Jurnal Ekonomi Malaysia 59(2) 2025
http://dx.doi.org/10.17576/JEM-2025-5902-12

The Role of Competition and Size on Zombie Rural Banks in Indonesia
(*Peranan Persaingan dan Saiz terhadap Bank Luar Bandar "Zombie" di Indonesia*)

Rahmat Siauwijaya
Bina Nusantara University

Claudya Calvina Izumi
Bina Nusantara University

Verin Dwi Tiana
Bina Nusantara University

Grisherra Valeryandra
Bina Nusantara University

ABSTRACT

This study aims to identify rural banks categorized as "zombies" and explore how competitiveness level and bank size affect their likelihood of becoming zombies. This study uses data from rural banks spanning 2015 to 2022 and applies logistic regression analysis on balanced panel data. Findings indicate that increasing competitiveness among rural banks reduces their likelihood of becoming zombies, while larger bank size increases this risk. Specifically, a 1 percent increase in competitiveness decreases the probability of rural banks becoming zombies by 15–17 percent, whereas a 1 percent increase in bank size can increase this probability by 29–88 percent. Province-level analysis also identifies specific provinces that strongly influence zombie information. Robustness tests using the Panzar–Rosse H-statistic confirm the negative competition effect, although statistical significance is concentrated in one zombie definition, thereby validating the main results. Instrumental variable estimates that use provincial banking density as an instrument indicate that potential endogeneity is limited and does not materially bias the conclusions. Moreover, the competition effect is markedly stronger on the island of Java, and Banten emerges as a provincial hotspot for zombie rural banks, underscoring geographic heterogeneity in the phenomenon. This study expands existing literature by considering regional differences and exploring the impact of competition and bank size on rural banks within and outside the island of Java. The findings of this study suggest that policymakers and regulators need to carefully monitor rural banks and enhance regulation and supervision to mitigate the risk of zombie bank formation. The insights provided can also be implemented to improve the stability and sustainability of the banking sector.

Keywords: Rural bank; zombie; competition; size; instrumental variable

ABSTRAK

Kajian ini bertujuan untuk mengenalpasti dan menganalisis bank-bank luar bandar/desa yang dikategorikan "zombie", dengan meneroka hubungan antara tingkat persaingan dan saiz bank terhadap risiko bank-bank luar bandar/desa menjadi zombie.Kajian ini menggunakan data bank-bank desa dari tahun 2015 hingga 2022 dengan menggunakan analisis regresi logistik panel data. Dapatan kajian menunjukkan bahawa peningkatan tingkat persaingan di antara bank-bank desa mengurangkan kemungkinan bank-bank tersebut menjadi zombi, sementara saiz bank yang lebih besar meningkatkan risiko ini. Secara khususnya, peningkatan tingkat persaingan sebanyak 1 peratus mengurangkan peluang bank-bank desa menjadi zombi sebanyak 15-17 peratus, sedangkan peningkatan saiz bank sebanyak 1 peratus dapat meningkatkan peluang ini sebanyak 29-88 peratus Analisis tingkat wilayah juga mendapati terdapat wilayah-wilayah tertentu signifikan mempengaruhi pembentukan zombi bank. Ujian keteguhan menggunakan H-Statistic dari model Panzar–Rosse mengesahkan hubungan negatif antara persaingan dan risiko zombi, walaupun secara statistiknya signifikan pada salah satu definisi zombi. Hasil penganggaran IV menggunakan kepadatan perbankan wilayah sebagai instrumen menunjukkan bahawa potensi endogen cenderung lemah dan tidak menyebabkan kesimpulan utama berat sebelah. Selain itu, kesan persaingan didapati lebih kuat pada BPR di Pulau Jawa, dan Wilayah Banten muncul sebagai kawasan tumpuan wilayah untuk bank desa zombi, menggariskan heterogeniti geografi dalam fenomena itu. Kajian ini mengembangkan literatur sediaada dengan mempertimbangkan perbezaan wilayah dan meneroka kesan persaingan, saiz bank terhadap bank-bank desa di dalam dan di luar pulau Jawa. Dapatan kajian ini, memberi implikasi kepada penggubal dasar dan pengawal selia untuk mamantau dengan teliti bank desa dan meningkatkan peraturan dan penyeliaan untuk mengurangkan risiko pembentukan bank zombi. Selain itu, pandangan yang diberikan boleh dilaksanakan untuk meningkatkan kestabilan dan kemampanan sektor perbankan.

Kata kunci: Bank-bank luar bandar/desa; zombi; persaingan; saiz, pembolehubah instrumen

JEL: G21, G28, L11, C23, R12

INTRODUCTION

Rural banks in Indonesia have a crucial function in supporting the rural economy. They provide financial services such as savings, agricultural financing, and loans for small businesses, helping reduce the economic gap between urban and rural areas. People in rural areas can use them to access capital more easily to start or expand their businesses. However, if rural banks experience financial problems and become "zombies," rural communities will have difficulty accessing the funds they need. Figure 1 illustrates the dynamics that may contribute to the emergence of zombie rural banks in Indonesia. The increase in non-performing loans (NPL) from 2015 to 2020 indicates that borrowers increasingly failed to repay loans, signaling credit problems for some rural banks and threatening their operational sustainability. At the same time, the decrease in return on assets (ROA) from year to year indicates the banks' declining profitability and weak financial health, increasing their risk of becoming zombies. The decrease in rural bank numbers over the past eight years also signifies financial difficulties that led to the zombification of some banks. Therefore, the declining number of rural banks, increasing NPLs, and decreasing ROA indicate financial challenges that underscore the need for research on zombie rural banks in Indonesia. However, despite these trends, literature on zombie rural banks in Indonesia remains scarce.

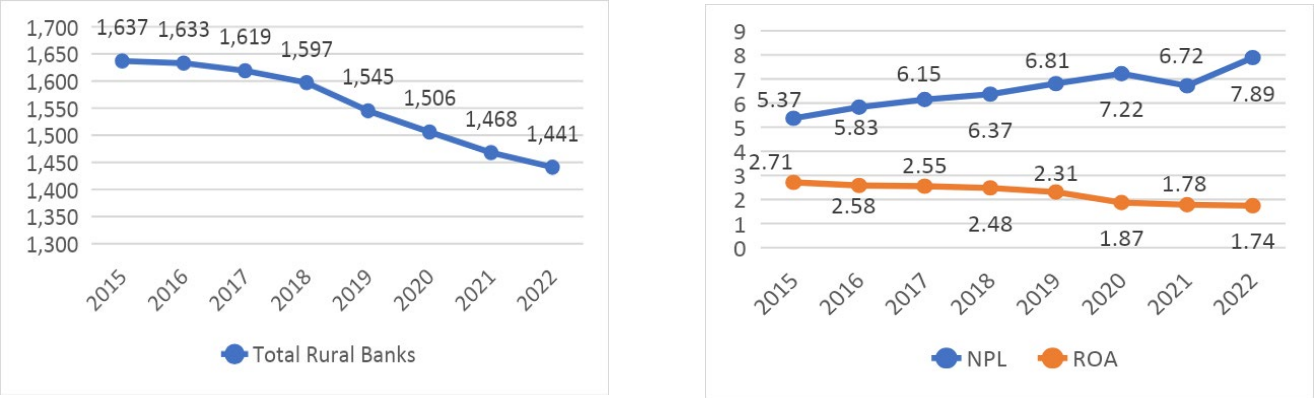


FIGURE 1. Statistics on the total number of rural banks, non-performing loans (NPL), and return on assets (ROA) in Indonesia from 2015 to 2022. Source: Indonesian Banking Statistics

Fukuda and Nakamura (2011) define a zombie company as a company with earnings before interest and taxes (EBIT) smaller than interest payments at the market interest rate, while McGowan et al. (2018) define it as a company that has existed for at least 10 years and have an interest coverage ratio (ICR) below 1 for three successive years. Figure 2 illustrates the number of zombie rural banks in three categories (zombie1, zombie2, zombie3) from 2015 to 2022. Over this eight-year period, the number of zombie rural banks in each category fluctuated. Although increases and decreases in the number of zombie rural banks occur yearly, there is a general decreasing trend from 2019 to 2022 in all categories. These data provide an overview of zombie rural banks in the Indonesian banking system. Further analysis can provide deeper insights into the factors influencing the presence of zombie rural banks and the efforts to reduce this issue in the banking industry.

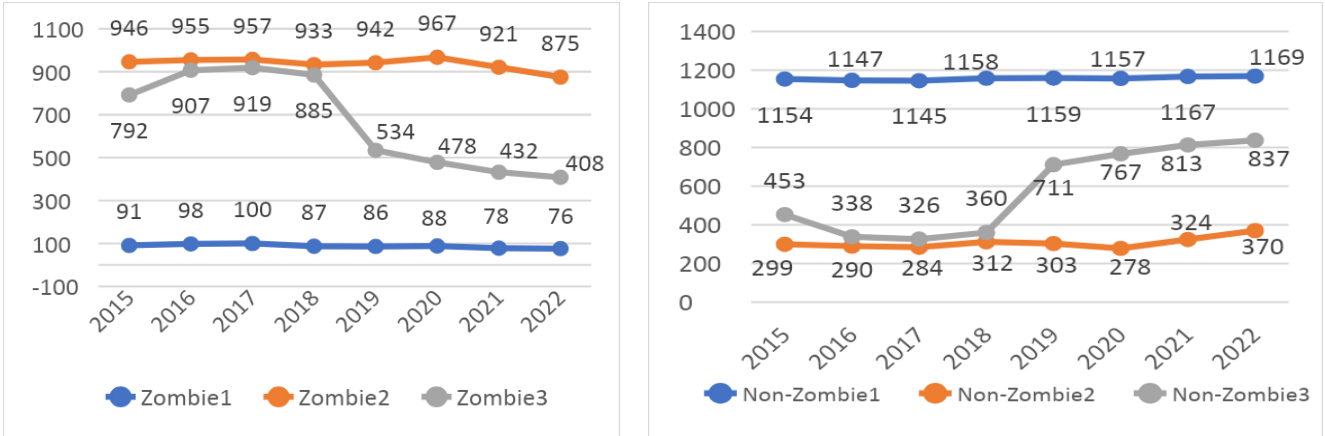


FIGURE 2. Number of reported zombie banks each year from 2015 to 2022. Three zombie categories are observed (zombie1, zombie2, zombie3).

