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Zombie Lending: Theoretical, International, and Historical Perspectives

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Abstract

This article surveys the theory on zombie lending incentives and the consequences of zombie lending for the real economy. It also offers a historical perspective by reviewing the growing empirical evidence on zombie lending along three dimensions: (*a*) the role of undercapitalized banks, (*b*) effects on zombie firms, and (*c*) spillovers and distortions for non-zombie firms. We then provide an overview of how zombie lending can be attenuated. Finally, we use a sample of US publicly listed firms to compare various measures proposed in the literature to classify firms as "zombies." We identify definitions of zombie firms that are adequate to investigate economic inefficiency in the form of real sector competitive distortions of zombie lending. We find that only definitions based on interest rate subsidies are able to detect these spillovers and thereby provide evidence in support of credit misallocation.

1. INTRODUCTION

In response to the coronavirus disease 2019 (COVID-19) crisis, policy makers around the world have adopted several measures, such as regulatory forbearance toward banks, to help borrowing firms navigate the pandemic (G30 Work. Group Corp. Sect. Revital. 2020). These interventions helped firms maintain their productive capacity, especially in sectors severely hit by the pandemic. Given the scale and the swift adoption of these policies, firm defaults are in many economies at record lows—a striking contrast with typical recessions. An inevitable consequence of, and at a minimum a significant risk arising from, this generalized support to the productive sector is the proliferation of zombie firms, namely firms that are known to be in distress but manage to avoid default only thanks to the support of their lenders.

While it is too early to reach a definitive judgement on the allocation efficiency of credit support measures in response to COVID-19, a few historical episodes can provide some guidance to understand and address the zombie lending phenomenon and its economic consequences. The extension of credit to borrowers known to be in distress is a regular feature in both advanced and emerging economies. The first evidence dates back at least to Japanese firms in the 1990s, a phenomenon that likely contributed to the subsequent "lost decades" in Japan, as shown by Hoshi (2000) and Caballero, Hishi & Kashyap (2008). More recent episodes have been documented in other economies such as China, Europe, and India. While these episodes differ based on the characteristics of each empirical context, the literature has shown several recurring themes: (*a*) the occurrence of zombie lending is usually the consequence of large economic shocks [e.g., the real estate shock in Japan and the global financial crisis (GFC), followed by the sovereign debt crisis in Europe], (*b*) regulatory forbearance in asset-quality recognition at banks and in bank supervision that allows undercapitalization of the banking sector to perpetuate, and (*c*) long-term aggregate consequences such as low economic growth for a protracted period following the shock. These observations have spurred researchers to develop theoretical frameworks that seek to model zombie lending as an equilibrium phenomenon.

Empirically, zombie firms have been typically identified in the data as firms that are in distress (according to income statement and balance sheet characteristics) and, in some cases, as receiving subsidized bank credit. This second criterion, at times hard to measure (e.g., lenders can subsidize their credit through amortizations or other concessions), is at the core of the credit misallocation induced by zombie lending. The subsidy reduces the sensitivity of borrowing costs to firm risk for zombie firms—i.e., they can pursue riskier strategies, such as aggressive product pricing for short-term profits, that are not adequately reflected in their cost of capital. In other words, operating strategies that are socially negative NPV (net present value) projects can become positive NPV projects for zombie firms due to subsidy in the cost of capital. Worse, firms competing with zombie firms suffer from so-called congestion effects, such as increased competition for inputs (such as labor and commodities) and excessive supply of goods produced and services provided (effectively reducing product prices and operating margins).

We review the theoretical and empirical literature on zombie lending and discuss different methods to identify zombie firms in the data, focusing on the role of the interest rate subsidy. In particular, we present various definitions that have been used in the literature and compare them in two ways. First, we compare the share of zombie firms and their characteristics and provide an estimate as to the size of the interest rate subsidy and its economic importance. Second, we document to what extent these measures capture spillover effects of zombie firms on non-zombie firms. Properly identifying spillover effects created by zombie firms is crucial for empirical research and policy design, since these spillover effects can accumulate to aggregate macroeconomic effects and can be considered a form of economic inefficiency or misallocation cost arising from zombie credit. Our analysis highlights the importance of considering whether impaired firms obtain debt

financing at subsidized rates, as it is not the presence per se of impaired firms but their receipt of subsidized financing that is associated with real economic consequences of zombie lending.

Section 2 discusses the theoretical framework supporting the existence of zombie lending. Section 3 presents the international and historical empirical evidence. Section 4 discusses ways to identify zombie lending in the data and their limitations, and Section 5 concludes.

2. THEORETICAL FRAMEWORK

What causes financial institutions, and banks in particular, to provide subsidized credit to borrowers they know to be insolvent, a practice also known as evergreening or extending and pretending? Why are these loans, effectively negative NPV projects, extended? What are the long-term economic consequences of zombie lending? How should optimal policy respond? And indeed, what policy choices contribute to zombie lending?

In our assessment, the leading explanation for zombie lending centers around bank capital and limited liability. Caballero, Hishi & Kashyap (2008) is the first paper to hypothesize that banks might have an incentive to extend zombie lending to avoid writing off their existing capital. While not presenting a formal model of bank portfolio choice, the authors model the congestion externalities imposed by zombie firms, i.e., zombie firms cause healthy firms to reduce investment, employment, and productivity. These negative effects, paired with the role of bank capital, call for policies aimed at correcting banks' portfolio choice, ex post through supervision and ex ante through capital requirements.

Bruche & Llobet (2014) formalize this hypothesis. In their model, weakly capitalized banks have an incentive to gamble for resurrection by trying to keep their insolvent borrowers alive to avoid realizing losses on their balance sheets. By allowing banks to choose whether to modify, foreclose, or sell loans, the authors extend the debt overhang problem from Bhattacharya & Nyborg (2013). In this richer setup, they show that banks holding many bad loans have an incentive to engage in evergreening, as their limited liability constraint binds in the bad state of the world.

