, calculated as financial debt over total assets, is 36% and substantially higher than that of healthy firms (23% in the median). Third, Zombie firms have a much higher average probability of default (19%) than healthy firms (5%), with higher median values as well (2% for zombies vs. 1% for healthy firms).[10]

Table 3. Financial characteristics of zombie firms vs. healthy firms

	Mean		Median		Std. dev.		Count	
	Healthy	Zombie	Healthy	Zombie	Healthy	Zombie	Healthy	Zombie
Firm age	24.50	27.12	21.00	24.00	17.76	17.61	24,659,231	338,584
Num. of employees	282.80	129.15	11.00	8.00	5,025.00	1,066.21	24,659,231	338,584
Total assets (Mio)	99.21	46.57	1.73	2.08	2,333.29	453.45	24,659,231	338,584
EBIT (Mio)	3.58	-2.15	0.056	-0.07	105.41	30.06	24,659,231	338,584
EBITDA/ total assets	0.08	-0.08	0.07	-0.02	0.27	0.30	24,659,231	338,584
Leverage ratio	0.27	0.47	0.23	0.36	0.37	1.87	24,659,231	338,584
Interest rate (%)	3.45	3.94	2.56	2.99	3.79	4.26	24,659,231	338,584
ONA (Mio)	0.81	1.01	0.091	0.12	12.83	6.90	24,580,690	337,987
PD	0.05	0.19	0.01	0.02	0.16	0.34	14,961,520	200,502

Notes: This table presents descriptive statistics of the average zombie and healthy firm in our matched Orbis-AnaCredit sample, across all 19 euro area countries and across time (from 2018 Q3 to 2021 Q4), after applying the sample restrictions described in Appendix A. The table includes the mean, median, standard deviation, and number of observations for each group and characteristic.

Note that the average zombie firm with a mean of 129 employees, is smaller than the average healthy firm, which has 283 employees. Similarly, zombie firms have significantly lower total assets than healthy firms. This finding is in line with the literature, see e.g.

[10] Note that the number of observations is slightly lower for the probability of default variable because not all banks report this variable.

Falagiarda et al. (2021). It is especially interesting because many papers so far, likely due to data availability constraints, have a sample that consists of larger firms. As a result, several studies on zombies either a priori exclude large firms (e.g., Storz et al. (2017)), or run their analysis again in a sub-sample of only small firms (e.g., Andrews and Petroulakis (2019)). Instead, resembling the structure of the euro area economy more accurately, the majority of firms in our sample are small and micro firms; see Figure 3.[11] Given zombie firms have higher leverage and larger firms are not dominating our sample, the mean and median ONA of zombie firms is higher than that of healthy firms, looking at the sample as whole. Disaggregating by firm size, this holds for all sizes, except for large firms (Figure 3). Finally, also note that the mean and median zombie firms are older than healthy firms. This confirms that the zombie definition employed does not mistakenly capture young firms, like start-ups, that are still in the growth phase and thus temporarily experience weaker fundamentals.

Further credit quality indicators in Table 4 confirm our previous findings. Zombie firms are more often declared to be in default: 12.01% of all zombies in our dataset, as opposed to only 1.76% of all firms from the healthy group. Moreover, zombie firms have a higher proportion of non-performing loans (15.29%) than healthy firms (2.27%). These differences are statistically significant at the 1%-level, employing t-tests controlling for sector and country. Finally, a much lower proportion of zombie loans is classified as IFRS stage 1, meaning that the credit risk attached to the loan has not significantly increased since initial recognition. Instead, 18.9% of zombie loans are classified as stage 2 (significant increase of credit risk) and 17.59% as stage 3 (credit risk increased so much to be considered credit-impaired) in contrast to 9.75% and 3.09% for healthy firms, respectively.

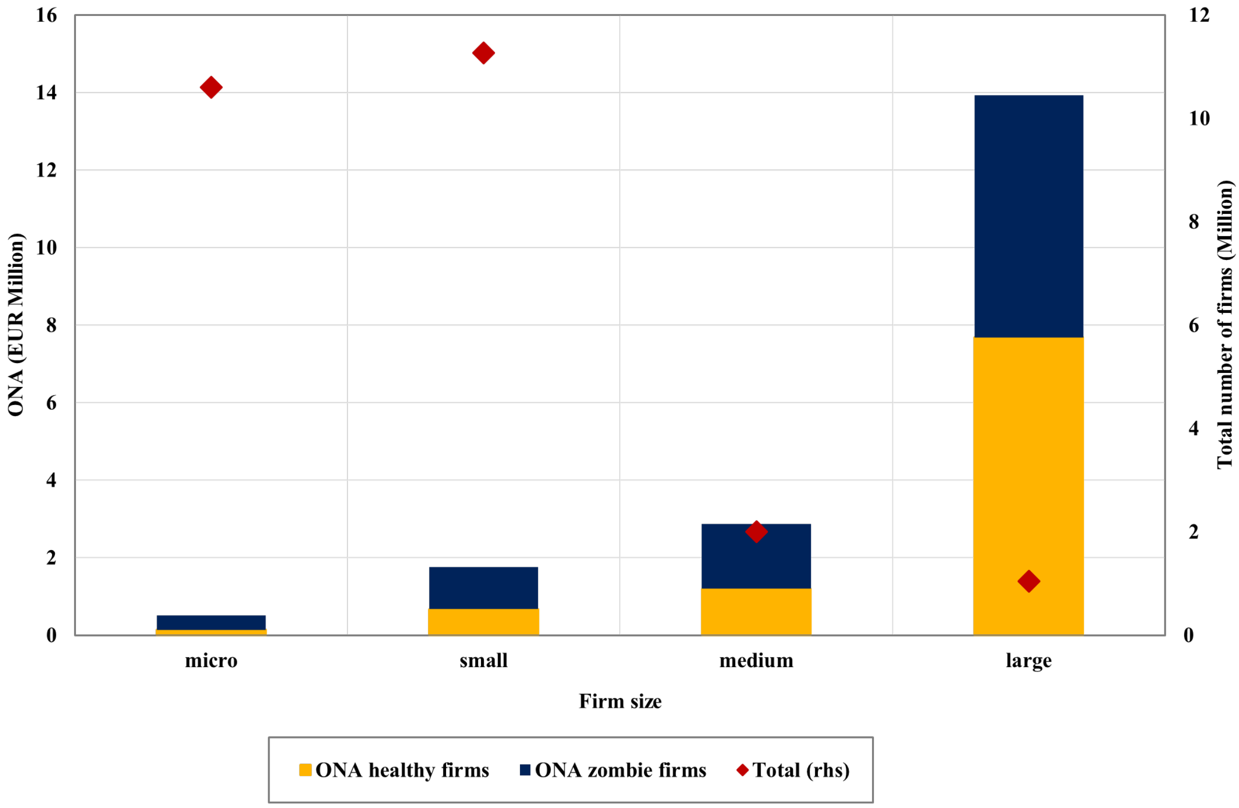
Table 4. Credit quality indicators of zombie firms vs. healthy firms

			IFRS			GAAP	
	In default	Non-performing	stage 1	stage 2	stage 3	unimpaired	impaired
Healthy firm	1.76%	2.27%	80.10%	9.75%	3.09%	5.97%	1.12%
Zombie firm	12.01%	15.29%	55.99%	18.94%	17.59%	6.43%	1.05%

Notes: This table shows, for the matched Orbis-AnaCredit sample, average numbers of healthy and zombie firms concerning the proportion of loans that are in default, non-performing, classified as IFRS stage 1, 2 or 3 under the IFRS reporting framework or as impaired with specific loss allowances under reporting frameworks other than IFRS 9 (GAAP).

[11] We follow the standard classification of the European Commission concerning firm size (European Commission, 2020): A micro firm has less than 10 employees and either up to EUR 2 million in annual turnover or up to EUR 2 million in balance sheet total. A small firm has between 10 and 50 employees, and either up to EUR 10 million in annual turnover or up to EUR 10 million in total assets. A medium-sized firm has between 50 and 250 employees, and either up EUR 50 million in turnover or EUR 43 million in total assets. Any firm larger than this is classified as a large firm.

Figure 3. Average credit volume for healthy and zombie firms by firm size and firm size distribution

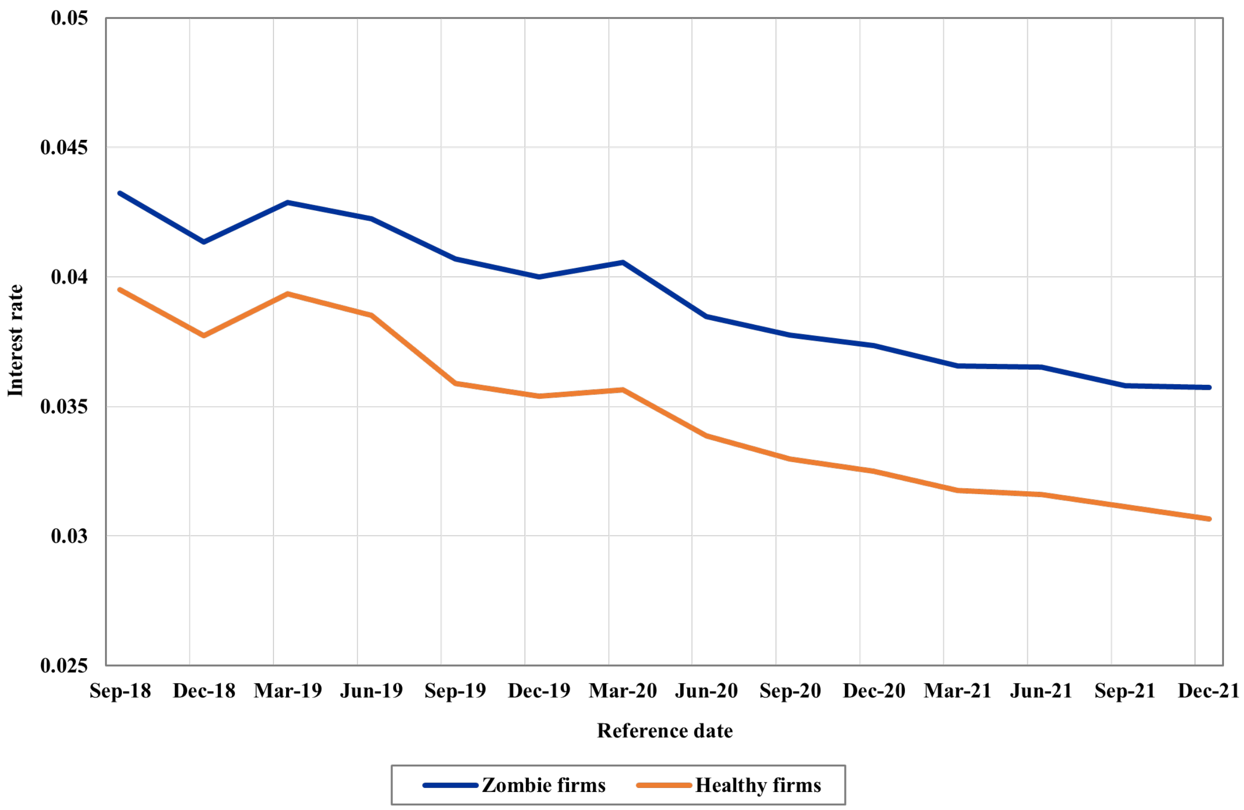


Notes: This chart shows the outstanding nominal amount of credit (lhs scale) across firm sizes for healthy and zombie firms, respectively. The red dots (rhs scale) represent total number of firms in the sample that are classified as large, medium, small, or micro.

We now turn to the first focus variables of this study: average interest. As Table 3 shows, mean interest rates in our dataset are roughly half a percentage point higher for zombie (3.94%) than for healthy firms (3.45%). Median values are at 2.99% and 2.56%, respectively, with a similar standard deviation. In the context of the existing literature, this is a very interesting finding. As mentioned in section 1, many papers argue that zombie firms receive credit at subsidised interest rates, so that zombie lending gives rise to credit misallocation (for instance, Acharya et al. (2019), p. 3372). Furthermore, Acharya et al. (2019) find that an increase in the proportion of zombie firms by one percentage point in a sector increases interest rates paid by healthy firms by 2.4p.p. The subsidised credit argument and the findings of the literature would foster the expectation that zombie firms pay lower interest rates than healthy firms.