Several studies have identified zombie banks from the operational side, such as profitability, efficiency, asset-based income, and cost-based income (Fiordelisi et al. 2021; Wezel et al. 2024). Zombie firms are caused by banks possessing reduced capital and liquidity levels (Acharya et al. 2024; Berger et al. 2021) and financial health (Albuquerque & Iyer 2023). Garcia-Merino et al. (2025) state that industries predominantly composed of zombie companies show lower job creation and productivity. This finding is supported by McGowan et al. (2018) and Banerjee and Hofmann (2018), who note that zombie firms can diminish economic performance by depressing productivity, thereby negatively impacting healthy firms. Siauwijaya (2017) argues that if a bank manager can utilize resources well, they can prevent the bank's finances from deteriorating. This article aims to report the number of zombie rural banks each year and investigate the characteristics of zombie firms through literature explaining their existence. Finally, it explores whether competition and bank size impact the formation of zombie rural banks at the national and provincial levels, specifically in Java.

Competition and size impact the formation of zombie rural banks across all categories (zombie1, zombie2, zombie3). Heightened market competition markedly decreases the probability of rural banks transitioning into zombie status (ZS) through enhanced efficiency, innovation, and product and service quality. It can drive companies to offer products and services that better meet market needs. We also discovered that expanding the size of rural banks will elevate their likelihood of becoming zombies because larger companies have greater complexity in their operational management. Moreover, larger rural banks tend to have higher levels of debt to finance their expansion, investments, and operational costs.

LITERATURE REVIEW

The idea of zombies in economic literature was initially put forth by Kane (1987), who characterizes zombies as institutions that remain alive despite having poor finances. Subsequently, several studies used the term "zombie firm" to describe companies that have gone bankrupt but can still operate by depending on loans from financial entities and government support (Albuquerque & Iyer 2023; Bargagli-Stoffi et al. 2023). The concept of zombies became more widely known when Banerjee et al. (2024) investigated Japanese companies that should have gone bankrupt but could continue operating for a long time. They found that these bankrupt companies survived because of support from government subsidies and lenders and categorized them as "zombies."

The empirical literature defines zombie companies in various ways, from firms with negative earnings to firms that are likely to receive subsidies. Zhaxi and Yasuda (2024) defined zombies as companies with interest costs lower than market interest rates. Meanwhile, Zhaxi and Yasuda (2024) defined them as insolvent firms that continue to operate due to support from financial institutions and the government. They argued that the financial structure of a company likely influences its probability of becoming a zombie. Fukuda and Nakamura (2011) defined zombie firms as companies with a debt-to-asset ratio of over 50 percent, which increases yearly, and EBIT smaller than interest payments at market interest rates.

Some empirical literature on zombie banks (e.g., Fiordelisi et al. 2021) and detecting zombie banks (Zhang & Huang 2022) have examined the effect of competition on zombie banks. Zhaxi and Yasuda (2024) identified and compared the traits of zombie firms. Banerjee et al. (2024) stated that job creation and productivity decrease while unemployment increases in industries dominated by zombie companies. Fiordelisi et al. (2021) stated that zombie banks with low profits cannot expand their activities, arguing that if these banks can survive, they can rebuild capital slowly from income rather than optimize balance sheet results. Reis (2018) believed that loss-making banks have difficulty raising equity capital from investors because they are hesitant to contribute.

Although several studies have explored the operational weaknesses of zombie firms, relatively limited literature explicitly integrates theory of competition—especially that measured by the Lerner index—into explaining the formation of zombie banks. The Lerner index captures the degree or market power and pricing above marginal cost, providing a theorical link between reduced competition and the persistence of inefficient banks, including zombie institutions. In markets with low competition, zombie banks may survive due to limited external pressure to restructure or exit, creating inefficiencies in resource allocation. Thus, in this study, the Lerner index is not merely a measure of market concentration but also a key transmission mechanism. The higher the index value (indicating greater market power and price markups above marginal cost), the greater the room for underperforming banks to survive, thereby increasing the prevalence of zombie banks

The Indonesia banking sector has shifted from high consolidation to heightened competition. Some literature about bank competition in Indonesia, such as Siauwijaya et al. (2025), investigate the correlation between banking competition and stability. Wijoyo et al. (2021) analyzed competition level between different banks and found the healthy competition positively impacts performance and competitive ability at regional and global levels. Conversely, Nuralyza et al. (2022) found that the greater the bank competition, the higher the credit risk the bank will face. Rural banks in Indonesia have shown increased credit risk in the last eight years. Acharya et al. (2024) stated that when credit risk increases, capital adequacy ratio decreases and bank credit supply increases, ultimately giving birth to zombie companies. Irawati and Maksum (2018) found that increasing the size of commercial banks increases bank profitability in Indonesia. This finding suggests that the size of the rural bank will help prevent the bank from becoming a zombie company.

However, the Indonesian banking landscape presents unique dynamics that may influence the emergence of zombie banks, particularly in rural areas. The disparity between rural and urban financial infrastructure, the concentration of economic activity on the island of Java, and the varying regional economic performance create heterogeneous pressures on rural banks. In regions with weak economic growth, limited access to alternative funding, and lower financial literacy, rural

banks may face prolonged credit distress, making them more susceptible to becoming zombie institutions. This situation is worsened by the fact that most rural banks operate in regions where MSME borrower incomes fluctuate, while urban rural banks face intense competition from commercial banks and fintechs. These structural disparities make rural banks outside Java particularly vulnerable to economic shocks, such as falling commodity prices that allow capital and liquidity to erode more quickly, potentially turning them into zombie institutions even when national-level competition indicators appear moderate. Moreover, rural bank often operate in thin markets with limited competition, allowing underperforming banks to survive despite inefficiencies, highlighting the need to examine how market structure and location influence zombie risk.

Zhang and Huang (2022) state that, based on the competition-stability perspective, increased competition can mitigate moral hazard and adverse selection, enabling banks to steer clear of the risk associated with extending credit to low-quality borrowers like zombie firms. Conversely, if the level of competition is low, it can increase moral hazards and adverse selection, causing banks to take greater risks (Berger et al. 2021). Braggion and Ongena (2019) and Love and Pería (2015) stated that, based on the competition-fragility perspective, low competition will reduce risk-taking while increasing the availability and cost of funding. Intense bank competition can simultaneously increase credit supply and lower funding costs (Fraisse et al. 2018), as well as increase investment, employment, sales, and company efficiency (Gao *et al.*, 2019). Rakshit and Bardhan (2022) stated that increased bank competition worsens bank profitability. Every bank, existing and new, will face productivity shocks, with more productive new entrants replacing unproductive companies. Zhaxi and Yasuda (2024) asserted that zombie banks skew competition and affect the efficiency of non-zombie banks.

Chowdhury et al. (2024) stated that increasing bank size will enhance bank profitability. These results suggest that the bigger the bank, the better its capability to meet both short-term and long-term liabilities. Zhaxi and Yasuda (2024) stated that while a larger size generally reduces the likelihood of a company becoming a zombie, among smaller firms, those that are relatively larger are more likely to receive protection and become zombies. However, Huynh (2024) argued that while larger banks with greater diversification typically fare better, they are also more likely to perform poorly.

METHODOLOGY

DATA

The population for companies in the banking industry was obtained from the Financial Services Authority and the Deposit Insurance Corporation. The sample we used spanned from 2015 to 2022. Sample selection was based on the following exclusion criteria: (1) companies with incomplete financial report indicators, (2) companies with an age indicator of less than five years, and (3) companies that do not have audited financial reports. The final sample consisted of 1,245 selected rural banks. We cleaned the financial report data for each rural bank by taking all the required data and compiling these into panel data format. All datasets and processed results employed in the baseline model, the province-level model, the instrumental variable (IV) estimation to address endogeneity issues, and the interaction model in this study are available to the public as referenced in Siauwijaya et al. (2025).

VARIABLE INTERPRETATION

ZOMBIE RURAL BANK

We begin by defining zombie rural banks as bankrupt banks that survive despite having a weak balance sheet or through government assistance. We use the classification based on the definition of ICR in the foundational analysis. This decision is motivated by three factors. First, comparing each company using the ICR is more appropriate. Second, the ICR does not directly affect productivity compared with negative earnings, as used in some previous literature. Third, the ICR includes channels besides subsidized credit that allow zombie companies to stay alive. Therefore, based on the definition of a zombie bank provided above, we use income-based costs as proposed by Fiordelisi et al. (2021). The initial step involves computing the overall interest expense $IE_{i,t}$ minimum that must be paid by company *i* in year *t*, where $TS_{i,t}$ and $DL_{i,t}$ are long-term and short-term bank loans, respectively. Short-term bank loans consist of savings that customers can withdraw at any time. Long-term bank loans consist of deposits based on contracts and typically have contract durations of 1, 3, 6, and 12 months. Banks must pay interest according to the agreed-upon rate in the contract. $rs_{i,t}$ and $rl_{i,t}$ are long-term and short-term interest rates, respectively.

$$IE_{i,t} = rs_{i,t}TS_{i,t} + \left(1\sum_{j=1}^{1} rl_{i,t}\right)DL_{i,t} \quad (1)$$

The second step is to estimate the interest income from loans provided to the public. The term distinguishes customers who borrow funds (credit) from those who deposit funds (time deposit and regular savings customers). $IL_{i,t}$, $WC_{i,t}$, $IV_{i,t}$, and $CS_{i,t}$ are interest income on loans, consumer loans, investment loans, and working capital loans, respectively. Each type of

loan has a different duration, with working capital loans being one year, and investment loans and consumer loans being more than one year. $rc_{i,t}$ is the interest rate for each type of loan.

$$IL_{i,t} = rc_{i,t}WC_{i,t} + rc_{i,t}IV_{i,t} + rc_{i,t}CS_{i,t} \quad (2)$$

The third step is to estimate the amount of net interest income $NI_{i,t}$ received by the company obtained from the interest income $IL_{i,t}$ minus the interest expense $IE_{i,t}$. The interest income $IL_{i,t}$ is obtained from interest and non-interest income (Fiordelisi et al. 2021).

$$NI_{i,t} = IL_{i,t} - IE_{i,t} \quad (3)$$

The fourth step is to estimate the interest ratio $IR_{i,t}$ obtained from the net interest income $NI_{i,t}$ divided by the interest expense $IE_{i,t}$ (Zhang & Huang 2022).