Policy choices may themselves, e.g., in the form of regulatory forbearance toward banks, induce zombie lending. Acharya, Lenzu & Wang (2021) consider heterogeneous firms and banks in general equilibrium and show that bailouts of bank creditors lead undercapitalized banks to engage in zombie lending, resulting in a diabolical sorting characterized by low-capital banks extending existing loans to low-productivity firms. The authors show that such bailouts may be a feature of myopic regulatory policy aimed at avoiding short-term recessions.

In a complementary view, Becker & Ivashina (2021) and Altman, Dai & Wang (2022) propose that the inefficient resolution of insolvency is an additional driver for zombie lending. This recent work highlights that zombie lending might emerge in equilibrium if insolvency is a costly undertaking and, in turn, restructuring is less attractive for lenders. Another recent explanation for the existence of zombie lending centers around the coexistence of market-based lenders and private lenders. According to this view, zombie lending is inevitable, including lending by well-capitalized banks. Based on the idea that private lenders have an information advantage over market-based lenders, Hu & Varas (2021) show that even well-capitalized banks might engage in zombie lending. Private lenders, such as banks, gather information about their borrowers and thus liquidate bad loans early. Hence, long borrower–bank relationships improve borrowers' reputation with market-based lenders, inducing banks to extend zombie loans to help the bad borrowers obtain market financing. While this explanation is consistent with indirect evidence from the pricing of debt securities in the United States in 1993–1995 [presented by Gande et al. (1997)] and some anecdotal evidence, it appears to be at odds with the empirical evidence from

Peek & Rosengren (2005) showing that zombie lending is significantly more prevalent among banks with capital ratios close to the required minimum. This finding is confirmed by Acharya et al. (2020), who find that in the European case only 32% of the total assets classified as zombies are linked to well-capitalized banks, whereas 60% of the total assets of low-quality non-zombie firms and 70% of the total assets of high-quality firms are connected to well-capitalized banks.[1]

The consequence of zombie lending is the misallocation of credit from high-quality firms to low-quality firms. The macro literature on factor misallocation (e.g., Hsieh & Klenow 2009; Midrigan & Xu 2014; Gopinath et al. 2017) is based on generic financial frictions such as incentive compatibility and collateral constraints. Asriyan et al. (2021) build a model with firm heterogeneity in productivity, wherein increases in aggregate demand and financing costs can crowd out high-productivity firms. Tracey (2021) more directly and quantitatively analyzes the effect of forbearance lending on financial decisions of firms. The model shows that zombie lending reduces firms' growth, investment rates, and total factor productivity, leading the author to conclude that zombie lending likely contributed to lower output in the euro area from 2011 to 2014. These results are consistent with the seminal formalization by Caballero, Hishi & Kashyap (2008), which shows that zombie lending causes a congestion of firms that, in turn, leads to some more productive firms and projects not receiving capital. Acharya, Lenzu & Wang (2021) consider such spillovers in a dynamic model of policy, where the role of bank capital is key to generating loan evergreening. The authors show that these spillovers can lead to policy traps of repeated forbearance, with a myopic policy to avoid short-term recessions transforming transitory shocks into permanent output losses (which they refer to as economic sclerosis from zombie lending).

3. EMPIRICAL EVIDENCE

The empirical literature started with investigating the causes and consequences of the "lost decades" in Japan. This research has become more prominent following the European sovereign debt crisis and has recently focused on the possible effects of government measures during the COVID-19 pandemic. We focus on the empirically documented implications of zombie lending for (*a*) bank balance sheets and lending decisions; (*b*) firms' productivity, employment, and investment decisions; (*c*) possible spillovers to the real sector and their consequences for growth; and (*d*) mechanisms to attenuate zombie lending.

3.1. Lending by Undercapitalized Banks to Zombie Firms

We focus below on the empirical literature on zombie lending in Japan and Europe. The key notion in this literature is that—following a large economic shock—some banks remain undercapitalized (e.g., because of regulatory forbearance following losses on housing and/or sovereign debt assets) and continue to provide credit toward zombie firms to avoid the recognition of loan losses (the so-called evergreening of loans). An important empirical exercise is to define and measure the existence of zombie firms and, in particular, to isolate zombie credit—subsidized credit to zombie firms—from the alternative that banks extend loans to risky firms but at risk-adjusted pricing.

3.1.1. Evidence from Japan. Peek & Rosengren (2005) investigate bank lending in Japan over the 1993–1999 period and document that firms are more likely to receive bank loans if bank balance sheets are weak. Specifically, they show that particularly low-quality firms (measured by

[1]A firm is considered to be connected to well-capitalized banks if the average Tier 1 ratio of all its lenders is above the sample median.

deteriorating return on assets and net working capital) obtain more credit and that banks appear to be more engaged in zombie lending if their capital ratios get closer to the regulatory minimum. Furthermore, they highlight that this lending pattern is only measurable for borrowing firms in the same business group (a keiretsu affiliate).

Caballero, Hishi & Kashyap (2008) highlight that the share of zombie firms in Japan among publicly listed firms in the manufacturing, construction, retail, real estate, wholesale, and service sectors almost tripled to approximately 30% between the early 1990s and 2000. In contrast to previous studies, Caballero, Hishi & Kashyap (2008) classify firms as zombies only if they receive subsidized credit, which they base on the comparison of the interest rate paid by the borrower relative to the interest rate expected to be paid by the highest quality borrowers (the prime rate).

Giannetti & Simonov (2013) classify zombies following the same approach and provide consistent evidence investigating the effect of capital injections on loan supply during the 1998–2004 period. They document that capital injections during this time were insufficient to fully address the debt overhang problem in the Japanese banking sector. Importantly, they find that banks that remain undercapitalized after the capital injections (in stark contrast to those banks that become well-capitalized) even increase zombie lending.[2]

3.1.2. Evidence from Europe. A series of papers investigates zombie lending in the aftermath of the GFC and the subsequent sovereign debt crisis in Europe.[3] A common notion in these papers is the weakness of the European banking sector following the GFC of 2008–2009. Indeed, Acharya et al. (2021) show that fiscally constrained European governments (e.g., Italy and Spain) appear to have been kicking the can down the road, providing banks with guarantees rather than equity during the GFC. Consequently, large parts of their banking sectors remained undercapitalized at the end of 2009 (i.e., before the start of the sovereign debt crisis in the fall of 2010). Over the 2009–2012 period, undercapitalized banks lost further equity capital and reduced lending but increased their loan-loss provisions compared with their better-capitalized peers. They also relied more on the support by the European Central Bank (ECB). Importantly, they increased (subsidized) zombie lending and increased investments in risky domestic sovereign debt.[4]

