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Determinants of Zombie Banks in Emerging Markets and Developing Economies

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ABSTRACT: While deeply undercapitalized banks have been shown to misallocate credit to weak firms, the drivers of such zombie banks are less researched, particularly across countries. To furnish empirical evidence, we compile a dataset of undercapitalized banks from emerging markets and developing economies. We classify zombie banks as those not receiving remedial treatment by owners or regulators or, alternatively, remaining chronically undercapitalized. Using logit regressions, we find that country-specific factors are more influential for zombie status than bank characteristics, alhough some become significant when disaggregating by region. The paper's overall findings imply the need for a proper regulatory framework and an effective resolution regime to deal with zombie banks more decisively.

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WORKING PAPERS

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Prepared by Hannah Sheldon, Torsten Wezel, and Zhengwei Fu[1]

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Contents

I. INTRODUCTION

Chronically insolvent banks that continue to operate, thanks to external support or regulatory forbearance, are known as zombie banks. Initially recognized during the U.S. savings and loan crisis of the late 1980s, the concerns surrounding zombie banks resurfaced in the aftermath of the European debt crisis of the early 2010s when sizable banks in several countries required support from competent governments and supervisory authorities. Many of them were not initially thought to be failing until the size of their hidden losses and corresponding capital shortfalls became apparent, leading to large-scale official interventions. There is, however, another more overt form of zombie banks where losses have been realized and undercapitalization has been apparent for longer periods, ostensibly tolerated by owners, and more importantly, by supervisory authorities who do not impose or strictly enforce corrective measures aimed at restoring long-run viability.

The issue this paper seeks to address evolves around the following conundrum. How is it that a bank that has been completely and gravely insolvent for several years is allowed to continue operating as normal? What factors may cause or contribute to the evident recalcitrance of owners to recapitalize and, if needed, restructure the bank, and supervisors' unwillingness to deal with the issue and resolve the bank in the absence of remedial action by owners? The range of such possible factors is wide, encompassing macroeconomic drivers, governance weaknesses, and bank-specific characteristics, including considerations like "too big to fail" or "too important to fail." As a case in point, a glaring example of a zombie bank in an African country, the encounter of which inspired this paper, was presumably kept afloat partly because of its vast presence across the country. This aspect of financial inclusion suggests a deliberate supervisory decision in favor of survival. In contrast, in some other instances, supervisors might prefer resolving the bank but eventually fail to do so for lack of an effective resolution framework or proper instruments.

To this end, we use publicly available databases to compile a dataset of undercapitalized banks from emerging markets and developing economies, some of which we categorize as zombies. In our cross-country analysis, it is impractical to detect zombie banks solely based on hidden losses, as in previous studies. Therefore, we define zombie banks as those either being chronically insolvent (with a negative net worth as stated in banks' financial statements) or, alternatively, gravely undercapitalized. This definition has its limitations because it unavoidably excludes zombie banks whose hidden losses remain unrecognized. To operationalize our empirical concept, we create a control group consisting of insolvent or, alternatively, severely undercapitalized banks that have received corrective "treatment." This treatment can take the form of recapitalization and/or restructuring by owners, mergers and acquisitions, or resolution measures, including intervention and liquidation. Zombie status is recognized if an insolvent (undercapitalized) bank has not undergone any of the above corrective measures within a year of being initially reported as non-compliant. However, to recognize that some actions may not have been sincere or sufficiently stringent, we also apply an alternative zombie bank criterion of continued insolvency (undercapitalization) two years after initial recognition, regardless of evidence of interim treatment.

We find that out of the 20 variables considered, only a few are consistently significant across most specifications (bank equity ratio, low-income country status, crisis episodes). Some macro and bank-specific variables significance only for a specific subset of our analysis. There is hardly any evidence for the significance of structural factors (e.g., governance variables or financial inclusion indicators). Disaggregation by region reveals additional significant drivers specific to individual regions. Some variables, which appear to cancel each other out in regressions at the global level, emerge as significant factors in certain regions.

That being said, there are admittedly unobservable factors that influence stakeholders' decisions on how to deal with insolvent banks that have or may become zombies. Indeed, the relative low power of our regression results is indicative of the influences of these non-measurable factors in addition to the usual omitted variable bias. In some cases, it may come down to decisions that are not based on observed drivers or characteristics but rather on other considerations that would contradict the evidence placed before decision-makers. Considering the measurement problem, we cannot investigate the reasons why supervisors let zombie banks emerge. Instead, we focus on the measurable factors in our empirical investigation. We also do not attempt to analyze the issues surrounding the problematic resolution of failed banks, including state-owned banks, as these have already been widely investigated elsewhere (e.g., Adams et al. 2022; Dell'Ariccia et al. 2018; Dobler et al. 2020).

Some policy implications emerge from this empirical paper. First, the paper highlights the need for a proper regulatory framework and effective resolution regime to minimize the arbitrary component of the decision-making process and maximize the efficiency of treatment of undercapitalized banks. Second, it also highlights the benefits of seeking external support, including an IMF program, during a crisis event to help handle failing banks that may otherwise turn into zombies.

The remainder of the paper is structured as follows: Section II reviews the pertinent literature. Section III presents the data, variables, and descriptive statistics, along with the methodology for identifying zombie banks and conducting the regression analysis. Section IV presents the empirical results for different sets of model specifications, including disaggregation by region and grouping by country. Section V discusses key achievements and concludes.

II. LITERATURE REVIEW

The term "zombie bank" refers to failing or insolvent institutions that by conventional standards would be expected to be liquidated but still survive. The term "zombie" was coined by Kane (1989), who observed that some insolvent saving institutions were allowed to stay in business without much of a penalty. He finds that these zombies implement risky operational strategies and do not incorporate risk assessment into their investment decision process.

Although the concept of a zombie bank is easily understood, the identification of zombie banks is not straightforward. Often, regulators and analysts cannot directly observe zombie banks' actual operational performance from financial reports. The main reason is that zombie banks tend to hide the true extent of bad loans through evergreening—a practice that helps banks avoid the realization of losses by providing subsidized credit to their ailing borrowers.

To investigate the extent of zombie banks, researchers have developed different approaches (see Willam 2015, for an extensive review). An accounting-based identification indicator used by several authors (Chernykh and Cole 2015; Ghosh 2023; Gonzalez-Hermosillo 1999) is the non-performing loan (NPL) coverage ratio, computed as the difference between the combined buffer of capital and loan loss reserves and non-performing loans, scaled by total assets. Banks with coverage below a certain threshold are then considered zombies. Another way is to estimate banks' true amount of bad loans or capital shortfalls through stress tests. For example, Acharya and Steffen (2014) use stress tests conducted by the European Central Bank to estimate the

capital shortages of commercial banks. It is important to note, however, that this stress test measure cannot be used to directly observe why banks turn into zombies. Instead of looking at bank characteristics, other papers document the zombie bank phenomenon through the behavior of borrowers that enjoy evergreening (Caballero et al. 2008; Papworth 2013). Other than the traditional banking book-based approaches, some researchers have developed market-based approaches to identify zombie banks, including comparing banks' book and market values (Schoenmaker and Peek 2014), measuring the distance-to-default (Kane 2017), or calculating a shadow return on equity (Fiordelisi et al. 2021).

Empirically, the zombie bank phenomenon has received much attention (see Nelms 2012 for an anthropological analysis). Studies show that the phenomenon could be explained by external support from governments (e.g., Homar and van Wijnbergen 2017). For example, using bank-level data from 124 countries, Calderon and Schaeck (2016) find that zombie banks are more likely to survive with liquidity support from government.

Kane (2017) shows that implicit guarantees from governments have fostered zombie banks in Europe. Gandrud and Hallerberg (2017) document that zombie banks in Japan survived due to a government recapitalization scheme. Another prime example of public support is the European Central Bank's Outright Monetary Transactions program, which shored up banks' capital by lifting the value of periphery sovereign bonds. However, this program also supported zombie banks by providing them with inexpensive liquidity (Acharya et al. 2019), which is typical when liquidity support is provided at below market rates (Kane and Klingebiel 2004). Zombie banks also use government subsidies to gamble for resurrection (see Hoshi and Kashyap 2010 for a full review) or evergreen loans to zombie clients, hoping that they might receive a lifesaving return in the future (Calderon and Schaeck 2016). Such behavior could also help zombie banks hide the realization of losses without getting caught by regulators and thus avoid falling below minimum capital requirements (Caballero et al. 2008).