$$IR_{i,t} = \frac{NI_{i,t}}{IE_{i,t}} \quad (4)$$

Fukuyama and Weber (2008) stated that as NPLs are a byproduct of the credit manufacturing process, they should not be regarded as a fixed input. According to Barros et al. (2012), NPLs have a major negative impact on bank performance. Zombie firms consider NPL factors in determining zombie firms (Fiordelisi et al. 2021; El Ghoul et al. 2021). They identify zombie firms using the following formula:

$$ICR_{i,t} = \frac{EBIT_{i,t}}{IE_{i,t}} \quad (5)$$

where $ICR_{i,t}$ and $EBIT_{i,t}$ are the ICR and EBIT, respectively. A bank is classified as a zombie firm if its $ICR_{i,t} < 1$ for two consecutive years. McGowan et al. (2018) identified zombie companies using ICR based on earnings before interest taxes depreciation and amortization (EBITDA) divided by interest expense, defining a bank as a zombie if $ICR_{i,t} < 1$ for one year.

$$ICR_{i,t} = \frac{EBITDA_{i,t}}{IE_{i,t}} \quad (6)$$

We classify rural banks as zombies if the following conditions are met: (1) The rural bank has been operating for over five years. (2) The IR and ICR of the bank are below 1 for three successive years (El Ghoul et al. 2021; McGowan et al. 2018; Caballero et al. 2008). (3) We then refer to Zhang and Huang (2022), who state that if the interest ratio (IR) derived from the net interest income divided by the interest expense is <1, then the rural bank can be classified as a zombie in period *t* and assigned a value of zombie1 = 1 (Formula 4).

The formula by Zhang and Huang (2022) has limitations because it overlooks NPLs, which are a result of the credit creation process (Fiordelisi et al. 2021; Fukuda and Nakamura 2011; Fukuyama and Weber 2008). This statement is supported by Barros et al. (2012), who assert that NPLs can still be a serious issue for banking performance. We use company EBIT because operational profit is the net result after deducting provisions for the write-off of productive assets following Fukuda and Nakamura (2011). If the calculated ICR is <1, then the firm is categorized as a zombie company in period *t* and documented as zombie2 = 1 (Formula 5).

We note that several studies calculate ICR using EBITDA, such as El Ghoul et al. (2021) and McGowan et al. (2018). They define ICR as EBITDA divided by total interest expenses. If the value of ICR is <1 for three successive years, then the firm is categorized as a zombie company in period *t* and documented as zombie3 = 1 (Formula 6).

BANKING COMPETITION

The empirical literature has noted several competition estimates, such as Lerner index (Lerner 1934) and H-statistic (Shaffer & Spierdijk 2015).

LERNER INDEX

Lerner defined the “index” as the measure of monopoly power. The Lerner index measures actual market power. Koetter et al. (2012) state that the traditional approach to calculating the Lerner index presupposes profit and cost efficiency. They believe that estimating price margins does not accurately measure actual market power. Therefore, they propose an adjustment that produces a Lerner index adjusted for efficiency. Each researcher has their reason for choosing the measure they will use. For instance, Khattak et al. (2021) use the Lerner index to measure bank competition in Indonesia because

almost all banks in Indonesia are diversified. Hence, the risk taken is not only in one channel. Amidu and Wolfe (2013) believe that more diversified banks will be more stable. Hence, we employ the Lerner index as a measure of bank competition in Indonesia, following Khattak et al. (2021) and Love and Pería (2015). Another reason is that the Lerner index can be estimated more readily. It varies in each bank, with a higher measure implying less competition and access.

The Lerner index is characterized as the disparity between marginal price and marginal cost, divided by marginal price. The formula is as follows:

$$Lerner\ Index_{i,t} = \frac{P_{i,t} - MC_{i,t}}{P_{i,t}} \tag{8}$$

where *P* represents the price of outputs, and *MC* denotes the marginal cost. Price is determined as the bank's total gross income divided by total assets. Marginal cost is calculated by taking the first-order derivative of the trans log cost function with respect to output (total assets), which reflects the local slope of the cost curve for each bank. This derivative is subsequently multiplied by the observed average cost measured as total cost divided by total assets to derive the marginal

$$\begin{aligned} ln(C_{it}) = \alpha_{0i} + \beta_0\, ln\, ln\, (Q_{it}) + \beta_1 0.5[ln(Q_{it})]^2 + \alpha_1 ln(W_{1it}) + \alpha_2\, ln\, ln\, (W_{2it}) + \alpha_3\, ln\, ln\, (W_{3it}) \\ + \beta_2 ln(Q_{it})^*\, ln\, ln\, (W_{1it}) + \beta_3 ln(Q_{it})^*\, ln\, ln\, (W_{2it}) + \beta_4 ln(Q_{it})^*\, ln\, ln\, (W_{3it}) \\ + \alpha_4 ln(W_{1it})^*\, ln\, ln\, (W_{2it}) + \alpha_5 ln(W_{1it})^*\, ln\, ln\, (W_{3it}) + \alpha_6 ln(W_{2it})^*\, ln\, ln\, (W_{3it}) \\ + \alpha_7 0.5[ln(W_{1it})]^2 + \alpha_8 0.5[ln(W_{2it})]^2 + \alpha_9 0.5[ln(W_{3it})]^2 + \alpha_{10}\, ln\, ln\, (Equity)_{it} + \alpha_{11} \\ ln\, ln\, (Net\ Loans)_{it} + F_i + e_{it,} \end{aligned} \tag{9}$$

cost value used in the Lerner index computation.

where $C_{i,t}$ is the sum total operational cost and financial cost for bank i in period t, $Q_{i,t}$ represents total asset, $W_{1i,t}$ is ratio of interest expense to total deposit, $W_{2i,t}$ is ratio of personnel expense to total asset, $W_{3i,t}$ is ratio of other operational and administrative expense to total asset, equity signifies ratio of firm equity to total asset, net loan denotes the ratio of loans to total assets, and F_i is bank fixed-effects. Regression with time dummies is conducted under constraints of symmetry and homogeneity of degree in price.

We use the data of government-owned and private rural banks registered with the Indonesian Financial Services Authority (OJK) from 2015 to 2022 to compute the Lerner index equation. For each bank, we exclude observations located in the top and bottom percentiles of the distribution of $ln(W_1)$, $ln(W_2)$, and $ln(W_3)$ and their interactions with one another, $ln(Equity)$ and $ln(Net\ Loan)$. After estimating the regression model (9) above on the annual data of each bank, we take the coefficient values from the estimated equation and use them to determine the marginal cost for bank i at period t. The marginal cost model is as follows:

$$\begin{aligned} MC_{it} = (\beta_0 + \beta_1{}^*\, ln\, ln\, (Q_{it}) + \beta_2{}^*\, ln\, ln\, (W_{1it}) + \beta_3{}^*\, ln\, ln\, (W_{2it}) + \beta_4{}^*\, ln\, ln\, (W_{3it}))^*\, (C_{it} \\ \div Total\ Assets) \end{aligned} \tag{10}$$

H-STATISTIC

The H-statistic is a nonstructural approach developed by Panzar and Rosse (1987) to measure the level of competition in the banking industry. This method is based on the elasticity of total revenue with respect to changes in input costs, calculated through a logarithmic regression of the input variables. The H value is obtained by summing the elasticity coefficients of the main input price, which indicates the market structure. An H value > 0 indicates the presence of competition, H = 1 indicates perfect competition, while H ≤ 0 point to a monopily or collusive oligopoly.

The econometric model for estimating the H-statistic involves regressing the logarithm of total revenue $LnTR_i$ on the logarithms of input price (e.g., labor cost, capital cost, and material cost):

$$Ln(TR_i) = \alpha + \beta_1(W1_i) + \beta_2(W2_i) + \beta_3(W3_i) + \varepsilon_i \tag{11}$$

where TR_i is the total revenue of bank *i*; $W1_i$, $W2_i$, and $W3_i$ represent the main input prices; α is the intercept; β_1, β_2, and β_3 are the elaticity coefficients of total revenue with respect to each input price; and ε_i is the error term. The H-statistic is then calculated as the sum of these estimated elasticity coefficients:

$$H = \beta_1 + \beta_2 + \beta_3 \tag{12}$$

This sum reflects the market competitiveness based on the input-output relationship described above.

BANK SIZE

Following Rakshit and Bardhan (2022), Siauwijaya (2025), and Siauwijaya et al. (2023), we employ the natural logarithm (ln) of total assets as the measure of a bank's size variable and explore commercial banks in Indonesia. We find that increasing bank size enhances profitability, which has several implications related to the formation of zombie banks. Although increased profitability is associated with larger bank size, it can also make banks more complex and involve greater risks. Rapidly growing rural banks may be more vulnerable to poorly detected internal or external weaknesses, which can lead to poorly managed risks, ultimately increasing the likelihood of zombification if the bank is faced with serious financial pressures. Large-growing rural banks face pressure to maintain high financial performance to meet investor and shareholder expectations, driving many to take greater risks and increasing the likelihood of vulnerability to adverse market conditions.

We use bank size as an important variable because it can indicate the complexity of the bank within the financial system. Additionally, larger rural banks may have a higher risk of failure if they encounter financial difficulties. The size of the bank can also provide clues about its ability to survive in the long term. Larger banks may have more resources and networks to overcome financial challenges but face more liabilities and risks. By considering bank size as a variable in the study of zombie banks, we can explore how bank size impacts the probability of the bank turning to zombie.

$$\text{Bank size} = \text{Natural logarithm of total asset} \tag{13}$$

CONTROL VARIABLES

Building on prior research (e.g., Rakshit & Bardhan 2022; Veríssimo et al. 2021), we control for bank-specific characteristics that may influence zombie firms. Using control variables, we can reduce the likelihood of bias caused by these factors and produce more accurate findings. Thus, we use capital measured by equity ratio to total asset, loan-to-deposit ratio (LDR) measured by total loan to total deposit, and liquidity ratio measured by loan to total asset as control variables.

