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Who pays when zombie firms Persist? Asymmetric debt conditions by credit rating

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ABSTRACT

We examine how zombie firm prevalence relates to debt financing conditions for viable firms in a bank-based economy. Using firm-level panel data from South Korea, we find that a higher share of zombie firms within an industry is associated with higher borrowing costs for non-zombie firms, without a significant reduction in their debt growth on average. However, the relationship is highly asymmetric; low-rated non-zombie firms exhibit both elevated interest rates and restricted credit access. Moreover, the adverse effects of zombie prevalence are more pronounced in the service sector than in manufacturing and during periods of monetary easing than tightening. This pattern reflects the heightened sensitivity of such contexts to macro-financial conditions. Our findings highlight credit policy frameworks that incorporate firm-level risk sensitivity and context-dependent amplification.

1. Introduction

The rising prevalence of zombie firms, financially non-viable enterprises sustained by persistent debt rollovers, has emerged as a major concern for macro-financial stability. By absorbing labor and capital that could be deployed more productively, zombie firms hinder creative destruction, distort resource allocation, and suppress aggregate productivity (Caballero et al., 2008; McGowan et al., 2018; Banerjee and Hofmann, 2022; Acharya et al., 2022). Their survival is often enabled by forbearance lending, as creditors defer loss recognition to protect their balance sheets, compounding systemic vulnerabilities (Albuquerque and Iyer, 2024).

While macro-level consequences of zombie firms have been widely studied (e.g., Caballero et al., 2008), less is known about their micro-level effects on viable firms, particularly in the form of distorted debt financing conditions. Recent research highlights how zombie prevalence may elevate perceived industry-level credit risk, tightening financing conditions even for fundamentally sound firms (Albuquerque and Iyer, 2024; Havemeister and Horn, 2023). These effects may be especially pronounced in bank-based economies, such as South Korea, where relational lending dominates credit allocation and amplifies sector-wide contagion.

Nonetheless, important empirical gaps remain. First, most existing studies focus on aggregate productivity or investment crowding-out, overlooking how zombie firms reshape the credit environment for healthy borrowers. Second, the heterogeneity of these aspects is underexplored, specifically, whether financially weaker firms or those in credit-dependent sectors face disproportionate burdens (Chodorow-Reich, 2014; Dell'Ariccia et al., 2008; Hadlock and Pierce, 2010). Third, the macro-financial context in which these

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relationships occur remains ambiguous. While some argue that tighter monetary policy may indirectly prolong zombie survival via evergreening incentives, others emphasize that accommodative conditions more directly foster zombie persistence by weakening market discipline and reducing restructuring pressures (Albuquerque and Mao, 2023; Acharya et al., 2022; Banerjee and Hofmann, 2022).

Understanding how zombie firm prevalence is associated with debt conditions of viable firms is critical, as rising credit costs and financing constraints for productive firms can dampen investment, innovation, and ultimately economic recovery. Identifying which firms are most vulnerable to these negative nexuses is therefore essential for designing targeted financial and industrial policies. This study addresses these gaps by examining how zombie firm prevalence influences the borrowing costs and debt growth of viable firms, using granular firm-level panel data from South Korea. We find that zombie-heavy industries are associated with significantly higher borrowing costs for non-zombie firms, without an overall decline in debt volume. However, among low-rated firms, zombie exposure is linked to both costlier borrowing and curtailed debt growth, reflecting dual financial constraints. These patterns are particularly acute in the service sector and during periods of monetary easing.

Our contributions are threefold. First, we uncover a firm-level risk-pricing channel linking zombie prevalence to higher financing costs for viable borrowers. Second, the study demonstrates substantial heterogeneity in these patterns across credit ratings and industries. We also show that accommodative monetary policy exacerbates these distortions. These findings shift the focus from aggregate inefficiencies to distributional effects in credit markets and highlight the need for policy frameworks sensitive to both firm-level vulnerabilities and macro-financial regimes. Specifically, practical measures include integrating zombie-prevalence indicators into supervisory monitoring and stress tests, applying sectoral capital requirements when zombie concentrations are high, and calibrating loan-classification and support programs to protect viable but vulnerable firms without subsidizing persistently unviable ones.

