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The Impact of Regulatory Penalties on Bank Stability: Evidence from Global Systemically
Important Banks

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Abstract

I investigate the impact of regulatory penalties on bank stability by focusing on 20 systemically important banks from Europe and the U.S. between 2011 and 2023. I use the Tier 1 Capital Ratio, Return on Assets and the Z-Score to measure bank stability, along with a manually collected dataset of regulatory penalties imposed by U.S. and European supervisory authorities. The findings reveal a strong, significant and lasting impact of imposed penalties on the Tier 1 capital ratio, which offsets the negative impact on Return on Assets, so that there is no decline in the Z-Score, implying a stable insolvency risk.

Keywords

Regulatory penalties

Banking regulation

Financial stability

Supervisory effectiveness

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1. Introduction

Banks play a systemically relevant role in the economy through their financial intermediation and transformation function (Köster and Pelster 2017). To prevent the systemically important functions of banks from failing, supervisory authorities use penalties to punish banks for misconduct. Since the general financial stability is closely linked to the overall stability of the banking system, regulatory penalties are an indispensable tool of supervisory authorities for minimizing far reaching economic and social disruptions (Deli et al. 2019; Swamy 2014). This study investigates whether penalties lead to the desired stabilization of banks, directly in the year of the event and in the following three years after the event. Thereby, stability is measured by three different metrics: Tier 1 Capital Ratio, Return on Assets and Z-Score.

The Tier 1 Capital Ratio is the central regulatory metric for the ability of loss absorption. Return on Assets is the indicator of earnings power and the ability to have a buffer against unexpected losses and to strengthen the capital base. Z-Score is the common metric to measure insolvency risk. In addition, regulatory penalties are quantified by three different penalty variables, which describe the absolute amount of the penalty, the relative amount of the penalty compared to the bank's total assets, and a variable that indicates if there was a penalty event in a specific year. This results in a comprehensive analysis of the effectiveness of regulatory penalties and elaborates on their impact and the respective measures taken by banks within a period of three years after the punishment.

The analysis shows if penalties have a disciplinary effect on the capital management and risk appetite of banks. In addition, the appropriateness of the amount of the penalty payment and possible effects on the insolvency risk are examined. For conducting the analysis, I manually collect the penalties imposed by supervisory authorities on 20 global systemically important and globally acting banks from the U.S. and Europe for the period between 2011 and 2023.

The resulting panel data set is then used to regress the three penalty variables on the stability metrics while controlling for both bank-specific and macroeconomic control variables by using two different regression approaches: pooled OLS and fixed effects models.

2. Literature Review

Delis and Staikouras (2011) examine the impact of regulatory on-site audits and penalties from 1998 to 2008 on banks' risk, which they measure by using the Z-Score. This underscores the relevance of the Z-Score as a metric of risk and stability. They find a highly significant linear negative relationship between penalties and risk. This indicates that penalties cause a disciplinary effect resulting from the banks' risk limitation when they are exposed to the direct costs of the penalty. They use different regression methods, including the pooled OLS model. Remarkable in this context is that the pooled OLS model leads to comparable results to the other, more complex regression models used.

A different methodology with strongly deviating results is carried out by Zeidan (2012). He questions the effectiveness of regulatory authorities and their penalties by investigating their effect on the financial performance measures Return on Assets and Equity of U.S. publicly traded banks over the period from 1990 until 2010. He does not find any significant effect on Return on Assets and concludes that enforcement actions need to be improved. Zeidan (2012) uses a different approach. He regresses penalties on the abnormal Return on Assets, which measures the deviation from competitors' average Return on Assets.

To also have a comparison with more recent data, especially data after the financial crisis, I look at the study by Köster and Pelster (2017). They analyze the impact of financial penalties from Global Systemically Important Banks and other major international banks between 2007 and 2014. They analyze the impact on profitability, measured by pre- and after-tax Return on Assets and on the bank's Z-Score. Under the usage of a dynamic regression model, they find no significant impact on after-tax Return on Assets when taking all banks into account.

However, when they only consider banks from the U.S., they find that penalties significantly decrease the banks' after-tax Return on Assets. In the analysis of the Z-Score they discover a weak significant negative coefficient, which they interpret as a result of a decrease in the equity resources that then leads to increased default risk. These results show that there still is not a clear assessment of the effectiveness of regulatory penalties and their interpretation.

Theory

When banks violate regulations and rules, penalties are an indispensable part of an institutional framework that ensures stable banking operations (Deli et al. 2019). The banking sector is based on a high level of trust between banks and between banks and their depositors. This is the reason why the behavior of banks and the resulting penalties are of great importance. Banks have a financial intermediation and transformation function and are therefore systemically relevant for the functioning of the economy (Köster and Pelster 2017). Banking regulation therefore tries to safeguard the interests of depositors, investors and creditors while preserving the reputation and integrity of the financial market by penalizing banks for their misconduct (Zeidan 2012; Köster and Pelster 2018). Supervisory authorities should therefore aim their penalties at limiting banks' risk-taking and ensuring long-term stability (Delis and Staikouras 2011). Based on these theoretical considerations, I hypothesize that regulatory penalties have a disciplinary effect on banks (H1).

Regulatory penalties unfold effects in two ways. First, penalties lead to a direct cost, leading to a reduction in earnings. Second, penalties have an indirect effect as a result of reputational damage (Deli et al. 2019). Banks have an incentive to be involved in potentially not legal activities when the economic gain from these activities exceeds the expected costs of a financial penalty (Köster and Pelster 2017). The costs need to be high enough to prevent future misconduct. Next to that effect, penalties ensure investors and customers confidence in the banking system by showing that misconduct is not tolerated (Köster and Pelster 2018).

However, imposing penalties also carries risks. A penalty can decrease bank stability because of reduced profits and equity resources, which can potentially weaken banks so that they become riskier (Köster and Pelster 2018). Stability is not a standalone metric, and there is not yet a widely accepted model or analytical framework. Banking stability is a composite of different parameters of individual banks as capital adequacy, profitability or the distance to insolvency (Swamy 2014).

Therefore, I analyze different factors to determine the impact on financial stability. The first metric to measure stability is Tier 1 Capital Ratio (T1CR). A higher value denotes a greater level of capital adequacy and a lower insolvency risk because a capital buffer can absorb potential losses (Delis, Staikouras, and Tsoumas 2017; World Bank 2020). A bank with a higher capital ratio therefore has a lower insolvency risk (Daoud and Kammoun 2020). It is computed as the ratio of Tier 1 capital to risk-weighted assets.

Regulatory authorities want a bank that receives a regulatory penalty to improve its stability (Götz and Tröger 2017). For T1CR, that would mean that a penalty should cause an increase in T1CR, particularly in the long term (H2). The easiest and often only way for banks to increase their capital ratio is to decrease the amount of risk-weighted assets by asset restructurings and portfolio shrinkage. This approach is feasible, as the asset side is where the banks have the most control (Delis, Staikouras, and Tsoumas 2017). Raising additional capital becomes harder for penalized banks due to their negatively affected reputation, and using retained earnings is not always possible (Zeidan 2012). In contrast, the penalty costs can be substantial and, combined with a negatively impacted reputation, the equity base can be hurt. This suggests a decrease in T1CR, especially in the short run, when immediate adjustments to the T1CR are limited (Fich and Shivdasani 2007; Köster and Pelster 2017).

The second metric I consider is the measurement of profitability, which I measure by using Return on Assets (ROA). ROA is composed of the division of net income by total assets. An

increase in profitability demonstrates earning power and thus improved opportunities to strengthen equity, which increases the bank's stability. ROA is a better metric for financial performance compared to Return on Equity, as it measures the ability of a company to produce returns on its asset portfolio without being distorted by high leverage (Rivard and Thomas 1997; Menicucci and Paolucci 2016). Regulatory authorities should aim for a direct effect of their penalties on the current business and its operating performance but without creating solvency problems (Zeidan 2012; Köster and Pelster 2017). Hence, I hypothesize that regulatory penalties cause a decline in ROA in the short run (H3). I expect the effect to disappear over time, as regulators do not want to hamper the stability of the respective bank in the long run. The last metric to measure stability is the Z-Score. The Z-Score primarily measures insolvency risk, and an increase in the Z-Score implies higher stability for the respective bank (Laeven and Levine 2009). It is calculated as:

$$Z - score = \frac{ROA + \frac{E}{A}}{\sigma_{ROA}} \quad (1)$$

where E/A is the equity to asset ratio and $\sigma(ROA)$ is an estimate of the standard deviation of the Return on Assets (Delis and Staikouras 2011). I calculate the standard deviation of ROA by taking the ROA of the current year and the two previous ones and calculate the standard deviation of it. The metric can be understood as the amount of standard deviations the ROA can drop before the bank is insolvent (Goetz 2018).

The goal of regulators is to incentivize banks to a lower risk tolerance (Köster and Pelster 2017). I therefore hypothesize that the Z-Score will rise rather than fall in the long term to maintain stability (H4). All hypotheses are shown in Table 1.

3. Empirical Design

3.1 Data Collection

I focus on regulatory penalties against 20 global systemically important banks from Europe and the U.S. (Table 2). These institutions have established regulatory frameworks and extensive, publicly accessible penalty data while also belonging to the most developed and integrated markets. For these banks, I investigate the impact of regulatory penalties on bank stability over a period of 13 years. I choose to look at the global systemically important banks for two reasons. Firstly, these are the banks that have the greatest impact on financial stability and the real economy, and secondly, the largest globally relevant banks are the most heavily sanctioned (Lorenc and Zhang 2020).

The Financial Stability Board yearly publishes a list of the global systemically important banks. In the most recent report from 2023, eighteen of the banks are from Europe or the U.S. and have been penalized for misconduct in the considered thirteen years (Financial Stability Board 2023). In addition, I also include NatWest Group PLC and Lloyds Banking Group PLC according to the S&P Global List of the largest banks by assets as of 2023, which is consistent with the Financial Stability Board's list, as the size of a bank also determines its global impact (Jimenea, Wu, and Terris 2024; Dzhagityan and Orekhov 2022; Zaring 2021). This approach creates a panel data set with 260 observations, with 20 banks and a period of 13 years.

All penalties need to be hand collected from multiple supervisory authorities, as there is not one single supervisory authority that penalizes banks. At least every country has its own supervisory authority. It is important to consider that especially in the U.S. there is a multi-layered system of federal regulatory authorities, state regulatory authorities and state attorney general offices that all distribute regulatory penalties. In Europe there are EU-wide supervisory authorities and national supervisory authorities. From the U.S., I consider eleven federal supervisory authorities, two state supervisory authorities and nine state attorney general offices. I include

three EU-wide authorities, four national authorities from the UK and one supervisory authority each from Germany, France and the Netherlands (Table 3). Each of these authorities has the power to impose monetary penalties (Zaring 2021). I consider monetary penalties, where there is a direct monetary payment imposed by a supervisory authority; these include sanctions, monetary settlements and penalties. Private litigations or court rulings that are not related to a supervisory authority are not considered. All penalties are collected from the news and press releases of the respective supervisory authority, because there is no central collection or publication of the punitive measures. Thereby, it is important that penalties are not considered twice, as the press releases partly overlap. To get the total fine for the year, I add up all fines of the respective year and use the respective average annual exchange rate to convert any penalty amounts that are not in dollars into dollars (Table 4). However, it is important to mention that the aggregated value for each year remains an approximation of the exact amount. On the one hand, this is because not every penalty is reported in press releases. On the other hand, due to the multitude of regulatory authorities and possible communication channels, it is impossible to ensure full completeness (Köster and Pelster 2017). Task is to identify the majority and above all the most important penalties imposed. In total, I collect 608 individual penalties, ranging from USD 90,000 (ING in November 2019) to USD 17 billion (Bank of America in August 2014). I also include small penalties, as they are relevant for the smaller banks or for banks with only few penalties. Table 5 presents the total amount and number of imposed penalties per bank. Figures 1 and 2 show the distribution and development of the imposed penalties. Figure 1 presents the annual value of penalties per year, and Figure 2 shows the penalties by bank over time. The annually aggregated total amount of penalties for all 20 analyzed banks peaked in 2013 and 2014 with a total amount of USD 20,389 million and USD 41,937 million, respectively. The lowest aggregated values were recorded in 2013 and 2023 with a penalty sum worth USD 1,545 million and USD 3,357, respectively (Figure 3).