In contrast, we find higher interest rates for zombies than for healthy firms. Figure 4 plots the average interest rate for zombies and healthy firms over time, portraying a higher rate

Figure 4. Average interest rate paid by healthy vs. zombie firms

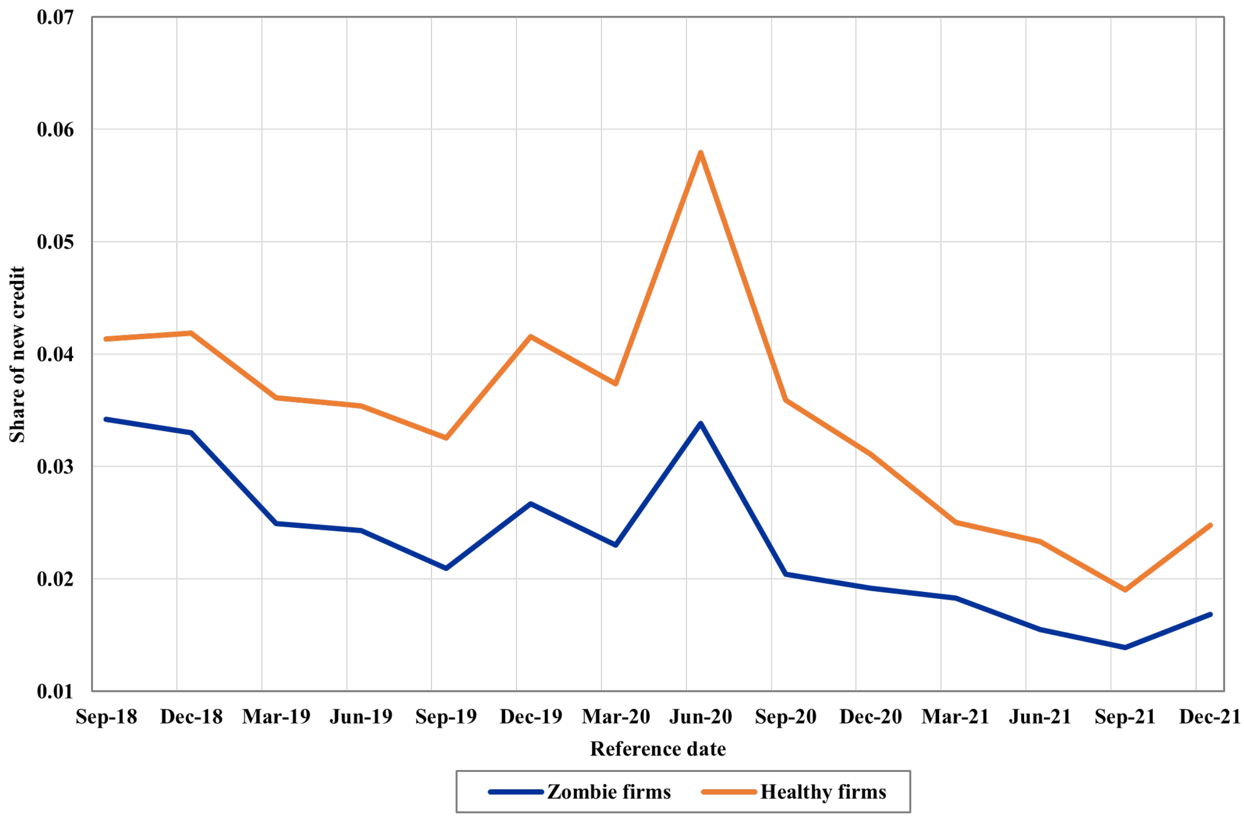


Notes: This figure plots the interest rates paid by zombie and healthy firms from 2018 Q3 to 2021 Q4, averaged across all loans held by firms in either group.

for zombie firms in the whole period of study. An explanation for the discrepancy with the literature could be that existing studies often rely on samples of large firms, as interest rate data is rarely available for unlisted, small firms. AnaCredit is the first euro area dataset to include detailed data on loan conditions also for micro, small, and medium-sized firms. Our finding of higher average rates for zombie firms suggests more efficient credit allocation than in the literature, indicating that banks lend more in line with fundamentals than previously thought.

Figure 5 shows our second focus variable, the amount of new credit zombie and healthy firms received between Q3 2018 and Q4 2021, as a share of their total credit stock. Similar to the graph in Figure 4 for interest rates, the graph depicts a rather clear pattern: The share of zombies varies between 1.5% and 3.5%, while the share of healthy firms was usually around 0.5% to 1% higher throughout. Thus, healthy firms seem to receive more new credit than zombies. Curious is the uptick in new credit for both groups in mid-2020, at the onset of the COVID-19 pandemic, where many firms were had a strong need for liquidity, the provision of which was supported by state aid programs. The following fall in the

Figure 5. New Credit Healthy vs. Zombie Firms



Notes: The graph plots the sum of new credit divided by the total amount of credit at a specific quarter for the average zombie and healthy firm. The indicator is capped at a value of 1000 for healthy firm.

share can be interpreted as a countermovement to the strong rise before, as many firms had also horded liquidity, which they did not need to acquire anymore in the months after (European Systemic Risk Board, 2022). Note that the increase in the share of new credit in 2020 exaggerated the difference between zombie and healthy firms, at it was considerably stronger for healthy firms. Relative to the first observation in September 2018, the share for zombie firms in June 2020 roughly reached the same level of 3.3%. For healthy firms instead it rose by 45%, from around 4% to almost 6%. As we argue in Appendix E, this difference is likely to be attributed to the fiscal support, first and foremost public guarantees, which governments tried to attribute to viable firms. As a consequence, zombie firms received less support, in line with the findings of Pelosi et al. (2021). We investigate a potential effect of the COVID-19 period on our main regression results in more detail in section 3.3. As it turns out, COVID-19 does not challenge the main conclusions of this paper.

Summing up, zombie firms did receive new credit during the period of study, albeit less then healthy firms. At the same time, the descriptive statistics clearly show that the credit quality of zombie firms is inferior to that of healthy firms. Whilst this finding points to a potential misallocation of resources, it raises the question whether it also has adverse implications for healthy firms and thus the broader economy.

2.4 Empirical model and hypotheses

The zombie literature addresses the question of spillover effects primarily with regard to "real" effects in terms of investment, employment or productivity. Most studies rely on the assumption that such real effects are transmitted either via the competition channel or the financial spillover channel, where zombie firms are assumed to receive credit at more favourable financing conditions than healthy firms (see for instance Acharya et al. (2019)). Our dataset allows us to actually study this financial channel and explore the question of whether the zombie presence in a bank really does impact credit conditions for healthy firms.

In the literature on real spillovers, the standard approach is to run a panel regression with fixed effects, measuring zombie shares on the sectoral level. This is reasonable, because one channel of transmission for spillovers on employment growth, investment or productivity is distorted competition between healthy firms and zombie firms in a specific industry of a certain country (Acharya et al., 2019). This paper, however, focuses on financial spillovers, which are more likely to take place on the bank-, rather than sector level. Therefore, our dependent variable is measured on the *firm-bank-time level*, which is more granular than an analysis on the firm-time level. Furthermore, one of our main explanatory variables, the share of loans held by zombie firms (bank zombie share), is measured per bank, not per sector. To avoid concerns of reverse causality, all independent variables including controls are lagged by one period.

The baseline panel regression in equation (1) includes the zombie share and the *not_zombie* dummy (see explanation below), but not their interaction term. This allows us to compare the main effect on healthy firms relative to on zombie firms (β_1), and on firms in banks with a higher zombie share relative to firms in banks with a lower zombie share (β_2):

$$\begin{aligned} CreditCondition_{ib,t} = {} & \beta_1 Not\_Zombie_i + \beta_2 Bank\_zombie\_share_{b,t-1} \\ & + Controls_{i,t-1} + Bank\_FE_b \\ & + Sector\_FE_s * Country\_FE_c * Time\_FE_t + \epsilon_t \end{aligned} \tag{1}$$

Including the interaction term then allows to capture the spillover effect the zombie share may have on healthy firms. In this specification (2), β_2 shows the effect an increase in the bank zombie share has on credit conditions for zombie firms, while $\beta_2+\beta_3$ shows the effect for healthy firms; that is, the difference between healthy firms in banks with a higher zombie share to healthy firms in banks with a lower zombie share. Finally, β_1 is the difference in credit conditions between zombie and healthy firms when the bank zombie share is zero. Specification (2) reads as follows:

$$\begin{aligned} CreditCondition_{ib,t} = {} & \beta_1 Not\_Zombie_i + \beta_2 Bank\_zombie\_share_{b,t-1} \\ & + \beta_3 Not\_Zombie_i * Bank\_zombie\_share_{b,t-1} \\ & + Controls_{i,t-1} + Bank\_FE_b \\ & + Sector\_FE_s * Country\_FE_c * Time\_FE_t + \epsilon_t \end{aligned} \tag{2}$$

In both specifications (1) and (2) the following variables apply:

- $CreditCondition_{ib,t}$: Dependent variable in time t, measured for firm i, which has at least one loan at bank b.
- Not_Zombie_i: Dummy variable equal to 1 if a firm does not identify as a zombie and equal to 0 if a firm is classified as a zombie.[12] Thus, β_1 shows the main effect on the dependent variable of being a healthy firm, as compared to being a zombie firm, in specification (1).
- $Bank\_zombie\_share_{b,t-1}$: Share of zombie loans held by bank b, computed as the ONA of zombie firms at bank b, divided by the total ONA of all firms at bank b in the sample. β_2 hence captures the effect on the dependent variable that a higher zombie share has on (zombie) firms (when the following interaction term is included).
- $Not\_Zombie_i * Bank\_zombie\_share_{b,t-1}$: Interaction term between the non-zombie dummy and the share of zombie loans at bank b. β_3 captures the additional effect on the dependent variable a higher zombie share has for healthy firms. Consequently, the total (spillover) effect of the bank zombie share for healthy firms is $\beta_2 + \beta_3$.
- $Controls_{i,t-1}$: Control variables on firm level, including firm size, firm age, leverage and EBITDA over total assets.
- $Time\_FE_t$, $Bank\_FE_b$: Capture unobserved time-invariant heterogeneity on the firm and bank level (for instance firm- or bank-specific characteristics like location).
- $Sector\_FE_s * Country\_FE_c * Time\_FE_t$: Country-sector-year fixed effects as commonly employed in the literature (for instance, Storz et al. (2017)). These fixed effects are meant to capture shocks affecting all firms in a specific sector s in country c at time t.

Different dependent variables can be employed to proxy credit characteristics of firms. As

[12] This variable does not have a time subscript because a fixed set of zombie firms is used throughout the analysis due to data availability.

argued by Acharya et al. (2019), "due to a loan supply shift to zombie firms, nonzombie firms had to pay higher interest rates if the zombie prevalence in their industry was particularly high" (page 3406). Hence, this paper first investigates the amount of new credit received by firm i from bank b in time t to examine whether a higher share of zombie loans in a bank really does lead to changes in loan supply for healthy firms. Apart from Andrews and Petroulakis (2019), who use a survey-based measure of a firm's subjective access to credit, our study is the first to analyse actual credit volumes.

As a second dependent variable we examine what Acharya et al. (2019) see as the consequence of a loan supply shift, namely a potentially increased average interest rate paid across all loans of firm i at bank b in time t. The argument made by Acharya et al. (2019) is that the increased prevalence of zombie firms in a sector shifts loan supply to zombie firms, reducing the loan supply for healthy firms. Assuming that healthy firms' demand for loans remains constant, this would increase the interest rates they need to pay, a claim the authors can also support empirically, as discussed in section 1. To our knowledge, this is the only other study that investigates spillover effects on interest rates as a dependent variable. Note, however, that Acharya et al. (2019) measure the effects on the sector, not the bank level, and that they focus their analysis on five larger EA countries. Thus, based on the existing studies by Andrews and Petroulakis (2019) and Acharya et al. (2019), the two main hypotheses for the spillover analysis are:

- **H1:** Healthy firms in banks with a higher zombie share receive less new credit than healthy firms in banks with a lower zombie share ($\beta_2+\beta_3<0$).
- **H2:** Healthy firms in banks with a higher zombie share pay higher interest rates than healthy firms in banks with a lower zombie share ($\beta_2+\beta_3>0$).