The unholy alliance of weak firms and undercapitalized banks is problematic because it is likely to cause misallocation of credit (Acharya et al. 2022; Acharya, Lenzu, and Wang 2021; Andrews and Petroulakis 2019; Bonfim et al. 2022; Chari, Jain, and Kulkami 2021; Hu and Varas 2021; Okamura 2011; Storz et al. 2017). For one thing, the provision of credit to zombie firms crowds out healthy firms by diverting loans that the latter should have received, as Chari et al. (2021), Chopra et al. (2021), and Ghosh (2023) show in the case of India, and Blattner et al. (2019) for Portugal. For another, by keeping insolvent firms alive, zombie banks prevent the entry of more efficient firms (Bruche and Llobet 2014). Consistent with this argument, research has shown that zombie banks are more likely to engage in evergreening, which in turn worsens the economic situation by preventing the entry of efficient firms (Caballero et al. 2008).

Most studies focus on developed countries, with very few examining the origins or determinants of zombie banks in emerging markets or developing economies, probably because of limited data availability. For example, Savvides (2021) argues that in Cyprus zombie banks emerged due to a combination of high indebtedness of borrowers, feeble domestic demand, a scarcity of bankable projects, and a lack of profitable alternative investments.

Chari et al. (2021) show that in India, zombie banks, including state-owned banks, emerged as a result of forbearance measures by the central bank. These zombie banks lent to troubled firms which, like elsewhere, led to a misallocation of credit. Recent anecdotal evidence points to the presence of the zombie bank phenomena in developing countries (for example, Chamseddine 2022, exploring zombie banks in Lebanon).

We contribute to closing this gap in the literature through our multi-country study on the identification and determinants of zombie banks in emerging and developing countries around the globe.

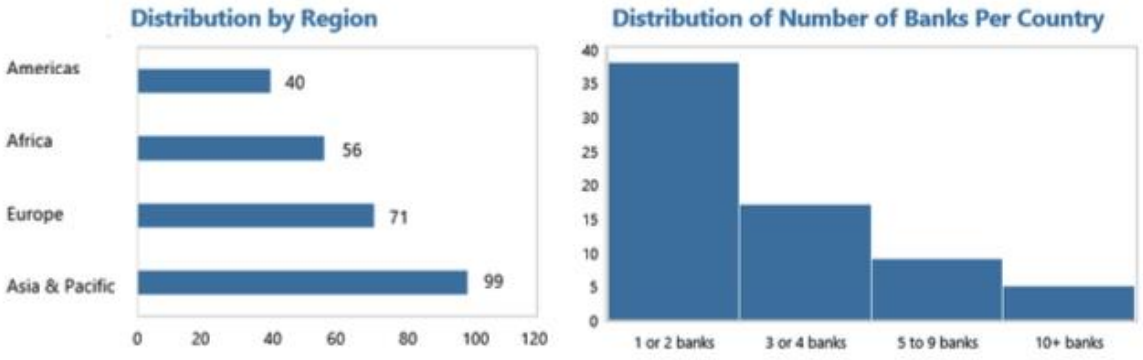
III. DATA AND METHODOLOGY

A. Data Compilation

Using the full universe of bank financial statements from Fitch and Orbis,[1] we build a cross-sectional annual dataset with 266 banks[2] from 69 emerging and developing economies covering the period from 2001-18. We include banks in our database if they have experienced at least one year of technical insolvency (negative net worth—181 banks) or, alternatively, showed clear undercapitalization (266 banks), as per the classifications provided below.

More than one third of the banks in our sample are from the Asia and Pacific region, followed in representation by Europe, Africa, and the Americas. Figure 1 shows the distribution of the number of banks in each region and a histogram of the number of banks per country. About 20 percent of our sample consists of state-owned banks, and 77 percent of all banks remained open for business two years after inadequate capitalization, which indicates the persistence of the zombie bank phenomenon.

Figure 1. Distribution by Region and Country



[1] At first, we used Orbis only. This database gave us a heavy concentration of certain countries. When we expanded our search to include Fitch, we were able to more than double our sample. In addition, the Fitch database allowed us to increase our coverage of the African region.

[2] Our analysis includes commercial banks, real estate and mortgage banks, cooperative banks, savings banks, and retail and consumer banks.

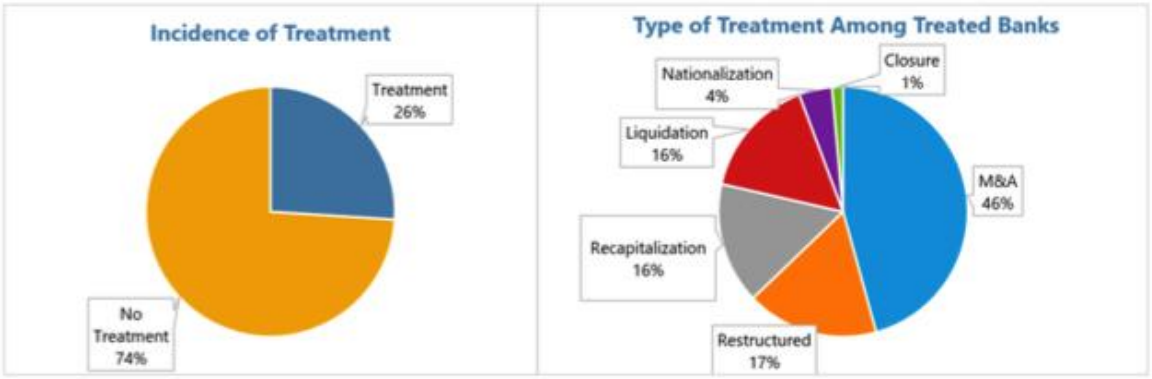
B. Zombie Bank Identification

The identification of zombie banks is challenging for many reasons, most notably the fact that forbearance lending "hides" bad loans on the balance sheet (Willam 2015). As mentioned earlier, various techniques have been used in the literature to detect zombie banks. Perhaps most notably, the coverage ratio indicator employed by Gonzalez-Hermosillo (1999), Chernykh and Cole (2015), and Ghosh (2023) appears to be a straightforward approach to identifying failing banks. However, it does not allow for identification of zombie banks that underreport NPLs and thus have hidden losses. Moreover, in our specific case, its application is impractical since the required components (NPLs and loan loss reserves) are not consistently reported across countries in the databases. The same goes for the borrower-based approach, which would require detailed corporate and supervisory data, as well as the market-based approaches. Unfortunately, we lack the necessary data given that many, if not most, banks in our sample are not publicly traded. Therefore, we develop a feasible cross-country approach that is based on reported bank undercapitalization and that identifies zombie banks from two perspectives: decision-based and outcome-based.

1. Decision-Based Analysis

In the decision-based analysis (DBA), we determine zombie bank status based on whether a bank received some form of "treatment" to remedy its undercapitalization. To do this, we searched news articles[3] to find any evidence of treatment being administered. Our allowable treatment categories include start of liquidation, closure, declaration of bankruptcy, capital injection, nationalization or privatization, a merger or acquisition (M&A), or restructuring to shore up profitability (even if it may take time to turn the bank around). We code this dummy variable as a 0 (i.e., not a zombie) if we find evidence of any of the above treatments within the first year of a bank becoming undercapitalized. A bank that has no evidence of treatment within the first year receives a value of 1 (i.e., a zombie). Using this classification, 34 percent of banks in our sample are classified as zombies. The most common type of treatment was M&A, followed by recapitalization, restructuring, liquidation, nationalization, and closure. Less than 7 percent of our sample received treatment one year following insufficient capitalization. Figure 2 provides more information on the treatment of our sample and Figure A2 (in the appendix) shows the progression of zombie status over time and by analysis type.

Figure 2. Statistics on Treatment



[3] We typically begin our search by using the bank name, and, if necessary, the country name. We translated results as needed.

2. Outcome-Based Analysis

As a complement to the DBA, we conduct another analysis that focuses more heavily on a bank's quantitative outcome, recognizing the fact that decision-based treatments may not restore adequate capitalization. We call this outcome-based analysis (OBA). A bank is classified as non-zombie if it either (i) is successfully recapitalized by the end of the second year (after showing up as undercapitalized in the database), or (ii) has been put in liquidation in that time frame, given that liquidation can be a drawn-out process. In all other cases, the bank is classified as a zombie. This classification framework helps capture cases where regulators and/or owners may have various intentions, including those that are less sincere (e.g., superficial restructuring that does not get to the root of the problem) or even well-intention actions (e.g., initiating a treatment in good faith with a high probability of fixing the issue, but ultimately falling short). Using this classification, 33 percent of banks in our sample are zombies.