3.2 Regression Approaches

I investigate the linear effect of the explanatory variable (regulatory penalties) on the three response variables (T1CR, ROA and Z-Score), which I use to measure stability by using two different regression approaches. The first one is a pooled ordinary least squares (OLS) regression. The pooled OLS regression relies on the assumption of a constant intercept and slopes, irrespective of the group and the period, and ignores the panel structure of the data, which has both a cross-sectional dimension and a temporal dimension (Park 2011; Arceneaux and Nickerson 2009). The second regression method I use is a fixed effect regression. The fixed effect model still has constant slopes, but the intercepts are allowed to differ across banks (Yaffee 2003). The fixed effect regression uses a so called within transformation, also known as a demeaned transformation, which absorbs all characteristics that are constant over time by subtracting the group mean of each variable from the respective observation (Wooldridge 2012). Especially for many panel data sets, this transformation makes the fixed effect model more realistic than the pooled OLS, since the fixed effect model can capture the differences between banks by using different intercepts while still using the ordinary least square principle (Zulfikar 2018). The omitted variable bias is a form of endogeneity that occurs when an unobserved variable is correlated with one of the regressors and the dependent variable, leading to biased regression estimates (Wooldridge 2010). Fixed effect models control for these unobserved, time-invariant bank-specific characteristics and can thereby mitigate the risk of the omitted variable bias. The pooled OLS, in contrast, can only produce unbiased estimates if these unobserved effects are not correlated with the explanatory variables. The resulting bias is known as heterogeneity bias (Wooldridge 2012). Although the fixed effect regression controls for the unobserved time-constant variables, the unobserved time-varying variables can still be subject to the problem of endogeneity which can cause biased estimates (Brüderl and Ludwig 2015).

3.3 Variable selection and transformation

I create three independent variables with my yearly collected penalties: Log-Penalty, which represents the variable for the log-transformed absolute value of the yearly penalty; Penaltyasset, which records the relative amount of the penalties in relation to total assets; and Penalty_Y/N, which is a binary indicator. I take the natural logarithm of the absolute value of the penalty because the penalty without a log-transformation is badly skewed to the right (Figures 4 and 5). For this case, logarithmic transformations are a common method to normalize the distribution (Manning 1998). Although the log-transformed penalty variable is not perfectly normal either, it is less skewed and more symmetric. The second independent variable Penaltyasset is the division of the yearly penalty by the bank's total assets. Using a ratio variable in regressions is a common technique, as it helps to control for differences in the scale and ensures comparability across variables (Lien, Hu, and Liu 2017). Dividing the penalties by total assets ensures that the effect of the penalties becomes relative to the size of the bank, as the same penalty can affect a smaller bank more than a larger one. To ensure the interpretability of the regression coefficients of the penalty to asset ratio, the ratio is rescaled by multiplying it by 10000. The mathematical derivation of the data scaling is shown in Technical Note 1. The last penalty variable is Penalty_Y/N. This is a dummy variable that becomes one in the years with a regulatory penalty and zero in the years without. The dummy variable is therefore used to examine the effect of the occurrence of a penalty without considering the amount of the penalty. I examine the distribution of the three stability variables to check for necessary transformations for the regression analysis. The distribution of the Z-Score is heavily skewed to the right, while its log transformation is much more symmetric and closer to a normal distribution. Therefore, the log-transformed Z-Score is the better choice for the dependent variable (Figures 6 and 7). The T1CR and ROA have a slight distribution to the right and a log transformation is not

necessary (Figures 8 and 9). The ROA values are very small; therefore, I rescale them to percentage values (Technical Note 2).

In order to get consistent estimates of the causal effect of regulatory penalties on bank stability, I need to control for confounding factors that also influence bank stability; these are called control variables (Hünermund and Louw 2023). The control variables for my regression model are divided into two groups. The bank-specific and the macroeconomic control variables. These control factors are determined on the basis of economic considerations and current literature. The bank-specific control variables explain the effect of the business model and the structure of the bank with respect to stability.

In the following, I describe the control variables that I use in the regression models of the three selected stability indicators. Table 6 gives a complete overview of the control variables for each stability metric. The control variables used for all three stability metrics are the size of the bank (Size), asset structure (Asset), funding structure (Funding) and loan loss provisions (LLP). The size of a bank has an impact on investment opportunities, access to capital and the bank's risk diversification and therefore is a determinant for all three stability measures (Rime 2001). I measure bank size by total assets, which are measured in millions of USD, and take their natural logarithm, as the log transformation is more symmetric and closer to a normal distribution and not as skewed to the right (Figures 10 and 11). Both asset and funding structure determine bank stability, as they have a strong informative value about the risk of a bank. The asset structure is calculated as total loans over total assets and the funding structure is measured by total deposits to total assets. Both metrics determine insolvency and credit risk through lending behavior and funding stability (Daoud and Kammoun 2020). The variable LLP represents the ratio of loan loss provisions to total loans. A high ratio of loan loss provisions to total assets is an indicator of a riskier loan portfolio and therefore weaker asset quality and poorer future performance (Menicucci and Paolucci 2016).

For the stability metrics Z-Score and ROA, the banks' expense efficiency (Expense Efficiency) is considered as a control variable. Expense Efficiency is calculated as the ratio of non-interest expenses to total assets and is therefore a key component of the bank's cost and earnings situation. Daoud and Kammoun (2020) show that these expenses also have a significant effect on Z-Score. Also, a relevant bank-specific control variable for the stability metrics Z-Score and ROA is the bank's capitalization (Capitalization), which describes the capacity of the bank to cover losses and handle risk exposures. The metric is calculated as the bank's total book equity divided by total assets. For the stability indicators Z-Score and T1CR I also control for profitability, measured by ROA. ROA is a major driver of the Z-Score and it can positively affect capital in case retained earnings are the preferred method for raising capital as suggested by the pecking order theory (Rime 2001). Finally, with respect to the stability indicator T1CR, the ratio of risk-weighted assets to total assets (RWA) is considered as a control variable. This is particularly important as it directly explains the regulatory capital ratios and determines the bank's risk exposure (Brewer III, Kaufman, and Wall 2008).

To consider the macroeconomic control variables in the regression models, I use economic indicators to describe macroeconomic conditions (Table 7). I select the global growth rate of the gross domestic product (GDP) as an indicator for growth momentum and the global inflation rate (Inflation) as an indicator for price stability and monetary conditions (Brewer III, Kaufman, and Wall 2008; Delis and Staikouras 2011). I decide to use the global rates in each case and not country-specific ones, as I only analyze global banks that all operate internationally. All variables and their calculations are displayed in Table 8. I use Bloomberg to collect all the needed data for calculating the needed financial control variables. The exact definitions of the needed key metrics are displayed in Table 9 (Bloomberg 2024).

Economically, I consider all the variables mentioned as relevant, but statistically, I have to be aware of multicollinearity problems, which can distort the model estimation (Daoud and

Kammoun 2020). I use the correlation matrix of all explanatory variables (Table 10) to check for correlations above 0.7, which is a suitable threshold for multicollinearity concerns (Dormann et al. 2013). Expense Efficiency and Capitalization are the only case with a higher correlation than 0.7, making one variable redundant. To determine which of the variables to exclude, I look at the coefficient of variation (CV), which divides the standard deviation of the respective variable by its mean (Santos and Dias 2021). I choose the variable with the higher within CV, as fixed effect regressions do not consider time-constant characteristics and the within CV reflects the changes over time within banks (Wooldridge 2010). I control for Expense Efficiency (CV: 0.15) and drop Capitalization (CV: 0.1) in the regression with Z-Score and ROA as the dependent variable (Technical Note 3).

Table 11 shows the summary statistics of the panel data set with 20 banks over 13 years. The mean value of all yearly penalties across all bank-year observations is USD 628 million, which indicates that, on average, a bank incurred penalties of USD 628 million per year during the analyzed period. The mean for the corresponding Log-Penalty variable is 13.8. Penaltyasset has a mean of 0.42, which means that on average the penalty amounts to USD 0.42 per 1000 USD of total assets across all bank-year observations. The standard deviation of 1.155 is high compared to the mean, and therefore the highest relative penalty amount is USD 8.42 per 1000 USD of total assets. The mean of the variable Penalty_Y/N is 0.74, which means that in 74% of all bank-year observations in the sample, at least one penalty is imposed. The stability variable T1CR has a mean of 14.93% and a minimum value of 10.7%, which is higher than the required 6% after the Basel III Pillar 1 minimum requirements. However the 6% threshold does not include possible additional buffer requirements, which can further increase the minimum capital levels (Bank for International Settlements 2019). ROA has a mean of 0.5% and lies in a range between -0.8% and 1.62%. The log-transformed Z-Score has a mean of 3.19.

3.4 Methodology

I investigate the effects of the three penalty specifications (Log-Penalty, Penaltyasset and Penalty_Y/N) on the three dependent variables (Tier 1 capital ratio, ROA and Z-Score). Within the two regression approaches, I use two different regression models to optimally estimate the effect of a regulatory penalty on the respective bank stability metric. Within the pooled OLS regression approach, the following regressions are conducted (Model 1 and 2):

$$1. \text{Stability}_{it} = \beta_0 + \beta_1(\text{penalty}_{it}) + \beta_2\text{controls}_{it} + \varepsilon_{it} \quad (2)$$

$$2. \text{Stability}_{it} = \beta_0 + \beta_1(\text{penalty}_{it}) + \beta_2\text{controls}_{it} + \gamma_t + \varepsilon_{it} \quad (3)$$

where Stability stands for one of the dependent variables, penalty for one of the three penalty specifications, controls for all the chosen control variables for the respective dependent variable, γ for the year-specific fixed effect and ε is the error term. The subscript i specifies the unit and t the respective year.

The difference between the first and the second regression model is that time fixed effects are added in the second model to explicitly control for all existing time-varying changes (Goetz 2018). This is a standard method for controlling for both observable and unobservable differences between the considered years. This approach therefore enables comprehensive control of the existing time-varying macroeconomic conditions and regulatory changes (Gösser and Moshgbar 2020). It is important that when including time fixed effects, all control variables that only account for time-varying factors and do not vary between banks are left out to avoid the problem of multicollinearity. In my case, this is inflation and GDP growth.

The next two regression models are fixed effect regressions (Models 3 and 4), and therefore display the equation for the within estimator (Bou and Satorra 2018):

$$3. \text{Stability}_{it}^* = \beta_1(\text{penalty}_{it})^* + \beta_2\text{controls}_{it}^* + \varepsilon_{it}^* \quad (4)$$

$$4. \text{Stability}_{it}^* = \beta_1(\text{penalty}_{it})^* + \beta_2\text{controls}_{it}^* + \gamma_t^* + \varepsilon_{it}^* \quad (5)$$

where the variable definitions are the same as explained above and where the * means that this is a demeaned variable. The exact calculation of the demeaned equation is shown in Technical Note 4.

A fixed effect regression model automatically absorbs all time-invariant unit-specific characteristics (Halaby 2004; Wooldridge 2012). It is realistic to assume that the banks differ in these unobserved characteristics, which is why this regression model might be a better fit for my panel data; this is confirmed by the fixed effect F-test (Table 12) (Bou and Satorra 2018). As described for the pooled OLS approach, the time fixed effects are also added in the second model of the fixed effect regression approach (Model 4). Model 4 therefore comprehensively captures both bank-specific characteristics and different time-varying conditions. The four regression models are applied to all three penalty variables (independent variables) for each of the three stability metrics (dependent variables). This leads to twelve regression models for every dependent variable (Technical Note 5). I run each regression three more times to also examine the effects over time for the next three subsequent years by lagging the respective penalty variables by one, two and three years.

A common problem in regression analysis is heteroskedasticity, where the OLS assumption of a constant variance of the unobserved errors is violated and the unobserved factors change across different segments (Wooldridge 2012). Especially in panel data models, there can easily be unit-specific heteroskedasticity (Yaffee 2003). To address the problem of heteroskedasticity, I use clustered standard errors in all regressions performed (Cameron and Miller 2015).