Both specifications (1) and (2) of the baseline regression include a bank-fixed effect to control for bank characteristics. Furthermore, a country-sector-time-fixed effect controls for shocks affecting firms in the same sector in the same country at the same time. Finally, specifications (1) and (2) include several firm-level control variables. Following the literature (see, for instance, Acharya et al. (2019); Andrews and Petroulakis (2019); Banerjee and Hofmann (2018)), these controls include firm age, the size of the firm as approximated by the number of employees, a firm's leverage ratio as a debt-related measure and EBITDA over assets as a firm profitability measure.[13] Additionally, we provide the following alternative specification of the baseline regression:

[13]Note that all of these control variables are significantly different between zombie and healthy firms, as established by a t-test (p-value $<$ 0.000) controlling for sector and country.

$$
\begin{aligned}
CreditCondition_{ib,t} = {} & \beta_2 Bank\_zombie\_share_{b,t-1} \\
& + \beta_3 Not\_Zombie_i * Bank\_zombie\_share_{b,t-1} \\
& + Firm\_FE_i + Bank\_FE_b \\
& + Sector\_FE_s * Country\_FE_c * Time\_FE_t + \epsilon_t
\end{aligned} \tag{3}
$$

Specification (3) includes firm-level fixed effects to control for time-invariant differences between firms, such as firm location. Since the zombie sample is fixed over time, the firm-fixed effect eliminates the zombie dummy variable in the regression. In all specifications, standard errors are clustered at the firm level.

3 Results

3.1 New credit

The descriptive statistics in section 2.3 suggest that healthy firms receive more new credit as a share of their total credit. This is confirmed by the regression results of specification (1) in Table 5: Healthy firms indeed receive significantly more new credit than zombie firms in absolute terms, as shown by the positive and significant coefficient on the non-zombie dummy (β_1). Ceteris paribus, healthy firms receive €109,538 more new credit in a quarter on average.[14] At the same time, firms in banks with many zombie firms do not receive significantly more or less new loans than firms in banks with fewer zombies, as reflected in the insignificant coefficient on the lagged bank zombie share (β_2).

[14] Concerning the control variables: A firm that is one year older receives €8,734 more new credit, on average, ceteris paribus. Similarly, an additional employee increases new credit by €202. These effects are statistically significant at the 1%-level. Increasing the leverage ratio by one percentage point increases new credit by €155,577, which is statistically significant on the 5%-level. The profitability measure of EBITDA over assets is not significant.

Table 5. Regression results for new credit as the dependent variable

	(1)	(2)	(3)
Not_Zombie	109537.7***	437127.9***	0.0
	(2.91)	(2.62)	(.)
Zombie_share	-389720.6	14329818.2*	31138966.7**
	(-0.38)	(1.82)	(2.37)
Not_Zombie X Zombie_share		-15062585.9*	-31659068.0**
		(-1.86)	(-2.36)
Firm_age	8734.9***	8734.3***	
	(1079.30)	(1079.29)	
Number_employees	202.0***	202.0***	
	(7.34)	(7.34)	
Leverage	156576.9**	155662.5*	
	(1.97)	(1.96)	
Ebitda_over_assets	12367.5	12169.4	
	(0.79)	(0.78)	
Firm-level controls	Yes	Yes	No
Firm FE	No	No	Yes
Bank FE	Yes	Yes	Yes
Country-Sector-Time FE	Yes	Yes	Yes
Observations	1,940,277	1,940,277	1,814,122
Adjusted R^2	0.085	0.085	0.328

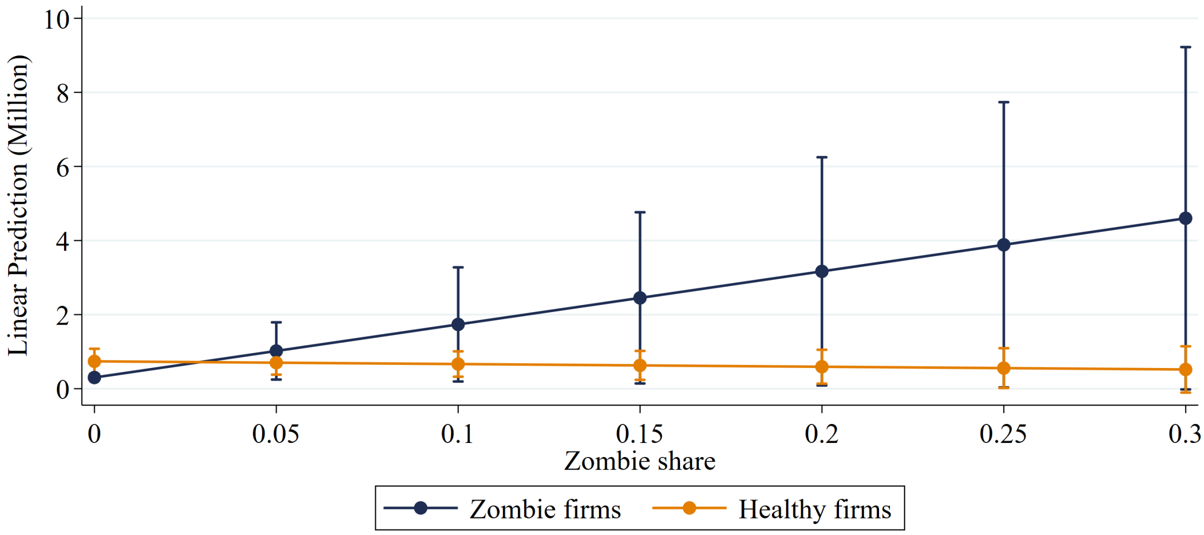
t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Notes: This table presents regressions at the firm-bank level. The dependent variable is the sum of new credit a specific firm holds at a specific bank in a specific quarter. The main explanatory variables are the non-zombie dummy, equal to 1 when a firm is classified as healthy (*Not_Zombie*=1), the share of zombie loans in a bank (*Zombie_share*), and the interaction of these two, *Not_Zombie=1 X Zombie_share*. Control variables include firm age, the number of employees in a firm, a firm's leverage ratio and the ratio of its EBITDA over its total assets. All independent variables are lagged by one period to avoid reverse causality. All three specifications include bank and country-sector-time fixed effects; specification (3) also firm fixed effects. Standard errors are clustered on the firm-level.

Specification (2) runs the same regression but including the interaction term to analyse the spillover effects (see equation (2) in section 2.4). According to our first hypothesis (H1) in section 2.4, healthy firms in banks with a higher zombie share are expected to receive less new credit than healthy firms in banks with a lower zombie share. On average, that is averaging over all observed bank zombie shares, this cannot be confirmed. The coefficients for zombie and healthy firms (β_2 and β_3) are not significant. Furthermore, for healthy firms, the negative sign of β_3 balances with the positive direction and almost same absolute size of β_2, such that the effect of a higher zombie bank share on healthy firms – even if coefficients were significant – becomes very small. Conducting a Wald test, the null hypothesis that

$H_0 : \beta_2+\beta_3=0$ cannot be rejected (F-statistic of 0.46 for specification (2) in Table 5). Thus, averaging over all zombie shares, there is no statistically significant effect of the presence of zombie firms on healthy firms' receipt of new credit. In terms of control variables, note that the lagged firm age, number of employees and leverage ratio are significant and very similar in sign, significance, and magnitude in both specifications (1) and (2).

Figure 6. Margin plot for new credit specification (2) as the dependent variable



Notes: This graph plots the marginal effects estimated using specification (2) in Table (6) for the dependent variable new credit. The y-axis shows the magnitude of the effect at different values of the zombie share on the x-axis, ranging between zero and 30%.

To see if this finding holds across all magnitudes of a bank's zombie share, Figure 6 plots the marginal effects for both groups in specification (2); that is, the effect on zombie firms' (blue) and healthy firms' (orange) new credit at specific values of a bank's zombie share. Note that the intercept for healthy firms is higher than for zombie firms. This is due to the significant and positive β_1 coefficient in specification (2). The slopes of the two lines corresponds to the other main coefficients of the model: β_2 for zombie firms (blue line) and $\beta_2+\beta_3$ for healthy firms (orange line). Since β_2 and β_3 are almost the same absolute size, the orange line is rather flat. It is interesting to study the marginal effects in more detail: Figure 6 shows that for bank zombie shares of up to 25%, a higher share of zombie loans in a bank significantly increases a zombie firm's amount of new credit (positive β_2). The reasoning could be that if a bank has a higher proportion of zombie loans, it might be less hesitant to continue providing these very weak firms with credit, to avoid realising the losses from a complete zombie default in their balance sheets. As an example, a zombie firm in a bank with a zombie share of 10% receives around EUR 1.4 million more new credit than a zombie firm in a bank with a zero zombie share.

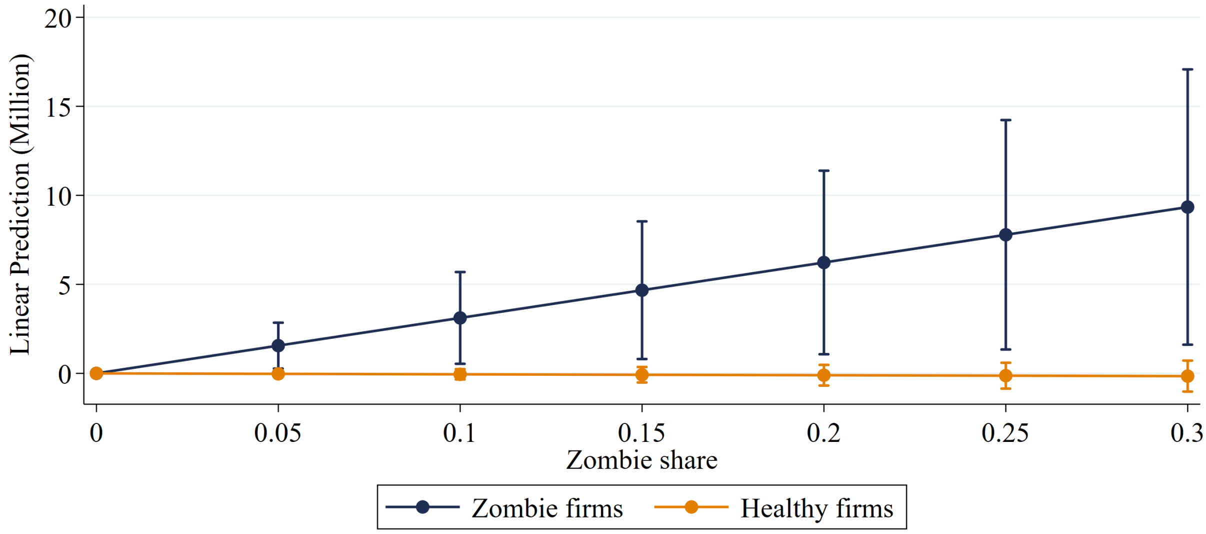
Note that in Figure 6, the marginal effect is significant at the 5%-level if the bars that mark the 95% confidence interval in the graph do not include the x-axis (i.e., the horizontal line through zero). Thus, the plot shows that marginal effects for both zombies and healthy firms are indeed positive at most levels of the bank zombie share; also see Table 10 in Appendix F. This is an important qualification to the regression results and tests conducted above, which average across all bank zombie shares: The marginal effect on healthy firms' new credit changes with the zombie share, and it is still significantly positive up until a zombie share of 25%, due to the positive β_1. For instance, at a zombie bank share of 10%, the marginal effect on healthy firms is EUR 73,276 smaller than in a bank with no zombie presence. However, this spillover effect is relatively minor. As a result, the marginal effect at a zombie share of 10% is still positive and amounts to EUR 666,330. Only for zombie bank shares higher than 25%, the marginal effect of a higher zombie share for healthy firms becomes statistically indistinguishable from zero, as (β_2+β_3) overcompensates β_1. To sum up these findings: Only at a very high zombie share of 25% or higher, the spillover effect is large enough to render the marginal effect on new credit for healthy firms zero. Given bank zombie shares of 25% are rare, a non-positive effect on new credit seems more the exception then the rule, also for healthy firms.