To address the weakness of the European banking sector, the European Banking Authority (EBA) unexpectedly increased capital requirements in their capital exercise in 2011.[5] Blattner, Farinha & Rebelo (2022) investigate lending by Portuguese banks over the 2009–2015 period and exploit this experiment to study the effects of reduced bank capital adequacy on bank lending. Affected banks significantly decreased lending following the capitalization exercise. Importantly,

[2]Related papers document an increase in bank credit to underperforming industries in Japan such as the real estate sector (e.g., Hoshi 2000) and find that loan rates do not appear to be high enough given the riskiness of the loans (e.g., Smith 2003, Schaede 2005).

[3]Anecdotal evidence suggests that Europe's weak economic recovery may be a repeat of Japan's zombie lending experience in the 1990s. In Portugal, Spain, and Italy, 50%, 40%, and 30% of debt, respectively, was owed by firms that were not able to cover their interest expenses out of their pretax earnings at the end of 2013. In those countries, approximately 12%, 8%, and 18% of total bank loans in 2014, respectively, were nonperforming according to data from the World Bank.

[4]Acharya & Steffen (2015) identify a risk-shifting or carry trade incentive of undercapitalized banks as the primary motive for sovereign bond purchases during this period. For a discussion of the role of ECB interventions in supporting domestic sovereign bond purchases, see also Crosignani, Faria-e-Castro & Fonseca (2020). Storz et al. (2017) also document an increase in zombie lending in peripheral European countries during the 2010–2014 period.

[5]The capital exercise required a subset of banks to reach and maintain a 9% core Tier 1 capital ratio by the end of June 2012.

and consistent with evergreening of loans to zombie firms, they find that these banks reallocate credit to firms in financial distress with previously underreported loan-loss provisioning. Relatedly, Bonfim et al. (2022) analyze data on firm–bank lending relationships in Portugal during the 2005–2015 period and show that Portuguese banks were more likely to provide credit to zombie firms if their profitability deteriorated, if they had a longer relationship with the firm, and if borrowers had previously defaulted on their loans.

At the peak of the sovereign debt crisis in summer 2012, the ECB launched the Outright Monetary Transactions (OMT) program, which marked the turning point of this crisis.[6] The OMT announcement significantly lowered spreads of sovereign bonds issued by distressed European countries, thereby increasing their bond prices. As a result, banks with significant holdings of these bonds experienced substantial windfall capital gains. Acharya et al. (2019) analyze bank lending during the 2009–2014 period and investigate the effect of the OMT on lending by banks with high- versus low-windfall capital gains. Consistent with evidence from Japan, several banks still remained undercapitalized after the OMT announcement. Acharya et al. (2019) show that these banks extended new subsidized loans to provide their impaired borrowers with the liquidity necessary to meet payments on other outstanding loans. Thereby, these banks avoided (or at least deferred) realizing immediate loan losses in the hope that the respective borrowers would eventually regain solvency. They show that approximately 8% of the loan volume extended to firms in their sample in the post-OMT period was for such zombie loans, up from 3.5% in the pre-OMT period. Consistent with Acharya et al. (2021), they also find eventually (3 years later) a significant increase in nonperforming loans relative to total loans for zombie lending banks compared with other banks.

Schivardi, Sette & Tabellini (2022) take the hypotheses of evergreening by weak banks to Italian data and study the 2008–2013 period. They find that Italian banks that became undercapitalized during the financial crisis were more likely to cut credit to healthy firms and to evergreen loans to zombie firms compared with better-capitalized banks. They do not classify zombies according to the existence of subsidized credit but rather as firms that are highly indebted and for which the returns on assets have been systematically below the cost of capital of the safest firms. We argue below that conditioning zombie credit on interest rate subsidy is important to identifying its misallocation effects.

3.1.3. Evidence from emerging markets. Other papers study zombie lending in emerging markets. Chopra, Subramanian & Tantri (2021) find evidence consistent with a debt overhang on bank balance sheets after an Asset Quality Review (AQR) in India in 2015 (outside of financial crises), which required banks to fully provision their loans by March 2017, as regulators were concerned with evergreening by banks. They find that banks that were undercapitalized after the AQR increased loans to zombie firms. Li & Ponticelli (2022) provide evidence for the existence of zombie lending and zombie-intensive industries in China in areas with less specialized courts. Relatedly, Charoenwong, Miao & Ruan (2021) argue that Chinese banks conceal nonperforming assets from regulators, which might further weaken bank health and affect loan supply.

In summary, this literature spanning historical episodes in Japan, Europe, and emerging markets provides consistent and robust findings that in the aftermath of large shocks, banks that remain undercapitalized evergreen loans to zombie firms to avoid the recognition of loan losses.

[6]Once activated toward a specific country, the OMT program allows the ECB to buy a theoretically unlimited amount of the country's government bonds in secondary markets. Even though the OMT program has not been activated yet, the sole announcement of its introduction lowered spreads of sovereign bonds issued by the distressed European countries.

Consequently, bank health and balance sheets continue to deteriorate when nonperforming loans eventually materialize and bank capitalization declines further.

3.2. Implications for Zombie Firms

A common result in the literature appears to be that bank lending to zombie firms does not translate to a subsequent better economic performance of zombie firms. This literature has mainly focused on the effects of zombie lending on employment, financing and investment policies, and/or profitability of zombie firms.

The evidence suggests that employment effects are limited. For example, Giannetti & Simonov (2013) analyze the effects of bank recapitalizations on firm outcomes in Japan and find no evidence that firms changed their employment decisions following a recapitalization of the banks with which they had a strong lending relationship. During the European sovereign debt crisis, Acharya et al. (2019) do not find evidence for employment effects of zombie vis-à-vis non-zombie firms. Blattner, Farinha & Rebelo (2022) document a temporary growth in employment and wages for zombie firms borrowing from undercapitalized banks. Schivardi, Sette & Tabellini (2022) also do not find significant employment effects.