2. Research design

2.1. Data

We construct an annual firm-level panel dataset using the Value Search database, which compiles standardized financial statements, credit ratings, and regulatory filings for South Korean firms. The sample includes all non-financial firms, both listed and unlisted, subject to external audits. The inclusion of privately held firms is essential in a bank-based financial system, such as South Korea, where many credit-reliant firms operate outside capital markets. The panel spans 2013 to 2022, a period selected to align with the implementation of a standardized ten-tier credit rating system, ensuring consistent comparability of credit risk across time. Importantly, to mitigate survivorship bias (Albuquerque and Iyer, 2024), we restrict the sample to firms continuously active throughout the period, yielding a balanced panel of 13,748 firms, resulting in 137,480 firm-year observations.

Importantly, we define zombie firms as those whose interest coverage ratio (EBIT/interest expenses) remains below one for three consecutive years, following El Ghoul et al. (2021) and McGowan et al. (2018). This criterion targets firms with a persistent inability to service debt from operating income, distinguishing structural unviability from temporary distress. To further refine identification, we exclude firms younger than ten years, given their typically volatile earnings and unstable capital structures. This definition is consistent with frameworks adopted by the Bank of Korea and OECD, lending both theoretical and policy relevance to our classification.

2.2. Empirical strategy

To estimate the effect of zombie firm concentration on borrowing conditions for healthy firms, we employ a panel fixed effects regression model.

$$Y_{i,n,t} = \beta_1 NonZombie_{i,n,t-1} + \beta_2 \left(NonZombie_{i,n,t-1} \times ZombieShare_{n,t-1} \right) + \beta_3 X_{i,n,t-1} + \alpha_i + \delta_{n,t} + \epsilon_{i,n,t}$$

$Y_{i,n,t}$ denotes the outcome variable for firm *i* in industry *n* and year *t*, either the firm's debt growth rate (year-on-year change in total debt) or its average interest rate (interest expenses divided by the average of total debt at the beginning and end of year). The binary indicator $NonZombie_{i,n,t-1}$ identifies firms classified as financially healthy, while $ZombieShare_{n,t-1}$ is defined as the ratio of total debt held by zombie firms to total debt of all firms within industry *n* at time *t*, constructed at the two-digit KSIC level.

Next, we control for time-varying firm characteristics through the vector $X_{i,n,t-1}$, which includes: log total assets (firm size), current ratio (liquidity), total debt-to-total capital (leverage), EBIT over total assets (profitability), ICR (EBIT/interest expenses), and firm age. Firm fixed effects (α_i) absorb time-invariant heterogeneity across firms, such as persistent differences in managerial quality or risk profiles. Industry–year fixed effects ($\delta_{n,t}$) absorb contemporaneous shocks common to all firms within the same sector and year: for example, changes in sectoral demand conditions or credit supply shifts that might otherwise confound the relationship between zombie prevalence and debt financing conditions. To mitigate simultaneity concerns, all continuous firm-level regressors are measured at $t − 1$, ensuring that current outcomes are related to predetermined covariates rather than contemporaneous firm conditions. Continuous variables are also winsorized at the 1st and 99th percentiles to reduce the influence of outliers. Under this empirical design, the interaction coefficient (β_2) captures the differential association between industry-level variation in zombie prevalence and the credit outcomes of non-zombie firms, after controlling for firm and industry–year fixed effects. Lastly, standard errors are clustered at the industry-year level to address within-cluster correlation. Table 1 provides a summary statistic of the variables used in the analysis.

3. Findings

3.1. Baseline results

We first find that the non-zombie indicator is positively associated with debt growth in the baseline model, but the effect becomes insignificant when firm fundamentals are included (see Table 2). This result suggests that any borrowing advantage for viable firms dissipates after controlling for financial strength. Furthermore, the interaction between non-zombie status and zombie debt share is not statistically significant, indicating that healthy firms' debt growth does not systematically decline with greater zombie prevalence in the industry.