Specification (3) in Table 5, which includes firm-fixed effects, confirms our results so far. The inclusion of firm-level fixed effects increases the adjusted R-squared of the model from 8.45% to 29.74% and renders both the coefficient on zombie firms' new credit (β_2) and the coefficient representing spillovers to healthy firms (β_3) significant at 5%. The direction of the coefficients' signs remain unchanged, though. Consequently, the F-statistic for the Wald test on the spillover effect is 0.12, s.t. the total effect can assumed to be zero, just like in specification (2).

Figure 7 shows the margin plot for specification (3), which looks similar to Figure 6. However, the marginal effect of a higher zombie share on zombie firms in Figure 7 is significantly different from zero for all bank zombie shares (blue line). In contrast to Figure 6, the marginal effect for healthy firms (orange line) is not different from zero for all bank zombie shares. This is because in specification (3), the firm-fixed effect eliminates the non-zombie dummy (β_1) and the absolute magnitudes of β_2 and β_3 are so similar that they cancel out already at low zombie shares. Thus, there is a positive effect on new credit for zombie firms and a zero spillover effect for healthy firms.

Taking all the results from specifications (2) and (3) together, we do not find a significant adverse spillover effect from the existence of zombie firms in a bank on healthy firm's new credit. This is not in line with Andrews and Petroulakis (2019) who find a small, but

Figure 7. Margin plot for new credit specification (3) as the dependent variable



Notes: This graph plots the marginal effects estimated using specification (3) in Table (6) for the dependent variable new credit. The y-axis shows the magnitude of the effect at different values of the zombie share on the x-axis, ranging between zero and 30%.

significant decrease in access to credit for healthy firms in sectors with more zombie firms. Neither does this finding support the claim by Acharya et al. (2019) of a loan supply shift from healthy firms to zombie firms in banks with a higher presence of zombie firms. Acharya et al. (2019) argue that because the increased presence of zombie firms in a sector reduces the loan supply for healthy firms, they need to pay higher interest rates; assuming healthy firms' demand for loans remains unchanged. Against the background that our analysis so far cannot establish an adverse shift in loan supply away from healthy firms, we will now investigate the effect on interest rates.

3.2 Interest Rates

As already indicated by the descriptive statistics in section 2.3, and contrary to expectations, we find that healthy firms pay significantly lower interest rates on their loans than zombies; see the coefficient on the non-zombie dummy in specification (1) in Table 6. More specifically, healthy firms pay 0.329p.p. lower rates on their loans on average, ceteris paribus. This finding contradicts the idea that zombie firms receive subsidised credit and is an important difference to the existing literature. A likely explanation could be that the Orbis-AnaCredit sample differs from those employed by previous studies; in particular, in terms of the number of unlisted and smaller firms. Moreover, AnaCredit provides direct interest rate data on loans. By contrast, the only other study that investigates interest rates infers their information from accounting data, dividing the total interest payments of a firm by its outstanding debt; see Acharya et al. (2019).[15]

Specification (1) in Table 6 also shows that all firms in banks with a higher zombie share generally pay lower interest rates than firms in banks with a lower share (β_2). This is statistically significant at the 1%-level. One possible explanation could be that a high share of zombie loans worsens a bank's credit portfolio, which is audited by a country's financial regulators. Thus, to balance their portfolio, banks with a higher zombie share might need to attract better-rated clients. One potential way of achieving this is by offering attractively low interest rates.[16] Concerning the control variables, lagged firm age, number of employees and EBITDA over assets are statistically significant. In line with expectations, a firm needs to pay lower interest rates when it is older, larger (more employees) and more profitable. The first two effects are statistically significant at the 1%-level, the effect of EBITDA over total assets is significant at the 5%-level.

[15] The measure by Acharya et al. (2019) (see p. 3385) is a yearly average interest rates paid by the firm. As explained in section 2.4, our interest rate measure is an average of individually and directly reported rates across all loans a firm holds at a specific bank in a certain quarter, which is a more granular level of aggregation.

[16] Another potential explanation might be the relatively recent rule for European capital-oriented credit institutions to report credit risk under the IFRS 9 framework. In contrast to the previous standard which required banks to recognize credit losses only when they became evident, IFRS 9 obliges banks to report and account for expected credit losses (Bundesbank, 2015; Bank for International Settlements, 2022). These new provisions might have implications on the bank's capital as it could reduce a bank's regulatory capital (Rhys et al., 2016). Thus, a high proportion of zombie loans could be costly for banks as it might reduce their profit through these value corrections for risky loans. To make up for this "lost" profit, banks could try to attract more new clients with lower interest rates, which could be one explanation for the significant and negative coefficient on the lagged zombie share in a bank in specification (1) in Table 6.

Table 6. Regression results for interest rates as the dependent variable

	(1)	(2)	(3)
Not_Zombie	-0.0033***	-0.0035***	0.0000
	(-14.46)	(-13.93)	(.)
Zombie_share	-0.0645***	-0.0710***	-0.0589***
	(-34.75)	(-17.27)	(-12.43)
Not_Zombie X Zombie_share		0.0068*	-0.0047
		(1.77)	(-1.02)
Firm_age	-0.0001***	-0.0001***	
	(0.00)	(0.00)	
Number_employees	-0.0016***	-0.0016***	
	(-4.62)	(-4.62)	
Leverage	0.0001	0.0001	
	(0.50)	(0.51)	
Ebitda_over_assets	-0.0018**	-0.0018**	
	(-2.18)	(-2.18)	
Firm-level controls	Yes	Yes	No
Firm FE	No	No	Yes
Bank FE	Yes	Yes	Yes
Country-Sector-Time FE	Yes	Yes	Yes
Observations	23,426,188	23,426,188	24,528,565
Adjusted R^2	0.228	0.228	0.442

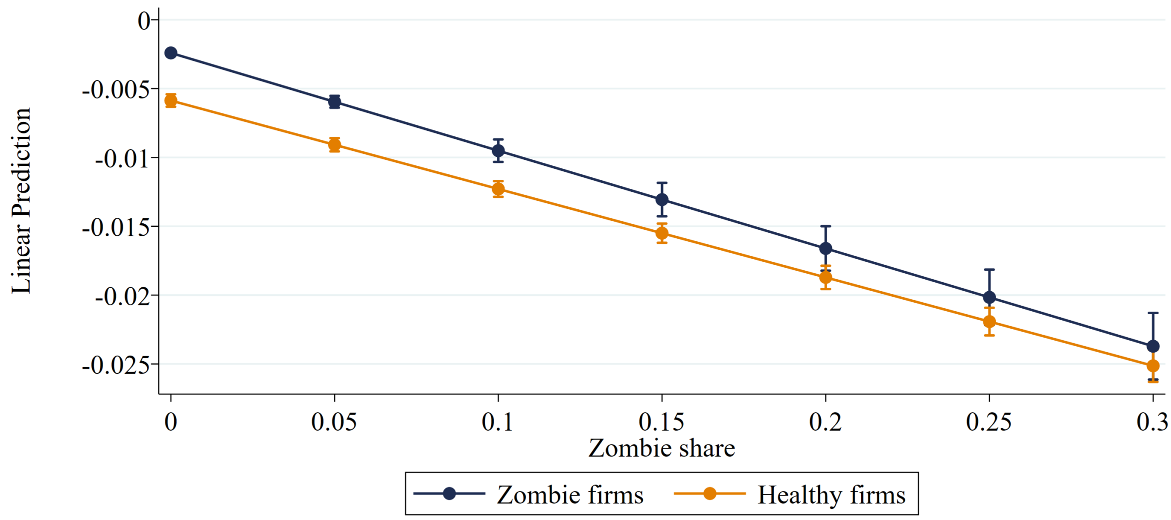
t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Notes: This table presents regressions at the firm-bank level. The dependent variable is the average interest rate a specific firm pays at a specific bank in a specific quarter. The main explanatory variables are the non-zombie dummy, equal to 1 when a firm is classified as healthy (*Not_Zombie*=1), the share of zombie loans in a bank (*Zombie_share*), and the interaction of these two, *Not_Zombie=1 X Zombie_share*. Control variables include firm age, the number of employees in a firm, a firm's leverage ratio and the ratio of its EBITDA over its total assets. All independent variables are lagged by one period to avoid reverse causality. All three specifications include bank and country-sector-time fixed effects; specification (3) also firm fixed effects. Standard errors are clustered on the firm-level.

We now turn to the potential financial spillover effect on healthy firms' interest rates. Recall that based on Acharya et al. (2019), we expect healthy firms in banks with a higher zombie share to pay higher interest rates than healthy firms in banks with a lower zombie share (H2). Our results in Table 6 do not confirm this hypothesis. In specification (2) with the interaction term, the main effect we found for all firms above is confirmed for both groups: A higher zombie bank share decreases the interest rates paid by zombie firms (β_2) and also that of healthy firms (spillover effect, as measured by the sum of β_2 and β_3). Both effects are highly significant; the F-statistic from the Wald test with the null hypothesis

$H_0: \beta_2+\beta_3=0$ exceeds 1185.

Figure 8. Margin plot for interest rates specification (2) as the dependent variable



Notes: This graph plots the marginal effects estimated using specification (2) in Table (7) for the dependent variable new credit. The y-axis shows the magnitude of the effect at different values of the zombie share on the x-axis, ranging between zero and 30%.

The marginal effects plot (Figure 8) over bank zombie shares ranging from 0-30% illustrates this negative effect on both zombie (blue line) and healthy firms' interest rates (orange line). Due to the negative β_1 in specification (2) in Table 6, the intercept for healthy firms is slightly lower. At the same time, their (orange) line is flatter, due to the positive β_3-coefficient, which attenuates the total effect for healthy firms. For example, at a zombie share of 10%, the marginal effect of increasing the zombie share on healthy firms interest rates is -1.23 p.p.. Compared to a healthy firm in a bank with no zombie firms, this means a 0.64 p.p. lower interest rate. Similarly, a zombie firm in a bank with a zombie share of 20% pays 0.71 p.p. lower interest rates than a zombie firm in a bank with 10% of zombie loans; also see Table 10 in Appendix F. While these are effects of non-negligible economic size, especially in the low-interest rate environment during the period of study, note that the mean share of zombie loans across bank in our sample is 1.81%. Hence, a 1% increase in the zombie share is already quite substantial. The marginal effects in Figure 8 for zombie (β_2) and healthy firms ($\beta_2+\beta_3$) are significantly different from zero for all levels of the zombie share. Note, however, that the difference in the slopes between the two groups, β_3, is not statistically significant. This implies that the two groups do not react differently to a zombie share increase in their bank.

Results from regression specification (3) in Table 6, employing firm-fixed effects, but no firm-level controls, are very similar to those of specification (2). Recall that the non-zombie dummy is omitted due to firm-fixed effects. The effect of being a zombie firm in a bank with a higher proportion of zombie loans is negative and statistically significant at the 1%-level, as in specification (2). Similarly, the spillover effect for healthy firms decreases healthy firms' interest rates and is statistically significant at all common levels of significance, with an F-statistic of 1253. These results suggest that an adverse spillover effect cannot be found.

Our findings up to this point neither confirm hypothesis H2, nor are they in line with the existing literature on interest rate spillovers. Acharya et al. (2019) find that a one percentage point increase in the zombie share in the sector increases healthy firms' interest rates by 2.4p.p. compared to healthy firms in a sector with a lower zombie share. Notice that the circumstances in Acharya et al. (2019) and the present study differ in four key respects: The calculation of interest rates, the period of study (2009-2014 vs. 2018-2021), the sample studied (large firms in Germany, Spain, France, the UK and Italy vs. firms of various sizes in all euro area countries) and the dataset used (firm-level data from Amadeus database by Bureau van Dijk vs. matched Orbis-AnaCredit sample).