We create two separate but somewhat overlapping samples. The *negative sample* contains banks that have a negative equity-to-assets ratio (equity ratio) and are therefore considered to be insolvent. Since we have no consistent information on risk-weighted assets (RWA), we use total assets as the scaling factor (i.e., a leverage ratio). As a robustness check, and to broaden our sample, we also created a *two percent sample* that includes all banks with an equity ratio of less than 2 percent. We assume an RWA density (RWA to total assets) of less than 50 percent, which is a conservative assumption for emerging markets. This translates into a capital adequacy ratio of no more than 4 percent. The *two percent sample* contains banks that have an equity-to-assets ratio below 2 percent. This broader sample includes banks that would be considered insufficiently capitalized, although not necessarily insolvent.

C. Potential Drivers of Zombie Status

We test a total of 20 variables that may explain the emergence of zombie banks, five in each of four categories (bank-level, macroeconomic, structural, and crisis/program). These factors may in part be different from those that caused the banks' undercapitalization (and inclusion in our dataset) in the first place. A matrix of pairwise correlation coefficients can be found in Appendix Table A1.

1. Bank-Level Indicators

Perhaps the most direct linkage to zombie status can be found by investigating bank-specific conditions, such as poor business models or an insufficient ability to sustainably generate a profit (Jagtiani et al. 2000). Our analysis includes leverage (the equity-to-assets ratio), return on assets (ROA), the size of a bank proxied by its contribution to total credit, the size of a bank relative to GDP, and a dummy for state ownership (if the government has any ownership stake in the bank). For example, banks with low or even negative ROAs are displaying an inability to use their assets effectively to generate a profit. Summary statistics for these bank-level indicators can be found in Table 1. While it would be useful to evaluate the impact of guarantees and liquidity support, we lack cross-country data on both topics.

2. Macroeconomic Indicators

At the same time, macroeconomic conditions impact bank performance. Thus, we investigate several macroeconomic indicators, notably inflation, the ratio of government debt to GDP, a dummy for low-income

countries (using the World Bank's 2021 classification),[4] the growth rate of credit, and the ratio of credit to GDP. The growth of credit is used as a bellwether for financial instability (Alessi and Detken 2014) and is particularly informative in emerging markets (Gersl and Jasova 2018). Inflation is a good proxy for economic instability. Since inflation also reduces consumption, it can impact asset quality and the demand for loans, both of which impair banks' bottom line. These variables are taken from the World Bank's World Development Indicators and the IMF's International Financial Statistics. Summary statistics for these indicators can be found in Table 2.

3. Structural Indicators

Pure macroeconomics aside, structural factors such as the state of governance can have an impact on a banks' ability to operate profitably. Here we test whether weak governance allows zombie banks to persist. For instance, operating in a country with high corruption could mean that money gets lent to those in power, with less consideration for their willingness and ability to repay. Specifically, we use the World Bank's Worldwide Governance Indicators, including government effectiveness, control of corruption, and regulatory quality. We expect that countries with lower government effectiveness, less control of corruption, and lower levels of regulatory quality (for the government in general) to be more likely to allow zombie banks to persist.

To test whether zombies are particularly prevalent in countries with underdeveloped financial infrastructure and access to financial products, we use data from the IMF's Financial Access Survey on the number of bank branches and ATMs per 100,000 adults. We hypothesize that countries with fewer bank branches may have an incentive to keep ill-performing banks in operation, particularly to provide financial service in rural areas. The credit-related variables also have an inclusion connotation in that undercapitalized banks may be tolerated where they contribute to the flow of credit in countries with low financial development. Table 3 displays the summary statistics for these indicators.

4. Crisis and Program Country Indicators

Lastly, banks may become zombies or be prevented from turning into zombies due to the occurrence of systemic crises, specifically debt, currency, and/or banking crises. Zombie banks may have a greater chance of being treated if a banking sector clean-up is part of the conditionality of an IMF program started in the face of crisis. Banks in countries experiencing any of such crises will certainly be challenged by the hard economic circumstances, and IMF programs are often agreed to in an effort to alleviate these challenges.

We use the database provided by Laeven and Valencia (2020) to generate dummy variables. We generate dummy variables equaling one if a currency, banking, or debt crisis had occurred in the year prior, the year of, or the year following the date in which a bank became undercapitalized. IMF program participation may influence zombie bank status as countries may be subject to conditionality mandating the resolution of certain banks (see Box 1 for selected country cases). In fact, such conditionality may act in a preemptive manner, avoiding the emergence of zombie banks. These summary statistics are provided in Table 4.

[4] 25 percent of our sample is classified as low income by the World Bank.

Box 1. Bank Restructuring and Program Conditionality

We hypothesize that countries covered by an IMF program would be less likely to see their banks become zombies. This is because bank restructuring is often part of the authorities' commitment to the IMF in exchange for program funding. Below, we highlight four countries where bank restructuring was included in the staff agreement of IMF programs. According to the Monitoring of Funding Arrangements Database, 92 percent of programs initiated since 2006 include financial sector reform as a conditionality. In an evaluation of all Fund conditionality between 1985 and 2014, Kentikelenis et al. (2016) find that there were 13,948 conditions associated with the financial sector, monetary policy, and central banking.

Amidst a decade-long civil war, **Nepal's** economy was struggling, and poverty was climbing. In 2003, the IMF Executive Board approved a three-year Poverty Reduction and Growth Facility. As part of the program, the authorities committed to several financial sector reforms, including restructuring troubled commercial and development banks. Specifically, special care was taken to ensure that loan recovery rates were increased (IMF 2006).

Ukraine, like many other countries, was not immune to the global financial crisis unravelling in 2008. Its currency plummeted, and the banking sector was on the verge of collapse after depositors withdrew their funds from banks (Segura 2009). In December 2008, Ukraine came to the IMF requesting a Stand-By Arrangement. In the period preceding the request, a larger bank had been put into receivership and the need for liquidity was great. The authorities committed to the agreement to bolster their bank resolution framework. In addition, the authorities and IMF staff agreed to the resolution of the bank to restore confidence in the banking sector (IMF 2008a).

In 2008, **Pakistan** was also impacted by the global financial crisis, high commodity prices, and its own political challenges (Haque 2010). By the end of the year, Pakistan had requested a Stand-By Arrangement from the IMF. Among the key elements of the program, financial sector vulnerabilities were meant to be addressed. Contingency plans were to be created to tend to problem banks. Further, steps were to be taken to bolster bank resolution capacity (IMF 2008b).

In **Moldova**, long-standing issues with related-party lending and weak internal controls culminated in the placement of three large banks under special supervision in 2015. A subsequent IMF program then required, among other things, enforcement actions to address regulatory breaches, a revamp of the bank resolution framework, and the restructuring of banks (IMF 2016). More concrete program conditionality necessitated taking enforcement action against the large banks for non-compliance with regulatory requirements (IMF 2017). Moldova did not experience drawn-out cases of undercapitalized banks.

Table 1. Bank-Specific Indicators Summary Statistics

Variable	N	Mean	Standard Deviation	Minimum	Maximum
Equity Ratio	266	-0.174	0.441	-3.344	.0197
Size (in log)	266	12.271	9.220	-3.994	26.568
Bank Assets to GDP	265	0.1382	2.003	0.00	32.61
State Ownership	266	0.2030	0.4030	0	1
ROA	256	-0.166	0.314	-2.012	0.200

Table 2. Macroeconomic Indicators Summary Statistics

Variable	N	Mean	Standard Deviation	Minimum	Maximum
Inflation	252	9.00	8.74	-0.73	53.23
Credit Growth	218	5.45	15.67	-47.96	71.02
Credit to GDP	233	45.61	30.72	4.66	125.67
Government Debt to GDP	262	43.40	29.31	6.90	159.46
Low Income Dummy	266	0.25	0.43	0	1

Table 3. Structural Indicators Summary Statistics

Variable	Definition	N	Mean	Standard Deviation	Minimum	Maximum
Government Effectiveness	Measures the perspectives on quality of public and civil service, the degree of independence, the quality of policy, and the credibility of such policy	229	-0.47	0.47	-1.56	0.61
Control of Corruption	Explains perceptions on the extent to which public power is used for private gain	229	-0.75	0.35	-1.54	0.29
Regulatory Quality	Measures perceptions on ability of government to implement policies and regulations for private sector development	229	-0.52	0.45	-1.98	0.70
Bank Branches per 100,000 people	The number of commercial bank branches per 100,000 people	182	14.11	12.37	0.56	38.52
ATMs per 100,000 people	The number of ATMs per 100,000 people	184	57.30	61.09	0.23	185.41