In contrast, borrowing costs exhibit a clear pattern. The interaction term is consistently positive and highly significant; a 1 percentage point increase in the zombie debt share raises borrowing rates for non-zombie firms by approximately 1 basis point. This relationship holds even after adjusting for firm-specific controls.[1] Theoretically, this pattern can be explained by the way banks perceive risk in zombie-dense industries. Higher zombie prevalence increases lenders' concerns about sectoral default risk and recovery values, inducing them to charge a risk premium on all firms in the sector. Information asymmetry further amplifies this tendency. When lenders cannot perfectly assess firm-specific fundamentals - especially in environments with limited collateral or intangible assets - they are more likely to price credit at the sector level. Consequently, even fundamentally sound firms are subject to higher borrowing costs simply because they operate in zombie-heavy industries.

Overall, this evidence highlights a distinct financial externality that operates through credit pricing, rather than quantity constraints. Whereas previous studies emphasize resource misallocation and productivity drag (Albuquerque and Iyer, 2024; McGowan et al., 2018), we demonstrate that zombie prevalence may distort price signals in credit markets, causing lenders to inadequately differentiate firm-specific risk in zombie-dense sectors.

3.2. Credit rating-based analysis

To examine heterogeneity in how zombie prevalence relates to debt financing outcomes, we disaggregate the baseline results by firm-level credit ratings,[2] testing whether financially weaker, low-rated firms are more exposed to adverse credit conditions.

Table 3 presents the regression results by credit rating group, from "High-grade" to "Speculative-grade." Panel A shows that the interaction between non-zombie status and zombie debt share is negative and statistically significant only for speculative-grade firms. That is, in industries with higher zombie concentration, debt growth is significantly curtailed for financially weaker firms. In contrast, high- and medium-grade firms show no meaningful change in debt volume, indicating stable credit access even in zombified sectors.[3] Panel B turns to borrowing costs. The interaction term is again significant only for speculative-grade firms, indicating that each 1 percentage point increase in zombie debt share raises their borrowing rates by 1.7 basis points. The coefficients for higher-rated firms are statistically insignificant and close to zero. These results confirm that the negative effects of zombie firms on debt financing conditions are not evenly distributed across the credit spectrum but disproportionately burden weaker but non-zombie firms.

This pattern illustrates how zombie prevalence exacerbates financial polarization. While stronger firms are shielded, weaker but viable firms could face both higher borrowing costs and reduced access to credit, a dual constraint. This divergence in credit conditions intensifies firm-level vulnerabilities and distorts market-based risk pricing. The findings underscore the need for macroprudential policies that go beyond average effects and target distributional impacts, with regulatory tools calibrated to firms' financial strength and credit access

3.3. Contextual amplification: industry sector and monetary policy stance

To explore the heterogeneity in the relationship between zombie prevalence and firms' credit conditions, we further conduct subsample analyses for speculative-grade firms, those most sensitive to credit conditions. Table 4 reports results by industry (Panel A) and monetary policy stance (Panel B).

Panel A shows that zombie firm prevalence is significantly associated with financial externalities in the service sector but not in

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[1] As a robustness check, we also apply a looser definition of zombie firms, requiring only two consecutive years with ICR<1. This broader threshold captures a larger set of firms, including those with more transitory episodes of financial distress. The results reported in Panel A of Table A1 remain qualitatively unchanged, indicating that our main findings are not sensitive to the precise persistence threshold used.

[2] We classify the ten-tier Value Search credit ratings into four risk groups, High-grade (1–3), Medium-grade (4–5), Non-investment-grade (6–7), and Speculative-grade (8–10), following the supervisory framework used in the *Bank of Korea Financial Stability Report* (June 2021) (Bank of Korea, 2021). This classification reflects economically salient thresholds of credit risk and broadly corresponds to global rating agency standards: for example, "High-grade" aligns with AAA–AA (S&P) and Aaa–Aa (Moody's), while "Speculative-grade" includes speculative-grade ratings, such as B–D (S&P) and Ba–C (Moody's).