Against this background, we now further break down the findings on interest rates relating to H2. To get a more detailed picture, debtors are classified into rating groups according to their probability of default. [17] Note that in AnaCredit only internal ratings-based approach (IRB) banks report probabilities of default.[18] Thus, the sample reduces from around 25 million observations to roughly 15 million observations. Nevertheless, for this sub-sample of firms, it is interesting to see if the results found above also hold when controlling for credit risk as classified by the bank that gives out the loan.

The distribution of probabilities of default for both zombie and healthy firms is such that most observations are in the "B-all" bucket, with 65.91% for healthy and 63.95% for zombie firms. Not surprisingly, the share of "A-all"-rated loans is higher for healthy firms (27.7% vs. 11.28% for zombie firms), and the share of "C and worse"-rated loans is higher for zombie firms (24.76% vs. 6.39% for healthy firms). Nonetheless, there is a substantial number of observations in each category, such that estimation in the sub-samples is meaningful.

[17] The S&P 2020 Global Report classifies firms into AAA, AA, A, BBB, BB, B or CCC/C according to their probability of default (PD). Similarly, the Eurosystem credit assessment framework (ECAF) establishes five credit quality steps, corresponding to S&P's categories AAA/AA+/AA/AA-, A+/A/A-, BBB+/BBB/BBB-, BB+ and BB (ECB, 2022). We use the S&P scale and group loans into three categories: "A-all" (including AAA, AA, A which cover PDs from 0%-0.39%), "B-all" (BBB, BB, B which cover PDs from 0.4-13.84%) and "C and worse" (CCC/C and unrated with PDs greater than 13.84%).

[18] There are two approaches to reporting risk-weighted assets under the Basel III revised credit risk framework (Bank for International Settlements, 2018). On the one hand, banks can compute their off-balance-sheet exposures weighted by risk by using a standardized risk weight scheme (standardized approach). On the other hand, banks can use their own internal rating schedules, for instance using probabilities of default as the risk parameters (internal ratings-based approach).

Table 7. Regression results for interest rates as the dependent variable

	(1a) A-all	(1b) B-all	(1c) C & worse	(2a) A-all	(2b) B-all	(2c) C & worse
Not_Zombie	-0.0019***	-0.0027***	0.0034***	-0.0017***	-0.0005	0.0031***
	(-4.06)	(-10.44)	(6.00)	(-2.72)	(-1.59)	(4.08)
Zombie_share	-0.1160***	-0.2365***	-0.1700***	-0.1100***	-0.1383***	-0.1839***
	(-13.35)	(-29.30)	(-7.41)	(-4.49)	(-8.27)	(-5.88)
Not_Zombie X				-0.0061	-0.1003***	0.0161
Zombie_share				(-0.26)	(-6.63)	(0.71)
Firm_age	-0.0001***	-0.0001***	-0.0002***	-0.0001***	-0.0001***	-0.0002***
	(0.01)	(0.00)	(0.02)	(0.01)	(0.00)	(0.02)
Number_employees	-0.0015***	-0.0010***	-0.0012	-0.0015***	-0.0010***	-0.0012
	(-6.10)	(-5.32)	(-0.55)	(-6.10)	(-5.32)	(-0.55)
Leverage	-0.0036***	-0.0005*	-0.0006***	-0.0036***	-0.0005*	-0.0006***
	(-5.70)	(-1.93)	(-2.71)	(-5.70)	(-1.92)	(-2.71)
Ebitda_over_assets	-0.0048**	-0.0042**	-0.0019***	-0.0048**	-0.0042**	-0.0019***
	(-6.41)	(-21.71)	(-4.35)	(-6.41)	(-21.71)	(-4.34)
Firm-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-Sector-Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,705,583	8,897,678	888,028	3,705,583	8,897,678	888,028
Adjusted R^2	0.185	0.228	0.275	0.185	0.228	0.275

t statistics in parentheses
* ps0.10, ** p<0.05, *** p<0.01

Notes: This table presents regressions at the firm-bank level. The dependent variable is the average interest rate a specific firm pays at a specific bank in a specific quarter, where firms are divided into three buckets of credit ratings: categories “A-all” (including ratings AAA, AA, and A, which cover PDs from 0%-0.39%), “B-all” (including ratings BBB, BB, B, which cover PDs from 0.4-13.84%) and “C and worse” (including ratings CCC/C and unrated firms with PDs greater than 13.84%). The main explanatory variables are the non-zombie dummy, equal to 1 when a firm is classified as healthy (*Not_Zombie*=1), the share of zombie loans in a bank (*Zombie_share*), and the interaction of these two, *Not_Zombie=1 X Zombie_share*. Control variables include firm age, the number of employees in a firm, a firm's leverage ratio and the ratio of its EBITDA over its total assets. All independent variables are lagged by one period to avoid reverse causality. All three specifications include bank and country-sector-time fixed effects; specification (3) also firm fixed effects. Standard errors are clustered on the firm-level.

First, consider the specifications including firm-level control variables and no interaction term (model (1) in section 2.4, which corresponds to specifications (1a)-(1c) in Table 7. Here, the difference in interest rates between healthy firms and zombie firms, β_1, is significant for all rating groups, as is the case for the full sample in the previous section. However, note that the coefficient on the non-zombie dummy changes sign for firms rated “C or worse”: Healthy firms in the worst credit rating category actually pay 0.31p.p. more interest than zombie firms in this category. This finding supports the idea of zombie firms receiving subsidised credit. However, this paper only finds support for this idea for firms that have high probabilities of default. Thus, it seems that the former findings in the literature are only valid with a very strict zombie definition and for healthy firms that are themselves already in bad shape. The coefficient on the zombie share is negative and significant at the 1%-level for all rating groups, which is in line with the finding for the whole sample in specification (1) in Table 6.

Looking at specifications (2a)-(2c) in Table 7 which include the interaction term, zombie firms in all credit rating groups exhibit significantly lower interest rates with an increasing zombie share (β_2). They same holds for healthy firms. This is confirmed by Wald tests on the spillover effects with $H_0 : \beta_2 + \beta_3 = 0$, which results in an F-statistics of 185.2 for A-rated firms, 872.1 for B-rated firms and 52.5 for firms rated C or worse. Note that the additional negative effect on healthy firms (interaction term), in line with the idea that banks try to attract decently rated healthy firms to balance the zombie loans in their portfolio (see above), is only significant for the "B-all" rated bucket. This means that healthy firms with any B rating (BBB, BB or B) pay lower interest rates than zombie firms in the same rating class when the zombie share increases; but not healthy firms with any A or C rating. This seems reasonable. If zombie firms with any A rating (AAA, AA or A), on the one hand, had to pay an interest premium compared to equally weighted healthy firms, they could try and move to a different bank offering lower rates. On the other hand, there is no incentive to attract firms with a C rating (CCC, CC or C).

In summary, the findings here cannot confirm the dominant view in the literature that there exist significant negative spillovers from zombie firms to healthy firms' access to credit (Andrews and Petroulakis, 2019), and that spillovers from zombie firms increase interest rates paid by healthy firms compared to healthy firms in sectors with fewer zombies (Acharya et al., 2019). Instead, the present analysis reveals that there is a significant difference between healthy firms and zombie firms both in new credit received (more new credit for healthy firms) and the average interest rate paid on their loans (healthy firms pay lower rates). Moreover, zombie firms receive significantly more new credit in banks with higher zombie shares, which seems plausible, while there is no spillover effect on healthy firms. Regarding interest rates, the presence of zombie firms lowers both zombies' and healthy firms' interest rates for all bank shares up to 30%. Thus, a clear adverse spillover effect on healthy firms' credit conditions is not discernible. Note again, however, our analysis differs from the papers above in several respects: It uses more direct measures of new credit and interest rates from AnaCredit, investigates a broader set of euro area countries and firms, has a more recent time frame of study (Q3 2018 to Q4 2021), and conducts the panel regression on the bank, not sector, level. These differences could well explain the discrepancies found.

3.3 Robustness checks

There are three dimensions along which robustness checks are conducted: Alternative zombie definitions, COVID-19-related concerns, and alternative fixed effect structures.

First, even though we employ a rather conservative zombie definition as discussed in section 2.2, this measure is a crucial concept. Therefore, three alternative zombie definitions are implemented to cross-check the main results. One simple alternative way to identify zombie firms is to classify them according to their leverage ratio. We follow Storz et al. (2017) and use a threshold of 85%, which Gebauer et al. (2018) find to be the level above which investment in the euro area is affected by debt overhang. Employing this "leverage" definition leads to an asset-weighted zombie share of 1.04% in our matched Orbis-AnaCredit sample. For the second and third alternative we follow the papers which use an interest coverage (IC) ratio below 1, instead of a debt servicing capacity below 5%, as a criterion to identify weak firms; see for instance, Adalet McGowan et al. (2018); Banerjee and Hofmann (2018, 2020); Nurmi et al. (2020). The IC ratio commonly is defined as EBIT over interest payments. Note that if zombie firms were indeed more prone to receive subsidized credit as is often argued in the literature, their interest payments would be lower, increasing the interest coverage ratio. Hence, this criterion might classify firms as healthy that otherwise would have been classified as zombies. This is why our baseline definition uses the debt servicing capacity as a criterion instead. Nevertheless, given their frequent use in the literature, two alternatives using the IC ratio are employed as robustness checks: The definition of the OECD (Adalet McGowan et al., 2018), on the one hand, defines a firm to be a zombie when its IC ratio is smaller than 1 over the last three periods, provided the firm is older than ten years. With this definition, the asset-weighted zombie share in our sample increases to 2.77%. Given the average firm in our sample is older than 24 years, it is not surprising that the Adalet McGowan et al. (2018) definition yields higher zombie shares than our baseline one. The definition by Nurmi et al. (2020), on the other hand, also needs the IC ratio of a firm to be below 1 for three consecutive years, but replaces the age criterion by a criterion of no positive average employment growth over the previous two periods. This definition yields a zombie share of 1.36%, which is close to our baseline asset-weighted zombie share (see Appendix D).

Running the regressions for new credit with these alternative definitions, none of the zombie coefficients is significant; see specifications (2d) to (2f) in Table 8. This seems surprising at first. However, note that our baseline zombie definition by Storz et al. (2017) is quite strict and poses restrictions on several financial variables. The present result suggests that for new credit there only is a significant difference for zombie as opposed to healthy firms when the zombie definition indeed indicates a very strong deterioration of performance, as is the case for our baseline definition; see section 2.3. Notwithstanding, these findings for new credit support our main conclusion that a clear and economically significant effect of an increased zombie presence on healthy firms' new credit is not discernible. Hence, these robustness checks confirm the discrepancy with the assumption of a zombie-induced loan supply shift by Acharya et al. (2019).

For interest rates, the results under the baseline definition as presented in section 3.2 are confirmed by all three alternative definitions. This is reassuring. All definitions find that a higher zombie share significantly lowers interest rates paid by zombie firms. The additional effect on healthy firms is either moderately positive or not significant. Consequently, the total (spillover) effect of a higher zombie share for all definitions lowers the interest rates of healthy firms.[19] Together with negative marginal effects, which we tested to be statistically significant at the 1%-level for both groups and all bank zombie shares considered, these robustness checks clearly confirm the findings under the baseline definition, deepening the discussed discrepancy with the findings by Acharya et al. (2019).

A second dimension for robustness checks addresses the concern that the inclusion of the pandemic in the period of study might distort results. By running the panel regressions in two sub-samples, a pre-COVID-19 sample from Q3 2018 to Q4 2019 (specification (2g) in Tables 8 and 9), and a COVID-19 sample from Q1 2020 to Q4 2021 (specification (2h) in Tables 8 and 9), we try to alleviate these concerns. Regarding new credit, the results of the COVID-19 sample are similar to those of the whole sample. In the pre-COVID-19 sample, both the positive coefficient for zombie firms and the negative coefficient for the additional effect on healthy firms (interaction term) turn significant. As a result, the total effect on healthy firms is positive. Hence, if at all, this robustness check would suggest a slightly positive spillover effect regarding new credit for healthy firms.