Table 4. Crisis and Program Country Summary Statistics

Variable	Definition	N	Mean	Standard Deviation	Minimum	Maximum
Banking Crisis	A dummy variable that equals one if the country experienced a banking crisis in the year before, of, or after a bank became a zombie	266	0.16	0.37	0	1
Debt Crisis	A dummy variable that equals one if the country experienced a debt crisis in the year before, of, or after a bank became a zombie	266	0.27	0.45	0	1
Currency Crisis	A dummy variable that equals one if the country experienced a currency crisis in the year before, of, or after a bank became a zombie	266	0.29	0.45	0	1
Any Crisis	A dummy variable that equals one if the country experienced any crisis (banking, debt, or currency) in the year before, of, or after a bank became a zombie	266	0.53	0.50	0	1
Program Country	A dummy variable that equals one if the country was covered by an IMF program in the year before, of, or after a bank became a zombie	266	0.44	0.50	0	1

D. Econometric Approach

To evaluate the determinants of zombie bank status (via the decision-based and outcome-based analysis), we run logit regressions with robust standard errors. For both DBA and OBA, we first run bivariate regressions (i.e., with only one independent variable) for each of the variables discussed above to test their predictive power in isolation.

Our bivariate regression model takes the form:

$$Pr(y_j \neq 0|x_j) = \frac{exp(x_j\beta)}{(1+exp(x_j\beta))},$$

where x represents an independent variable of interest.

Informed by the outcome of our bivariate regressions, we craft parsimonious multivariate regressions, incorporating several of the most significant variables. We generate bivariate and multivariate regressions for both the negative sample and the two percent sample.

The multivariate regressions take one variable from each of our four categories of potential drivers of zombie status (mentioned above).

These multivariate equations can be defined as[5]:

$$Pr(y_j \neq 0|x_j) = \frac{e^{\beta_1 bank_j + \beta_2 macro_j + \beta_3 structural_j + \beta_4 crisis_j}}{1 + e^{\beta_1 bank_j + \beta_2 macro_j + \beta_3 structural_j + \beta_4 crisis_j}}.$$

IV. REGRESSION RESULTS

A. Main Specifications

Our empirical findings comprise four sets of results: the decision-based analysis for the negative and the two percent sample with both bivariate and multivariate regressions, and the outcome-based analysis applied to these sets of regressions for both samples. We then also divide the larger two percent sample into four regions and display results for the decision-based analysis.

1. Decision-Based Regressions for the Negative Sample

Our empirical results start with bivariate DBA regressions for the negative sample (Table 5). The only significant bank-specific variable is the equity ratio. Banks with strongly negative equity ratios may be deemed "too expensive" to fix, and regulators and investors may ignore the issue, propelling banks into indefinite zombie status.

By contrast, several macroeconomic factors have a significant relationship with zombie status. Banks in countries experiencing strong credit growth are more likely to be zombies. Studies have highlighted the relevance of credit growth as an early warning indicator of financial crises, which, by nature, tend to have a substantially negative impact on bank performance (Alessi and Detken 2014). Additionally, we find that higher inflation is associated with a lower likelihood of becoming a zombie. Since banks' financial statements are presented in nominal terms, higher inflation tends to increase credit and revenue (through higher interest rates) and result in strong bank performance, at least in the short run (OCC 2021). Banks operating in low-income countries are also more likely to be zombies, pointing to lower capacity of regulatory authorities to deal with and ultimately resolve zombie banks.

We do not find indicators of governance, such as government effectiveness, control of corruption, and regulatory quality, to play a significant role in determining zombie status. However, the existence of a banking or currency crisis is associated with a lower likelihood of zombie bank status. Countries experiencing a crisis may be forced to take action on undercapitalized banks, especially if external parties apply pressure.

[5] In the event that there are no significant variables available for a block, we choose reduced combinations.

Table 5. Decision-Based Bivariate Regressions: Negative Sample

	DBA	DBA	DBA	DBA	DBA		DBA	DBA	DBA	DBA	DBA
	Bank						Macroeconomic				
Size	0.00122					Inflation	-0.0500**				
	(0.0177)						(0.0214)				
Equity Ratio		-0.581*				Low Income		0.579*			
		(0.321)						(0.335)			
State Ownership			0.435			Credit to GDP			-0.00506		
			(0.367)						(0.00556)		
Bank Assets to GDP				-0.0027		Credit Growth				0.0200*	
				(0.0035)						(0.0113)	
ROA					0.324	Government Debt to GDP					-0.00556
					(0.561)						(0.00567)
Constant	-0.692**	-0.844***	-0.780***	-0.6429***	-0.568***		-0.248	-0.866***	-0.355	-0.608***	-0.478*
	(0.271)	(0.184)	(0.183)	(0.164)	(0.199)		(0.242)	(0.196)	(0.291)	(0.176)	(0.282)
Observations	181	181	181	181	174		172	181	164	154	179
Pseudo R2	0.000	0.015	0.006	0.002	0.002		0.021	0.013	0.004	0.015	0.004

	DBA	DBA	DBA	DBA	DBA		DBA	DBA	DBA	DBA	DBA
	Structural						Program and Crisis				
Government Effectiveness	-0.432					Program Country	-0.431				
	(0.371)						(0.318)				
Control of Corruption		-0.310				Banking Crisis		-1.117**			
		(0.545)						(0.480)			
Regulatory Quality			-0.641			Currency Crisis			-0.788**		
			(0.467)						(0.376)		
Bank Branches				0.015		Debt Crisis				-0.518	
				(0.015)						(0.362)	
ATMs					-0.0044	Any Crisis					-0.640**
					(0.139)						(0.319)
Constant	-0.819***	-0.840*	-0.944***	-0.737***	-0.412*		-0.470**	-0.492***	-0.465**	-0.532***	-0.332
	(0.258)	(0.460)	(0.314)	(0.270)	(0.056)		(0.216)	(0.172)	(0.183)	(0.184)	(0.229)
Observations	155	155	155	127	184		181	181	181	181	181
Pseudo R2	0.007	0.002	0.011	0.006	0.021		0.008	0.028	0.021	0.009	0.018

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

2. Decision-Based Multivariate Regressions for the Negative Sample

Next, we combine significant variables from our bivariate regressions to construct two multivariate regressions.

In the first specification (Table 6), we combine the equity ratio with the banking crisis dummy, and then, in a separate regression, we combine the equity ratio with a dummy for any crisis. Here, the signs of all three variables are the same as they were in the bivariate regressions.

Despite the individual significance of inflation and credit growth in the bivariate regressions, we found no multivariate regressions in which these variables were significant. Their inclusion alongside crisis dummies appears to have had a cancelling out effect, as monetary conditionality under IMF programs often involves specific bands around inflation, as was the case with Brazil in the early 2000s (Bléjer et al. 2002).

Table 6. Decision-Based Multivariate Regressions: Negative Sample

VARIABLES	DBA	DBA
Equity Ratio	-0.773**	-0.698*
	(0.338)	(0.382)
Any Crisis	-0.783**	
	(0.330)	
Banking Crisis		-1.241**
		(0.489)
Constant	-0.4665*	-0.671***
	(0.239)	(0.194)
Observations	181	181
Pseudo R2	0.040	0.048

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

We next run bivariate regressions using the outcome-based zombie indicator (see Table 7). We find that larger banks are less likely to become zombies, regardless of whether treatment has occurred or not, suggesting that capitalization issues of smaller banks are more likely to go unnoticed. In contrast to the decision-based analysis, the equity ratio is not a statistically significant determinant of zombie status in the outcome-based analysis. Like in the decision-based analysis, banks in low-income countries are more likely to be classified as zombies. Higher ratios of government debt to GDP are associated with a lower probability of zombie status.