4. Results

The following paragraph describes an overview of the key results of the analysis carried out. The results and the statistical basis are then presented in detail. My analysis shows that regulatory penalties have a disciplinary effect on banks. This is particularly evident in the adjustments to the capital management and risk appetite of the affected banks. Regulatory

penalties influence capital management decisions by incentivizing banks to increase their T1CR, both immediately and in the longer run. The results of the analysis suggest that banks immediately try to adjust their T1CR after a penalty is imposed, possibly as a reaction to regulatory and market expectations. Even after two years there is a continued strengthening of the T1CR. A plausible interpretation of the subsequent increase in T1CR is that the banks are stabilizing their capital ratios to recover from the negative impact on earnings because of the penalty, which may otherwise reduce equity resources. Penalties cause an immediate financial burden for the bank, which lowers net income and therefore decreases ROA in the short run. A striking result is that in the longer run, the mere existence of a penalty, regardless of its amount, leads to a further decline in ROA. This could presumably be due to harmed stakeholders' confidence and increased funding costs (Köster and Pelster 2017). The observed increases in T1CR help to offset negative impacts on ROA. This makes it possible for penalized banks to maintain a constant Z-Score and remain stable.

In the following, the analysis results are presented according to the tested stability metrics (ROA, T1CR and Z-Score). I find a negative effect of an imposed penalty on ROA in the year of the event, resulting from an immediate loss position in the profit and loss statement caused by the penalty, which directly impacts net income. This can be seen by the uniformly negative coefficients for all three penalty specifications in each of the four regression models (Table 13). Thereby, the negative effect in the short run is statistically most strongly driven by the effect of the relative amount of the penalty compared to total assets (Penaltyasset variable). This confirms that the impact and severity of a penalty vary depending on the size of the bank. In the subsequent years, this relative effect loses its impact (Table 14). Three years after the imposed penalty, the absolute amount and the mere existence of a penalty are responsible for a negative effect on ROA. This becomes evident from the regression results of the other two penalty variables (Log-Penalty, Penalty_Y/N) which show significant negative coefficients.

These results suggest that the direct cost effect of the relative size of the penalty decreases over time, whereas subsequent effects, such as reputational damage caused by penalties, have a more relevant impact.

The observed effects in the longer run are likely to be attributable to the associated negative effect on reputation, which can lead to lower sales, loss of stakeholder confidence and strained funding conditions (Köster and Pelster 2017). While these findings indicate a clear trend, the associated regression coefficients are only partially significant (Tables 13 and 14). This casts doubt on the robustness of the effect of penalties on ROA. Economically, the reason for only a few weak significant coefficients could be that there is only a limited effect on ROA, which would support the result of Zeidan (2012), who concludes that enforcement actions need to be improved as they do not harm banks profitability. Another similar explanation would support the result of the study by Köster and Pelster (2017). They only find a significant negative effect on pre-tax profitability. They conclude that the tax deductibility of specific penalties eliminates the negative impact of regulatory penalties when considering after-tax profitability. Another possible reason could be that the negative effect of penalties was already anticipated in previous years and considered in the profit or loss statement by the creating risk provisions. Statistically, the few weakly significant coefficients may be due to the rather small panel data set, which makes it harder to obtain statistically significant results (Thiese, Ronna, and Ott 2016).

The in-depth analysis of the regression results of ROA shows that in the short run, only for the pooled OLS models with the independent variable *Penaltyasset*, the coefficients are statistically significant at the ten percent level and range between -0.008 and -0.031. Therefore, an increase in penalties of one dollar per thousand dollars in assets is associated with a decrease between 0.8 and 3.1 basis points on average in ROA, holding the other variables constant. Since only the pooled OLS models are statistically significant and the fixed effect models are not, further indicates that the bank-specific characteristics explain a significant portion of the sample

variation in the dependent variable. The variable Penaltyasset leads to the most meaningful results in the short run. This is further supported by comparing the explanatory power of the different models by using the goodness-of-fit measure R^2 . The models with the same regression approach, same dependent variable and same control variables can be compared (Wooldridge 2012). This is the case for the different models where only the penalty variable differs, and regression approach, dependent variable and control variables are equal (Table 15). In all cases the regression models with the dependent variable Penaltyasset deliver slightly better explanatory power, as they have marginally higher or at least equally high R^2 values than the comparable regression models with the same regression approach and the same control variables but different penalty specifications. For the Log-Penalty and Penalty_Y/N variables, the coefficients are not statistically significant in the short run. Therefore, the interpretation of the coefficients does not lead to meaningful conclusions regarding the effect triggered by the absolute amount of the penalties or the mere existence of penalties. For the longer run, one year and two years after the imposed penalty, it seems that the effect of the penalty on profitability disappears, since none of the coefficients are significant. All coefficients of the one- and two-year lagged penalties are smaller in their magnitude and partly even marginally positive. But three years after the penalty, for the variables Log-Penalty and Penalty_Y/N, the coefficients for the fixed effect regression without year fixed effects (Model 3) become statistically significant. For the variable Log-Penalty, the coefficient from the pooled OLS with year fixed effects (Model 2) is also statistically significant. Furthermore, all coefficients are uniformly negative. The significant coefficients three years after the imposed penalty are even higher or equally high compared to the coefficients of the regression without lags. The significant coefficient of the variable Penalty_Y/N after three years can be interpreted as the existence of a penalty compared to no penalty is associated with a decrease of 5.2 basis points in ROA on average, holding the other variables constant. Regarding the significant coefficients of the

variable Log-Penalty, the results indicate that if a penalty is doubled in size (increase by 100 percent), is associated with a decrease in ROA between 0.3 and 0.4 basis points on average, holding the other variables constant.

In the set of control variables, many coefficients are significant, such as Size, Asset, Funding, LLP, Expense Efficiency and GDP. The coefficients of inflation are not statistically significant for all models used. This does not imply Inflation is not an important control variable, as I include control variables to control for factors that might be correlated with other explanatory variables and then lead to heterogeneity bias. Additionally, they are selected to control for factors that are economically relevant for the dependent variable. Even with significant control variables, I need to be cautious with their causal interpretations. Control variables are often endogenous, which means they are correlated with other unobserved factors, making them biased (Hünermund and Louw 2023). This can lead to wrong theoretical conclusions.

The results of the effect of regulatory penalties on ROA confirm the hypothesis that regulatory penalties cause a decline in ROA in the short run (H3) (Table 1). The result with uniformly negative and partly significant coefficients from the regression without lags confirms the hypothesis that in the short run there is a negative effect on ROA. But in the longer run, the following consequences, like reputational damage, have a higher impact than the initial financial burden, which cause a further decline in ROA. Although this result is consistent with economic theory, it must be viewed with caution as only a few coefficients are statistically significant, and the most comprehensive model (Model 4) never delivers a significant coefficient for any of the penalty variables. This indicates that regulatory authorities should aim for higher penalties, which have a stronger significant negative impact on ROA in the short run, as regulatory penalties are only effective if they are high enough to outweigh the gains from the illegal activities and decrease ROA (Köster and Pelster 2017).

The following paragraph provides an overview of the results of the impact of penalties on bank's capitalization and explains them in economic terms; the statistical details follow that. Regulatory penalties incentivize banks to hold higher capital ratios in the short run. This becomes clear when looking at Table 16. All coefficients from the regression analysis of regulatory penalties on the stability metrics are uniformly positive with significant coefficients in the variables Log-Penalty and Penalty_Y/N. Notably, the variable Penalty_Y/N has the most significant results. This indicates the reason for this immediate increase in T1CR may be either regulatory pressure or simply the result of a precautionary measure to maintain stability. It is plausible to assume that this immediate increase in the T1CR is achieved mainly through a change in risk appetite and a reduction in risk-weighted assets. An increase in Tier 1 capital can be achieved, on the one hand, by using retained earnings. This becomes harder as penalties negatively affect ROA, and a dividend cut might negatively affect the stock price (Berk and DeMarzo 2024). On the other hand, it can be achieved by issuing new equity, which could also be difficult in the event of a loss of trust due to the penalty imposed and is unattractive to shareholders, as announcements of equity issuances negatively impact stock returns (Berk and DeMarzo 2024). In the longer run, the reputational pressure from the mere existence of a penalty decreases but still significantly impacts T1CR. This is demonstrated by the regression coefficients of the variable Penalty_Y/N, but also Log-Penalty, which weaken over time but are still positively significant. However, two years after the imposed penalty, the financial pressure has a stronger effect on T1CR, as the relative amount of the penalty compared to its assets (Penaltyasset) shows the most significant coefficients (Table 17). This suggests that the banks are reacting in two phases with their T1CR adjustments. First, banks react with precautionary increases in their T1CR, and later they make structural adjustments to their capital structure based on the relative costs of the penalties and the resulting financial burden.

The statistical in-depth analysis of the regressions of regulatory penalties on T1CR in the short run shows that the variable Penalty_Y/N has the most consistent and significant impact, as all four models yield statistically significant coefficients for the variable Penalty_Y/N. Also, the fixed effect regression with year fixed effects (Model 4), which is the most comprehensive model, also produces a positive significant coefficient at the ten percent level. Whereas the Penalty_Y/N coefficients of the pooled OLS models are statistically significant at the one percent level. The coefficients of the variable Penalty_Y/N can be interpreted as that the presence of a penalty is on average associated with an increase of T1CR between 36 and 130 basis points, holding the other variables constant. The coefficients from the variable Log-Penalty, except for the coefficient of the fourth model, also provide positive significant results. The coefficients lie in a range between 0.0175 and 0.0728 and mean that a 100 percent increase in the penalty amount is associated with an average increase in the T1CR between 1.75 and 7.28 basis points. The fact that these two variables are most responsible for the increase in T1CR is supported by comparing the R^2 values of the different groups (Table 15). For all four model specifications, the second independent variable Penaltyasset exhibits the lowest R^2 value (Table 16). This means that the variable Penaltyasset explains less of the variation of the T1CR compared to the other two penalty specifications, especially for the pooled OLS models. Moreover, none of the coefficients of the variable Penaltyasset are statistically significant. In the longer run, the significance of the coefficients of the variables Log-Penalty and Penalty_Y/N decreases but remains, and the size of the coefficients also decreases in the period between the penalty event and the one- and two-year lags. For the three-year lag effect, the coefficients of these two variables show minimal variation.

The results of the variable Penaltyasset show a different pattern. It is striking that one year after the penalty, all coefficients are insignificant but negative, and two years after the penalty, they become significant and positive for all four models. Three years after the penalty, the effect of

the relative penalty metric decreases. This insignificant negative effect on T1CR after one year can have different reasons. When a penalty is too high relative to their total assets, the penalty reduces the firm's future cash flow (Köster and Pelster 2017). This can then hurt the firm's equity, which cannot be directly offset by the bank by lowering risk-weighted assets. Two years after the penalty, the affected banks can then stabilize and try to recapitalize and restructure their asset side.

Looking at the control variables, the variables Size, ROA and GDP deliver the most significant results with a uniform direction of the coefficients. Whereas most of the coefficients from the variables Asset, Funding, Capitalization and Inflation are not statistically significant.

The results of the impact of penalties on T1CR, which show an immediate increase in T1CR, contradict the fourth hypothesis that the significant costs of a penalty reduce equity and thus the T1CR. However, the third hypothesis is confirmed, as I observe significant positive effects in the long run. Nevertheless, it points out that the positive effect in the year of the penalty event is even stronger than in the longer term. The immediate increase in T1CR is a sign of regulatory success and the effectiveness of regulatory penalties, as there is an immediate and lasting incentive for banks to strengthen their capital ratios.

Finally, the most important results and economic effects in relation to the stability metric Z-Score are presented, followed by an explanation of the statistical details. In the analysis of the Z-Score, I do not find an impact of regulatory penalties on Z-Score and therefore insolvency risk remains unchanged. This can be verified by the observation that none of the coefficients of a penalty variable in the regression on Z-Score are significant either in the short or long term (Tables 18 and 19). Furthermore, the direction of the coefficients of the twelve regression models is not clear, not even within the regression models for a specific penalty variable. On the one hand, regulatory penalties imply direct and indirect costs for banks, which decrease cash flow and can also negatively affect profitability. On the other hand, banks react to penalties

by increasing their capital ratios. The Z-Score captures this interaction by analyzing the combined effect of ROA and the capital ratio. The effects on these two components appear to offset each other, so that there is at least no increase in insolvency risk. This result is not consistent with the findings of Delis and Staikouras (2011), who find a highly significant positive relationship between bank penalties and Z-Score, nor with the more recent findings of Köster and Pelster (2017), who find a weak negative relationship between penalties and Z-Score.