Researchers have also investigated financing and investment policies of zombie firms. Giannetti & Simonov (2013), for example, find that zombie firms more exposed to Japanese banks that benefited from capital injections and that remained undercapitalized appear to invest more, consistent with financial constraints for these firms in the absence of zombie banks. Zombie firms borrowing from well-capitalized banks, conversely, invest less. Together, these findings suggest potential credit misallocation. Acharya et al. (2019) show that zombie firms, on average, increase leverage but do not use the loans to build up cash reserves (in contrast to other low-quality non-zombie firms), likely because they had to service interest payments on existing debt. They also do not find evidence that zombie firms increase or decrease investments (measured as capital expenditures). Acharya et al. (2019) also consistently find a sharp increase in the default rate of zombie vis-à-vis non-zombie firms from 2015 onward (i.e., 3 years after receiving zombie credit), contributing also to the increase in nonperforming loans on bank balance sheets. Acharya et al. (2021) provide similar evidence.

The literature also does not find evidence that zombie firms become more profitable after receiving subsidized credit. Acharya et al. (2019), for example, do not find any effect on the profitability of zombie firms in Europe. Acharya et al. (2021) show that European zombie firms that borrowed from undercapitalized banks experienced a decline in operating earnings, had a lower and on average negative return on assets, had lower sales, and had lower cash flows relative to zombie firms borrowing from better-capitalized banks.

Overall, this literature provides evidence that bank lending to zombie firms does not translate into a subsequent better economic performance of zombie firms, suggesting that credit appeared to have been allocated away from healthy firms that might have employed it in more efficient ways. We investigate potential spillovers from such misallocation in the next subsection.

3.3. Spillovers to Competition, Inflation, and Innovation

By keeping zombie firms alive, undercapitalized banks (and forbearing policies) indirectly allow these firms to distort competition throughout the rest of the economy. These distortions might come in many ways, including distorted market prices and wages and, more generally, a congestion of markets in which zombie firms operate. This prevents the normal competitive outcome, or creative destruction, whereby the zombies would exit the market and more productive firms would enter to fill in their space. Importantly, these distortions might reduce profits and collateral of

non-zombie firms, reducing their entry and weakening their incentives to invest. Several studies on Japan and Europe have put these hypotheses to the data and found corroborating evidence.[7]

In their seminal paper, Caballero, Hishi & Kashyap (2008) analyze the congestion effects caused by zombie firms in Japan and provide evidence that the increase in the presence of zombie firms in an industry reduces employment growth and investments of non-zombie firms in the same industry. Moreover, the productivity gap between zombie and non-zombie firms increases significantly.

The literature on zombie lending in Europe and related cross-country studies has documented spillover effects similar to those found in Japan by Caballero, Hishi & Kashyap (2008). For example, Acharya et al. (2019) document a reduction in employment growth and investment of non-zombie firms in industries with a high presence of zombie firms after the OMT announcement; Acharya et al. (2020) find consistent evidence in a panel of 11 European countries; Blattner, Farinha & Rebelo (2022) show consistent evidence for Portuguese non-zombie firms; and Banerjee & Hofmann (2020) and Adalet McGowan, Andrews & Millot (2018) provide evidence for these spillovers in international cross-country samples. Schivardi, Sette & Tabellini (2020) argue that these effects might not be driven by the presence of zombies per se but rather by an overall deterioration of industry quality.

Some authors also study implications of competitive distortions on prices and markups in industries with a high presence of zombie firms. Acharya et al. (2020), for example, find that healthy firms that face competition from a growing number of zombie firms have lower markups, profitability, and sales growth as well as higher input costs using a sample of 11 European countries over the 2009–2016 period. Importantly, they find that industry–country pairs that experience a stronger increase in the share of zombie firms subsequently have a lower product price inflation. To quantify this effect, the authors provide a counterfactual partial equilibrium estimate of how much higher inflation would have been if banks in Europe had been adequately recapitalized. This finding suggests that zombie lending can affect macroeconomic variables—not just growth but also inflation—which are of direct interest to monetary policy makers.

Schmidt et al. (2021) investigate the effects of zombie lending in a sample of Spanish firms over the 2010–2016 period. They find evidence for competitive distortions in industries with a high share of zombie firms in the form of lower entry rates of healthy firms, lower material costs, and higher markups, consistent with a decline in competition. More importantly, they study the effect of zombie lending on corporate innovation as a key driver of economic growth. Using both patent and survey data, they find a significant reduction in innovation in industries with a large share of zombie firms and undercapitalized banks.

Overall, this literature emphasizes significant negative externalities of zombie lending on non-zombie firms and the economy. These distortions manifest in a number of different ways but are usually associated with potentially long-term implications for economic growth and productivity and can help us understand asymmetric economic developments across countries with a large or small presence of undercapitalized banks and, in turn, of zombie firms.

3.4. Attenuating Zombie Lending

Given these distortions caused by zombie lending, what measures can regulators and governments adopt to prevent and tackle this practice? Based on our reading and understanding of the literature,

[7] Congestion externalities have also been documented in the context of delayed resolution of impaired financial institutions, notably in the case of the savings and loan crisis in the United States in the 1980s. In this crisis, competition from impaired and bailed-out thrifts significantly raised deposit rates for healthier thrifts and banks, causing the latter to experience reduced profitability, loan contraction, and in some cases, eventual impairment (see, e.g., Kane 1989; White 1991).

we focus on three areas: the role of bank supervision and stress tests, the role of bank capital, and the role of restructuring and bankruptcy laws.

Angelini et al. (2020) and Bonfim et al. (2022) use granular data to assess the effectiveness of regulatory on-site inspection in curbing zombie lending in the context of Italy and Portugal, respectively. Angelini et al. (2020) analyze bank inspections conducted by the Bank of Italy and find that audited banks are more likely to reclassify loans as nonperforming and more likely to increase loan loss provisions after audits. Inspections also cause a reallocation of credit supply from impaired borrowers to productive firms. Bonfim et al. (2022) analyze two inspections in mid-2012 and mid-2013 and find that audited banks are 20% less likely to refinance a zombie firm, in turn causing these borrowers to default more.