The inclusion of these controls is theoretically grounded. Capital (equity-to-assets ratio) reflects the solvency and resilience of a bank in absorbing financial shocks (capital-buffer theory), which is crucial for preventing zombification. LDR captures the lending aggressiveness and funding risk of a bank, with higher LDRs suggesting higher credit risk exposure (risk-shifting theory), which is often associated with zombie bank behavior. Liquidity (loan-to-assets ratio) represents the bank's ability to meet short-term obligations; when liquidity is low or mismatched (e.g., excessive illiquid loans), the bank is more vulnerable to asset-liability mismatches, heightening rollover risk and the tendency to evergreen NPLs under financial distress.

BENCHMARK REGRESSION

To examine the relationship between competition and bank size for zombie and non-zombie companies, we start with the following logit regression framework:

$$Logit(Zombie_{i,t} = 1) = \alpha_0 + \alpha_1 Competition_{i,t} + \alpha_2 Size_{i,t} + \alpha_3 Control_{i,t} + \theta_i + \theta_t + \varepsilon_{i,t} \tag{14}$$

Zombie is a dummy variable (zombie =1; non-zombie = 0), including zombie1, zombie2, and zombie3. The Lerner index indicates the level of competition of all rural banks, and the size represents the assets of each bank i in year t. Control variables at the firm level encompass capital, which is the ratio of total equity to total assets, LDR is the ratio of total loan to total deposits, while liquidity is the ratio of total loans to total assets. θ_i and θ_t denote bank-year fixed effects, and ε is the error term.

$$Logit(Zombie_{i,p,t} = 1) = \alpha_0 + \alpha_1 Competition_{i,p,t} + \alpha_2 Size_{i,p,t} + \alpha_3 Control_{i,p,t} + \theta_i + \theta_p + \theta_t + \varepsilon_{i,t} \tag{15}$$

where p shows the bank's province, and θ_p is the province fixed effect. Every independent variable then interacts with a dummy variable indicating the location of a rural bank. We indicate Java = 1 for banks located on the island of Java, and Java = 0 otherwise. Separating the banks by location is necessary due to the stark difference in development between Java and other regions. In reality, bank lending extends beyond the city where the bank is situated. The main and branch offices also provide loans in the province where the bank is located. Banks compete at the provincial level with rural and commercial banks around the same location because the products offered are similar. The size of the bank's assets is also a consideration when customers decide to borrow or save funds because most of them believe that if the bank has large assets, the ability to repay their debt is also high. Thus, the influence of bank competition on the emergence of zombie must be investigated at national and provincial levels. Competition indicators and bank size at these levels were used as explanatory variables.

INSTRUMENTAL VARIABLE ESTIMATION FOR ENDOGENEITY

One potential concern in estimating the relationship of banking competition with zombie firm status is endogeneity, particularly reverse causality, in which the existence of zombie firms might affect the degree of competition within the sector. To mitigate this issue, we utilize an IV strategy within a two-stage least squares (2SLS) regression framework.

Following recent empirical approaches (e.g., Li et al. 2023; Shen et al. 2023), we construct an instrument for banking competition by calculating the number of banks in each province divided by regional gross domestic product (GDP). This ratio serves as a proxy for banking density relative to economic activity and is assumed to be strongly correlated with local banking competition while plausibly exogenous to individual firm-level survival decisions. This choice satisfies the relevance and exclusion restriction requirements for a valid instrument.

In the first stage, we regress the Lerner index on the banking density instrument along with a set of firm-level control variables. In the second stage, we utilize the predicted values of the Lerner index obtained from the first stage to estimate its causal impact on the likelihood of a firm being identified as a zombie. This 2SLS approach helps address issues of simultaneity and omitted variable bias in the relationship between market power and firm viability. The first-stage regression model is specified as follows:

$$Competition_{i,t} = \alpha_0 + \alpha_1 BankDensity_{p,t} + \alpha_2 X_{i,t} + \mu_{i,t} \tag{16}$$

where $Competition_{i,t}$ is measured using both the Lerner index and the H-statistic for bank i in year t, $BankDensity_{p,t}$ represents the number of banks per unit of GDP in province p, $X_{i,t}$ is a vector of control variables, and $\mu_{i,t}$ is the error term. The second-stage regression model is defined as

$$ZombieStatus_{i,t} = \beta_0 + \beta_1 \widehat{Competition}_{i,t} + \beta_2 X_{i,t} + \varepsilon_{i,t} \tag{17}$$

where $ZombieStatus_{i,t}$ is a binary indicator equal to 1 if bank i is classified as a zombie in year t, and 0 otherwise; $\widehat{Competition}_{i,t}$ represents the predicted values of the Lerner index and H-statistic obtained from the first stage; and $\varepsilon_{i,t}$ is the error term.

RESULTS AND DISCUSSION

Table 1 summarizes the descriptive statistics for the main variables. Zombie1, zombie2, and zombie3 exhibit mean values of 0.130, 0.904, and 0.803, respectively, each with maximum and minimum values of 1.000 and 0.000. The Lerner index exhibits a mean value −8.068, with minimum and maximum values of −19.932 and 5.000, respectively. Finally, bank's size exhibits a mean value of 24.662, with a maximum and minimum values of 30.716 and 18.256, respectively.

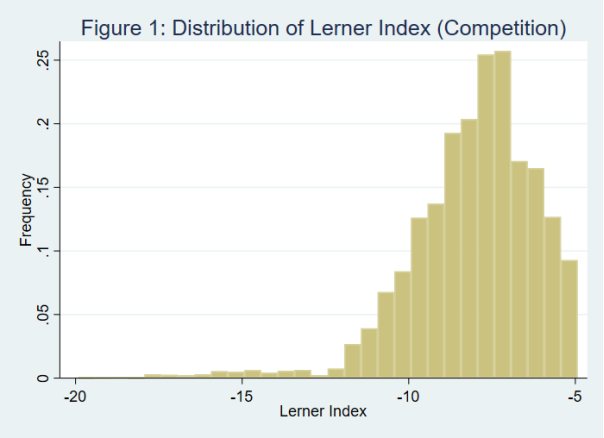
TABLE 1. Descriptive statistics and correlation analysis

Panel A: Descriptive statistics

Statistics	Z1	Z2	Z3	H_Stat	LI	BD	Size	Capital	LDR	LQ
Mean	0.130	0.904	0.803	0.789	−8.069	0.000	24.662	0.477	1.023	0.703
Std. Dev.	0.336	0.295	0.398	0.227	1.927	0.000	1.449	0.278	0.713	0.205
Min	0.000	0.000	0.000	0.403	−19.932	0.000	18.256	−0.630	0.011	0.001
Max	1.000	1.000	1.000	1.062	−5.101	0.001	30.716	2.307	34.741	11.533
Obs	9,960	9,960	9,960	9,960	9,960	9,960	9,960	9,960	9,960	9,960
Panel B: Results of the Pearson product-moment correlation test										
Variables										
Zombie1	1.000									
Zombie2	0.157	1.000								
Zombie3	0.253	0.601	1.000							
H_Stat	−0.015	−0.022	−0.213	1.000						
LI	−0.011	−0.092	−0.123	0.064	1.000					
BankDensity	0.169	0.190	0.221	−0.062	−0.013	1.000				
Size	0.129	0.059	−0.045	0.256	0.216	0.055	1.000			
Capital	−0.060	−0.131	−0.368	0.477	0.097	0.061	0.2462	1.000		
LDR	−0.038	−0.087	−0.069	−0.003	0.024	−0.022	−0.090	0.069	1.000	
Liquidity	−0.029	−0.005	0.017	−0.063	0.046	0.056	0.012	0.184	0.052	1.000

Notes: The table illustrates descriptive statistics of bank-specific and industry-specific variables by banking group for the period 2015–2022. Competition = Lerner index, H-statistic; Size = natural logarithm of assets ratio; Capital = ratio equity to total asset; LDR = ratio total loan to total deposits; Liquidity = ratio loan to total assets.

Competition



Size

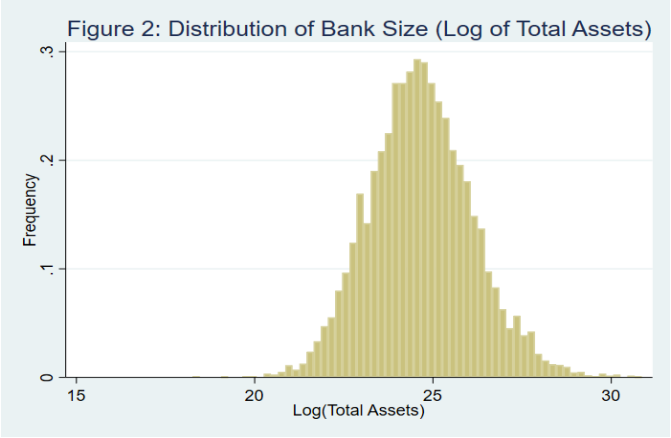


FIGURE 3. Distribution of Lerner Index and Bank Size

The histogram of the Lerner index distribution, used as proxy for market competition among banks, shows that most rural banks operate with a moderate market power level, with Lerner index values skewed to the right and ranging between -10 and -7, indicating relatively low competition in Indonesia's rural bank sector. Meanwhile, the distribution of bank size, measured by the natural logarithm of the assets, exhibits an approximately normal distribution with a peak around log 25, suggesting that most rural banks have relatively uniform scale and that this size variable is suitable for use in regression models without additional transformation.

To facilitate intuitive interpretation, we report the direction and magnitude of effects using the transformation of the odds ratio as (1 - OR) × 100 for OR < 1, and (OR - 1) × 100 for OR > 1. This approach allows us to interpret the findings in terms of the approximate percentage increase or decrease in the likelihood of rural banks becoming zombies. Therefore, odds ratios < 1 are interpreted as a decrease in the chance of becoming a zombie bank, and odds ratios > 1 as an increase.

Table 2 shows the impact of competition and bank size at the national level on the formation of zombie companies. Our findings explain that the more competitive a bank is, the chance of a rural bank becoming a zombie will decrease by 16 percent for zombie1 and zombie2 and 15 percent for zombie3. Calderon and Schaeck (2016) and Zhang and Huang (2022) found that increasing competition will reduce the likelihood of a company turning into a zombie. We also found that the bigger the bank size, the greater the chance of rural banks becoming zombies. Every 1 percent increase in bank size will increase the chance of a rural bank becoming a zombie by 88 percent, 44 percent, and 37 percent for zombie1, zombie2, and zombie3 with a 1% level of significance level. This finding is in line with Banerjee and Hofmann (2020), Lam et al. (2017), and Zhang and Huang (2022), who found that the bigger the size of a firm, the higher the likelihood of its zombification. Barros et al. (2007) argued that large banks tend to become zombies. However, El Ghoul et al. (2021) found that, in contrast, when a company's size increases, the chance of the company becoming a zombie decreases, while Hoshi (2006) found that the size of a bank has no relationship in the emergence of zombie companies.