The in-depth statistical analysis reveals that there are no significant penalty coefficients in the short run and all of them have an arbitrary sign. This indicates that there is no linear relationship between regulatory penalties and the Z-Score in the short term. The R^2 values of the stronger fixed effect regression models are slightly higher for the variable Penaltyasset, but as there are no statistically significant results, no causal interpretation can be drawn. Also, over the next three years there are no significant penalty coefficients with one exception. Two years after the imposed penalty, the coefficient of the variable Penalty_Y/N from the fixed effect regression with year fixed effects (Model 4), which is the most comprehensive model, becomes statistically significant at the ten percent level. The coefficient is 0.13 and means that the existence of a penalty is on average associated with a 13 percent increase in the Z-Score, holding the other variables constant. This would indicate a reduction in insolvency risk. The other coefficients are not statistically significant. Therefore, the robustness of this supposedly positive effect can be questioned. Nevertheless, the results indicate that a stabilizing trend in relation to the insolvency risk is more likely than a negative trend. This is supported by the fact that the coefficients of the variables Log-Penalty and Penalty_Y/N are uniformly positive in the fixed effect models for all lagged effects.

The control variables in the regression with Z-Score as the dependent variable exhibit fewer significant coefficients than in the regressions with the other two stability metrics. There may

be different reasons for this. First, the log transformation of the Z-Score leads to a reduction of the variability of the data (Feng et al. 2014). Second, the construction of the Z-Score, which includes both ROA and the capital ratio. This indicates that the effects of the control variables might offset each other.

In H4, I hypothesize that the Z-Score would rise in the longer run, as regulatory authorities should incentivize banks for lower risk takings and higher stability. In the short run, I do not find any effect on this stability indicator, and in the longer run, the robustness of the one significant coefficient is not enough to conclude that there is a positive effect on Z-Score. Therefore, I would reformulate my hypothesis to the finding that there is no statistically robust effect on Z-Score in either the short or the longer term. But my result shows a slight tendency towards a neutral to positive effect rather than a negative one. I regard this result as an indicator for regulatory success, as the penalties do not increase the insolvency risk of banks.

The analysis of the individual stability metrics now allows an evaluation of the initial main hypothesis (H1), that regulatory penalties should have a disciplinary effect on banks. My empirical results confirm this hypothesis. Penalties have different effects on stability indicators. But the increase in the T1CR demonstrates a disciplinary effect on the bank's capital management, which compensates for the negative effect on profitability, thereby the overall stability measured by Z-Score remains stable.

5. Conclusion

In this paper, I examine the changes in bank stability after a regulatory penalty. The results provide important insights for supervisory authorities and banks on the effectiveness of regulatory penalties and measures against banks in the year of the punishment and in the following three years. By empirically examining the development of three different stability metrics, namely T1CR, ROA and Z-Score, of systemically important banks from the U.S. and Europe after being imposed to a regulatory penalty, it can be proven that penalties have a

disciplinary effect on banks. Regulatory penalties incentivize banks to adapt their capital management and risk appetite and to increase their T1CR, both immediately and in the longer run. This is a regulatory success, as regulatory actions lead to immediate effects in the desired direction. A key finding is that penalties expose banks to an immediate financial burden, which reduces net income and ROA in the short run. This is important to achieve a deterrent effect on banks. However, it is important that the negative impact on net income does not lead to solvency problems for the bank. The analysis of the Z-Score proves that the insolvency risk is not increased by regulatory penalties. There are no effects on the Z-Score in either the short or longer term. Penalized banks offset the negative effect on ROA by increasing their capital ratios, which stabilizes the Z-Score. For supervisory authorities, this means that penalties are designed to deter banks and bring about immediate adjustments in the capital structure while at the same time not jeopardizing the stability of the bank and its insolvency risk. However, the analysis also shows that the negative effects on ROA are often not strongly measurable, which means that penalties could even be higher.

This study provides valuable insights for supervisory authorities and banks, who expect a fine. However, this work also has limitations, and further in-depth analyses are possible. Firstly, a larger sample of banks could improve the robustness of the results and increase their statistical significance. This step can be extended by including banks from other regions and markets. Moreover, regulatory penalties are not the only response of regulatory authorities to penalize banks for their misconduct. The overall effectiveness of the supervisory authorities' actions would be complete if the other enforcement actions, such as the power to stop certain practices, the termination or suspension of deposit insurance and the withdrawal, restriction or suspension of banking activities, employees or managers, were also examined (Zaring 2021).

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7. Appendix

7.1 Tables

Table 1. Hypotheses based on theory

Number	Hypotheses
1	Regulatory penalties should have a disciplinary effect on banks
2	Regulatory penalties cause TICR to increase in the long run
3	Regulatory penalties cause a decline in ROA in the short run
4	Regulatory penalties cause the Z-score to rise rather than to fall in the long run to maintain stability

This table presents all my hypotheses based only on economic theory before looking at my results.

Table 2. List of global systemically important banks

Bank ID	Bank Name
1	JPMORGAN CHASE & CO
2	HSBC HLDGS PLC
3	DEUTSCHE BANK AG
4	GOLDMAN SACHS GROUP INC
5	UBS Group AG
6	Citigroup INC
7	Bank of America Corporation
8	BNP Paribas
9	Barclays PLC
10	NatWest Group PLC
11	Crédit Agricole SA
12	Lloyds Banking Group PLC
13	Banco Santander, S.A.
14	Société Générale SA
15	Wells Fargo & Company
16	ING Groep N.V.
17	The Bank of New York Mellon Corporation
18	Morgan Stanley
19	Standard Chartered PLC
20	State Street Corporation

This table lists all selected systemically important banks with their respective bank ID used for identification in the data set. The bank classification is based on the data of the Financial Stability Board (2023), except for NatWest Group PLC and Lloyds Banking Group PLC, which are classified according to S&P Global data (Jimenea, Wu, and Terris 2024).

Table 3. Compilation of all supervisory authorities by country

United States		
Federal Regulatory Authority	State Attorney General Offices	State Regulatory Authorities
U.S. Securities and Exchange Commission (SEC)	California Attorney General	California Department of Insurance
Office of the Comptroller of the Currency (OCC)	Massachusetts Attorney General	New York Department of Financial Services (DFS)
U.S. Department of Justice (DOJ)	New York Attorney General	
Consumer Financial Protection Bureau (cfpb)	Maryland Attorney General	
Commodity Futures Trading Commission (CFT)	Virginia Attorney General	
Financial Industry Regulatory Authority (finra)	New Jersey Attorney General	
Board of Governors of the Federal Reserve System (Fed)	Nevada Attorney General	
National Credit Union Administration (NCUA)	Arizona Attorney General	
U.S. Department of Labor (dol)	Illinois Attorney General	
Federal Deposit Insurance Corporation (FDIC)		
Federal Energy Regulatory Commission (FERC)		
European Union		
European Commission		
European Central Bank (ECB)		
European Data Protection Board (edpb)		
United Kingdom		
Financial Conduct Authority (FCA)		
Financial Services Authority (FSA)		
Bank of England		
Payment Systems Regulator (PSR)		
Office of Fair Trading (OFT)		
Germany		
Bundesanstalt für Finanzdienstleistungen (BaFin)		
France		
Autorité de Contrôle Prudential et de Résolution (ACPR)		
Netherlands		
Netherlands Public Prosecution Service		

This table presents an overview of all supervisory authorities, I collected penalties from.

Table 4. Average annual exchange rates, 2011-2023

Year	EUR USD	GBP USD
2011	1.29	1.55
2012	1.32	1.63
2013	1.38	1.66
2014	1.21	1.56
2015	1.09	1.47
2016	1.05	1.23
2017	1.20	1.35
2018	1.15	1.27
2019	1.12	1.33
2020	1.22	1.37
2021	1.14	1.35
2022	1.07	1.21
2023	1.11	1.27

This table presents the average annual exchange rates of the euro and british pound in dollars. The data is obtained from Macrotrends (2023a, 2023b).

Table 5. Overview of individual collected penalties

Bank	Total penalties imposed	Total penalty amount in Mio USD
JPMORGAN CHASE & CO	42	22395
HSBC HLDGS PLC	30	5516
DEUTSCHE BANK AG	51	16439
GOLDMAN SACHS GROUP INC	34	9324
UBS Group AG	46	10802
Citigroup INC	61	12429
Bank of America Corporation	73	21409
BNP Paribas	15	14318
Barclays PLC	43	7119
NatWest Group PLC	32	12842
Crédit Agricole SA	4	918
Lloyds Banking Group PLC	9	824
Banco Santander, S.A.	17	960
Société Générale SA	20	4551
Wells Fargo & Company	59	13252
ING Groep N.V.	5	1517
The Bank of New York Mellon Corporation	11	953
Morgan Stanley	37	3968
Standard Chartered PLC	8	2456
State Street Corporation	11	1935

This table presents an overview of the individual regulatory penalties collected from the 20 systemically important banks included in the analysis from 2011 until 2023. It shows the total number of the imposed penalties per bank and the total penalty amount per bank in millions of USD.

Table 6. Control variables for the different stability metrics

Control variables	Tier 1 capital ratio	ROA	Z-score
	Size	Size	Size
	Asset	Asset	Asset
Bank specific	Funding	Funding	Funding
	LLP	LLP	LLP
		Expense Efficiency	Expense Efficiency
	ROA		ROA
	RWA		
Macroeconomic	GDP	GDP	GDP
	Inflation	Inflation	Inflation

This table presents the control variables used in the regression models for the three stability metrics (T1CR, ROA and Z-Score). Control variables are categorized into bank-specific and macroeconomic factors.

Table 7. Macroeconomic control variables, global annual Data 2011-2023

Year	Global GDP growth rate	Global inflation rate
2011	4.17%	4.97%
2012	3.52%	4.08%
2013	3.45%	3.63%
2014	3.56%	3.22%
2015	3.46%	2.73%
2016	3.26%	2.73%
2017	3.82%	3.25%
2018	3.63%	3.65%
2019	2.84%	3.51%
2020	-2.69%	3.24%
2021	6.47%	4.71%
2022	3.46%	8.73%
2023	3.21%	6.78%

This table represents the annual global macroeconomic indicators. Global GDP growth rate represents the annual percentage of the growth of the global gross domestic product. Global inflation rate is measured as the annual percentage change in consumer prices, also expressed in percent. The data is obtained from Statista (2024a, 2024b).

Table 8. Explanatory variable definitions and calculations

Variable	Calculation
Log-Penalty	Natural logarithm of the annual penalty
Penaltyasset	Division of the annual penalty by the total assets of the respective bank
Penalty_Y/N	1 for the existence of a penalty, 0 otherwise
Size	Natural logarithm of total assets in millions of USD
Asset	Division of total loans by total assets
Funding	Division of total deposits by total assets
LLP	Division of loan loss provisions by total loans
Expense Efficiency	Division of non-interest expenses by total assets
Capitalization	Division of equity by total assets
ROA	Division of net income by total assets
RWA	Division of risk-weighted assets by total assets
GDP	Annual growth rate of global gross domestic product
Inflation	Average price change of goods and services globally

This table presents the calculation methods for all explanatory variables used in the regression analysis.

Table 9. Bloomberg definitions of financial metrics used in regression analysis

Variable	Bloomberg description
Tier 1 Capital Ratio	Tier 1 or Core capital ratio. Tier 1 is used for commercial banks and core capital is used for savings and loans in the United States (U.S.). The ratio of Tier 1 capital to risk-weighted assets.
Total Assets	This is the sum of Cash & bank balances, Fed funds sold & resale agreements, Investments for Trade and Sale, Net loans, Investments held to maturity, Net fixed assets, Other assets, Customers' Acceptances and Liabilities
Total Loans	Includes Commercial loans, Consumer loans and Other loans
Total Deposits	Total deposits received from customers Amounts due to banks are shown in borrowings
Provisions for Loan Losses	The periodic expense for possible future loan losses May include other provisions if they are not disclosed separately Could be negative when there is a recovery of loan losses
Total Non-Interest Expense	Non-interest expense represents the total of expenses such as salaries, employee benefits, occupancy expenses, depreciation and amortization, marketing and all other operating expenses Banks under International Financial Reporting Standards (IFRS) will also include commissions and fees paid in Non-Interest Expense
Total Equity	Firm's total assets minus its total liabilities Common Equity + Minority Interest + Preferred Equity
Net Income/Net Profits	Amount of profit the company made after paying all of its expenses. It is known as bottom-line or net profit. This field returns the Risk-Weighted Assets, as disclosed by the company, that are used in the calculation of a bank's Tier 1 and Total Capital Ratios. Risk-Weighted Assets is calculated by weighing each type of asset relative to its risk

This table presents key metric definitions from Bloomberg (2024) required to calculate the used variables for the regression models. All data is obtained from the Bloomberg database.