Since there are both human capital and operational limits to doing more and more micro-founded microprudential supervision of banks, stress testing and subsequent recapitalizations are considered possible ways to attenuate zombie lending as differences in the European and US stress test experiences suggest. In contrast to Europe, the United States implemented the Supervisory Capital Assessment Program (SCAP) in 2009. This program involved a much more rigorous stress test than those in Europe. Moreover, US authorities required banks with a capital shortfall to recapitalize. This program proved successful in stabilizing the US banking sector (Greenlaw et al. 2012) and keeping the share of zombie firms below the level in most European countries (Favara, Minoiu & Perez-Orive 2021).

Several aforementioned papers also propose bank recapitalizations as the key tool to tackle zombie lending. Once again, the first evidence of the effectiveness of recapitalizations comes from Japan, where Giannetti & Simonov (2013) document that capital injections, if large enough to meet bank capital requirements, have a positive effect on credit and investment. The fact that recapitalizations have to be sufficiently large to avoid a binding limited liability constraint is consistent with work by Blattner, Farinha & Rebelo (2022) showing how a policy that caused banks to fall below the regulatory capital ratios induced zombie lending by affected banks. Acharya et al. (2021) argue that the limited bank recapitalizations in Europe during the 2008–2009 crisis caused banks to gamble for resurrection buying risky sovereign debt and engaging in zombie lending. Moreover, analyzing the 2015 Indian bank AQR, Chopra, Subramanian & Tantri (2021) show that bank cleanups without capital-injection plans are ineffective in spurring market recapitalizations and in curbing zombie lending by low-capital banks.

Finally, the literature has emphasized the importance of efficient restructuring and bankruptcy processes. Kulkarni et al. (2021) analyze the introduction of a new bankruptcy law in 2016 in India and find that the reform had muted effects on zombie lending because of weakly capitalized and state-owned banks; however, better-capitalized banks employed the improved bankruptcy code to reduce zombie credit by filing more distressed firms into bankruptcy courts. Li & Ponticelli (2022) find that the introduction of more efficient courts in China helped reallocate labor and capital away from zombie firms. Jordà et al. (2020) analyze 17 advanced economies since the nineteenth century and find that the costs of corporate debt booms rise when inefficient debt restructuring and liquidation impede the resolution of corporate financial distress. Becker & Ivashina (2021) find that European countries with better insolvency regimes make more use of private debt markets that heavily rely on functioning insolvency frameworks. Finally, Altman, Dai & Wang (2022) also find similar evidence based on their analysis of global zombies.

Policy makers can use bad banks as a further option to reduce zombie lending if the stock of nonperforming loans on bank balance sheets has increased substantially. However, removing loans from bank balance sheets at cost (and not at market value or discounts to it) requires a substantial capitalization of the bad bank to absorb the market value losses. The effectiveness of using bad banks to meaningfully reduce zombie lending is thus unclear, as viewed one way

it shifts the problem of recapitalizing banks to that of capitalizing the bad bank; however, some coordination gains could be made in resolution of nonperforming loans from setting up the bad bank.[8]

4. MEASUREMENT AND CONSEQUENCES OF ZOMBIE LENDING: EVIDENCE FROM THE UNITED STATES

As emphasized above, Caballero, Hishi & Kashyap (2008) provide a comprehensive theory of the effects of zombie firms on real economic activity. At the core of this theory is the insight that, by receiving subsidized credit, nonviable firms are kept alive instead of defaulting and exiting the market. Importantly, subsidized credit reduces borrowing costs for zombie firms and creates idiosyncratic (but not socially) positive NPV projects. Hence, the presence of zombies distorts the normal creation and destruction patterns that are otherwise operative in the economy. These distortions negatively affect productivity and, importantly, as the share of zombie companies rises, larger competitive distortions will arise for healthy (non-zombie) companies. Hence, a key prediction of the zombie lending channel is that healthy firms will be negatively affected by the presence of zombie companies in their industry. Moreover, Acharya, Lenzu & Wang (2021) show theoretically that these negative spillover effects can lead to forbearance policy traps that result in permanently lower growth and productivity in the economy, thereby prolonging recoveries even after transitory shocks.[9]

Despite a clear theoretical underpinning for the significance of these spillovers from zombie lending, empirical research of both academics and practitioners has not yet settled on a clear definition of what constitutes a zombie firm in the first place. These theoretical considerations, however, raise an important question if one wants to properly define zombie lending: Does lending to a (zombie) firm lead to credit misallocation that causes economic distortions even if lending is not at subsidized rates? In other words, is it crucial to distinguish between identifying distressed firms (zombie candidates) and firms that actually receive zombie loans (i.e., loans at subsidized interest rates) from their banks?

In the following analysis, we compare various definitions of zombie firms, the corresponding share of zombie firms, their characteristics, and their competitive spillover effects on healthy firms. Consistent with the theoretical prediction that credit misallocation is key for detecting spillover effects, we find that only definitions of zombies that rely on an interest rate subsidy are able to identify these spillover effects.

4.1. Data and Zombie Firm Definitions

We focus our analysis on definitions of zombie firms from Acharya et al. (2019), which builds on Caballero, Hishi & Kashyap (2008); Adalet McGowan, Andrews & Millot (2018); and Banerjee & Hofmann (2020).

To compare these different approaches of defining zombie firms, we construct a sample of US publicly traded companies for the period 2004–2020 from the Compustat–CapitalIQ database.

[8]Overall, while bad banks set up during the savings and loan crisis, the South East Asian crisis, and in Ireland following the GFC appear to have worked well, asset management companies set up in China and India appear to have simply rearranged economic risks from on- to off-balance sheets of banks without substantial economic efficiency.

[9]Our analysis focuses on competitive distortions (spillovers). In general, other sources of spillovers could be at play, for instance, demand or agglomeration spillovers. For a detailed discussion of these various spillover effects, see Berg, Reisinger & Streitz (2021).