For interest rates, the COVID-19 sub-sample is the only specification in our analysis where the coefficient on the zombie share, i.e. the effect of a higher bank zombie share on zombie firms' interest rates, turns insignificant. At the same time the additional effect on healthy firms is significant and positive. That is, this is the only specification where we indeed find evidence for an adverse spillover effect of the zombie share, namely healthy firms' interest rates. Interestingly, however, this evidence is related not to an ordinary period of study, but to the phase of COVID-19. During COVID-19, especially between Q1 2020 to Q4 2021, the world economy experienced an external shock, which central banks and governments tackled by deploying extensive monetary policy and fiscal support. Fiscal support first came mostly in the form of liquidity, later also in the form of solvency support measures. The most widely used measure throughout the pandemic were public guarantee programmes. On average, a guarantee will ease credit conditions for customers, reduce interest, and may even increase credit volume of the credit contract that it is to support. As we show in Appendix E, healthy

[19]While the interpretation is the same, note again that the sign and significance of the coefficient on the interaction term differ: It is significant and positive for the "leverage" definition (specification (2d) in Table 9), not significant and positive for the Adalet McGowan et al. (2018) definition (specification (2e) in Table 9), and not significant and negative for the definition by Nurmi et al. (2020) (specification (2f) in Table 9).

firms that were indeed hit by the pandemic, or just seized the opportunity of cheap credit, made more use of guarantees. This makes sense, because governments wanted measures to be directed at viable customers.

As a result, banks with a higher zombie share likely profited relatively less from the public support. For this reason, it seems possible that the average interest charged on healthy firms in these banks would be higher, as compared with banks having a lower zombie share (and thus more healthy firms), because a smaller portion of these banks' portfolios were supported with guarantees. That could explain the adverse effect on healthy firms interest rates during the COVID-19 period. Note, however, that this development would not be due to the zombie presence, but the state-supported liquidity, which was directed at viable firms, and therefore benefited banks with a lower zombie share and their customers, at the expense of banks with a higher zombie share and their customers. Also note that the main effect for healthy firms' interest rates is still significant and negative for both groups, as in the case for the whole and the pre-COVID-19 sample. Therefore, the COVID-19 period does not change our more general result that the presence of zombie firms significantly decreases interest rates for healthy firms. We conclude that the inclusion of the COVID-19 period does not distort our results. Rather, it suggests that adverse spillover effects on healthy firms may result from external shocks and government intervention that favour certain parts of the economy, which leads to a comparative disadvantage of others.

A third dimension to check the robustness of our results is to employ different combinations of fixed effects and control variables. Variations that are explored are: Running the regressions both with firm-level controls and firm-fixed effects (specification (7) in Tables 9 and 10), adding lagged bank-level control variables like the size of the bank and its turnover of the bank (specification (8) in Tables 9 and 10), or including only time-fixed effects instead of the more conservative country-sector-time fixed effects (specification (9) in Tables 9 and 10). None of these variations changes the main conclusions. Summing up, the robustness checks using alternative zombie definitions, controlling for COVID-19 and implementing different fixed effect structures confirm the main findings under the baseline regression specification.

Although the main results of this paper are robust to different specifications and zombie definitions, two drawbacks related to data quality and data availability need to be kept in mind. First, AnaCredit is still a quite novel dataset. It is based on the reporting by euro area banks, which is collected by the national central banks and compiled by the ECB. All institutions try to minimise reporting errors, but of course they cannot be ruled out. An example are the very high interest rates at the beginning of the period of study (Q3 and Q4 2018), which may be due to banks misunderstanding reporting standards or simply typing errors (e.g., confusing a value of "1" with 1% when it actually means 100%). To address such potential shortcomings, additional sample restrictions mentioned in Appendix A on interest rates (excluding anything below -100% and above 100%) and on the return on assets (excluding observations below -10 for healthy firms, which is mostly due to extremely low reported total assets) are imposed. Second, data availability constraints the analysis in different ways. A main issue is that Orbis data has a time lag of approximately 1.5 to 2 years, counted from the closing date, simply due to accounting policies. Consequently, in this analysis, Orbis financial accounting data is only available up until 2019 for all firms (until 2020 for some exceptions), which is why a fixed zombie sample is used. Moreover, since AnaCredit data only starts in Q3 2018, the analysis cannot go back further in time. As a result, the analysis cannot include firms that became zombies in 2020 and 2021, or zombie firms that recovered to healthy status, or firms that exited the market because they died. Rather, it focuses on firms that were zombies already before the pandemic. It will be very interesting to extend this analysis with a zombie sample allowing for entry and exit of zombies during the pandemic, once the data become available. A related issue is that Orbis data are not only used to identify zombie firms, but also as firm-level control variables, while all controls are lagged by one period. This means that the controls leverage, number of employees and EBITDA over assets are assumed to be constant from 2020 onwards, while firm age is constructed as being continuous. To address this issue, the regressions are run with different specifications: including firm-level controls, but without firm-fixed effects, without controls, but with firm-fixed effects, and including both. As it turns out, the results do not differ much comparing these specifications. Finally, bank-level control variables employed in the robustness checks are taken from AnaCredit. While the quality of these variables, like for all others is checked, it might be less reliable then if one were to use a direct source of bank balance sheet data to control for bank-specific time-variant characteristics. However, it is not trivial to match the present Orbis-AnaCredit dataset with a third once containing bank information. This task is outside the scope of this paper. Nonetheless, this idea gives rise to very interesting avenues of future research. For example, this would allow to implement an instrumental variable approach, as done on the sector level by Banerjee and Hofmann (2018). A possible instrument might be the exposure of a bank to the average zombie share across all banks in the sample, which is very similar to what Banerjee and Hofmann (2018) use. This could be an interesting way to cross-check our panel regression results and investigate causal relationships. Furthermore, one could extend the analysis to different types of banks with a higher or lower zombie share.

Table 8. Robustness checks for new credit

	Definitions				Reference periods		FE and controls		
	(2) Baseline	(2d) Leverage	(2e) Ad. McG.	(2f) Nurmi	(2g) Pre Covid	(2h) Covid	(4) Firm FE	(5) Bank FE	(6) Time FE
Not_zombie	437,127.9***	-88,029.1	-287,574.2	-278,959.2	424,701.2**	448,601.3**	0	421,074.7***	443,333.7***
	(2.62)	(-0.81)	(-1.38)	(-0.70)	(2.51)	(2.13)	(.)	(3.02)	(2.77)
Zombie_share	14,329,818.2*	731,993.7	-1,280,274.6	6,682,405.3	15,495,717.2**	11,335,205.7	30,680,911.3**	12,584,963.5*	13,918,145.8*
	(1.82)	(0.24)	(-0.25)	(0.64)	(2.27)	(0.93)	(2.28)	(1.94)	(1.85)
Not_zombie X zombie_share	-15,062,585.9*	-1,142,654.9	13,153.2	-7,180,652.6	-13,851,623.6**	-16,949,275.3	-31,428,828.1**	-13,456,907.2**	-14,501,124.5*
	(-1.86)	(-0.39)	(0.18)	(-0.67)	(-2.01)	(-1.38)	(-2.29)	(-2.01)	(-1.86)
Number_employees	202.0***	202.0***	202.1***	202.0***	175.5***	217.6***	63.03	205.1***	162.8***
	(7.34)	(7.34)	(7.35)	(7.34)	(5.81)	(6.43)	(0.64)	(7.15)	(4.11)
Leverage	155,662.5*	147,499.3*	153,941.8*	152,625.1*	100,539.6	254,924.3***	-29,073.5	155,316.2*	197,234.2**
	(1.96)	(1.82)	(1.95)	(1.94)	(1.45)	(2.61)	(-1.16)	(1.81)	(2.44)
Ebitda_over_assets	12,169.4	14,953.9	20,979.6	21,225.8	-607.8	121,218.7	4,895.2	12,182.8	1,337.2
	(0.78)	(0.89)	(1.03)	(1.03)	(-0.14)	(1.59)	(0.94)	(0.78)	(0.10)
Turnover_creditor								4.65e-12	
								(0.04)	
Employees_creditor								-0.00502	
								(-1.10)	
Firm-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-level controls	No	No	No	No	No	No	No	Yes	No
Firm FE	No	No	No	No	No	No	Yes	No	No
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Sector-Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Time FE	No	No	No	No	No	No	No	No	Yes
Observations	1,940,277	1,940,277	1,940,277	1,940,277	791,509	1,148,677	1,716,056	1,669,448	1,951,384
Adjusted R^2	0.085	0.085	0.085	0.085	0.071	0.096	0.336	0.085	0.038

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

*Notes:*This table presents regressions for robustness checks at the firm-bank level. The dependent variable is the sum of new credit a specific firm holds at a specific bank in a specific quarter. Robustness checks include: three alternative zombie definitions (specifications (2d) to (2f)), splitting the sample into a period before and during the COVID-19 pandemic (specifications (2g) and (2h)) and employing different structures of fixed effects (specifications (4) to (6)). The main explanatory variables are the non-zombie dummy, equal to 1 when a firm is classified as healthy (Not_zombie=1), the share of zombie loans in a bank (Zombie_share_lag), and the interaction of these two, Not_zombie=1 X Zombie_share_lag. Control variables include firm age, the number of employees in a firm, a firm's leverage ratio and the ratio of its EBITDA over its total assets. All independent variables are lagged by one period to avoid reverse causality. All nine specifications include bank fixed effects. All also use country-sector-time fixed effects, except for specification (9), which uses only time fixed effects. Specification (7) additionally includes firm-fixed effects. Standard errors are clustered on the firm-level.

Table 9. Robustness checks for interest rates

	Definitions				Reference periods		FE and controls		
	(2) Baseline	(2d) Leverage	(2e) Ad. McG.	(2f) Nurmi	(2g) Pre Covid	(2h) Covid	(4) Firm FE	(5) Bank FE	(6) Time FE
Not_zombie	-0.0035***	-0.0026***	-0.0033***	-0.0033***	-0.0029***	-0.0040***	0	-0.0036***	-0.0035***
	(-13.93)	(-9.79)	(-18.68)	(-13.52)	(-9.10)	(-14.64)	(.)	(-13.62)	(-13.71)
Zombie_share	-0.0710***	-0.0853***	-0.0651***	-0.0604***	-0.1410***	0.0013	-0.0573***	-0.0348***	-0.0603***
	(-17.27)	(-14.53)	(-15.42)	(-9.45)	(-16.64)	(0.34)	(-11.96)	(-8.65)	(-14.45)
Not_zombie X zombie_share	0.00679*	0.0214***	0.0007	-0.0041	0.0030	0.0148***	-0.0050	0.01180***	0.0093**
	(1.77)	(3.76)	(0.18)	(-0.65)	(0.47)	(4.01)	(-1.06)	(3.02)	(2.38)
Number_employees	-0.0016***	-0.0016***	-0.0016***	-0.0016***	-0.0018***	-0.0014***	0.0004	-0.0014***	-0.0010**
	(-4.62)	(-4.68)	(-4.53)	(-4.63)	(-3.63)	(-4.69)	(0.53)	(-4.27)	(-2.53)
Leverage	0.0001	-0.0000	0.0001	0.0001	-0.0002	0.0002*	-0.0003**	-0.0001	-0.0002
	(0.51)	(-0.08)	(0.69)	(0.75)	(-0.77)	(1.84)	(-2.48)	(-1.06)	(-1.62)
Ebitda_over_assets	-0.0017**	-0.0018**	-0.0017**	-0.0017**	-0.0017*	-0.0017	0.0001	-0.0018*	-0.0017**
	(-2.18)	(-2.18)	(-2.19)	(-2.19)	(-1.79)	(-1.63)	(1.42)	(-1.95)	(-2.23)
Turnover_creditor								3.60e-18***	
								(13.08)	
Employees_creditor								-1.15e-11***	
								(-4.73)	
Firm-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-level controls	No	No	No	No	No	No	No	Yes	No
Firm FE	No	No	No	No	No	No	Yes	No	No
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Sector-Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Time FE	No	No	No	No	No	No	No	No	Yes
Observations	23,426,188	23,426,188	23,426,188	23,426,188	8,575,793	14,850,394	23,401,152	20,172,719	23,433,100
Adjusted R^2	0.228	0.228	0.228	0.228	0.252	0.284	0.448	0.242	0.200

t statistics in parentheses

* p<0.10, ** p<0.05, *** p<0.01

*Notes:*This table presents regressions for robustness checks at the firm-bank level. The dependent variable is the average interest rate a specific firm pays at a specific bank in a specific quarter. Robustness checks include three alternative zombie definitions (specifications (2) to (4)), splitting the sample into a period before and during the COVID-19 pandemic (specifications (5) and (6)) and employing different structures of fixed effects (specifications (7) to (9)). The main explanatory variables are the non-zombie dummy, equal to 1 when a firm is classified as healthy (is_not_zombie=1), the share of zombie loans in a bank (zombie_share_bank_lag), and the interaction of these two, is_not_zombie=1 X zombie_share_bank_lag. Control variables include firm age, the number of employees in a firm, a firm's leverage ratio and the ratio of its EBITDA over its total assets. All independent variables are lagged by one period to avoid reverse causality. All nine specifications include bank fixed effects. All also use country-sector-time fixed effects, except for specification (9), which uses only time fixed effects. Specification (7) additionally includes firm-fixed effects. Standard errors are clustered on the firm-level.