Table 7. Outcome-Based Bivariate Regressions: Negative Sample

	OBA	OBA	OBA	OBA	OBA		OBA	OBA	OBA	OBA	OBA
	Bank						Macroeconomic				
Size	-0.057***					Inflation	-0.016				
	(0.018)						(0.016)				
Equity Ratio		-0.250				Low Income		0.685**			
		(0.298)						(0.332)			
State Ownership			0.069			Credit to GDP			0.007		
			(0.371)						(0.005)		
Bank Assets to GDP				-0.0030		Credit Growth				0.016	
				(0.0038)						(0.011)	
ROA					0.451	Government Debt to GDP					-0.014**
					(0.429)						(0.006)
Constant	0.0732	-0.674***	-0.619***	-0.566***	-0.440**		-0.452**	-0.828***	-0.935***	-0.671***	-0.072
	(0.254)	(0.179)	(0.178)	(0.163)	(0.185)		(0.218)	(0.195)	(0.293)	(0.179)	(0.286)
Observations	181	181	181	181	174		172	181	164	154	179
Pseudo R2	0.046	0.003	0.000	0.002	0.004		0.003	0.018	0.007	0.0010	0.024

	OBA	OBA	OBA	OBA	OBA		OBA	OBA	OBA	OBA	OBA
	Structural						Program and Crisis				
Structural							Program and Crisis				
Government Effectiveness	-0.483					Program Country	-0.568*				
	(0.362)						(0.316)				
Control of Corruption		-0.331				Banking Crisis		-1.204**			
		(0.532)						(0.480)			
Regulatory Quality			-0.823*			Currency Crisis			-0.127		
			(0.470)						(0.344)		
Bank Branches				-0.001		Debt Crisis				-1.180***	
				(0.015)						(0.395)	
ATMs					-0.000	Any Crisis					-0.794**
					(0.871)						(0.318)
Constant	-0.734***	-0.745*	-0.931***	-0.347	-0.628***		-0.333	-0.405**	-0.566***	-0.301*	-0.178
	(0.251)	(0.449)	(0.313)	(0.265)	(0.219)		(0.213)	(0.170)	(0.185)	(0.180)	(0.227)
Observations	155	155	155	127	184		181	181	181	181	181
Pseudo R2	0.009	0.002	0.018	0.000	0.999		0.014	0.032	0.001	0.043	0.027

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Lower levels of regulatory quality are loosely linked to zombie status, albeit with an unexpected negative sign, while banking crises and debt crises are associated with a lower probability of becoming a zombie, which is consistent with our DBA results. In addition, countries covered by an IMF program are less likely to develop zombie banks. This supports the hypothesis that IMF program conditionality may mandate measures to deal with weak and undercapitalized banks.

Using significant variables from the bivariate regressions, we again prepare two separate multivariate regressions for the outcome-based dependent variable. We combine size, government debt to GDP, a dummy variable for debt crisis, and an indicator of regulatory quality. Table 8 shows that size and the incidence of a debt crisis reduce the probability of zombie status to a significant level. We see a similar story when we combine size, government debt to GDP, regulatory quality, and a dummy for the occurrence of any crisis.

Table 8. Outcome-Based Multivariate Regressions: Negative Sample

VARIABLES	OBA	OBA
Size	-0.043**	-0.046**
	(0.019)	(0.019)
Government Debt to GDP	0.003	-0.009
	(0.008)	(0.007)
Debt Crisis	-1.544***	
	(0.594)	
Regulatory Quality	-0.872	-0.668
	(0.535)	(0.480)
Any Crisis		-0.797**
		(0.357)
Constant	-0.329	0.400
	(0.517)	(0.510)
Observations	154	154
Pseudo R2	0.100	0.086

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

3. Decision-Based Regressions for the Two Percent Sample

We repeat our process of bivariate regressions with the two percent sample for the decision-based analysis. Table 9 shows the multivariate results with four regressions. First, we combine significant variables from the bivariate regressions. We find that state-owned banks are more likely to be classified as zombies. State-owned banks are typically plagued by numerous inefficiencies, resulting in lower profitability, higher risk, less capital, and higher NPLs (Berger et al. 2005; Cornett et al. 2010; Levy Yeyati et al. 2004). In addition, it is well documented that state-owned banks can be challenging to supervise due to legal shortcomings, practical autonomy, business structure, and risk management (Adams et al. 2022). Thus, our results support the theory that state-owned banks have less of an incentive to maintain a strong capital position and may be propped up by the government when needed.

Table 9. Decision-Based Bivariate Regressions: Two Percent Sample

	DBA	DBA	DBA	DBA	DBA		DBA	DBA	DBA	DBA	DBA
	Bank						Macroeconomic				
Size	-0.010					Inflation	-0.054***				
	(0.014)						(0.019)				
Equity Ratio		-0.497*				Low Income Dummy		0.799***			
		(0.300)						(0.291)			
State Ownership			0.780**			Credit to GDP			-0.004		
			(0.312)						(0.005)		
Bank Assets to GDP				-0.1180***		Credit Growth				0.018*	
				(0.042)						(0.009)	
ROA					0.370	Government Debt to GDP					-0.003
					(0.541)						
Constant	-0.551**	-0.761***	-0.854***	-0.658***	-0.605***		-0.210	-0.888***	-0.440*	-0.664***	-0.549**
	(0.214)	(0.142)	(0.151)	(0.130)	(0.154)		(0.199)	(0.156)	(0.249)	(0.150)	(0.232)
Observations	266	266	265	265	256		252	266	233	220	262
Pseudo R2	0.001	0.009	0.018	0.002	0.002		0.02	0.022	0.002	0.012	0.001

	DBA	DBA	DBA	DBA	DBA		DBA	DBA	DBA	DBA	DBA
	Structural						Program and Crisis				
Government Effectiveness	-0.265					Program Country	-0.385				
	(0.303)						(0.265)				
Control of Corruption		-0.214				Banking Crisis		-1.281***			
		(0.388)						(0.463)			
Regulatory Quality			-0.433			Currency Crisis			-0.773**		
			(0.321)						(0.314)		
Bank Branches				0.00339		Debt Crisis				-0.204	
				(0.012)						(0.297)	
ATMs					-0.004	Any Crisis					-0.544**
					(0.003)						(0.262)
Constant	-0.748***	-0.782**	-0.854***	-0.660***	-0.412*		-0.507***	-0.511***	-0.472***	-0.617***	-0.392**
	(0.202)	(0.323)	(0.224)	(0.234)	(0.216)		(0.169)	(0.138)	(0.149)	(0.151)	(0.183)
Observations	229	229	229	182	184		266	266	266	266	266
Pseudo R2	0.003	0.001	0.007	0.000	0.012		0.006	0.028	0.019	0.001	0.013

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

In an attempt to capture unobserved country characteristics, we add country dummies to our analysis of the two percent sample (since the loss of degrees of freedom is less than in the negative sample). While the fit of the regressions improves considerably, some dummy variables, such as the banking crisis dummy, lose significance (Table 10).

Table 10. Decision-Based Multivariate Regressions: Two Percent Sample

VARIABLES	DBA	DBA	DBA	DBA
Equity Ratio	-0.627*	-1.011**	-0.690**	-1.146**
	(0.337)	(0.442)	(0.309)	(0.461)
State Ownership	1.043***	1.376***	1.014***	1.232***
	(0.349)	(0.478)	(0.327)	(0.465)
Low Income	0.866***	0.202	0.758**	0.676
	(0.313)	(1.474)	(0.298)	(1.413)
Banking Crisis	-1.306***	-1.006		
	(0.492)	(0.960)		
Inflation	-0.039	-0.034		
	(0.269)	(0.056)		
Constant	-0.758***	-0.483	-0.890***	-1.075
	(0.269)	(1.345)	(0.232)	(1.214)
Country Dummies	No	Yes	No	Yes
Observations	252	185	266	193
Pseudo R2	0.098	0.190	0.070	0.186

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Next, informed by the bivariate regressions (see Table 11) we generate multivariate regressions for the outcome-based analysis. We test the interaction of dummy variables for IMF programs and banking crises. In addition, we include the equity ratio, regulatory quality, and a dummy for low income (Table 12). Notably, banks in countries experiencing a banking crisis are less likely to be zombies, but only when country dummies are included. Again, this supports the notion that there is a lot of country heterogeneity at play that is not easily quantifiable in the variables we have investigated.