More precisely, we combine CapitalIQ with the company-specific information from Compustat North America. We drop observations for which the debt categories do not add up to 100% in case the deviation exceeds 5%.[10] We further drop firms that are not incorporated in the United States or have a Standard Industrial Classification (SIC) code between 6000 and 6999. In addition, we exclude observations that contain missing values for the CapitalIQ debt categories or the Compustat debt items. To merge the debt items of the two providers, we match the total amount of debt outstanding of CapitalIQ to the sum of the current liabilities and long-term debt items of Compustat (DLC and DLTT variables in Compustat, respectively). We drop observations for which the two values vary by more than 10% to assure a clean matching procedure. Moreover, we drop firms that have a leverage ratio exceeding one. We then use CUSIPs to merge the Capital IQ–Compustat data set to rating information from Thomson Reuters, covering ratings from S&P, Moody's, and Fitch. We follow Becker & Milbourn (2011) in transferring the ratings into numerical values to estimate the firms' median ratings.

Next, we briefly describe each zombie definition. Adalet McGowan, Andrews & Millot (2018) focus their analysis on a profitability-based measure to identify zombie firms. More precisely, they define zombies as firms with an interest rate coverage ratio (ICR) below 1 for 3 consecutive years and an age of at least 10 years.[11]

Banerjee & Hofmann (2020) refine this definition, which is mainly based on profitability, by considering whether a firm has a low future profit potential in the eyes of investors, as reflected in a relatively low Tobin's q. More precisely, Banerjee & Hofmann (2020) define zombies as firms with (*a*) an ICR, defined as earnings before interest and taxes (EBIT) over interest payments, below 1 and (*b*) a Tobin's q below the median within the firm's sector. To obtain persistence in the zombie classification, both criteria have to be satisfied for 2 consecutive years, and either of the two criteria must be violated for 2 consecutive years before a firm leaves the zombie classification.

Both of these widely used definitions focus primarily on the quality of the respective firms. In contrast, Caballero, Hishi & Kashyap (2008) argue that quality should not be the (sole) determinant of a firm's zombie status, especially if the goal is to evaluate the effect of zombies on the economy. The key distortion created by zombies stems from their subsidized financing, i.e., the fact that they receive debt funding at highly advantageous interest rates. Caballero, Hishi & Kashyap (2008) thus define zombie companies as firms that obtain credit at an interest rate below the relevant prime rate in the economy. A similar approach has been employed by Giannetti & Simonov (2013) and Acharya et al. (2019). Inspired by this literature, our third zombie definition follows Acharya et al. (2019) and defines a firm as zombie if it obtained subsidized debt financing and has a rating of BB or worse, implied by its ICR.

We follow Caballero, Hishi & Kashyap (2008) and Acharya et al. (2019) and classify a firm as receiving subsidized credit if, in a given year, the firm's interest expense scaled by total debt is below the expense paid by the most creditworthy firms in the economy. To determine the benchmark, we consider the median interest rate r_t^B paid by firms with a median rating of at least AA issued by S&P, Moody's, or Fitch in the same year. That is, we formally define for each firm i a hypothetical lower bound for its interest expenses:

$$R_{it}^{*} = r_t^B * Debt_{it}, \qquad 1.$$

[10]The debt categories consist of commercial paper, revolving credit, subordinated bonds and notes, senior bonds and notes, general/other borrowings, capital leases, and term loans. We also take into account the total trust preferred, unamortized premium, unamortized discount, and adjustment items.

[11]ICR is defined as earnings before interest and taxes divided by interest expenses.

where $Debt_{it}$ is defined as the sum of the DLC and DLTT items of Compustat. We then compare the actual interest payments of our sample firms R_{it} with this hypothetical lower bound by defining the interest expense gap as:

$$x^*_{it} = R_{it} - R^*_{it}. \qquad 2.$$

We classify a firm as receiving subsidized credit if its interest rate gap x^*_{it} is negative. This leads us to the following zombie definitions we consider in our analysis:

- *Low-Quality*$_1$: Three-year average ICR implied rating of BB (ICR cutoff: 2.5) or lower.
- *Zombie*$_1$: *Low-Quality*$_1$ and $x^*_{it} < 0$ (Acharya et al. 2019).
- *Zombie*$_{2a}$: ICR below 1 for 3 consecutive years and an age of at least 10 years (Adalet McGowan, Andrews & Millot 2018).
- *Zombie*$_{2b}$: *Zombie*$_{2a}$ and $x^*_{it} < 0$.
- *Zombie*$_{3a}$: Two consecutive years with (*a*) ICR below 1 and (*b*) a Tobin's *q* below the median within the firm's sector (Banerjee & Hofmann 2020).
- *Zombie*$_{3b}$: *Zombie*$_{3a}$ and $x^*_{it} < 0$.

Additionally, we follow Acharya et al. (2019) and compare the firms classified as zombies under our first definition (*Zombie*$_1$) with firms that satisfy that low-interest coverage criterion but do not receive subsidized credit. We refer to these firms as *Low-Quality*$_1$ firms.[12]

4.2. Results Mapping Zombie Firm Definitions to Real Sector Spillovers

In a first step, we document the time-series evolution of the share of zombie firms in the United States from 2004 to 2020 for each zombie definition (**Figure 1**). **Figure 1*a*** shows that if zombie firms are solely defined based on their quality, the share of zombie firms in the US economy varies between 10% and 20%, with some definitions suggesting a substantial increase in the share of zombie companies. In contrast, **Figure 1*b*** shows that once the additional criterion of firms