Table 10. Correlations between the explanatory variables

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Log-Penalty	1.000												
2. Penaltyassets	0.347	1.000											
3. Penalty_Y/N	0.973	0.217	1.000										
4. Size	0.248	-0.034	0.242	1.000									
5. Asset	0.038	-0.055	0.046	0.375	1.000								
6. Prof	0.019	-0.016	0.026	-0.177	-0.114	1.000							
7. Capitalization	0.202	0.114	0.191	-0.258	-0.133	0.652	1.000						
8. Funding	-0.058	0.002	-0.055	-0.412	0.180	0.539	0.588	1.000					
9. Expense Efficiency	0.196	0.167	0.184	-0.438	-0.315	0.466	0.740	0.371	1.000				
10. LLP	0.064	-0.100	0.069	0.360	0.273	-0.286	-0.051	-0.184	-0.151	1.000			
11. RWA	0.263	0.104	0.251	0.046	0.111	0.582	0.853	0.429	0.592	0.162	1.000		
12. GDP	-0.009	-0.003	-0.009	-0.014	0.003	0.124	0.009	-0.038	0.075	-0.317	0.033	1.000	
13. Inflation	-0.178	-0.159	-0.159	0.080	-0.003	0.125	-0.135	0.099	-0.121	-0.077	-0.130	0.185	1.000

This table presents the correlation coefficients between all independent variables used in the empirical analysis. The variable definitions can be found in Table 7.

Table 11. Descriptive statistics

Variable		Observations	Mean	Std. Dev.	Min	Max	
Log-Penalty	overall	N=	260	13.829	8.393	0.000	23.598
	between	n=	20		4.756	5.378	19.149
	within	T=	13		6.990	-4.027	28.936
Penaltyasset	overall	N=	260	0.424	1.155	0.000	8.419
	between	n=	20		0.282	0.041	0.915
	within	T=	13		1.121	-0.491	8.072
Penalty_Y/N	overall	N=	260	0.742	0.438	0.000	1.000
	between	n=	20		0.233	0.308	1.000
	within	T=	13		0.374	-0.181	1.435
Z-Score	overall	N=	260	3.190	0.700	1.700	5.683
	between	n=	20		0.302	2.806	3.924
	within	T=	13		0.635	1.758	5.164
TICR	overall	N=	260	14.939	2.294	10.700	21.400
	between	n=	20		1.643	12.685	18.567
	within	T=	13		1.640	9.972	19.624
ROA	overall	N=	260	0.499	0.413	-0.799	1.622
	between	n=	20		0.325	-0.004	1.084
	within	T=	13		0.263	-0.482	1.628
Size	overall	N=	260	14.112	0.632	12.287	15.170
	between	n=	20		0.625	12.467	14.842
	within	T=	13		0.163	13.781	14.768
Asset	overall	N=	260	0.348	0.150	0.046	0.703
	between	n=	20		0.148	0.086	0.621
	within	T=	13		0.041	0.208	0.458
Funding	overall	N=	260	0.496	0.141	0.234	0.811
	between	n=	20		0.133	0.294	0.760
	within	T=	13		0.055	0.284	0.649
Expense Efficiency	overall	N=	260	0.021	0.007	0.008	0.038
	between	n=	20		0.007	0.010	0.034
	within	T=	13		0.003	0.005	0.033
Capitalization	overall	N=	260	0.071	0.024	0.025	0.129
	between	n=	20		0.023	0.036	0.107
	within	T=	13		0.007	0.050	0.098
LLP	overall	N=	260	0.005	0.005	-0.009	0.024
	between	n=	20		0.003	0.000	0.013
	within	T=	13		0.004	-0.012	0.020
RWA	overall	N=	260	0.382	0.143	0.153	0.765
	between	n=	20		0.137	0.186	0.685
	within	T=	13		0.049	0.272	0.583
Inflation	overall	N=	260	0.042	0.017	0.027	0.087
	between	n=	20		0.000	0.042	0.042
	within	T=	13		0.017	0.027	0.087
GDP	overall	N=	260	0.032	0.019	-0.027	0.065
	between	n=	20		0.000	0.032	0.032
	within	T=	13		0.019	-0.027	0.065

This table presents the basic descriptive statistics of all used variables. All variables are defined in Table 7. I report the total number of observations, mean, standard deviation, maximum and minimum values. Overall describes the overall variation of the variable, within is the variation within one unit (bank) and between describes the variation between different units (banks).

Table 12. Fixed effect F-test for the three stability metrics

Panel A: ROA as dependent variable							
Equation	(1)	(2)	(3)	(4)	(5)	(6)	
Penalty specification	Log-Penalty		Penaltyasset		Penalty_Y/N		
Dependent variable	ROA	ROA	ROA	ROA	ROA	ROA	
Specification	without year fixed effects	with year fixed effects	without year fixed effects	with year fixed effects	without year fixed effects	with year fixed effects	
Fixed effect F-test	14.010***	15.610***	13.850***	15.480***	14.100***	15.700***	
Panel B: T1CR as dependent variable							
Equation	(1)	(2)	(3)	(4)	(5)	(6)	
Penalty specification	Log-Penalty		Penaltyasset		Penalty_Y/N		
Dependent variable	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	
Specification	without year fixed effects	with year fixed effects	without year fixed effects	with year fixed effects	without year fixed effects	with year fixed effects	
Fixed effect F-test	20.040***	19.330***	22.570***	21.950***	20.480***	19.930***	
Panel C: Z-Score as dependent variable							
Equation	(1)	(2)	(3)	(4)	(5)	(6)	
Penalty specification	Log-Penalty		Penaltyasset		Penalty_Y/N		
Dependent variable	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	
Specification	without year fixed effects	with year fixed effects	without year fixed effects	with year fixed effects	without year fixed effects	with year fixed effects	
Fixed effect F-test	2.120***	2.270***	2.200***	2.390***	2.110***	2.270***	

This table presents the fixed effect F-test, which tests the joint significance of bank-specific effects. ROA stands for return on assets and T1CR stands for Tier I capital ratio. Panel A reports the results with the dependent variable ROA, Panel B reports the result with the dependent variable T1CR, and Panel C reports the results with the dependent variable Z-Score. Models (1 and 2) use Log-Penalty as the independent variable; Models (3 and 4) use Penaltyasset and Models (5 and 6) use Penalty_Y/N. Models (1, 3 and 5) are fixed effect regressions without time fixed effects, while Models (2, 4 and 6) are fixed effect regressions with time fixed effects. All models are estimated using Stata's "xtreg" command to generate the F-statistic for fixed effects. ***, **, * denote significance at the 1%, 5% and 10% levels respectively, where significance means that null hypothesis (that the group dummies of the different groups are all equal to zero) can be rejected.

Table 13. Panel regression results of the impact of regulatory penalties on Return on Assets

Equation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Penalty specification	Log-Penalty				Penaltyasset				Penalty_Y/N			
Regression method	pooled OLS		FE regression		pooled OLS		FE regression		pooled OLS		FE regression	
Dependent variable	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA
Penalty	-0.004 (0.003)	-0.004 (0.003)	-0.002 (0.001)	-0.002 (0.001)	-0.030* (0.017)	-0.031* (0.016)	-0.007 (0.009)	-0.008 (0.009)	-0.057 (0.045)	-0.059 (0.049)	-0.035 (0.027)	-0.028 (0.028)
Size	0.229*** (0.062)	0.228*** (0.070)	-0.251 (0.157)	-0.207 (0.179)	0.211*** (0.059)	0.210*** (0.068)	-0.254 (0.164)	-0.212 (0.187)	0.223*** (0.062)	0.222*** (0.070)	-0.250 (0.156)	-0.207 (0.179)
Asset	-0.495** (0.227)	-0.506** (0.218)	2.017** (0.831)	1.905** (0.750)	-0.492** (0.227)	-0.504** (0.216)	2.033** (0.829)	1.914** (0.739)	-0.494** (0.229)	-0.503** (0.220)	2.016** (0.833)	1.906** (0.754)
Funding	1.591*** (0.309)	1.544*** (0.364)	0.100 (0.648)	0.698 (0.709)	1.580*** (0.311)	1.540*** (0.369)	0.0924 (0.642)	0.706 (0.701)	1.591*** (0.312)	1.544*** (0.367)	0.101 (0.648)	0.701 (0.709)
LLP	-14.800*** (4.612)	-13.420** (6.196)	-14.910** (6.273)	-17.470** (6.952)	-15.350*** (4.712)	-14.060** (6.351)	-15.190** (6.338)	-17.860** (6.939)	-14.670*** (4.655)	-13.370** (6.247)	-14.900** (6.241)	-17.520** (6.894)
Expense Efficiency	19.350*** (5.306)	20.000*** (5.418)	-43.150*** (8.779)	-46.990*** (7.802)	18.690*** (4.701)	19.180*** (4.828)	-43.000*** (8.940)	-46.710*** (7.782)	18.960*** (5.332)	19.600*** (5.469)	-43.270*** (8.752)	-47.090*** (7.816)
Year fixed effects	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
GDP	1.218 (0.715)		2.458*** (0.794)		1.184* (0.671)		2.413*** (0.793)		1.225 (0.729)		2.462*** (0.791)	
Inflation	1.135 (1.325)		0.436 (0.945)		1.169 (1.462)		0.557 (0.989)		1.235 (1.309)		0.448 (0.938)	
Constant	-3.723*** (0.955)	-3.553*** (1.061)	4.186 (2.462)	3.688 (2.821)	-3.493*** (0.907)	-3.310*** (1.026)	4.207 (2.574)	3.729 (2.935)	-3.650*** (0.955)	-3.463*** (1.053)	4.175 (2.454)	3.683 (2.819)
Observations	260	260	260	260	260	260	260	260	260	260	260	260
R-squared	0.479	0.507	0.757	0.789	0.481	0.509	0.757	0.789	0.477	0.505	0.757	0.789

This table presents the results of the regression analysis of regulatory penalties on Return on Assets (ROA). Models (1-4) use Log-Penalty as the independent variable, Models (5-8) use Penaltyasset and Models (9-12) use Penalty_Y/N. Models (1, 5 and 9) are pooled OLS regressions without time fixed effects, while Models (2, 6 and 10) are pooled OLS regressions with time fixed effects. Models (3, 7 and 11) execute fixed effect regressions without time fixed effects and Models (4, 8 and 12) are fixed effect regressions with time fixed effects. All models are estimated with robust standard errors clustered by bank (reported in parentheses). ***, **, * denote significance at the 1%, 5% and 10% levels respectively. Variable definitions are provided in Table 7. Variable definitions are provided in Table 7. Pooled OLS models are estimated using Stata's "reg" command, while fixed effects models are estimated using the "reghdfe"

Table 14. Time lagged panel regression results of the impact of regulatory penalties on Return on Assets

Panel A: One year lagged penalty variable												
Equation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Penalty specification	Log-Penalty				Penaltyasset				Penalty_Y/N			
Regression method	pooled OLS		FE regression		pooled OLS		FE regression		pooled OLS		FE regression	
Dependent variable	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA
Penalty	-0.002 (0.003)	-0.003 (0.002)	-0.001 (0.002)	-0.001 (0.001)	0.017 (0.011)	0.017 (0.012)	0.003 (0.012)	0.004 (0.011)	-0.051 (0.048)	-0.064 (0.044)	-0.024 (0.033)	-0.020 (0.027)
Other controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
Observations	240	240	240	240	240	240	240	240	240	240	240	240
R-squared	0.467	0.498	0.772	0.798	0.468	0.497	0.772	0.798	0.562	0.590	0.731	0.752

Panel B: Two year lagged penalty variable												
Equation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Penalty specification	Log-Penalty				Penaltyasset				Penalty_Y/N			
Regression method	pooled OLS		FE regression		pooled OLS		FE regression		pooled OLS		FE regression	
Dependent variable	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA
Penalty	-0.002 (0.002)	-0.003 (0.003)	0.000 (0.001)	0.001 (0.002)	-0.003 (0.018)	-0.007 (0.019)	-0.012 (0.013)	-0.012 (0.012)	-0.032 (0.041)	-0.032 (0.048)	0.010 (0.021)	0.027 (0.029)
Other controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
Observations	220	220	220	220	220	220	220	220	220	220	220	220
R-squared	0.455	0.486	0.781	0.811	0.453	0.484	0.782	0.812	0.453	0.485	0.781	0.811