[3] Our baseline measure of Δ Debt is defined as the year-on-year change in firm debt relative to the previous year's debt stock, which captures the pace of new borrowing compared with existing leverage. As a robustness check, we alternatively scale the change in debt by lagged total assets. This alternative specification mitigates concerns that debt growth may mechanically reflect firm size and ensures that our results are not driven by differences in firm scale. That is, the two measures are conceptually distinct: while the former reflects the intensity of new borrowing relative to past debt, the latter normalizes debt changes by firm scale. As reported in Panel B of Table A1, the results under this alternative specification remain qualitatively similar to the baseline, reinforcing the robustness of our findings.

Table 1
Descriptive statistics.

Variable	N	Mean	Std. Dev	10 %	50 %	90 %
Debt Growth (%)	115,398	9.71	64.14	−40.01	−0.32	59.77
Borrowing interest rate (%)	112,137	4.13	2.90	1.71	3.50	6.64
Total assets (in USD billion)	137,480	2.19	25.42	0.15	0.38	2.23
Liquidity (CA/CL, %)	137,468	212.15	279.34	34.41	125.45	449.79
Capital structure (TL/TE, %)	137,480	225.66	484.16	14.30	110.9	523.30
Profitability (EBIT/TA, %)	137,480	4.16	7.21	−2.85	3.50	12.79
ICR (EBIT/IE, times)	122,860	45.71	155.52	−2.67	2.62	66.78
Age (years)	137,480	22.84	11.74	9.0	21.0	41.0

Table 2
Baseline results.

	(1) Δ Debt	(2) Δ Debt	(3) Δ Int. rate	(4) Δ Int. rate
Non-Zombie	**5.916***	0.268	**−0.762***	**−0.642***
	(1.359)	(1.568)	(0.057)	(0.052)
Non-Zombie * Zombie share	−0.026	−0.010	**0.010***	**0.010***
	(0.065)	(0.072)	(0.002)	(0.002)
Total assets		**−34.88***		**0.419***
		(1.874)		(0.047)
Liquidity		**0.047***		**−0.001***
		(0.004)		(8.88e-05)
Capital structure		**−0.005***		**0.0002***
		(0.001)		(2.26e-05)
Profitability		**0.425***		−0.001
		(0.062)		(0.002)
ICR		**0.081***		**−0.0025***
		(0.005)		(0.0002)
Firm age		**0.763***		**−0.032***
		(0.423)		(0.018)
Constant	5.198***	356.2***	4.640***	0.955
	(0.755)	(19.94)	(0.035)	(0.679)
Firm FE	Yes	Yes	Yes	Yes
Industry * Year FE	Yes	Yes	Yes	Yes
Observations	115,125	112,445	111,818	110,103
R-squared	0.001	0.049	0.005	0.019

Table 3
Results by credit rating.

Panel A: Δ Debt	(1) High-grade	(2) Medium-grade	(3) Non-investment-grade	(4) Speculative-grade
Non-Zombie	−19.06	0.394	**6.088***	**8.675***
	(13.32)	(4.087)	(2.173)	(1.926)
Non-Zombie * Zombie share	0.469	**0.277***	−0.043	**−0.226***
	(0.355)	(0.147)	(0.082)	(0.086)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Industry * Year FE	Yes	Yes	Yes	Yes
Observations	13,059	38,613	37,585	17,529
R-squared	0.042	0.076	0.111	0.078

Panel B: Δ Int. rate	(1) High-grade	(2) Medium-grade	(3) Non-investment-grade	(4) Speculative-grade
Non-Zombie	0.771	−0.136	**−0.577***	**−0.712***
	(1.357)	(0.133)	(0.088)	(0.088)
Non-Zombie * Zombie share	−0.001	0.003	0.004	**0.017***
	(0.013)	(0.004)	(0.003)	(0.003)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Industry * Year FE	Yes	Yes	Yes	Yes
Observations	11,807	37,963	37,475	17,354
R-squared	0.021	0.029	0.028	0.013

Table 4
Results by industry sector and monetary policy stance.