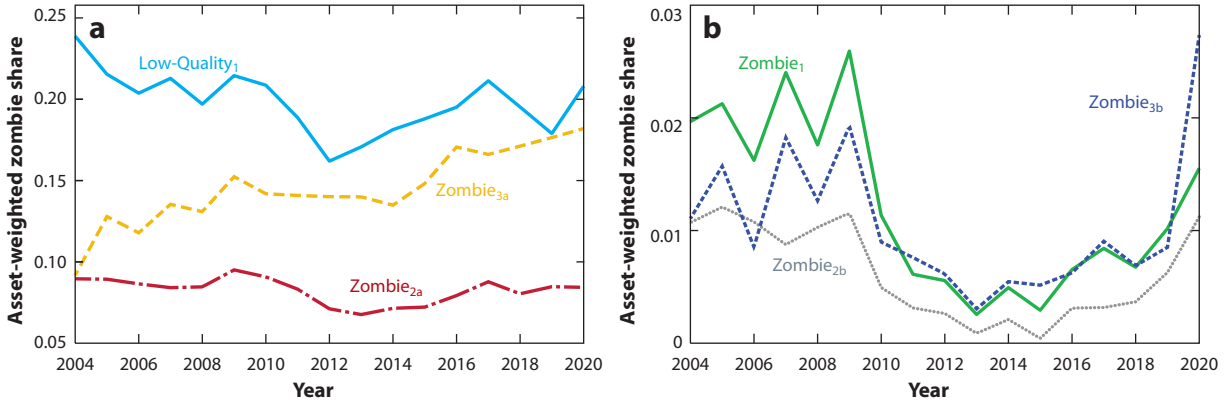

Figure 1

This figure shows the asset-weighted share of low-quality and zombie firms for various definitions of zombie firms. Panel *a* considers classifications that focus only on the quality aspect of the respective zombie definitions. Panel *b* additionally considers whether the respective low-quality firms receive subsidized credit.

[12] Stata code for each of these zombie definitions can be found at the following link: **https://drive.google.com/file/d/19PaVaZNYnhnZte_2g8d6CJl-Neb2b_b1/view?usp=sharing**.

Table 1 Descriptive statistics[a]

	Column 1	Column 2	Column 3	
	Non-Zombie	*Low-Quality*$_1$	*Zombie*$_1$	Column 2 – Column 3
EBITDA/assets	2.8	−10.8	−17.6	6.8***
ICR	7.2	−3.1	−10.5	7.4***
Employment growth	3.1	0.0	−3.5	3.5**
CAPX/assets	6.2	5.0	3.3	1.7***
Interest expenses/debt	7.0	10.9	3.3	7.6***
Tangibility	31.7	29.3	18.5	10.8***
Exit	3.4	8.2	12.0	−3.8***
	Non-Zombie	*Zombie*$_{2a}$	*Zombie*$_{2b}$	
EBITDA/assets	2.4	−12.1	−17.5	5.4**
ICR	6.0	−3.2	−9.6	6.4***
Employment growth	2.9	−2.0	−4.5	2.5
CAPX/assets	6.1	4.8	3.0	1.8***
Interest expenses/debt	7.5	10.9	3.2	7.7***
Tangibility	31.7	31.0	20.1	10.9***
Exit	3.5	7.8	14.9	−7.1***
	Non-Zombie	*Zombie*$_{3a}$	*Zombie*$_{3b}$	
EBITDA/assets	1.8	−2.2	−5.0	2.8***
ICR	6.8	−0.3	−2.2	1.9***
Employment growth	3.3	−2.6	−5.5	2.9**
CAPX/assets	5.9	4.8	3.8	1.0**
Interest expenses/debt	7.5	9.6	3.1	6.5***
Tangibility	29.1	34.5	23.4	11.1***
Exit	3.8	8.4	12.0	−3.6***

[a]This table provides descriptive statistics separately for high-quality (non-zombie) firms (column 1), firms that satisfy only the low-quality criterion of the respective zombie definition (column 2), and firms that additionally obtain subsidized debt financing (column 3). The last column provides a t-test for the significance of the difference between firms in columns 2 and 3.
Abbreviations: CAPX, capital expenditures; EBITDA, earnings before interest and taxes, depreciation, and amortization; ICR, interest rate coverage ratio.

receiving subsidized credit is introduced, the share of zombie firms in the US economy is significantly lower—consistent with the analysis by Favara, Minoiu & Perez-Orive (2021). Moreover, all three zombie definitions, including the subsidized credit criterion, closely track each other. This finding suggests that while the share of poorly performing companies has been at relatively high levels—and increasing according to some definitions—many of these companies did not obtain debt financing at subsidized rates.[13]

Table 1 presents descriptive statistics for our sample firms, split into non-zombie (high-quality firms; column 1); firms that satisfy the low-quality criterion of the respective zombie definition (column 2); and firms that are low quality but additionally obtain debt financing at advantageous interest rates (column 3). Importantly, the only difference between firms in columns 2 and 3 is whether a firm receives debt at subsidized rates, i.e., both groups of firms satisfy the same quality

[13]Under our preferred zombie definition (*Zombie*$_1$), the industry years with the highest zombie shares were General Building Contractors in 2007 (23%), Motor Freight Transportation and Warehousing in 2008 (35%), Amusement and Recreation Services in 2009 (17%), Eating and Drinking Places in 2020 (18%), and Electronic and Other Electric Equipment in 2008 (14%).

criteria in each panel. The last column of **Table 1** highlights that firms obtaining subsidized financing are significantly worse along several dimensions, even when compared with other low-quality firms. In particular, low-quality firms that additionally obtain subsidized credit have lower profitability, ICR, employment growth, and investment. Additionally, they have a lower share of tangible assets, suggesting they might have less collateral to pledge. Moreover, these firms have a higher propensity of an exit event (defined as either filing for Chapter 7 or Chapter 11 bankruptcy or being acquired) over the 4-year horizon after they were first classified as zombies.

To investigate whether the difference between the various zombie definitions matters for spillover effects on healthy companies, we follow Caballero, Hishi & Kashyap (2008) and Acharya et al. (2019) and estimate the following specification:

$$Y_{ijt} = \beta_1 \times Non\text{-}Zombie_{ijt} + \beta_2 \times Non\text{-}Zombie_{ijt} \times Share\ Zombies_{jt} + \eta_{jt} + \epsilon_{ijt}, \quad 3.$$

where Y_{ijt} represents the employment growth or investment of firm i in industry j at time t. $Non\text{-}Zombie_{ijt}$ is an indicator for whether a firm is classified as zombie in year t. For zombie definitions $Zombie_1$, $Zombie_{2b}$, and $Zombie_{3b}$, we classify a firm as *Non-Zombie* if it is not classified as a zombie under any of the three definitions. We proceed in the same way with the other three (non-interest rate subsidy based) zombie measures. $Share\ Zombies_{jt}$ is the asset-weighted share of zombie firms in industry j at time t. Industry-year fixed effects η_{jt} allow us to control for any industry-specific shock that might affect the employment growth or investment of healthy firms.