Using the alternative competition proxy (i.e., the Panzar–Rosse H-statistic), we observe a statistically significant effect only under the strictest zombie definition: a 1-unit rise in competition lowers the odds of becoming zombie3 by about 39 percent (odds ratio = 0.606, $p < 0.01$). Well-capitalized rural banks are consistently less prone to zombification; each percentage-point increase in the capital ratio cuts the odds of becoming a zombie by 85–92 percent across the three definitions (odds ratios = 0.083–0.147, all significant at the 1 percent level). Higher LDR also provides a modest buffer, reducing the probability of zombie1 status by 54 percent and zombie2 and zombie3 status about 8–9 percent (odds ratios = 0.466 and ~0.914, $p < 0.10$). Liquidity appears largely irrelevant in most specifications, yet column (6) reveals that extremely liquid banks may be vulnerable; the odds of being classified as zombie3 jump more than 12-fold (odds ratio = 12.199, $p < 0.01$). All regressions include year and bank fixed effects and are estimated on 9,960 bank year observations, reinforcing the robustness of the reported relationships.

TABLE 2. Impact of market competition on the probability of becoming a zombie rural bank (national level)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Zombie1	Zombie2	Zombie3	Zombie1	Zombie2	Zombie3
Competition	0.844 ***	0.842 ***	0.846 ***			
	(0.050)	(0.023)	(0.021)			
H_Statistic				0.862	1.271	0.606***
				(0.264)	(0.216)	(0.094)
Size	1.877 ***	1.397 ***	1.365 ***	1.922***	1.333***	1.048
	(0.157)	(0.067)	(0.057)	(0.161)	(0.065)	(0.044)
Capital	0.083 ***	0.147 ***	0.096 ***	0.088***	0.129***	0.005***
	(0.022)	(0.024)	(0.023)	(0.025)	(0.023)	(0.001)
LDR	0.466 *	0.914 *	0.915 *	0.446*	0.908*	0.907*
	(0.205)	(0.051)	(0.047)	(0.197)	(0.053)	(0.048)
Liquidity	0.525	1.343	1.398	0.534	1.405	12.199***
	(0.324)	(0.316)	(0.315)	(0.330)	(0.354)	(3.776)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes

Observations	9,960	9,960	9,960	9,960	9,960	9,960

Notes: This table reports the estimation results of Equation (14), analyzing how market competition (proxied by the Lerner index and H_Statistic) effects the likelihood of rural banks becoming zombies, defined using three alternative measures (zombie1 from Zhang & Huang 2022; zombie2 from Caballero et al. 2008; Fukuda & Nakamura 2011; and El Ghoul et al. 2021, and zombie3 from McGowan et al.2018) while controlling for capital, LDR, and liquidity. All models include year and bank fixed effects. Standard errors are in parentheses, reported coefficients are odds ratios, and significance levels are denoted by *, **, and ***, for p-value 0.10, 0.05, and 0.01, respectively.

TABLE 3. Number of zombie rural banks by year

Year	(1)	(2)	(3)
	Zombie1	Zombie2	Zombie3
2015	91	946	792
2016	98	955	907
2017	100	957	919
2018	87	933	885
2019	86	942	534
2020	88	969	478
2021	78	921	432
2022	75	875	408

Notes: Zombie1 equals IR < 1 for at least one year; zombie2 and zombie3 equal ICR <1 for at least one year.

Table 4 illustrates the influence of competition and bank size on the emergence of zombie rural banks after pairing with the province. We found that every 1 percent increase in competition will reduce the chance of rural banks becoming zombies. This indicates that when competition increases, the chance of rural banks becoming zombies will decrease by 17 percent for zombie1 and 16 percent for zombie2 and zombie3 at a 10% significance level. Furthermore, as the size of each bank increases, the chances of rural banks becoming zombies will increase. This indicates that for a 1 percent increase in bank size, the chance of a rural bank becoming a zombie will increase by 83 percent for zombie1, 29 percent for zombie2, and 34 percent for zombie3.

To support the odds ratio findings, we also calculate the average marginal effects. We found that a 1-unit increase in competition is associated with a reduction in zombie probability by approximately 2.3 percentage points (zombie1), 2.0 percentage points (zombie2), and 1.9 percentage points (zombie3), holding other variables constant. Meanwhile, a 1-unit increase in bank size increases zombification probability by approximately 6.10–8.70 percentage points depending on the model. These marginal effects help illustrate the practical significance of each determinant.

We also found that 17 provinces significantly influenced the formation of zombie rural banks (zombie1), consisting of 16 provinces with a 1% significance level and 1 with a 10% significance level. There are 26 provinces in zombie2, consisting of 21 provinces with a 1% significance level, 3 with a 5% significance level, and 2 with a 10% significance level. Finally, there are 29 provinces in zombie3, consisting of 27 provinces with a statistical confidence of 99 percent and 2 at 5 percent. Overall, no province increases the likelihood of rural banks becoming zombies. For example, the possibility of rural banks in South Sulawesi province becoming zombies decreased by 82 percent compared with other provinces.

This finding aligns with economic indicators from the Central Bureau of Statistics (Badan Pusat Statistik/BPS), where South Sulawesi shows steady GDP growth above the national average in several periods, driven by a diversified economy in the agriculture, fisheries, and trade sectors. The relatively strong and stable economic environment of a province may provide a buffer for rural banks, reducing default rates and stabilizing liquidity flows, which helps lower zombie risk.

In addition to South Sulawesi, our analysis reveals significant variation in zombie bank probability across provinces. These disparities may be partly explained by differences in regional economic structures. For example, provinces with higher zombie bank prevalence tend to exhibit slower GDP growth and a heavier reliance on single-sector economies, such as agriculture or extractive industries, which are more vulnerable to external shocks. By contrast, provinces like South Sulawesi, with its more diversified sectoral composition and consistent economic expansion, appear to offer a more stable environment for rural banks. This suggests that regional economic resilience, driven by sectoral diversification and growth performance, plays a role in mitigating zombie bank risks across provinces.

TABLE 4. Impact of competition and bank size at the provincial level on the formation of zombie rural banks

Variables	(1)		(2)		(3)	
	Zombie1		Zombie2		Zombie3	
	Odds Ratio	Std. Err	Odds Ratio	Std. Err	Odds Ratio	Std. Err
Lerner index	0.834 ***	0.050	0.842 ***	0.023	0.836 ***	0.020
Size	1.823 ***	0.161	1.285 ***	0.061	1.337 ***	0.068
Capital	0.073 ***	0.020	0.168 ***	0.028	0.005 ***	0.001
LDR	0.394 ***	0.176	0.927	0.048	0.918 *	0.043
Liquidity	0.559	0.350	1.197	0.256	1.319	0.374
Province						
Banten	0.085 ***	0.058	0.109 ***	0.058	0.047 ***	0.019
Bengkulu			0.194 ***	0.030	0.022 **	0.030
D.I. Yogyakarta	0.006 ***	0.006			0.123 ***	0.052
DKI Jakarta			0.086 ***	0.072	0.044 ***	0.030
Gorontalo			0.044 **	0.073	0.037 ***	0.050
Jambi	0.014 ***	0.018	0.076 ***	0.057	0.030 ***	0.019
West Java	0.007 ***	0.004	0.071 ***	0.028	0.031 ***	0.009
Central Java	0.005 ***	0.003	0.122 ***	0.049	0.043 ***	0.013
East Java	0.016 ***	0.008	0.018 ***	0.007	0.013 ***	0.004
West Kalimantan	0.012 ***	0.015	0.150 ***	0.114	0.097 ***	0.058

South Kalimantan	0.053 ***	0.073	0.038 ***	0.033	0.014 ***	0.010
Central Kalimantan			0.003 ***	0.005	0.005 ***	0.007
East Kalimantan	0.011 ***	0.018	0.026 ***	0.022	0.019 ***	0.014
Bangka Belitung Islands			0.047 *	0.082	0.079 **	0.113
Riau Islands	0.075 ***	0.056	0.262 **	0.161	0.124 ***	0.056
Lampung	0.065 ***	0.059	0.023 ***	0.016	0.029 ***	0.016
North Maluku					0.033 ***	0.053
Nanggroe Aceh Darussalam			0.004 ***	0.006	0.009 ***	0.012
West Nusa Tenggara	0.034 ***	0.040	0.108 ***	0.079	0.035 ***	0.021
East Nusa Tenggara			0.016 ***	0.014	0.011 ***	0.009
Papua			0.041 ***	0.057	0.002 ***	0.003
Riau	0.023 ***	0.025	0.133 ***	0.096	0.081 ***	0.047
South Sulawesi	0.181 *	0.189	0.067 ***	0.050	0.045 ***	0.027
Central Sulawesi			0.091 **	0.108	0.104 ***	0.101
Southeast Sulawesi			0.008 ***	0.007	0.004 ***	0.003
North Sulawesi			0.208 *	0.177	0.087 ***	0.057
West Sumatra	0.001 ***	0.001			0.036 ***	0.013
South Sumatra	0.031 ***	0.001	0.107 ***	0.084	0.050 ***	0.031
North Sumatra	0.009 ***	0.009	0.044 ***	0.023	0.009 ***	0.004
Year FE	Yes		Yes		Yes	
Bank FE	Yes		Yes		Yes	
Bank-specific controls	Yes		Yes		Yes	
Province FE	Yes		Yes		Yes	
Observations	9,960		9,960		9,960	

Notes: This table presents the regression results of Equation (15). Columns (1), (2), and (3) report the effect of competition (measured by the H-statistic) and bank size at the provincial level on the likelihood of rural banks becoming zombie banks. Reported values are odds ratios, with robust standard errors in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

For comparison, Table 5 presents the regression results using the H-statistic as an alternative measure of competition. The results suggest that competition continues to play a role in the formation of zombie banks, although the magnitude, direction, and significance of the effect differ across model specifications. In the case of zombie1, the H-statistic shows a negative but statistically insignificant effect. For zombie2, competition has a positive and statistically significant effect at the 10% level, indicating that in certain contexts, greater competition may increase the likelihood of a bank becoming a zombie. Conversely, for zombie3, competition exhibits a negative and highly significant effect at the 1% level, supporting the earlier result that intensified competition tends to reduce the probability of zombie bank formation.