Table 11. Outcome-Based Bivariate Regressions: Two Percent Sample

	OBA	OBA	OBA	OBA	OBA		OBA	OBA	OBA	OBA	OBA
	Bank						Macroeconomic				
Size	-0.022					Inflation	-0.020				
	(0.014)						(0.013)				
Equity Ratio		-0.757**				Low Income Dummy		0.873***			
		(0.303)						(0.292)			
State Ownership			0.029			Credit to GDP			0.000		
			(0.324)						(0.005)		
Bank Assets to GDP				2.31		Credit Growth				0.013	
				(3.270)						(0.009)	
ROA					-0.341	Government Debt to GDP					0.002
					(0.399)						(0.005)
Constant	-0.461**	-0.859***	-0.722***	-0.764***	-0.739***		-0.541***	-0.962***	-0.776***	-0.842***	-0.812***
	(0.212)	(0.142)	(0.147)	(0.142)	(0.149)		(0.179)	(0.159)	(0.250)	(0.156)	(0.248)
Observations	266	266	265	265	256		252	266	233	220	262
Pseudo R2	0.007	0.019	0.000	0.008	0.002		0.004	0.027	0.000	0.007	0.000

	OBA	OBA	OBA	OBA	OBA		OBA	OBA	OBA	OBA	OBA
	Structural						Program and Crisis				
Government Effectiveness	-0.441					Program Country	-0.660**				
	(0.297)						(0.273)				
Control of Corruption		-0.432				Banking Crisis		-1.022**			
		(0.388)						(0.438)			
Regulatory Quality			-0.568*			Currency Crisis			-0.157		
			(0.316)						(0.294)		
Bank Branches				0.001		Debt Crisis				-0.504	
				(0.012)						(0.311)	
ATMs					-0.000	Any Crisis					-0.442*
					(0.003)						(0.263)
Constant	-0.853***	-0.968***	-0.948***	-0.607***	-0.628***		-0.450***	-0.588***	-0.677***	-0.594***	-0.494***
	(0.202)	(0.326)	(0.223)	(0.235)	(0.2188)		(0.168)	(0.140)	(0.154)	(0.150)	(0.185)
Observations	229	229	229	182	184		266	266	266	266	266
Pseudo R2	0.007	0.004	0.011	0.000	0.000		0.018	0.019	0.001	0.008	0.008

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 12. Outcome-Based Multivariate Regressions: Two Percent Sample

VARIABLES	OBA	OBA
Equity Ratio	-0.994**	-0.923
	(0.458)	(0.580)
Low Income	0.8672**	3.33
	(0.335)	(2.794)
Regulatory Quality	-0.344	-2.430
	(0.333)	(1.779)
Program Country	-0.575*	-0.537
	(0.323)	(0.793)
Banking Crisis	-1.125**	-2.23**
	(0.559)	(0.997)
Constant	-0.887***	-4.608
	(0.258)	(3.445)
Country Dummies	No	Yes
Observations	229	164
Pseudo R2	0.082	0.146

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

B. Alternative Specifications

1. Disaggregation by Region

In our analysis above, we have identified the importance of country specific characteristics via the inclusion of country dummies. To further understand this relationship, we divide our wider two percent sample into four regions: Africa, Asia and Pacific, Europe, and the Americas, and obtain multivariate regressions for each region (see Table 13).

We find that the determinants of zombie status (using the decision-based criterion) are vastly different across regions. This suggests that in the global regressions many factors may be “cancelling out” some of the effects seen in certain geographical areas. In Africa, for example, state ownership is an important driver of zombie status, as is the bank’s location in a low-income country. In Asia and the Pacific, ROA, as a bank-specific variable, is found to be significant, along with inflation, suggesting that relatively profitable banks are allowed to persist as zombie banks. In the Americas, bank size is a significant factor for zombie bank status. However, contrary to the “too-big-to-fail” hypothesis, it is the smaller banks that are not treated and become zombies. Additionally, lower control of corruption also increases the likelihood of zombie bank status. The regression for Europe reveals that a higher level of government debt relative to GDP is associated with a lower probability of zombie status, which is somewhat counterintuitive given that the cost of bank resolution is typically less bearable for highly indebted jurisdictions.

2. Country-Level Regressions for Share of Zombie Banks

In addition, we specify an alternative set of regressions for the two percent sample using DBA and OBA. These regressions relate the share of zombie banks, as measured by the ratio of zombie bank assets to system

assets, to each of our 20 explanatory variables. We use the country average of each variable, with each variable measured at the year a bank enters the sample. This helps us capture banking sector concentration and is an alternative to the Herfindahl-Hirschman Index, which we found to be insignificant.

The results of these bivariate OLS regressions using DBA and OBA with robust standard errors are shown in Tables 14 and 15, respectively. We find that inflation and banking crises lower the probability of a high share of zombie assets in the DBA. This is consistent with bank-level results using a dummy variable for DBA as the dependent variable. In the OBA, higher shares of government debt to GDP are associated with an increasing share of zombie assets in a given country. This lies in contrast to the bank-by-bank regressions for the OBA analysis, where government debt to GDP was not a significant determinant of zombie status. Overall, though, most regressors are not significant in isolation. For this reason, we omit a multivariate analysis using zombie shares.

Table 13. Regional Regressions

Africa		Asia and Pacific	
	DBA		DBA
Equity Ratio	-5.373***	Inflation	-0.075*
	(1.978)		(0.045)
State Ownership	2.728***	Government Effectiveness	-0.770
	(0.985)		(0.559)
Low Income Dummy	1.650**	ROA	4.411**
	(0.765)		(1.889)
Constant	-2.216***	Constant	0.202
	(0.752)		(0.395)
Observations	56	Observations	82
Pseudo R2	0.290	Pseudo R2	0.099

Europe		The Americas	
	DBA		DBA
Government Debt to GDP	-0.044**	Size	0.275***
	(0.021)		(0.103)
ROA	-0.134	Control of Corruption	-5.002**
	(0.749)		(2.046)
State Ownership Dummy	0.612	Debt Crisis	3.396**
	(0.732)		(1.711)
Regulatory Quality	1.348		
	(1.054)		
Constant	0.291	Constant	-9.628***
	(0.594)		(3.049)
Observations	61	Observations	26
Pseudo R2	0.103	Pseudo R2	0.484

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 14. Decision-Based Bivariate Regressions: Two Percent Sample with Zombie Shares

	Bank						Macroeconomic					
Size	0.0414					Inflation	-0.803**					
	(0.661)						(0.358)					
Equity Ratio		5.026				Low Income		-0.894				
		(5.808)						(7.717)				
State Ownership			0.155			Credit to GDP			0.009			
			(6.401)						(0.124)			
Bank Assets to GDP				-0.0000		Credit Growth				-0.366		
				(0.0000)						(0.230)		
ROA					16.51	Government Debt to GDP					0.081	
					(13.76)						(0.103)	
Constant	13.04	19.05***	14.31***	13.85***	13.58***		19.05***	13.85***	13.45**	16.77***	8.512	
	(9.938)	(5.195)	(3.798)	(3.832)	(4.796)		(5.195)	(3.832)	(5.505)	(4.663)	(5.639)	
Observations	69	63	69	69	69		63	69	59	56	67	
Pseudo R2	0.000	0.042	0.003	0.000	0.002		0.042	0.000	0.000	0.015	0.009	

	Structural						Program and Crisis					
Government Effectiveness	-6.867					Program Country	1.588					
	(6.785)						(6.628)					
Control of Corruption		-9.623				Banking Crisis		-14.56***				
		(8.164)						(3.555)				
Regulatory Quality			-10.28			Currency Crisis			-6.390			
			(6.585)						(8.872)			
Bank Branches				-0.0434		Debt Crisis				6.873		
				(0.217)						(7.099)		
ATMs					-0.0861	Any Crisis					0.790	
					(0.054)						(6.462)	
Constant	9.152**	6.489	7.065*	9.652**	11.25***		12.79***	14.70***	14.76***	10.660***	13.21***	
	(4.075)	(5.785)	(3.863)	(4.120)	(3.533)		(4.640)	(3.554)	(3.634)	(3.253)	(3.957)	
Observations	62	62	62	53	54		69	69	69	69	69	
Pseudo R2	0.020	0.027	0.058	0.001	0.023		0.001	0.019	0.008	0.016	0.000	

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 15. Outcome-Based Bivariate Regressions: Two Percent Sample with Zombie Shares

	Bank						Macroeconomic					
Size	0.297						Inflation	-0.463**				
	(0.333)							(0.226)				
Equity Ratio		-1.200					Low Income		2.392			
		(3.689)							(5.436)			
State Ownership			6.713				Credit to GDP			0.0236		
			(5.015)							(0.085)		
Bank Assets to GDP				0.000***			Credit Growth				-0.242	
				(0.0000)							(0.226)	
ROA					0.530		Government Debt to GDP					0.184**
					(9.472)							(0.076)
Constant	0.297	9.956***	7.390***	9.468***	10.48***			12.99***	9.559***	9.078***	12.22***	-0.342
	(0.333)	(2.615)	(2.467)	(2.294)	(2.894)			(3.332)	(2.678)	(3.398)	(3.843)	(3.720)
Observations	69	69	69	69	67			63	69	59	56	67
Pseudo R2	0.007	0.000	0.030	0.0064	0.000			0.036	0.003	0.001	0.058	0.122