Panel C: Three year lagged penalty variable												
Equation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Penalty specification	Log-Penalty				Penaltyasset				Penalty_Y/N			
Regression method	pooled OLS		FE regression		pooled OLS		FE regression		pooled OLS		FE regression	
Dependent variable	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA
Penalty	-0.003 (0.002)	-0.004* (0.002)	-0.003* (0.002)	-0.004 (0.002)	-0.004 (0.014)	-0.006 (0.013)	-0.025 (0.016)	-0.020 (0.015)	-0.041 (0.035)	-0.057 (0.037)	-0.052* (0.030)	-0.054 (0.037)
Other controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
Observations	200	200	200	200	200	200	200	200	200	200	200	200
R-squared	0.452	0.488	0.784	0.817	0.450	0.484	0.786	0.818	0.451	0.486	0.783	0.816

This table presents the results of the regression analysis of regulatory penalties on Return on Assets (ROA). Panel A reports the results with the one-year lagged penalty variable, Panel B reports the result with the two-year lagged penalty variable and Panel C reports the results with the three-year lagged penalty variable. Models (1-4) use Log-Penalty as the independent variable, Models (5-8) use Penaltyasset and Models (9-12) use Penalty_Y/N. Models (1, 5 and 9) are pooled OLS regressions without time fixed effects, while Models (2, 6 and 10) are pooled OLS regressions with time fixed effects. Models (3, 7 and 11) execute fixed effect regressions without time fixed effects and Models (4, 8 and 12) are fixed effect regressions with time fixed effects. All models are estimated with robust standard errors clustered by bank (reported in parentheses). ***, **, * denote significance at the 1%, 5% and 10% levels respectively. Variable definitions are provided in Table 7. Variable definitions are provided in Table 7. Pooled OLS models are estimated using Stata's "reg" command, while fixed effects models are estimated using the "reghdfe" command.

Table 15. Models which can be compared using R²

Group	Models
1	1, 5, 9
2	2, 6, 10
3	3, 7, 11
4	4, 8, 12

This table presents groups of the used regression models, which models can be compared using R². The detailed model equations are displayed in Technical Note 5. The models in one group all have the same regression approach, the same dependent variable and the same number of controlled variables. In cases with a different number of control variables, the R² values are inflated because R² values can never decrease with additional variables in a model (Wooldridge 2012).

Table 16. Panel regression results of the impact of regulatory penalties on Tier 1 Capital Ratio

Equation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Penalty specification	Log-Penalty				Penaltyasset				Penalty_Y/N			
Regression method	pooled OLS		FE regression		pooled OLS		FE regression		pooled OLS		FE regression	
Dependent variable	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR
Penalty	0.073*** (0.0184)	0.072*** (0.0202)	0.021* (0.0109)	0.018 (0.0109)	0.096 (0.1070)	0.123 (0.1030)	-0.004 (0.0588)	0.007 (0.0609)	1.304*** (0.3310)	1.239*** (0.3510)	0.421** (0.1930)	0.356* (0.1960)
Size	-0.987* (0.5310)	-1.344** (0.6330)	-3.055*** (0.9390)	-3.941*** (0.8920)	-0.695 (0.5540)	-1.060 (0.6470)	-3.049*** (0.9540)	-3.917*** (0.8990)	-0.952* (0.5380)	-1.292* (0.6370)	-3.079*** (0.9350)	-3.959*** (0.8890)
Asset	2.381 (1.5920)	2.539 (1.6990)	-0.365 (4.4160)	1.681 (4.3210)	2.006 (1.8240)	2.139 (1.8840)	-0.669 (4.4750)	1.446 (4.3480)	2.285 (1.6230)	2.405 (1.7280)	-0.258 (4.4430)	1.811 (4.3370)
Funding	-1.052 (2.8550)	-3.054 (3.0440)	9.487*** (2.8930)	0.083 (4.6350)	-0.983 (3.0770)	-3.009 (3.2700)	9.733*** (2.9060)	0.166 (4.6770)	-1.008 (2.8540)	-2.965 (3.0680)	9.420*** (2.8970)	0.003 (4.6380)
LLP	-151.000*** (42.3800)	-120.600** (48.7100)	-45.300 (28.1600)	-11.830 (22.7400)	-163.000*** (47.1200)	-128.400** (54.1000)	-45.820 (28.4300)	-10.390 (23.0500)	-154.200*** (44.4200)	-123.400** (50.8900)	-45.410 (27.9100)	-11.530 (22.5100)
Capitalization	0.987 (0.6430)	0.727 (0.6200)	0.457 (0.4730)	0.579 (0.4980)	0.780 (0.6240)	0.525 (0.6230)	0.392 (0.4690)	0.531 (0.5010)	0.926 (0.6470)	0.660 (0.6260)	0.457 (0.4720)	0.580 (0.4960)
ROA	-7.414*** (2.1430)	-5.700** (2.2270)	-20.080*** (2.8150)	-19.220*** (2.6240)	-6.066** (2.3820)	-4.401* (2.5180)	-19.790*** (2.8030)	-19.030*** (2.6200)	-7.199*** (2.1470)	-5.489** (2.2520)	-20.120*** (2.8030)	-19.320*** (2.5800)
Year fixed effects	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
GDP	-30.290*** (5.1420)		-11.550*** (3.9380)		-30.480*** (5.6880)		-11.230*** (3.9640)		-30.310*** (5.2990)		-11.580*** (3.9030)	
Inflation	11.150* (5.4950)		-10.030 (5.8030)		6.628 (6.4620)		-11.730* (6.4600)		10.290* (5.3930)		-10.040 (5.8650)	
Constant	31.100*** (7.7320)	34.770*** (9.1080)	61.640*** (13.5300)	75.350*** (12.7900)	27.880*** (8.0890)	31.280*** (9.3300)	61.820*** (13.6600)	75.180*** (12.8200)	30.650*** (7.8020)	34.040*** (9.1520)	61.960*** (13.4700)	75.610*** (12.7600)
Observations	260	260	260	260	260	260	260	260	260	260	260	260
R-squared	0.422	0.491	0.782	0.809	0.366	0.441	0.778	0.806	0.416	0.483	0.783	0.809

This table presents the results of the regression analysis of regulatory penalties on Tier 1 Capital Ratio (T1CR). Models (1-4) use Log-Penalty as the independent variable, Models (5-8) use Penaltyasset and Models (9-12) use Penalty_Y/N. Models (1, 5 and 9) are pooled OLS regressions without time fixed effects, while Models (2, 6 and 10) are pooled OLS regressions with time fixed effects. Models (3, 7 and 11) execute fixed effect regressions without time fixed effects and Models (4, 8 and 12) are fixed effect regressions with time fixed effects. All models are estimated with robust standard errors clustered by bank (reported in parentheses). ***, **, * denote significance at the 1%, 5% and 10% levels respectively. Variable definitions are provided in Table 7. Variable definitions are provided in Table 7. Pooled OLS models are estimated using Stata's "reg" command, while fixed effects models are estimated using the "reghdfe" command.

Table 17. Time lagged panel regression results of the impact of regulatory penalties on Tier 1 Capital Ratio

Panel A: One year lagged penalty variable												
Equation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Penalty specification	Log-Penalty				Penaltyasset				Penalty_Y/N			
Regression method	pooled OLS		FE regression		pooled OLS		FE regression		pooled OLS		FE regression	
Dependent variable	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR
Penalty	0.066*** (0.021)	0.063*** (0.021)	0.008 (0.007)	0.005 (0.007)	-0.038 (0.078)	-0.067 (0.085)	-0.106 (0.069)	-0.139* (0.071)	1.225*** (0.400)	1.164*** (0.393)	0.232* (0.133)	0.190 (0.120)
Other controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
Observations	240	240	240	240	240	240	240	240	240	240	240	240
R-squared	0.394	0.454	0.774	0.801	0.344	0.412	0.776	0.805	0.392	0.452	0.775	0.801
Panel B: Two year lagged penalty variable												
Equation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Penalty specification	Log-Penalty				Penaltyasset				Penalty_Y/N			
Regression method	pooled OLS		FE regression		pooled OLS		FE regression		pooled OLS		FE regression	
Dependent variable	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR
Penalty	0.069*** (0.024)	0.061** (0.023)	0.000 (0.009)	-0.006 (0.011)	0.259*** (0.090)	0.182** (0.081)	0.135*** (0.043)	0.094** (0.039)	1.163** (0.446)	1.033** (0.428)	-0.048 (0.160)	-0.113 (0.214)
Other controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
Observations	220	220	220	220	220	220	220	220	220	220	220	220
R-squared	0.381	0.442	0.765	0.797	0.345	0.410	0.770	0.799	0.368	0.433	0.765	0.797
Panel C: Three year lagged penalty variable												
Equation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Penalty specification	Log-Penalty				Penaltyasset				Penalty_Y/N			
Regression method	pooled OLS		FE regression		pooled OLS		FE regression		pooled OLS		FE regression	
Dependent variable	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR	T1CR
Penalty	0.081*** (0.025)	0.073*** (0.025)	0.005 (0.013)	0.000 (0.010)	0.178* (0.096)	0.108 (0.090)	0.110** (0.045)	0.057 (0.044)	1.380*** (0.463)	1.244** (0.445)	0.043 (0.249)	0.006 (0.197)
Other controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
Observations	200	200	200	200	200	200	200	200	200	200	200	220
R-squared	0.408	0.452	0.802	0.829	0.339	0.395	0.806	0.830	0.391	0.440	0.802	0.829

This table presents the results of the regression analysis of regulatory penalties on Tier 1 Capital Ratio (T1CR). Panel A reports the results with the one-year lagged penalty variable, Panel B reports the result with the two-year lagged penalty variable and Panel C reports the results with the three-year lagged penalty variable. Models (1-4) use Log-Penalty as the independent variable, Models (5-8) use Penaltyasset and Models (9-12) use Penalty_Y/N. Models (1, 5 and 9) are pooled OLS regressions without time fixed effects, while Models (2, 6 and 10) are pooled OLS regressions with time fixed effects. Models (3, 7 and 11) execute fixed effect regressions without time fixed effects and Models (4, 8 and 12) are fixed effect regressions with time fixed effects. All models are estimated with robust standard errors clustered by bank (reported in parentheses). ***, **, * denote significance at the 1%, 5% and 10% levels respectively. Variable definitions are provided in Table 7. Variable definitions are provided in Table 7. Pooled OLS models are estimated using Stata's "reg" command, while fixed effects models are estimated using the "reghdfe" command.