Bank size remains consistently significant in the zombie1 and zombie2 models but not in zombie3, suggesting that larger banks are more prone to becoming zombies, particularly under the first two specifications. Additionally, control variables such as capital and the LDR generally exhibit a significant negative relationship with zombie bank formation, indicating that strong capitalization and a healthy LDR reduce the likelihood of zombification. By contrast, liquidity shows a significant positive effect especially in the zombie3 model, potentially signaling distortions in how liquidity is managed, which may contribute to elevated risk and a greater likelihood of ZS.

The findings from both tables indicate that level of competition and bank size are critical factors influencing the formation of zombie banks in rural areas. However, the direction and significance of these effects vary depending on the competition measure employed and the specific model. The consistently significant results across provinces also underscore the importance of accounting for geographical heterogeneity when analyzing the rural banking sector in Indonesia.

TABLE 5. Impact of competition and bank size at the provincial level on the formation of zombie rural banks

Variables	(1)		(2)		(3)	
	Zombie1		Zombie2		Zombie3	
	Odds Ratio	Std. Err	Odds Ratio	Std. Err	Odds Ratio	Std. Err
H_Statistic	0.963	0.298	1.383 *	0.235	0.673 ***	0.104
Size	1.833***	0.163	1.221 ***	0.060	0.965	0.040
Capital	0.075***	0.022	0.142 ***	0.025	0.006 ***	0.001
LDR	0.392**	0.176	0.920	0.049	0.910 *	0.047
Liquidity	0.559	0.352	1.1253	0.282	9.616 ***	2.924
Province						
Banten	0.084***	0.057	0.114 ***	0.060	0.050 ***	0.021
Bengkulu			0.017 ***	0.026	0.020 ***	0.029
D.I. Yogyakarta	0.006***	0.006	0.385	0.228	0.116 ***	0.050
DKI Jakarta	0.510	0.568	0.127 **	0.112	0.057 ***	0.040
Gorontalo			0.041 *	0.070	0.034 ***	0.047
Jambi	0.014 ***	0.018	0.071 ***	0.054	0.030 ***	0.019
West Java	0.006 ***	0.004	0.076 ***	0.030	0.034 ***	0.010
Central Java	0.005 ***	0.003	0.120 ***	0.048	0.044 ***	0.013
East Java	0.016 ***	0.008	0.018 ***	0.007	0.013 ***	0.004
West Kalimantan	0.012 ***	0.015	0.132 ***	0.101	0.090 ***	0.055
South Kalimantan	0.053 **	0.072	0.037 ***	0.033	0.015 ***	0.011
Central Kalimantan	0.158	0.350	0.003 ***	0.005	0.005 ***	0.007
East Kalimantan	0.011 ***	0.018	0.024 ***	0.021	0.019 ***	0.014
Bangka Belitung Islands	0.094	0.213	0.042 *	0.074	0.072 *	0.105
Riau Islands	0.077 ***	0.057	0.231 **	0.142	0.114 ***	0.052
Lampung	0.065 ***	0.059	0.022 ***	0.15	0.028 ***	0.015
North Maluku			0.115	0.234	0.044 *	0.071
Nanggroe Aceh Darussalam			0.003 ***	0.005	0.008 ***	0.011
West Nusa Tenggara	0.035 ***	0.041	0.102 ***	0.075	0.035 ***	0.021
East Nusa Tenggara			0.014 ***	0.013	0.011 ***	0.009
Papua			0.040 **	0.056	0.002 ***	0.003
West Papua			0.052	0.100	0.123	0.203

Riau	0.023 ***	0.027	0.122 ***	0.089	0.081 ***	0.047
West Sulawesi			0.014 *	0.036	0.033	0.076
South Sulawesi	0.196	0.205	0.059 ***	0.044	0.044 ***	0.027
Central Sulawesi	0.161	0.265	0.086 **	0.103	0.101 **	0.100
Southeast Sulawesi			0.008 ***	0.006	0.004 ***	0.003
North Sulawesi	0.319	0.340	0.169 **	0.144	0.074 ***	0.049
West Sumatra	0.000 ***	0.001	0.582	0.298	0.043 ***	0.016
South Sumatra	0.030 ***	0.035	0.089 ***	0.070	0.043 ***	0.027
North Sumatra	0.010 ***	0.009	0.037 ***	0.020	0.008 ***	0.004
Year FE	Yes		Yes		Yes	
Bank FE	Yes		Yes		Yes	
Bank-specific controls	Yes		Yes		Yes	
Province FE	Yes		Yes		Yes	
Observations	9,960		9,960		9,960	

Notes: This table presents the regression results of Equation (15). Columns (1), (2), and (3) report the effect of competition (measured by the H-statistic) and bank size at the provincial level on the likelihood of rural banks becoming zombie banks. Reported values are odds ratios, with robust standard errors in parentheses. *, **, and ***, indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

In the next step, we will identify the location of the rural bank by interacting each independent variable with a dummy variable (1 for Java; 0 for outside Java). Hudson (1969) introduced a theory of rural settlement that explains changes in residential distribution over time. Thus far, infrastructure development in Indonesia has been concentrated more on the island of Java, so distribution outside Java will take a long time and be costly. This is why we divide rural bank locations into two, because of development inequality. Apart from that, we also consider economic growth factors in both locations.

Based on data from Badan Pusat Statistik Indonesia 2023 (pp. 1, 699), economic growth rate in Indonesia has risen from 5.20 percent in 2018 to 5.30 percent in 2022. The rates of economic growth at constant prices in Java for 2019 and 2022 are 5.60 percent and 5.26 percent, respectively, while outside Java, these are 4.49 percent and 5.86 percent. The data show that the economic growth rate in 2019 on the island of Java was higher than outside Java, while in 2022, the opposite was true. McGowan et al (2018) and Banerjee and Hofmann (2018) found that zombie companies can reduce economic performance. This phenomenon is the reason we divide the province into two (inside Java and outside Java). Since our paper does not raise economic issues, we are more interested in looking at the proportion of zombie rural banks on the island of Java and outside Java. Then, we will explore whether competition and bank size influence rural bank zombies on Java.

TABLE 6. Regression results of the interaction of independent variables with dummy variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Zombie1	Zombie2	Zombie3	Zombie1	Zombie2	Zombie3
Lerner × Location	0.878 ***	0.883 ***	0.854 ***			
	(0.026)	(0.028)	(0.025)			
H_Statistic × Location				1.457	1.382	0.651 **
				(0.676	(0.298)	(0.129)
Size × Location	1.023	1.001	0.978	1.020	1.026	1.043 ***
	(0.034)	(0.017)	(0.014)	(0.030)	(0.016)	(0.014)
Capital × Location	0.288 ***	0.228 ***	0.004 ***	0.243 ***	0.173 ***	0.004 ***
	(0.095)	(0.040)	(0.001)	(0.091)	(0.034)	(0.001)
LDR × Location	0.408	0.867 **	0.902 *	0.385	0.867 **	0.904 *
	(0.253)	(0.062)	(0.052)	(0.239)	(0.063)	(0.053)
Liquidity × Location	0.350	0.348 ***	8.431 ***	0.389 ***	0.487 *	8.640 ***
	(0.254)	(0.137)	(2.970)	(0.000)	(0.196)	(3.115)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank-specific control	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,960	9,960	9,960	9,960	9,960	9,960

Notes: This table shows the regression results of the interaction of the independent variable with dummy variables (Java = 1 and outside Java = 0). Columns (1), (2), and (3) report the results for models using the Lerner index as a measure of competition, while columns (4) to (6) use the H-statistic. Standard errors are reported in parentheses, and the opposite is the odds ratio. *, **, and *** denote 10%, 5%, and 1% confidence levels, respectively.

Table 6 presents the impact of banking competition and bank size on the likelihood of rural banks becoming zombies on the island of Java. The results show that greater competition, measured by the Lerner index, is significantly linked to a lower probability of rural banks turning into zombies. Specifically, a 1 percent increase in competition (indicated by a decrease in the Lerner index) reduces the chances of a rural bank becoming a zombie by about 12.2 percent, 11.7 percent, and 14.6 percent for zombie1, zombie2, and zombie3, respectively. These findings imply that competitive pressure may act as a disciplinary force, preventing inefficient rural banks from surviving in the market.

When competition is measured using the H-statistic, the results exhibit a less consistent pattern. The interaction term between the H-statistic and location is statistically significant only for zombie3, indicating that higher competition is linked to a reduced likelihood of a rural bank becoming a zombie. However, for zombie1 and zombie2, the coefficients are not statistically significant, suggesting that the effect of competition on zombie bank formation depends on the competition measure used. Overall, although both measures indicate a similar direction for zombie3, only the Lerner index consistently demonstrates a significant relationship across all three zombie definitions.

While we acknowledge the potential endogeneity, especially reverse causality between ZS and banking competition, we still empirically evaluated its impact by comparing baseline estimates with those from IV regressions that use provincial banking density as a valid instrument for competition. The consistency of results across these specifications suggests that endogeneity is likely minimal and does not significantly affect the main findings. Additionally, robustness checks using an

alternative competition measure (i.e., the H-statistic from the Panzar–Rosse model) further support the reliability and validity of the empirical results.