4 Conclusion

The findings of this study underline that zombie firms exist in the euro area, but not that they pose significant negative externalities on the credit conditions of healthy firms in the economy. Firms are identified as zombie firms when, for two consecutive years, they report a negative return on assets, negative net investments and a debt servicing capacity below 5%. Under this definition, the bank zombie share in our sample averages at 1.81% of loans in a bank held by zombie firms, with the highest share in Greece at 7.73%. A closer look at zombie firms shows that these are, on average, smaller, less profitable, and more leveraged than healthy firms. In addition, zombie firms are found to have a higher amount of bank loans, except for among large firms, and perform much worse in terms of credit quality indicators like probability of default, share of non-performing loans or share of loans where credit risk significantly increased since their origination (IFRS stage 2). These findings motivate the analysis of adverse financial spillovers from zombies to healthy firms. If the existence of zombie firms adversely impacted healthy firms, this would render them a more far-reaching economic problem.

Indeed, the majority of the existing literature finds negative real spillover effects from zombies to healthy firms in terms of employment growth, investment, and productivity, which are transmitted through two main channels: competition and credit conditions. Using the matched Orbis-AnaCredit sample from Q3 2018 to Q4 2021 and a panel regression with fixed effects, however, our analysis cannot confirm the existence of negative financial spillovers on credit conditions; neither for new credit, nor for interest rates. More specifically, while healthy firms do receive significantly more new credit than zombie firms in general, a significant adverse spillover effect on of a higher bank zombie share healthy firms' new credit cannot be found.

As regards interest rates, our analysis reveals several interesting results. First, interest rates paid by zombie firms are significantly higher than those paid by healthy firms. This contradicts the widely held notion of subsidised credit for zombie firms. Distinguishing firms based on their probability of default, we find one exception: Healthy firms rated C or worse pay higher interest rates than zombie firms rated C or worse, suggesting that the subsidised credit argument applies only within the realm of firms that are indeed in very bad shape. Second, banks with a higher share of zombie firms charge significantly lower rates for both groups of firms. Third, in contrast to the one existing study examining spillovers on interest rates in the euro area, there exists a spillover effect to healthy firms, but it is benefiting them. Healthy firms in banks with a higher zombie share pay significantly lower interest rates than firms with loans in banks with a lower zombie share. The spillover effect does not seem to depend on the credit quality of loans, as is examined using sub-samples of similarly rated firms. The total combined effect of the existence of zombie firms in a bank actually reduces the interest rates paid by healthy firms for all bank zombie shares between 0-30%. These main conclusions are robust to using alternative zombie definitions and alternative fixed effect specifications, with slight differences of the individual effects during the COVID-19 period, which could be related to pandemic-induced state support measures.

There are several possible explanations for this discrepancy of our findings with the literature. First, our data sources permit a more direct and granular measurement of interest rates and credit attributes as compared to previous studies. Second, we look at an extensive sample of not only large, but also medium, small, and micro sized firms. Because of the granularity of our sample, our analysis can take place on the bank, not the sector, level. Finally, to the best of our knowledge, this is the first paper that investigates financial spillovers from zombie to healthy firms including all euro area countries.

In terms of policy implications, our findings seem like "good news": Zombie firms are charged higher interest rates according to the elevated credit risk that they pose, and an unambiguous adverse spillover effect is not discernible. Healthy firms receive more new credit than zombie firms and a significant adverse spillover effect on healthy firms' new credit cannot be found. Nevertheless, this does not mean that one should disregard the issue of zombie firms altogether. After all, the mere existence of zombie firms suggests misguided lending incentives by banks or policy structures that favour artificially keeping inefficient firms alive. Although zombie firms pay higher rates than healthy firms, it is not clear if these appropriately reflect these firms' elevated credit risk. Even though zombie firms receive less new credit than healthy firms, they do receive new credit; and also public guarantees in the COVID-19 context. Finally, while financial spillovers might not be as significant as assumed by the literature, real spillovers through the competition channel might still exist, as demonstrated by the existing literature in several contexts. Therefore, the existence of zombie firms in the euro area remains an important issue that warrants further research, assessing potential risks to financial stability, especially in the aftermath of the COVID-19 pandemic.

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Appendix

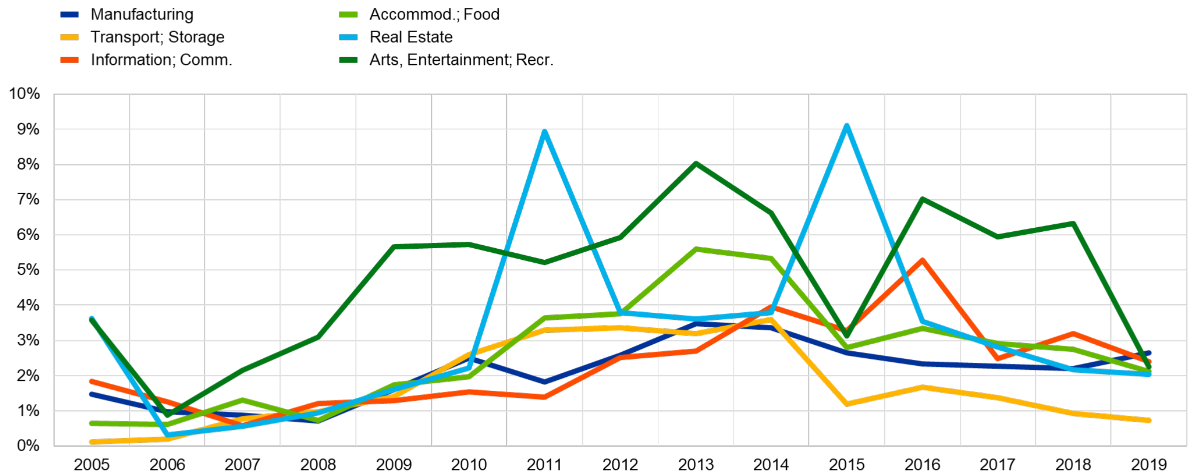
A Sample restrictions for the datasets used

Regarding the Orbis sample, observations where key financial variables needed for analysis are missing are excluded. To ensure that only plausible information is analysed, further sample restrictions along the lines of Storz et al. (2017) are employed: Firms without financial debt, inactive firms, and those with inconsistent balance sheets (zero or negative total assets, negative debt, sum of equity and liabilities not between 99% and 101% of total assets) are excluded. Moreover, as is common practice in the zombie literature, firms in the sectors A and B (primary sector), K (financial sector), O (public administration, defence, and social security) and U (extraterritorial organisations) are excluded. In contrast to Storz et al. (2017), our sample includes large and listed firms to ensure representativeness. Furthermore, all firms with negative equity are excluded. Negative equity arises when a firm's total debt exceeds total assets. When not applying this restriction, the descriptive statistics become very distorted also for healthy firms. Considering that our sample size is already very large, the amount of observations lost through this restriction is not substantial. All sample restrictions for the Orbis-only dataset are also applied to the matched Orbis-AnaCredit dataset. In addition, observations with interest rates below -100% or above 100% are excluded, because we assume these are reporting errors. Furthermore, observations with missing values in the key variables of interest (total assets, fixed assets, leverage, EBITDA, number of employees, and firm age) are eliminated. Finally, healthy firms with a return on assets below -10 are excluded. This very negative ratio is due to a low amount of total assets reported and affects 450 firms. These sample restrictions yield an Orbis-AnaCredit sample of 24.998 million observations. Recall that all firms included in AnaCredit must have loans. Therefore, the matched sample used here only includes firms that use credit instruments, on top of the aforementioned filters. As discussed above, observations resemble firm-bank relationships, whereas a debtor can have loans at multiple banks. For the sub-sample analysis of interest rates based on a firm's credit rating, firms are classified into rating buckets based on their probability of default as reported in AnaCredit. Since this variable is only reported by banks who compute PDs according to the IRB approach, the sample in this part of the analysis decreases to 15 million observations.

B Zombie prevalence by sector

A factor influencing country-specific zombie shares could be that countries specialise in different sectors of economic activity, while zombie shares vary across sectors. This is also flagged in Banerjee and Hofmann (2020). Figure 9 sheds light on the variance and decomposition of zombie shares on the sectoral level for our Orbis-only sample; see section 2.2.

Figure 9. Asset-weighted zombie shares for first-level NACE sectors, 2005-2019



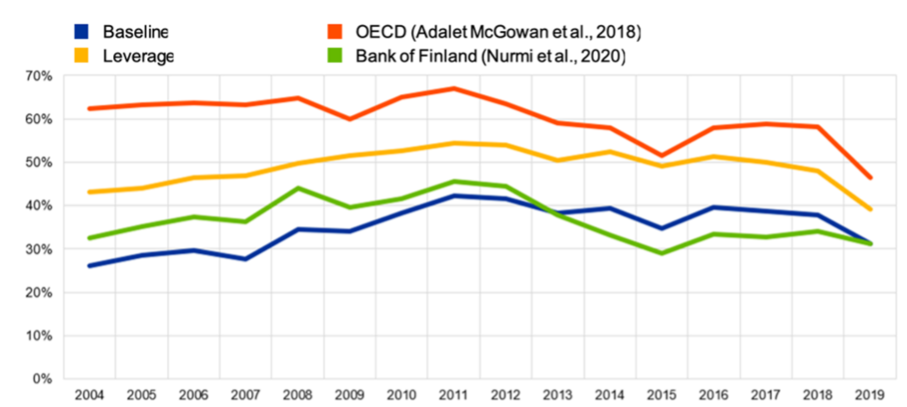
Notes: This graph shows the percentage share of assets held by zombie firms in a given sector (following the EU's NACE-2 classification) and year. Firms are classified as zombie firms when their return on assets is negative, their net investments are negative, and their debt servicing capacity is lower than 5%, for two consecutive years. This graph is based on the Orbis-only sample from 2005 to 2019.

Figure 9 shows that zombie shares have increased for most sectors after the global financial crisis 2008/09. On average, sector R, "Arts, Entertainment and Recreation", exhibits the highest average zombie share of around 7%, in line with the findings of Banerjee and Hofmann (2020). The zombie share in this sector peaks in 2013, but remains elevated afterwards compared to the remaining sectors. This development might be influenced by the global financial crisis and the following recession, where consumers cut back on cultural activities, travelling, and eating out, but also on large investments. In fact, sectors like "Arts, Entertainment and Recreation", "Accommodation and Food", and "Real Estate", peaking in 2011 and 2015, all have average zombie shares higher than 4%. These sectors seem to be more pro-cyclical. Note this also increases the likelihood that firms in these sectors fulfil the zombie criteria for two consecutive years.