Table 18. Panel regression results of the impact of regulatory penalties on Z-Score

Equation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Penalty specification	Log-Penalty				Penaltyasset				Penalty_Y/N			
Regression method	pooled OLS		FE regression		pooled OLS		FE regression		pooled OLS		FE regression	
Dependent variable	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score
Penalty	-0.002 (0.006)	-0.004 (0.005)	0.002 (0.007)	-0.001 (0.005)	0.029 (0.028)	0.022 (0.026)	0.052 (0.030)	0.047 (0.027)	-0.034 (0.129)	-0.079 (0.107)	0.019 (0.131)	-0.028 (0.109)
Size	0.124 (0.111)	0.156 (0.105)	0.233 (0.421)	0.391 (0.428)	0.105 (0.123)	0.125 (0.117)	0.243 (0.420)	0.401 (0.425)	0.122 (0.114)	0.154 (0.108)	0.233 (0.422)	0.393 (0.426)
Asset	0.963** (0.419)	0.764* (0.390)	3.255* (1.562)	1.601 (1.634)	0.965** (0.418)	0.774* (0.389)	3.337** (1.534)	1.687 (1.601)	0.964** (0.420)	0.769* (0.390)	3.250* (1.562)	1.590 (1.624)
Funding	-0.585 (0.688)	-0.545 (0.701)	-1.231 (1.345)	-1.154 (1.688)	-0.598 (0.697)	-0.559 (0.714)	-1.322 (1.353)	-1.238 (1.671)	-0.587 (0.690)	-0.551 (0.704)	-1.225 (1.346)	-1.148 (1.685)
LLP	-13.510 (11.280)	-5.141 (13.190)	-22.960** (10.680)	-8.170 (9.342)	-12.170 (11.560)	-4.309 (13.350)	-21.380** (10.550)	-7.339 (9.248)	-13.460 (11.370)	-5.060 (13.340)	-22.960** (10.690)	-8.107 (9.276)
Expense Efficiency	15.570** (6.878)	20.060** (7.458)	3.443 (19.360)	18.410 (22.270)	13.620* (7.124)	17.300** (7.911)	-0.665 (19.330)	15.000 (22.230)	15.470** (6.998)	19.960** (7.536)	3.592 (19.330)	18.470 (22.150)
ROA	0.287* (0.147)	0.189 (0.168)	0.162 (0.175)	0.138 (0.215)	0.304* (0.152)	0.210 (0.171)	0.169 (0.172)	0.152 (0.210)	0.288* (0.149)	0.192 (0.170)	0.161 (0.177)	0.137 (0.216)
Year fixed effects	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
GDP	-0.655 (1.633)		-0.958 (1.802)		-0.597 (1.637)		-0.780 (1.716)		-0.656 (1.634)		-0.952 (1.813)	
Inflation	6.139** (2.338)		6.277** (2.936)		6.557** (2.217)		6.514** (2.723)		6.165** (2.309)		6.226** (2.903)	
Constant	0.776 (1.796)	0.321 (1.757)	-0.919 (6.538)	-2.973 (6.776)	1.014 (1.938)	0.764 (1.896)	-0.996 (6.537)	-3.051 (6.777)	0.796 (1.831)	0.359 (1.796)	-0.912 (6.539)	-2.990 (6.749)
Observations	260	260	260	260	260	260	260	260	260	260	260	260
R-squared	0.102	0.224	0.235	0.350	0.103	0.223	0.241	0.355	0.102	0.224	0.235	0.350

This table presents the results of the regression analysis of regulatory penalties on Z-Score. Models (1-4) use Log-Penalty as the independent variable, Models (5-8) use Penaltyasset and Models (9-12) use Penalty_Y/N. Models (1, 5 and 9) are pooled OLS regressions without time fixed effects, while Models (2, 6 and 10) are pooled OLS regressions with time fixed effects. Models (3, 7 and 11) execute fixed effect regressions without time fixed effects and Models (4, 8 and 12) are fixed effect regressions with time fixed effects. All models are estimated with robust standard errors clustered by bank (reported in parentheses). ***, **, * denote significance at the 1%, 5% and 10% levels respectively. Variable definitions are provided in Table 7. Variable definitions are provided in Table 7. Pooled OLS models are estimated using Stata's "reg" command, while fixed effects models are estimated using the "reghdfe" command.

Table 19. Time lagged panel regression results of the impact of regulatory penalties on Z-Score

Panel A: One year lagged penalty variable												
Equation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Penalty specification	Log-Penalty				Penaltyasset				Penalty_Y/N			
Regression method	pooled OLS		FE regression		pooled OLS		FE regression		pooled OLS		FE regression	
Dependent variable	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score
Penalty	-0.002 (0.005)	-0.004 (0.005)	0.002 (0.005)	0.001 (0.004)	-0.024 (0.028)	-0.024 (0.038)	-0.010 (0.028)	0.001 (0.036)	0.001 (0.090)	-0.022 (0.097)	0.087 (0.090)	0.071 (0.081)
Other controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
Observations	240	240	240	240	240	240	240	240	240	240	240	260
R-squared	0.108	0.227	0.270	0.380	0.109	0.227	0.270	0.379	0.107	0.226	0.272	0.381

Panel B: Two year lagged penalty variable												
Equation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Penalty specification	Log-Penalty				Penaltyasset				Penalty_Y/N			
Regression method	pooled OLS		FE regression		pooled OLS		FE regression		pooled OLS		FE regression	
Dependent variable	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score
Penalty	-0.003 (0.004)	-0.003 (0.004)	0.003 (0.004)	0.005 (0.004)	-0.034 (0.032)	-0.036 (0.031)	-0.024 (0.030)	-0.017 (0.028)	-0.022 (0.061)	-0.016 (0.074)	0.115 (0.072)	0.130* (0.074)
Other controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
Observations	220	220	220	220	220	220	220	220	220	220	220	220
R-squared	0.120	0.242	0.327	0.433	0.122	0.244	0.328	0.432	0.119	0.241	0.329	0.435

Panel C: Three year lagged penalty variable												
Equation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Penalty specification	Log-Penalty				Penaltyasset				Penalty_Y/N			
Regression method	pooled OLS		FE regression		pooled OLS		FE regression		pooled OLS		FE regression	
Dependent variable	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score
Penalty	0.002 (0.005)	-0.001 (0.005)	0.010 (0.007)	0.008 (0.006)	0.018 (0.028)	-0.007 (0.029)	0.031 (0.030)	0.015 (0.029)	0.013 (0.095)	-0.013 (0.086)	0.134 (0.145)	0.133 (0.110)
Other controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
Observations	200	200	200	200	200	200	200	200	200	200	200	200
R-squared	0.118	0.251	0.322	0.432	0.118	0.251	0.317	0.427	0.117	0.251	0.318	0.430

This table presents the results of the regression analysis of regulatory penalties on Z-Score. Panel A reports the results with the one-year lagged penalty variable, Panel B reports the result with the two-year lagged penalty variable and Panel C reports the results with the three-year lagged penalty variable. Models (1-4) use Log-Penalty as the independent variable, Models (5-8) use Penaltyasset and Models (9-12) use Penalty_Y/N. Models (1, 5 and 9) are pooled OLS regressions without time fixed effects, while Models (2, 6 and 10) are pooled OLS regressions with time fixed effects. Models (3, 7 and 11) execute fixed effect regressions without time fixed effects and Models (4, 8 and 12) are fixed effect regressions with time fixed effects. All models are estimated with robust standard errors clustered by bank (reported in parentheses). ***, **, * denote significance at the 1%, 5% and 10% levels respectively. Variable definitions are provided in Table 7. Variable definitions are provided in Table 7. Pooled OLS models are estimated using Stata's "reg" command, while fixed effects models are estimated using the "reghdfe" command.

7.2 Figures

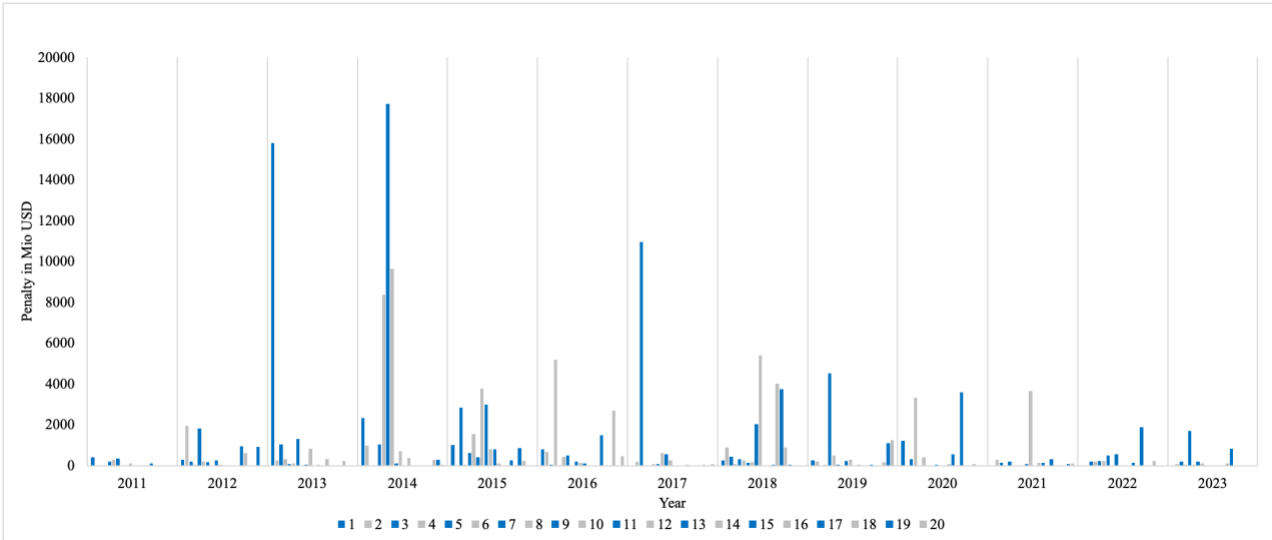


Figure 1. Distribution of regulatory penalties over time
 This figure shows the penalties in Mio USD for the years 2011 until 2023 for each bank. Each bar represents the penalty amount imposed on a specific bank. The Bank IDs correspond to the ones listed in Table 2.

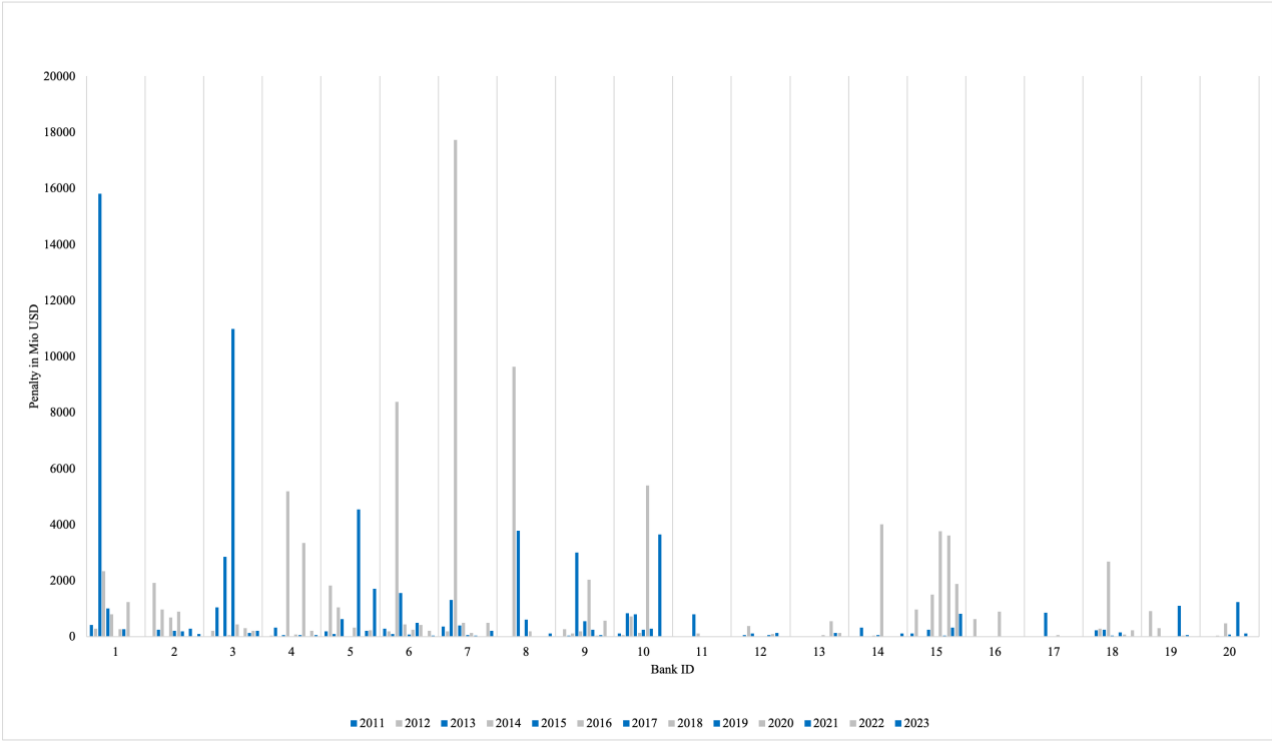


Figure 2. Distribution of regulatory penalties by bank
 This figure shows the penalties in Mio USD for each bank across the observation period from 2011 to 2023. The Bank IDs correspond to the ones listed in Table 2 and each bar indicates the total penalty amount for a given year.