TABLE 7. Instrumental variable regression results on zombie status using Lerner index and H-statistic as endogenous regressors

	(1)	(2)	(3)	(4)	(5)	(6)
	ZS1	ZS2	ZS3	ZS1	ZS2	ZS3
Lerner	0.091	−0.201**	−0.096			
	(0.065)	(0.094)	(0.093)			
H_Statistic				0.018	0.131***	−0.149***
				(0.028)	(0.045)	(0.051)
Size	0.017*	−0.004	0.007	0.017*	−0.003	0.007
	(0.010	(0.013)	(0.014)	(0.009)	(0.012)	(0.014)
Capital	−0.093***	−0.348***	−0.507***	−0.111***	−0.308***	−0.488***
	0.033	(0.051)	(0.054)	(0.029)	(0.040)	(0.048)
LDR	−0.002	−0.003	−0.002	−0.001	−0.006	−0.003
	(0.003)	(0.011)	(0.008)	(0.002)	(0.008)	(0.006)
Liquidity	−0.045***	0.079***	0.123***	−0.035***	0.057***	0.112***
	(0.015)	(0.032)	(0.036)	(0.013)	(0.022)	(0.031)
dYear2	0.006	0.009	0.098***	−0.000	−0.025**	0.141***
	(0.005)	(0.009)	(0.010)	(0.008)	(0.013)	(0.014)
dYear3	0.004	0.017	0.113***	−0.001	−0.026*	0.161***
	(0.006)	(0.011)	(0.010)	(0.009)	(0.04)	(0.015)
dYear4	−0.005	−0.005	0.083***	−0.013	−0.051***	0.140***
	(0.007)	(0.012)	(0.012)	(0.010)	(0.016)	(0.018)
dYear5	−0.034	0.262***	0.066	0.021*	0.118***	0.030
	(0.044)	(0.072)	(0.070)	(0.013)	(0.019)	(0.024)
dYear6	−0.021	0.262***	0.007	0.014***	0.074***	0.051***
	(0.039)	(0.063)	(0.061)	(0.004)	(0.011)	(0.011)
dYear7	−0.031	0.221***	−0.035	0.003	0.035***	0.011
	(0.038)	(0.062)	(0.060)	(0.003)	(0.008)	(0.009)
dYear8	−0.038	0.198***	−0.045			
	(0.042)	(0.067)	(0.065)			
FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,960	9,960	9,960	9,960	9,960	9,960
Clusters FE	1.245	1.245	1.245	1.245	1.245	1.245
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000
R^2(centered)	−0.266	−0.381	0.182	0.013	0.024	0.228
Root MSE	0.208	0.373	0.367	0.184	0.313	0.357
Instrument	BankDensity	BankDensity	BankDensity	BankDensity	BankDensity	BankDensity
Hansen J	11.623	11.623	11.623	2.257	5.720	1.170
P(Hansen J)	0.001	0.001	0.001	0.133	0.017	0.280

Notes: This table presents the results of instrumental variable regressions examining the impact of market power on bank zombie status (ZS). Columns (1)–(3) use the Lerner index as the endogenous regressor, while columns (4)–(6) use the H-statistic. ZS1, ZS2, and ZS3 refer to three alternative measures of ZS. All regressions include bank-level control variables (Size, Capital, LDR, Liquidity) and year fixed effects (FE). Standard errors are robust to heteroskedasticity and clustered at the bank level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 7 displays the results of IV regressions analyzing the impact of market power on bank ZS, with the Lerner index and H-statistic treated as endogenous regressors. The findings reveal that the Lerner index is significantly negative only for ZS2, whereas the H-statistic is significantly positive for ZS2 and negative for ZS3. These indicate an inconsistent relationship between market power or competition and ZS, which varies depending on the specific ZS measure employed.

The control variable Capital is consistently and significantly negative across all models, indicating that well-capitalized banks are less likely to become zombies. Liquidity is also significant in several models, though the direction of the effect varies. Size and LDR are generally not statistically significant. All models control for year fixed effects, with some year dummies showing significance, implying that certain periods had a measurable effect on zombie probability. Overall, the findings highlight the importance of bank capitalization and the sensitivity of results to the choice of market power and ZS indicators.

Although IV regressions were conducted to address potential endogeneity in market power measures, the results of the Hansen J-statistic (particularly with p-values above conventional significance levels in some models, such as 0.133 and 0.280) indicate weak evidence of endogeneity in certain specifications. Given the weak endogeneity signals, and to maintain robustness, this study retains the logit regression results as the main specification. The logit model provides more consistent and interpretable findings in line with theoretical expectations, and the IV results serve as complementary analyses to reinforce the primary conclusions.

DISCUSSION

The primary aim for this research was to examine the correlation between level of competitiveness and bank size with the risk of rural banks becoming zombies. Analysis was performed using various models (zombie1, zombie2, zombie3) to evaluate such a correlation. We find that increasing competitiveness will decrease the odds of a rural bank becoming a zombie, whereas the bigger a rural bank's size, the greater its likelihood of becoming a zombie. In addition, the interaction between competition and geographic location show that rural banks located on the island of Java experience a stronger negative relationship between competition and the probability of zombification, especially when competition is measured using the Lerner index. However, when the H-statistic is used, this relationship is less consistent and only statistically significant for the zombie3 definition, indicating that the effect of competition on zombie risk is sensitive to the measurement

approach used. These findings and analytical results can benefit policymakers, especially financial authorities, bank owners, and scholars concerned with the stability and longevity of Indonesia's rural banks.

The more competitive a rural bank is, the lower the chance it will become a zombie. Competitive rural banks tend to be more adaptable to market changes. They have more effective risk management and flexible business strategies, helping them avoid serious financial issues. By utilizing resources more efficiently, they lower operational costs and improve cost management. Intense competition drives rural banks to innovate new products and services to remain attractive to customers, reducing the risk of becoming zombies due to customer loss. Competitive rural banks are also usually more cautious in managing risks, such as loans, operations, and market risks, and find it easier to attract funds and support from investors, helping them overcome financial challenges and prevent falling into difficult situations. Finally, healthy and competitive competition within the banking industry incentivizes rural banks to improve their performance, thereby reducing their risk of becoming zombies. Therefore, rural banks that can compete well in a competitive environment tend to have lower chances of becoming zombies because they are more capable of facing market challenges.

The bigger the size of the bank, the greater the likelihood of a rural bank becoming a zombie. This is because large rural banks often engage in large and complex transactions that carry high risks. Accordingly, if any of these transactions incur losses, it will significantly impact their financial condition. Large rural banks often rely on short-term loans from other rural banks or commercial banks, so if the banking industry conditions deteriorate, they may struggle to repay their debts. They are also closely linked to the economic conditions in their surrounding areas, so if the local economy is poor, they may be significantly affected and experience financial problems that could put them at risk of becoming zombie banks. For example, the likelihood of rural banks becoming zombies in Banten province is higher compared to other provinces for the zombie1 and zombie2 definitions. Moreover, the size of rural banks can provide advantages regarding access to resources and markets. However, size can also increase the complexity of financial risks for rural banks if not appropriately managed. The relationship between size and zombie risk remains statistically significant even after controlling for bank-specific variables and fixed effects, highlighting the robustness of this finding across different specifications.

The specific analysis of rural banks on the island of Java indicates that an increase in competition in the region can reduce the risk of rural banks becoming zombies. This may be due to increased competitive pressure, which is encouraging rural banks to be more efficient in risk management and financial performance. Additionally, tighter competition can drive rural banks to be more innovative and responsive to market changes. Adequate infrastructure, stable economic growth, and government support on the island of Java can also contribute to reducing the risk of rural banks becoming zombies.

In light of these findings, several policy implications are proposed. First, regulators should implement tiered capital requirements for larger rural banks to ensure they hold sufficient buffers relative to their systemic importance. Second, policymakers can offer structured incentives for small rural banks to merger or consolidate, thus improving their operational scale, governance, and financial health. Third, supervision efforts should be aligned with the implementation of the Indonesian Financial Sector Development Plan (*Rencana Pemgembangan Sektor Jasa Kuangan*/RPJSK) as outlined by OJK, especially in strengthening banking resiliency and digital innovation. Fourth, to promote financial system soundness, regulatory frameworks such as Basel III, particularly those related to capital adequacy and liquidity coverage ratios, should be progressively applied to rural banks in a proportionate manner.

CONCLUSION

The research findings can be summarized as follows. A notable correlation exists between bank size and competitiveness level with the risk of rural banks becoming zombies in Indonesia. Specifically, the more competitive a rural bank is, the less likely it will become a zombie, while the bigger the rural bank's size, the higher its likelihood of becoming a zombie. These findings are consistent across various models (zombie1, zombie2, and zombie3) at national and provincial levels. An analysis of rural banks on the island of Java also reveals that increased competition can reduce the risk of zombification.

Robustness tests using an alternative competition metric (i.e., the H-statistic from the Panza–Rosse model) corroborate the main results, as the negative relationship between competition and zombie risk remains, though statically significant only for zombie3. Furthermore, IV estimations that employ provincial banking density as an instrument confirm that potential endogeneity (reverse causality or omitted variables) is limited and does not materially bias the principal conclusions. The positive association between bank size and zombification also persists after controlling for bank-specific characteristics and fixed effects, underscoring the structural nature of the size effect. Lastly, provincial heterogeneity analysis identifies Banten as a hotspot where the probability of zombification under zombie1 and zombie2 definitions is markedly higher than in other provinces, signaling local-level vulnerabilities that require targeted oversight.

Based on these findings, we provide clear policy recommendations that focus on improved monitoring, stronger regulatory oversight, and the promotion of healthy competition among rural banks. First, policymakers and regulators should intensively monitor rural banks, particularly those identified as vulnerable to zombification. This monitoring should include regular evaluation of key financial indicators (e.g., IR and ICR), along with proactive follow-ups on banks exhibiting early signs of financial distress. Second, there is a need for enhanced regulation and supervision of rural banks to reduce their risk of becoming zombies. Regulators must ensure that rural banks comply with established financial standards and have effective recovery plans and strategies. Third, rural bank owners must develop strategies to remain competitive in an increasingly competitive market. This includes diversifying products and services, leveraging technology, and improving operational

efficiency. Fourth, policymakers, regulators, and rural bank owners need to collaborate in addressing the risks faced by the rural banking sector. Collaboration with local governments, other financial institutions, and community organizations can help strengthen the position of rural banks in facing challenges. Implementing these recommendations is expected to lower the risk of rural banks becoming zombies and enhance the sustainability of Indonesia's rural banking sector.

Lastly, findings from this study provide evidence-based support for integrating rural bank stability into broader national financial planning strategies, such as the National Medium-Term Development Plan (*Rencana pembangunan Jangka Menengah Nasional*/RPJMN). This integration is crucial to ensuring the resilience of rural banks as key financial intermediaries supporting inclusive economic growth. The study likewise highlights the importance of strengthening regulatory frameworks by aligning with international standards like Basel III. Such regulatory convergence will enhance risk management practices and capital adequacy requirements, particularly for larger rural banks, thereby reducing the likelihood of zombification and promoting long-term sector sustainability.