	Structural						Program and Crisis					
Government Effectiveness	-5.943						Program Country	-6.267				
	(4.433)							(4.777)				
Control of Corruption		-10.38*					Banking Crisis		-1.021			
		(6.026)							(6.163)			
Regulatory Quality			-8.713				Currency Crisis			3.106		
			(5.701)							(8.957)		
Bank Branches				-0.0925			Debt Crisis				4.996	
				(0.196)							(4.966)	
ATMs					-0.0958**		Any Crisis					2.461
					(0.0436)							(4.516)
Constant	7.865**	4.157	6.164**	11.24***	12.51***			13.47***	10.19***	9.574**	7.942***	8.759***
	(2.517)	(3.425)	(2.728	(3.355)	(2.960)			(4.165)	(2.478)	(2.146)	(2.313)	(2.733)
Observations	62	62	62	53	54			69	69	69	69	69
Pseudo R2	0.027	0.054	0.073	0.003	0.034			0.027	0.000	0.004	0.017	0.004

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

C. Discussion of Results

The results of the spatially disaggregated regressions illustrate that the relationship between individual variables and zombie bank status is much more pronounced by region than overall. This is borne out by the regression fit being much tighter than in the aggregate (e.g., a pseudo R2 of between 0.1 and 0.48 compared to between 0.05 and 0.1 for the global specifications without country dummies). More specifically, the rather low fit for individual variables at the global level is due to significant results in one of the regions being offset by a loose fit in others.

While at the global level mostly country-specific drivers are found to matter (e.g., low-income country status, banking crisis), bank-specific variables where we had expected significance overall show a tight relationship only at the regional level, For example, the equity ratio and state ownership are notable for Africa, return on assets stands out for Asia and the Pacific, and bank size emerges as a significant factor for the Americas. The lack of significance of the macroeconomic variables should not be a surprise because it is not evident that systemic factors should impact banks differently (the macro environment should impact a bank's probability of default but not necessarily the likelihood of being treated). Also, the significance of credit growth in countries with higher incidence of zombie banks may be a function of the level of economic development, which aligns with the significance of the low-income dummy (the two variables have a correlation of 0.3).

It is also noteworthy that we find consistently significant results for both the decision-based and the outcome-based analyses for only a few variables, such as low-income status and crisis variables. The equity ratio, except in the OBA for the negative sample, also demonstrates significance. This illustrates that the decision to treat an ailing bank is quite different from the actual outcome post-treatment or the lack thereof. For example, while it does not appear that bank size plays a role in the decision whether to treat a bank, smaller banks tend to end up as zombies regardless of prior treatment. Also, we find significance for credit growth and inflation as determinants in the treatment decision but not for the eventual outcome. Conversely, being under an IMF program cannot be shown to influence the treatment decision, but we find that such programs lower the incidence of zombie bank status after the fact. However, the significance of the program dummy vanishes when combined or interacted with any of the crisis variables. Nevertheless, the significance of the crisis variables illustrates that during banking crises and/or other crisis episodes the zombie bank issue is addressed more extensively, often propelled by IMF programs requiring a clean-up of the banking sector.

The fact that inclusion of country dummies approximately doubles the regression fit, which was initially on the low side, conveys that important drivers are not modelled. Apart from the usual omitted variable bias, it becomes apparent that the factors weighing heavily in decision-making processes are difficult to capture. In fact, it may indeed come down to a certain preference of decision-makers to keep specific banks afloat and to resolve others. Given the extensive set of regressors tested, it appears that the share of these unobserved factors in the process dominates the empirical results.

We do not find evidence supporting the involvement of structural factors in the zombie bank process. Apart from mild significance for the regulatory quality variable in the two percent sample and the control of corruption variable in the regional regression for the Americas, governance variables do not appear to have significant impact. Similarly, the financial inclusion variables related to the number of bank branches or ATMs relative to population size, and other such variables we initially tested, do not show a significant influence. The lack of significance, however, does not rule out the possibility that unobserved bank-specific governance factors or considerations around facilitating access to finance play a role in the decision-making process, as indicated by

the significance of the credit growth variable. Lastly, though we recognize that there is a link between weak banks and weak borrowers, the nature of our data did not allow us to explore this question. We leave the exploration of this relationship to future research.

V. CONCLUSIONS

The contribution of this paper to the zombie bank literature is twofold. First, we conduct the first comprehensive multi-country study on the determinants of zombie bank status outside the advanced economies sphere. To operationalize the identification of zombie banks in vastly different regulatory regimes of emerging and developing countries around the globe, we apply the objective criterion of clear undercapitalization and identify zombie banks by the lack of treatment by owners and regulators and, alternatively, subsequent continued undercapitalization regardless of previous treatment.

Second, we conduct an empirical investigation into the drivers of zombie bank status, testing variables representing four different types of factors (bank-specific, country, structural, and crisis-related). It would seem from the findings that, overall, country-specific factors matter more than bank-specific drivers or structural factors for the emergence of zombie banks. In particular, the regression results corroborate that undercapitalized banks in low-income countries are more likely to end up as zombies, while the reverse is true for countries experiencing banking or other crises. Additionally, there is also some evidence for bank-specific factors, such as state ownership and the equity ratio, which indicates that the size of the capital gap matters. Disaggregation by region illustrates that there are specific drivers in each region, including some that are not found significant overall (e.g., return on assets and bank size) because they evidently do not matter in other regions. This also explains the relatively loose regression fit at the overall level compared to that of the regional regressions.

Since most of the variation remains unexplained empirically, we conclude that beyond omitted variable bias, a good part of the factors behind the decision whether to treat a bank or let it linger remains unobserved and hence difficult to model. In the end, it is a complex decision involving a variety of considerations and restrictions, especially in less-developed countries where regulatory recapitalization rules, resolution triggers, and processes may be less well-defined. In these contexts, there may be perceived merit in the survival of undercapitalized banks, notwithstanding the long-run disadvantages associated with this decision. The results seem to point to the importance of reducing the random component of the decision-making process. Achieving this goal might be achieved by installing a proper regulatory framework and an effective resolution regime, both of which are essential to maximize the efficiency of dealing with undercapitalized banks and minimize the possibility of moral hazard. While not directly borne out by the empirical findings, the paper raises important questions about the ability of governments to backstop the restructuring and resolution of zombie banks and how this affects the outcomes from treatment. The results also underscore the role of external support, such as an IMF program in a crisis situation, in expediting the needed bank restructuring and resolution. Further research into the productivity implications of inadequate restructuring/resolution of zombie banks and the tangible impacts of such banks, such as inefficient allocation of capital, hiding of losses, or the need for state support, is clearly warranted. as is investigation of the less apparent drivers of zombie bank status.

APPENDIX

Table A1. Correlation Matrix

	Size	Equity Ratio	State Ownership	Bank Assets to GDP	ROA	Inflation	Low Income	Credit to GDP	Credit Growth	Gov. Debt to GDP
Size	1.00	-0.03	0.05	0.35	0.01	-0.03	-0.32	-0.24	0.16	0.03
Equity Ratio	-0.03	1.00	0.02	0.09	0.73	-0.04	-0.08	-0.06	0.05	0.10
State Ownership	0.05	0.02	1.00	-0.02	-0.05	0.16	-0.10	-0.01	-0.06	-0.05
Bank Assets to GDP	0.35	0.09	-0.02	1.00	0.11	0.01	-0.12	-0.05	0.09	0.08
ROA	0.01	0.73	-0.05	0.11	1.00	-0.08	0.17	-0.16	0.16	-0.06
Inflation	-0.03	-0.04	0.16	0.01	-0.08	1.00	-0.22	0.08	-0.55	0.11
Low Income	-0.32	-0.08	-0.10	-0.12	0.17	-0.22	1.00	-0.19	0.30	-0.11
Credit to GDP	-0.24	-0.06	-0.01	-0.05	-0.16	0.08	-0.19	1.00	-0.28	0.19
Credit Growth	0.16	0.05	-0.06	0.09	0.16	-0.55	0.30	-0.28	1.00	-0.29
Gov. Debt to GDP	0.03	0.10	-0.05	0.08	-0.06	0.11	-0.11	0.19	-0.29	1.00
Gov. Effectiveness	0.14	0.01	-0.10	0.14	-0.09	-0.09	-0.56	0.41	-0.18	0.11
Reg. Quality	0.10	0.10	-0.10	0.10	-0.05	-0.22	-0.42	0.23	-0.11	0.22
Control of Corruption	0.05	0.15	-0.15	0.26	0.14	-0.27	-0.04	0.19	0.07	0.25
Bank Branches	0.03	-0.06	-0.03	-0.05	-0.09	-0.01	-0.44	0.13	0.09	-0.47
ATMs	-0.08	-0.17	0.06	-0.14	-0.30	0.22	-0.56	0.35	-0.30	-0.29
Currency Crisis	-0.10	-0.21	0.10	-0.12	-0.32	0.47	-0.35	0.26	-0.42	-0.07
Debt Crisis	0.08	0.00	0.13	0.05	-0.10	0.30	-0.05	-0.18	-0.06	0.30
Banking Crisis	0.07	-0.07	0.19	-0.05	-0.28	0.43	-0.16	0.23	-0.35	0.16
Any Crisis	0.09	-0.17	0.18	-0.05	-0.29	0.43	-0.28	-0.00	-0.20	-0.21
Program Country	-0.12	0.11	0.06	-0.08	-0.02	0.13	0.04	-0.04	-0.19	0.31