Our coefficient of interest is β_2, that is, whether non-zombie firms that are active in industries with a higher share of zombie firms have different employment or investment behavior than non-zombie firms in industries with a lower share of zombie firms. Results are presented in **Table 2**. Several observations are noteworthy. First, under each of the zombie definitions, non-zombie firms perform better than zombie firms, suggesting that each definition is identifying weaker performing firms. Second, we find that the negative spillover effects first documented by Caballero, Hishi & Kashyap (2008) are only present in definitions that consider the subsidized lending criterion. Conversely, zombie firms identified primarily based on their quality do not seem to exert negative spillover effects on non-zombie public US companies. This finding is consistent with the idea that a subsidy needs to be granted to create real economic distortions. Similarly, using a sample of European firms, Acharya et al. (2020) find that spillovers are present only when zombies are defined based on subsidized credit.[14]

Overall, our analysis highlights that inefficiencies in terms of negative spillover effects arise primarily when considering firms as zombies that receive subsidized credit. In other words, it is subsidized zombie credit that leads to economic inefficiencies and not the presence of low-quality firms per se. Misallocation due to such a credit subsidy helps otherwise nonviable firms to stay afloat in the short run and thus creates economic distortions. In turn, how zombies are defined is a crucial choice researchers make that can affect conclusions drawn on the economic inefficiency attributable to zombie firms: Definitions employed in the literature based on Caballero, Hishi & Kashyap's (2008) seminal idea to identify zombie firms as firms that receive subsidized credit are able to identify the misallocation inefficiency arising from the proliferation of such firms, whereas definitions of zombie firms as simply low-quality firms [such as by Adalet McGowan, Andrews &

[14]These results continue to hold if we run a horse between the respective zombie definitions with and without the subsidy criterion.

Table 2 Spillover effects of zombie firms[a]

	Employment growth	Capital expenditures/fixed assets
High-Quality$_1$	0.018***	0.016***
	(0.002)	(0.003)
High-Quality$_1$ × *Share Low-Quality*$_1$	−0.004	−0.000
	(0.004)	(0.004)
Observations	42,461	44,010
R-squared	0.081	0.209
Non-Zombie$_1$	0.022***	0.017**
	(0.004)	(0.006)
Non-Zombie$_1$ × *Share Zombies*$_1$	−0.017**	−0.020**
	(0.002)	(0.004)
Observations	42,461	44,010
R-squared	0.074	0.199
Non-Zombie$_{2a}$	0.018***	0.017***
	(0.001)	(0.002)
Non-Zombie$_{2a}$ × *Share Zombies*$_{2a}$	−0.001	−0.001
	(0.003)	(0.004)
Observations	42,461	44,010
R-squared	0.081	0.210
Non-Zombie$_{2b}$	0.006***	0.007***
	(0.001)	(0.002)
Non-Zombie$_{2b}$ × *Share Zombies*$_{2b}$	−0.017**	−0.020**
	(0.007)	(0.009)
Observations	42,461	44,010
R-squared	0.169	0.292
Non-Zombie$_{3a}$	0.026***	0.025***
	(0.002)	(0.003)
Non-Zombie$_{3a}$ × *Share Zombies*$_{3a}$	−0.004	−0.002
	(0.005)	(0.004)
Observations	42,461	44,010
R-squared	0.074	0.200
Non-Zombie$_{3b}$	0.011***	0.010***
	(0.002)	(0.002)
Non-Zombie$_{3b}$ × *Share Zombies*$_{3b}$	−0.012***	−0.022***
	(0.002)	(0.003)
Observations	42,461	44,010
R-squared	0.075	0.200
Industry-year fixed effects	Yes	Yes
Firm-level controls	Yes	Yes

[a]This table presents results from estimating Equation 3. The dependent variables are employment growth and investment. *Non-Zombie* is an indicator variable equal to one if a firm is not classified as zombie in year *t* and zero else. For zombie definitions *Zombie*$_1$, *Zombie*$_{2b}$, and *Zombie*$_{3b}$, we classify a firm as *Non-Zombie* if it is not classified as a zombie under any of the three definitions. Similarly, we proceed in the same way with the other three (non-interest rate subsidy based) zombie measures (including *High-Quality*$_1$). *ShareZombies* represents the asset-weighted share of zombie firms in a two-digit Standard Industrial Classification industry. Additional firm-level controls include the log of total assets, firm leverage (debt/assets), and net worth. Moreover, we add an indicator variable for firms that are not classified as zombie under the respective definition but are zombies under one of the other two related zombie classifications. All specifications include industry-year fixed effects. Standard errors are double clustered at the industry and year levels.

Millot (2018); Banerjee & Hofmann (2020); and Schivardi, Sette & Tabellini (2020)] appear to be unable to identify this inefficiency in our tests.

5. CONCLUSION

In this review, we provide theoretical, historical and international perspectives on zombie lending. We discuss the theoretical and empirical literature on the causes and consequences of zombie lending and highlight the role of undercapitalized banks, the effects of zombie lending on zombie borrowers, and importantly, spillovers and competitive distortions on non-zombie firms. Using data on US firms, we contrast different definitions of zombie borrowers that differ in one key dimension, i.e., whether they include an interest rate subsidy for the borrower. Importantly, we show that, while all definitions identify low-quality borrowers, only when we identify zombies based on an interest rate subsidy are we able to detect negative spillovers on non-zombie borrowers such as lower employment growth and lower capital expenditures. Based on our discussion of the literature and our empirical analysis, we conclude that both undercapitalization of banks and interest rate subsidies to low-quality firms are necessary conditions to investigate the consequences of zombie lending for allocative efficiency. This is an important result for both academics and policy makers, as they assess the implications of COVID-19–induced forbearance policies and credit support on growth, productivity, and inflation.

DISCLOSURE STATEMENT

The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review. The views expressed in this article are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Federal Reserve Bank of New York, the Federal Reserve System, or anyone associated with these institutions.

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