In addition to the above, we recommend that regulators consider implementing tiered capital requirements, whereby larger rural banks with higher systemic risk are subject to stricter capital adequacy thresholds. This approach could mitigate the zombification risk associated with size. Furthermore, policymakers could provide incentives for mergers or consolidations among small rural banks, particularly those struggling to remain competitive or maintain profitability. Such structural measures may enhance resilience in the sector and reduce fragmentation in the rural banking market.

REFERENCES

Acharya, V.V. Crosignani, M. Eisert, T. Eufinger, C. Acharya, V.V., Crosignani, M, Eisert, T. 2024. Zombie credit and (dis-)inflation: Evidence from Europe. *Journal of Finance* 79(3): 1883–1929.

Albuquerque, B. & Iyer, R. 2023. The rise of the walking dead: Zombie firms around the world. *IMF Working Papers International Monetary Fund* 2023 No. 125.

Amidu, M. & Wolfe, S. 2013. Does bank competition and diversification lead to greater stability? Evidence from emerging markets. *Review of Development Finance* 3(3): 152–166.

Banerjee, R., Doerr, S. & Hofmann, B. 2024. Whither the walking dead? The consequences of artificial intelligence for zombie firms. *Economists' Voice* 21(2): 237–248.

Banerjee, R. & Hofmann, B. 2018. The rise of zombie firms: Causes and consequences. *BIS Quarterly Review*.

Banerjee, R. & Hofmann, B. 2020. Corporate zombies: Anatomy and life cycle. *SSRN Electronic Journal*.

Bargagli-Stoffi, F.J., Incerti, F., Riccaboni, M. & Rungi, A. 2023, Machine learning for zombie hunting: Predicting distress from firms' accounts and missing values. *Industrial and Corporate Change* 33(5): 1063–1097.

Barros, C.P., Ferreira, C. & Williams, J. 2007. Analysing the determinants of performance of best and worst European banks: A mixed logit approach. *Journal of Banking & Finance*, North-Holland (31)7: 2189–2203.

Barros, C.P., Managi, S. & Matousek, R. 2012. The technical efficiency of the Japanese banks: Non-radial directional performance measurement with undesirable output, *Omega* 40(1): 1–8.

Berger, A.N., Li, X., Morris, C.S. & Roman, R.A. 2021. The effects of cultural values on bank failures around the world. *Journal of Financial and Quantitative Analysis* 56(3): 945–993.

Braggion, F. & Ongena, S. 2019. Banking sector deregulation, bank–firm relationships and corporate leverage. *The Economic Journal* 129 (618): 765–789.

Caballero, R.J., Hoshi, T. & Kashyap, A.K. 2008. Zombie lending and depressed restructuring in Japan. *American Economic Review* 98(5): 1943–77.

Calderon, C. & Schaeck, K. 2016. The effects of government interventions in the financial sector on banking competition and the evolution of zombie banks. *Journal of Financial and Quantitative Analysis* (51)4: 1391–1436.

Chowdhury, T., Karim, R. Al, Awanis, A. & Rownak, A. 2024. Does the size of a bank moderate the relationship between income, asset diversification, and bank stability? *International Journal of Financial Studies* 12(4): 1-15.

Fiordelisi, F., Radić, N. & Weyman-Jones, T. 2021. Detecting zombie banks. *The European Journal of Finance Routledge* (27)15: 1459–1488.

Fraisse, H., Hombert, J. & Lé, M. 2018. The competitive effect of a bank megamerger on credit supply. *Journal of Banking & Finance* 93: 151–161.

Fukuda, S. ichi & Nakamura, J. ichi. 2011. Why did 'zombie' firms recover in Japan? *The World Economy* 34(7): 1124–1137.

Fukuyama, H. & Weber, W.L. 2008. Japanese banking inefficiency and shadow pricing. *Mathematical and Computer Modelling* 48(11–12): 1854–1867.

Gao, H., Ru, H., Townsend, R. & Yang, X. 2019. Rise of bank competition: Evidence from banking deregulation in China.

Garcia-Merino, J.D., Urionabarrenetxea, S. & San-Jose, L. 2025. The economic and social dilemma of zombie companies worldwide: Institutional context and poverty impact analysis. *Sustainability Accounting, Management and Policy Journal*: 1-25.

El Ghoul, S., Fu, Z. & Guedhami, O. 2021. Zombie firms: Prevalence, determinants, and corporate policies, *Finance Research Letters* 41.

Hoshi, T. 2006. Economics of the living dead. *The Japanese Economic Review* 57(1): 30–49

Huynh, J. 2024. Bank diversification strategies under market competition. *SAGE Open* 14(4).
Irawati, N. & Maksum, A. 2018. The Impact of risk management and bank size on profitability of commercial banking in Indonesia. *Atlantis Press*: 38–41.
Kane, E.J. 1987. Dangers of capital forbearance: The case of The FSLIC and Zombie S&Ls. *Contemporary Economic Policy* 5(1): 77–83.
Khattak, M.A., Hamid, B.A., Islam, M.U. & Ali, M. 2021. Competition, diversification, and stability in the Indonesian Banking System. *Buletin Ekonomi Moneter dan Perbankan* 24: 59–88.
Koetter, M., Kolari, J. & Spierdijk, R. 2012. Enjoying the quiet life under deregulation? Evidence from adjusted Lerner indices for US banks. *The Review of Economics and Statistics* 94(2): 462–480.
Lam, W.R., Schipke, A., Tan, Y. & Tan, Z. 2017. Resolving China's zombies: Tackling debt and raising productivity. *IMF Working Papers* 17(266): 1-26.
Lerner, A.P. 1934. The concept of monopoly and the measurement of monopoly power. *Review of Economic Studies* 1(3): 157–175.
Li, X., Shao, X., Shen, G. & Zou, J. 2023. Bank competition and formation of zombie firms: Evidence from banking deregulation in China. *SSRN Electronic Journal*.
Love, I. & Pería, M.S. 2015. How bank competition affects firms' access to finance. *The World Bank Economic Review* 29(3): 413–448.
McGowan, M.A., Andrews, D. & Millot, V. 2018. The walking dead? Zombie firms and productivity performance in OECD countries. *Economic Policy*: 1-42.
Nuralyza, O., Dian, N.P., Handayani Narsa, R., Sriani, D., Putu, N., Rosalina, D. & Narsa, H. 2022. Bank competition, credit risk, and foreign bank penetration: Empirical evidence from Indonesia. *Jurnal Bisnis, Manajemen dan Perbankan* 8(1): 7–24.
Panzar, J.C. & Rosse, J.N. 1987. Testing for 'monopoly' equilibrium. *The Journal of Industrial Economics* 35(4): 443-456.
Rakshit, B. & Bardhan, S. 2022. An empirical investigation of the effects of competition, efficiency and risk-taking on profitability: An application in Indian banking. *Journal of Economics and Business* 118.
Reis, R. 2018. Is something really wrong with macroeconomics? *Oxford Review of Economic Policy* 34(1–2): 132–155.
Shaffer, S. & Spierdijk, L. 2015. The Panzar-Rosse revenue test and market power in banking. *Journal of Banking and Finance* 61: 340–347.
Shen, Y., Ren, M. & Zhao, J. 2023. Bank competition and zombie company: Empirical evidence from China. *Economic Analysis and Policy* 80: 297–318.
Siauwijaya, R. 2017. The evaluation of bank efficiency in post merger stage in banking industry. *Binus Business Review* Universitas Bina Nusantara 8(2): 133–139.
Siauwijaya, R. 2025. Green credit policy, market competition, and bank risk-taking: Evidence from Indonesian commercial banks. *SSRN Electric Journal.*
Siauwijaya, R., Grania, G.C. & Yusanto, T.J. 2025. The impacts of green credit policy and competition on bank profitability in Indonesia. *Global Business and Economics Review* 32: 134-159.
Siauwijaya, R., Izumi, C.C., Tiana, V.D. & Valeryandra, G. 2025. *The role of competition and size on zombie rural banks in Indonesia.* Zenodo.
Siauwijaya, R., Meiryani & Lesmana, T. 2023. The impacts of green credit policy, bank-specific, industry-specific, and macroeconomic variables on bank profitability in Indonesia. *Journal of System and Management Sciences*, Success Culture Press 13(6): 502–522.
Veríssimo, P., de Carvalho, P.V. & Laureano, L. 2021. Asymmetries in the Euro area banking profitability. *The Journal of Economic Asymmetries* 24.
Wezel, T., Sheldon, H. & Fu, Z. 2024. Determinants of zombie banks in emerging markets and developing economies. *IMF Working Papers* 2024 No. 036.
Wijoyo, N.A., Kriswantriyono, A., Adhi, A.K. & Rifin, A. 2021. Analysis of the level of competition in commercial banks in Indonesia, *Journal of Hunan University Natural Sciences* 48(12): 258-265.
Zhang, X. & Huang, B. 2022. Does bank competition inhibit the formation of zombie firms? *International Review of Economics & Finance* 80: 1045–1060.
Zhaxi, Y. & Yasuda, Y. 2024. Determinants of zombie firms: The impact of corporate insolvency efficiency and cultural factors. *Journal of Risk and Financial Management* 17(8): 1-13.

Rahmat Siauwijaya*
School of Accounting
Bina Nusantara University
Jl. Jalur Sutera Bar. No.Kav. 21, RT.001/RW.004
Panunggangan, Kec. Pinang, Kota Tangerang, Banten 1514, INDONESIA.
E-mail: rahmat.siauwijaya@binus.ac.id

Claudya Calvina Izumi
School of Accounting
Bina Nusantara University
Jl. Jalur Sutera Bar. No.Kav. 21, RT.001/RW.004
Panunggangan, Kec. Pinang, Kota Tangerang, Banten 1514, INDONESIA.
E-mail: claudya.izumi@binus.ac.id

Verin Dwi Tiana
School of Accounting
Bina Nusantara University
Jl. Jalur Sutera Bar. No.Kav. 21, RT.001/RW.004
Panunggangan, Kec. Pinang, Kota Tangerang, Banten 1514, INDONESIA.
E-mail: verin.tiana@binus.ac.id

Grisherra Valeryandra
School of Accounting
Bina Nusantara University
Jl. Jalur Sutera Bar. No.Kav. 21, RT.001/RW.004
Panunggangan, Kec. Pinang, Kota Tangerang, Banten 1514, INDONESIA.
E-mail: grisherra.valeryandra@binus.ac.id

*Corresponding author