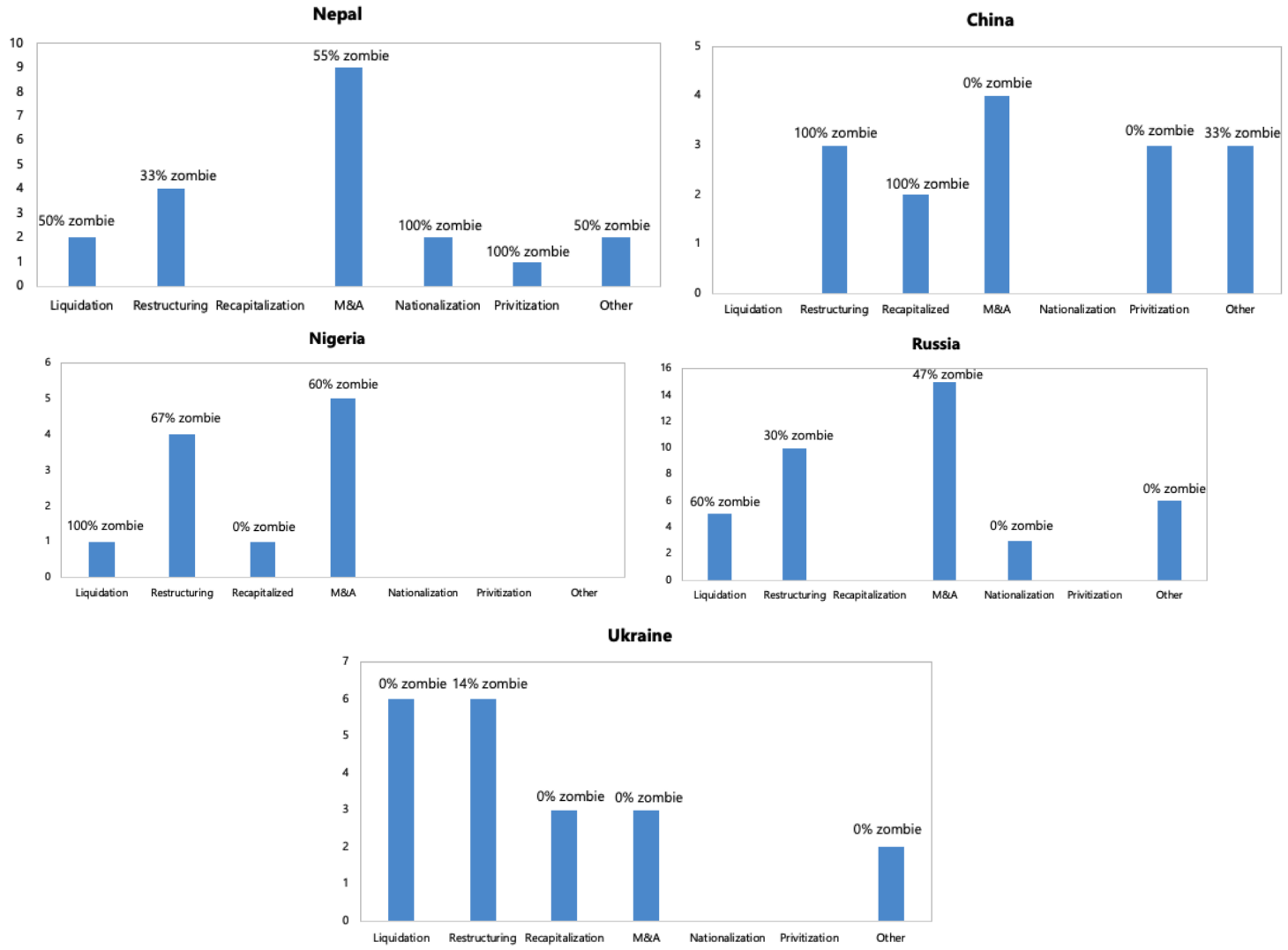
	Gov. Effectiveness	Regulatory Quality	Control of Corruption	Bank Branches	ATMs	Currency Crisis	Debt Crisis	Banking Crisis	Any Crisis	Program Country
Size	0.14	0.10	0.05	0.03	-0.08	-0.10	0.08	0.07	0.09	-0.12
Equity Ratio	0.01	0.10	0.15	-0.06	-0.17	-0.21	0.00	-0.07	-0.17	0.11
State Ownership	-0.10	-0.10	-0.15	-0.03	0.06	0.10	0.13	0.19	0.18	0.06
Bank Assets to GDP	0.14	0.10	0.26	-0.05	-0.14	-0.12	0.05	-0.05	-0.05	-0.08
ROA	-0.09	-0.05	0.14	-0.09	-0.30	-0.32	-0.10	-0.28	-0.29	-0.02
Inflation	-0.09	-0.22	-0.27	-0.01	0.22	0.47	0.30	0.43	0.43	0.13
Low Income	-0.56	-0.42	-0.04	-0.44	-0.56	-0.35	-0.05	-0.16	-0.28	0.04
Credit to GDP	0.41	0.23	0.19	0.13	0.35	0.26	-0.18	0.23	-0.00	-0.04
Credit Growth	-0.18	-0.11	0.07	0.09	-0.30	-0.42	-0.06	-0.35	-0.20	-0.19
Gov. Debt to GDP	0.11	0.22	0.25	-0.47	-0.29	-0.07	0.30	0.16	-0.21	0.31
Gov. Effectiveness	1.00	0.77	0.53	0.47	0.47	0.11	-0.27	-0.21	-0.13	-0.31
Reg. Quality	0.77	1.00	0.58	0.26	0.20	-0.09	-0.23	-0.08	-0.20	-0.07
Control of Corruption	0.53	0.58	1.00	-0.03	-0.18	-0.30	-0.19	-0.32	-0.41	-0.08
Bank Branches	0.47	0.26	-0.03	1.00	0.71	0.31	-0.41	-0.32	0.19	-0.51
ATMs	0.47	0.20	-0.18	0.71	1.00	0.69	-0.12	0.04	0.51	-0.30
Currency Crisis	0.11	-0.09	-0.30	0.31	0.69	1.00	0.12	0.26	0.77	-0.07
Debt Crisis	-0.27	-0.23	-0.19	-0.41	-0.12	0.12	1.00	0.34	0.42	0.39
Banking Crisis	-0.21	-0.08	-0.32	-0.32	0.04	0.26	0.34	1.00	0.45	0.33
Any Crisis	-0.13	-0.20	-0.41	0.19	0.51	0.77	0.42	0.45	1.00	-0.02
Program Country	-0.31	-0.07	-0.08	-0.51	-0.30	-0.07	0.39	0.33	-0.02	1.00

Table A2. Zombie Transition Matrix

	Zombie in t1 (DBA)	Zombie in t1 (OBA)	Zombie in t2 (DBA)	Zombie in t2 (OBA)
Yes	34%	47%	19%	33%
No	66%	53%	81%	67%

Note: DBA = decision-based analysis; OBA = outcome-based analysis; t1 = year 1; t2 = year 2

Figure A1. Treatment and Zombie Status for Selected Countries



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