Panel A: by Industry sector	(1) Δ Debt Manufacturing	(2) Δ Int. rate	(3) Δ Debt Services	(4) Δ Int. rate
Non-Zombie	**6.330*****	**−0.590*****	**9.850****	**−0.753*****
	(2.193)	(0.102)	(4.537)	(0.199)
Non-Zombie * Zombie share	−0.024	0.006	**−0.300****	**0.019*****
	(0.136)	(0.005)	(0.136)	(0.005)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Industry * Year FE	Yes	Yes	Yes	Yes
Observations	9585	9524	7924	7793
R-squared	0.097	0.017	0.075	0.013
Panel B: by MP stance	(1) Δ Debt MP tightening	(2) Δ Int. rate	(3) Δ Debt MP easing	(4) Δ Int. rate
Non-Zombie	5.009	−0.525**	**8.010*****	**−0.646*****
	(5.039)	(0.239)	(2.353)	(0.107)
Non-Zombie * Zombie share	−0.109	0.009	**−0.199***	**0.015*****
	(0.207)	(0.007)	(0.105)	(0.004)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Industry * Year FE	Yes	Yes	Yes	Yes
Observations	5138	5053	10,625	10,511
R-squared	0.051	0.013	0.110	0.013

manufacturing. In services, a 1 percentage point increase in zombie debt share is associated with a 0.3 percentage point decline in debt growth and a 1.9 basis point increase in borrowing costs. By contrast, effects in manufacturing are small and statistically insignificant. This sectoral gap likely reflects structural differences in asset tangibility and credit assessment practices. Service firms typically rely more heavily on intangible assets and have limited collateral value, which constrains banks' ability to differentiate risk at the firm level. Credit assessments in services therefore depend more on projected cash flows, which are harder to verify and more volatile, prompting lenders to adopt sector-wide repricing strategies when zombie prevalence rises. Manufacturing firms, by contrast, generally possess more tangible and collateralizable assets, enabling banks to tailor credit terms more precisely to firm-specific conditions. This aligns with Dell'Ariccia et al. (2008), who find that finance-dependent sectors are more susceptible to credit disruptions.

Panel B examines the role of monetary policy. Adverse effects from zombie firms are concentrated during monetary easing; a 1 percentage point rise in zombie debt share reduces debt growth by 0.199 percentage points and raises borrowing costs by 1.5 basis points. Under monetary tightening, these effects are not significant. This pattern shows that accommodative monetary conditions may amplify zombie-related distortions, possibly due to looser credit standards or forbearance incentives. These findings are consistent with Banerjee and Hofmann (2022), who argue that low interest rates and ample liquidity weaken credit allocation by sustaining unproductive zombie firms. Overall, we highlight that the negative effects of zombie prevalence on debt financing conditions are both structurally and cyclically amplified, stronger in fragile sectors and under expansionary monetary regimes.[4] Macroprudential responses should therefore consider sectoral vulnerabilities and the credit cycle to better mitigate resource misallocation risks.

4. Conclusion and policy implications

This study provides new evidence that higher zombie firm prevalence is associated with distortions in credit markets. While average effects on debt volume are limited, borrowing costs for viable but financially weaker firms are significantly higher in zombie-heavy industries. This reflects a repricing externality: lenders, perceiving elevated sectoral risk, tend to increase borrowing costs broadly, even for fundamentally sound firms. The mispricing is especially pronounced among speculative-grade borrowers, intensifying their financing constraints and amplifying financial segmentation. More interestingly, these patterns are shaped not only by firm-specific characteristics, but also by macro-financial conditions. In low-interest-rate environments, banks face reduced incentives to restructure zombie exposures, prolonging misallocation. In service sectors, where intangible assets dominate and credit risk is harder to assess, lenders are more likely to adopt sector-wide pricing adjustments rather than firm-level differentiation.[5]

The policy implications are best understood as guidance for surveillance and macroprudential calibration. Macroprudential

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[4] As reported Panel C of Table A1, scaling debt growth by firm size yields results similar to the baseline, thereby reinforcing the robustness of our findings.