C Probability of remaining a zombie

A potential concern related to choosing a zombie definition could be that the definition does not capture accurately whether firms recover from their zombie status or whether they exit the market. To investigate this concern raised by Nurmi et al. (2020), we calculate the probability of remaining a zombie for the baseline and the alternative definitions using the longer Orbis-only sample used in section 2.2.

Figure 10. Probability of remaining a zombie



Notes: This graph shows the probability that a firm is classified as a zombie firm, conditional on the fact that it was classified as a zombie in the previous year, for a given zombie definition and year. Next to the baseline definition, the three alternative definitions used are the leverage definition, the definition introduced by Adalet McGowan et al. (2018) and the one used by Nurmi et al. (2020). This graph is based on the Orbis-only sample from 2005 to 2019.

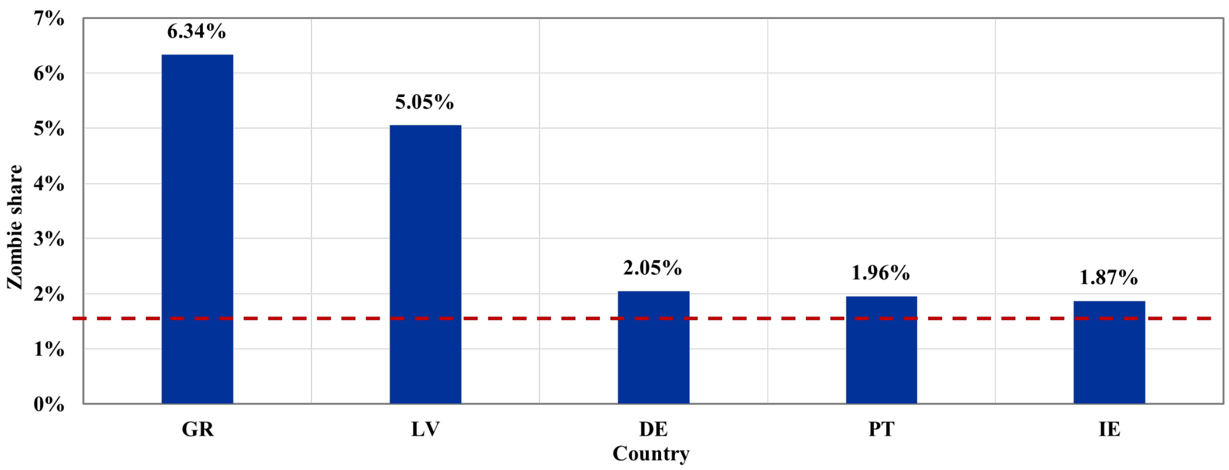
Note that our baseline definition by Storz et al. (2017) allows zombies to recover. The probability of remaining a zombie averages at 35.1%, reaching a peak at 42.3% in 2011 (Figure 10).[20] Despite recent decreases since the European sovereign debt crisis, zombie persistence has risen over period of study. This is also in line with Banerjee and Hofmann (2020). As shown in Figure 8, the probability of remaining a zombie under our baseline definition is very similar to that under the zombie definition by Nurmi et al. (2020)). In contrast, using the definition by Adalet McGowan et al. (2018) or using the 85% leverage threshold to identify zombies yields higher probabilities of remaining a zombie. This supports the notion that our baseline definition is not overestimating the number of zombie firms in the economy.

[20]Following Banerjee and Hofmann (2020), the probability of remaining a zombie firm is calculated as the number of zombies in the current period which will stay zombies in the subsequent period, divided by the total number of zombie firms in the current period.

D Asset-weighted zombie share in the AnaCredit-Orbis sample

To ensure comparability with the literature and our Orbis-only sample, we also compute the asset-weighted zombie share for our matched AnaCredit-Orbis sample, which averages at 1.4%. This is slightly lower than the average bank zombie share, i.e. the share of bank loans held by zombie clients at a certain bank and time (1.89%). Levels over countries are, however, comparable, as Figure 11 shows. It portrays the countries with the top 5 asset-weighted shares in the euro area, whereas three of them also exhibit the highest bank zombie share; see Figure 2. For instance, Greece has the highest share of zombie firms in our matched sample both in asset-weighted (6.34%) and in bank loan-weighted terms (7.73%).

Figure 11. Top 5 asset-weighted zombie shares in Orbis-AnaCredit matched sample



Notes: This graph shows the five countries with the highest percentage share of assets held by zombie firms in our matched Orbis-AnaCredit sample from 2018 Q3 to 2021 Q4. The red dotted line is the share of assets held by zombie firms averaged across all 19 euro area countries.

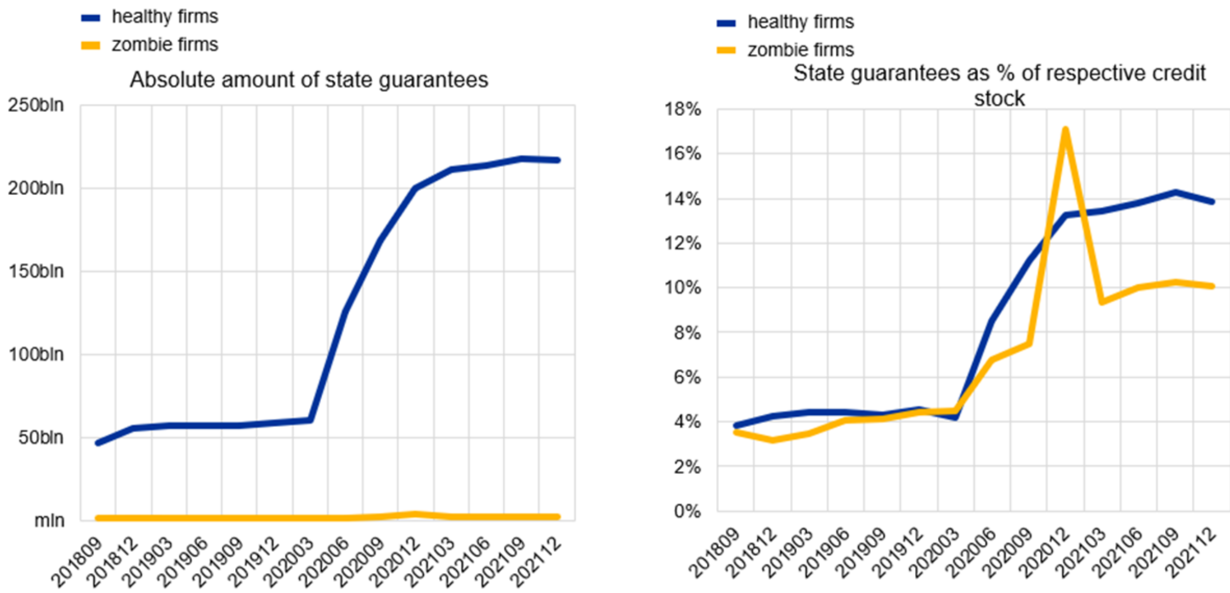
E COVID-19 and state guarantees

New lending during the COVID-19 pandemic has been strongly supported by liquidity measures like moratoria and public guarantees, which was by far the most widely used instrument (European Systemic Risk Board, 2022). Using data on the protections backing individual loans, we can identify the amount of financial guarantees state sector entities provided to zombie and healthy firms during COVID-19. As Figure 10 (LHS) shows, the amount of state guarantees has increased substantially for healthy firms after March 2020, to a level of 200 billion. Zombie firms witnessed a very similar development over time, yet on a lower level, both in absolute and in relative terms. The absolute amount of state-backed guarantees for zombie firms was around 1 billion before the pandemic and increased to around 1.7 billion in late 2021.[21] Note that the increase for both types of firms is driven by the number of enterprises receiving state guarantees, rather than the amount of state guarantees per contract: It increased from an average of 67,400 healthy (646 zombie) firms before March 2020 to around 500,000 healthy (roughly 4000 zombie) firms in each quarter of 2021; a rise of 740% (620%). As a percentage of outstanding credit, state guarantees made up for around 4% before the onset of the pandemic for both types of firms. Afterwards, however, the share rose sharply to 10% for zombie and 14% for healthy firms in the last quarter of 2021, see Figure 12 (RHS). While this shows that healthy and zombie firms both profited from guarantees, healthy firms received considerably more support during COVID-19. This confirms existing findings on support measures related to the COVID-19 pandemic, as discussed in Pelosi et al. (2021) for instance.

This trend is very likely due to the fact that governments wanted measures to be directed at viable customers. Thus, healthy firms also saw a stronger increase in new credit at the onset of the crisis, as discussed in section 2.3. As a consequence, banks with a higher zombie share profited relatively less from the public support. This means that during COVID-19 the difference in interest between healthy and zombie firms in banks with a higher zombie share was less marked, which may explain the single adverse spillover effect on healthy firms we find in our study; see section 4.3. As we argue there, these findings suggest that including the pandemic and thus also potential effects of support measures in our period of study do not distort but merely qualify the main results of our analysis for times of crisis and government interference.

[21] The peak in December 2020 at 4 billion is due to a single guarantee over 1.9 billion, which is an outlier.

Figure 12. State-guaranteed protections to healthy and zombie firms



Notes: The graph on the left shows the absolute amount of state guarantees (in EUR billion) that were given to zombies and healthy firms, respectively, for each quarter during the time of study in our matched Orbis-AnaCredit sample. The right hand side chart expresses this amount as a share of the total credit stock held by each group.

F Marginal effects table

Table 10. Marginal effects

Zombie share	New credit spec. (2)	New credit spec. (3)	Interest rates spec. (2)	Interest rates spec. (3)
Panel A: Zombie firms				
0%	302479.6***		-.0024***	
	(36490.5)		(.0001)	
5%	1018970***	1556948.0**	-.0060***	-.0029***
	(394246.9)	(657425.9)	(.00022)	(.0002)
10%	1735461.0**	3113897.0**	-.0095***	-.0059***
	(786373.5)	(1314852.0)	(.00042)	(.0005)
15%	2451952.0**	4670845.0**	-.01306***	-.0088***
	(1179063.0)	(1972278.0)	(.00062)	(.0007)
20%	3168443.0***	6227793.0**	-.01661***	-.0118***
	(1571894.0)	(2629704.0)	(.00082)	(.0009)
25%	3884934.0**	7784742.0**	-.02016***	-.0147***
	(1964781)	(3287130.0)	(.00103)	(.0012)
30%	4601425.0*	9341690.0**	-.02371***	-.0176***
	(2357696.0)	(3944556.0)	(.0012)	(.0014)
Panel B: Healthy firms				
0%	739607.4***		-.00587***	
	(172731.7)		(.0002)	
5%	702969.1***	-26005.1	-.0091***	-.0032***
	(74023.33)	(74023.3)	(.0002)	(.0001)
10%	666330.7***	-52010.1	-.0123***	-.0064***
	(174648.0)	(148046.7)	(.0003)	(.0002)
15%	629692.3***	-78015.2	-.0155***	-.0095***
	(198976.4)	(222069.9)	(.0004)	(.0003)
20%	593053.9**	-104020.3	-.0187***	-.0127***
	(233493.5)	(296093.3)	(.0004)	(.0004)
25%	556415.5**	-130025.3	-.0219***	-.0159***
	(274380.5)	(370116.6)	(.0005)	(.0004)
30%	519777.1	-156030.4	-.0251***	-.0191***
	(319199.1)	(444139.9)	(.0006)	(.0005)

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Imprint and acknowledgements

We thank Christoph Seitz, Andreas Westphal and Tuomas Peltonen as well as participants of seminars at the European Systemic Risk Board for helpful comments. We also gratefully acknowledge valuable advice from Prof. Kelly Ragan as well Prof. Magnus Johannesson from the Stockholm School of Economics.

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ISSN	2467-0677 (pdf)
ISBN	978-92-9472-330-7 (pdf)
DOI	10.2849/572899 (pdf)
EU catalogue No	DT-AD-23-004-EN-N (pdf)