[5] In comparing our results with prior evidence, Havemeister and Horn (2023) find little evidence of deteriorating credit conditions for healthy firms in the Euro area, whereas Albuquerque and Iyer (2024) show that credit growth of non-zombie firms is constrained in zombie-heavy industries worldwide. Taken together, our findings are broadly consistent with these global patterns, while also underscoring the contextual factors that may amplify such effects in a bank-based financial system.

frameworks could integrate indicators of zombie prevalence into supervisory dashboards and stress tests, and tailor regulatory intensity to firms' credit sensitivity. Practical measures may include sectoral capital buffers when zombie concentration is elevated, especially during accommodative monetary phases; tighter loan-classification to limit persistent rollover of unviable firms; and targeted guarantee or liquidity programs that safeguard viable but financially weaker borrowers without subsidizing zombies. Coordinated policy responses that align enhanced sectoral supervision with liquidity-support measures are essential to prevent resource misallocation and maintain credit-market efficiency.

In sum, zombie firms not only depress productivity through direct misallocation, but may also erode the integrity of credit markets by distorting pricing for viable firms. Addressing these observed links are critical to safeguarding financial system resilience in economies, where bank lending remains the dominant source of corporate finance.

CRediT authorship contribution statement

Jaeweon You: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Beomseok Seo:** Writing – original draft, Validation, Supervision, Software, Resources. **Junyoung An:** Formal analysis, Data curation.

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Appendix

Table A1.

Table A1
Robustness tests.

Panel A: ICR<1 for 2 years	(1) Δ Debt	(2) Δ Debt	(3) Δ Int. rate	(4) Δ Int. rate
Non-Zombie	**4.451*****	**−3.217****	**−0.535*****	**−0.404*****
	(1.305)	(1.465)	(0.051)	(0.051)
Non-Zombie * Zombie share	−0.056	−0.045	**0.007*****	**0.008*****
	(0.053)	(0.053)	(0.002)	(0.002)
Constant	7.375***	360.6***	4.423***	0.852
	(0.646)	(19.92)	(0.026)	(0.683)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Industry * Year FE	Yes	Yes	Yes	Yes
Observations	115,125	112,445	111,818	110,103
R-squared	0.002	0.050	0.003	0.017
Panel B: Δ Debt scaled by size	**(1) High-grade**	**(2) Medium-grade**	**(3) Non-investment-grade**	**(4) Speculative-grade**
Non-Zombie	−0.837	0.843	**1.692*****	**3.620*****
	(1.198)	(0.598)	(0.519)	(0.682)
Non-Zombie * Zombie share	0.048	0.015	−0.014	**−0.134*****
	(0.035)	(0.025)	(0.020)	(0.035)
Constant	31.44***	94.29***	170.7***	135.4***
	(6.771)	(5.633)	(7.466)	(14.49)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Industry * Year FE	Yes	Yes	Yes	Yes
Observations	17,817	42,421	38,426	17,801
R-squared	0.067	0.093	0.133	0.082
Panel C: Δ Debt scaled by size	**(1) Manufacturing**	**(2) Services**	**(3) MP tightening**	**(4) MP easing**
Non-Zombie	**2.442*****	**3.732****	2.023	**3.912*****
	(0.740)	(1.530)	(1.742)	(0.915)
Non-Zombie * Zombie share	−0.019	**−0.155*****	−0.089	**−0.149*****
	(0.039)	(0.050)	(0.0715)	(0.047)
Constant	94.58***	161.3***	125.1***	160.5***
	(13.84)	(22.32)	(29.99)	(21.29)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Industry * Year FE	Yes	Yes	Yes	Yes

Table A1 (*continued*)

Panel C: Δ Debt scaled by size	(1) Manufacturing	(2) Services	(3) MP tightening	(4) MP easing
Observations	8494	8134	5252	10,751
R-squared	0.105	0.079	0.055	0.101

Data availability

Data will be made available on request.

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