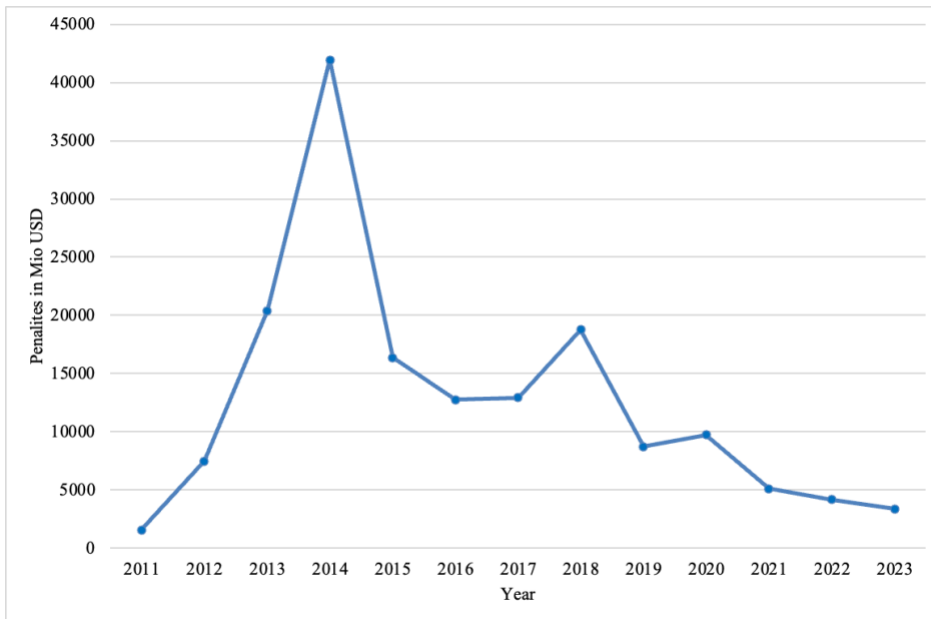


Figure 3. Aggregated penalties over time

This figure shows the aggregated sum of the penalties of the twenty banks in millions of USD. For the years from 2011 to 2023. The graph depicts the fluctuation of the aggregated penalties over this period.

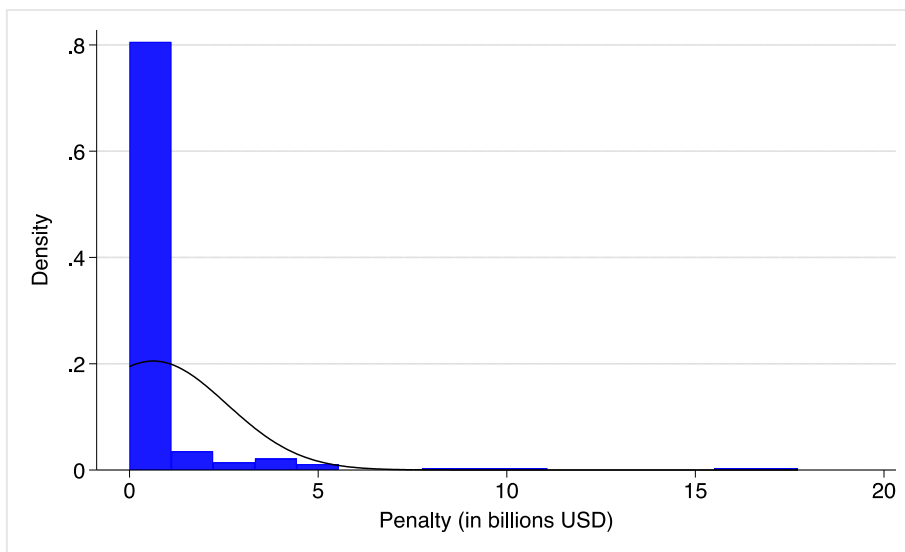


Figure 4. Distribution of regulatory penalties untransformed

This figure shows the histogram of regulatory penalties in billions of USD in their untransformed form. The black line represents the normal distribution, through which the right-skewed distribution becomes visible.

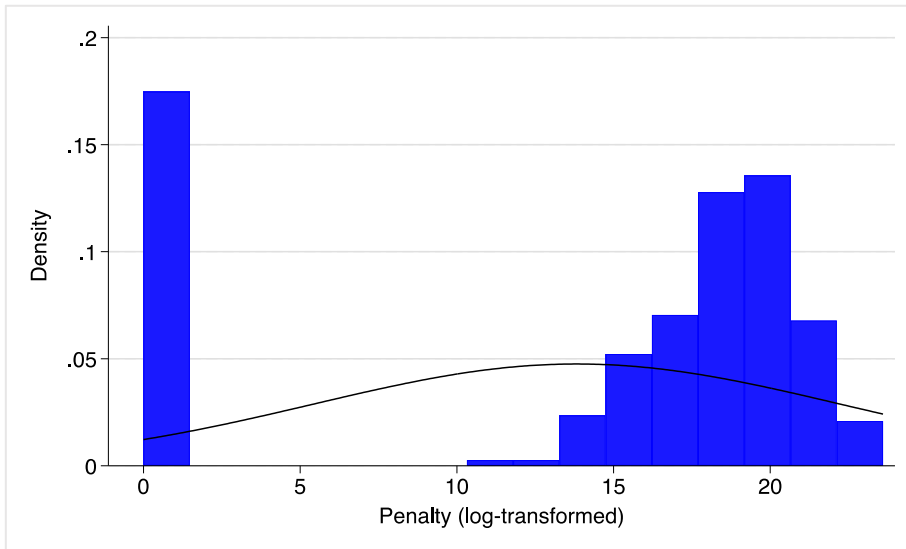


Figure 5. Distribution of regulatory penalties log-transformed
 This figure shows the histogram of the log-transformed penalties. The black line represents the normal distribution, through which it becomes visible that the log transformation normalizes the right-skewed distribution of the untransformed penalties.

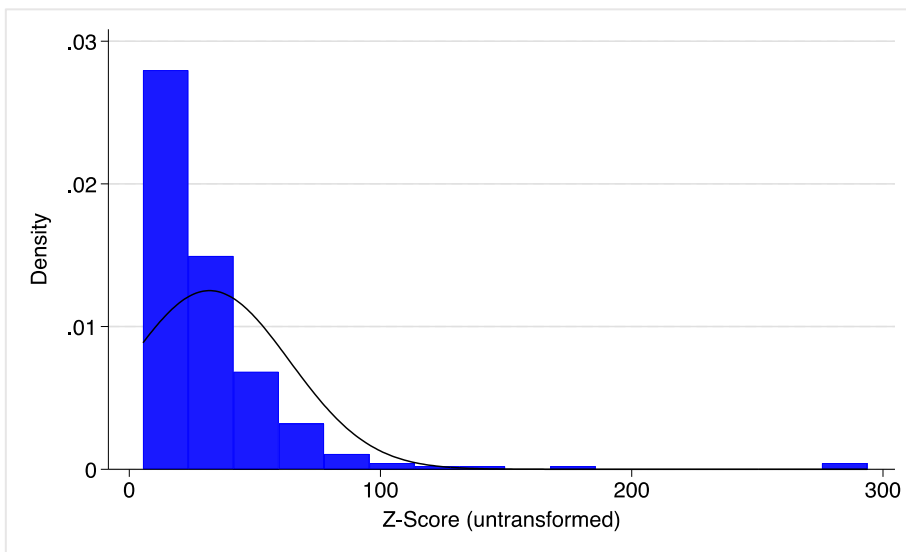


Figure 6. Distribution of bank Z-Score untransformed.
 This figure shows the histogram of the untransformed Z-Score variable. The black line represents the normal distribution.

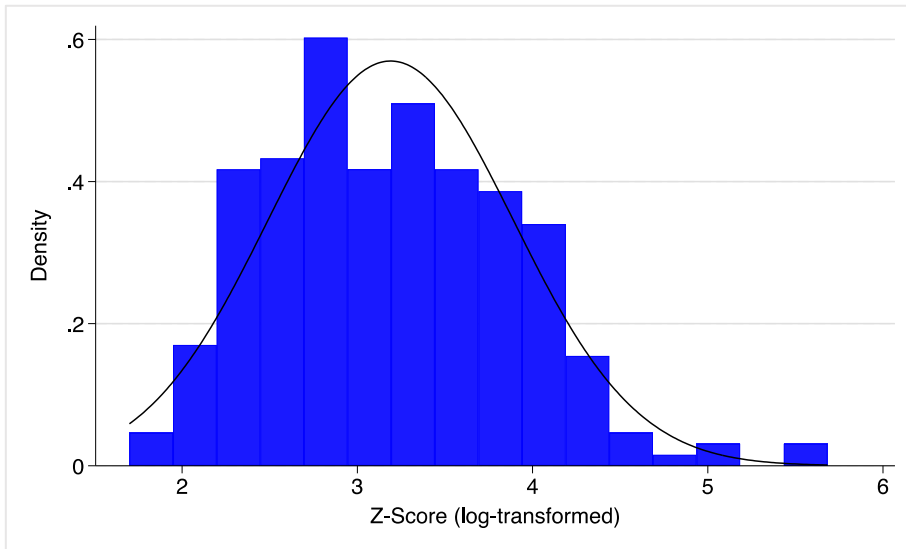


Figure 7. Distribution of bank Z-Score log-transformed.
 This figure shows the histogram of the log-transformed Z-Score variable. The black line represents the normal distribution.

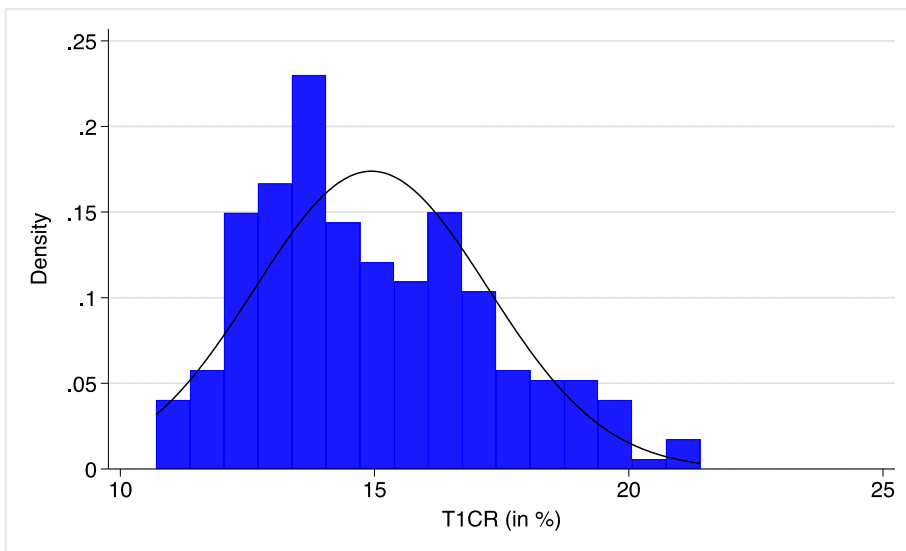


Figure 8. Distribution of T1CR untransformed
 This figure shows the histogram of the untransformed T1CR. The black line represents the normal distribution.

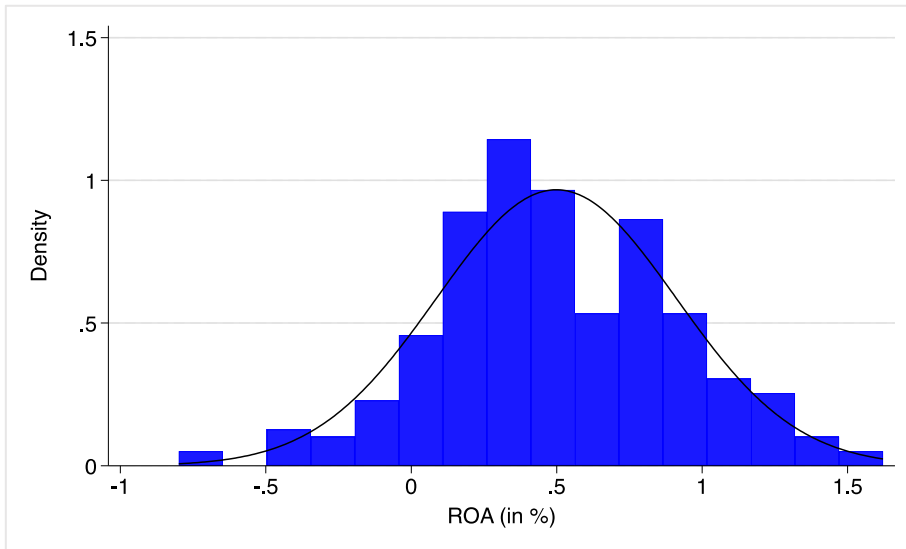


Figure 9. Distribution of ROA untransformed

This figure shows the histogram of the untransformed ROA. The black line represents the normal distribution.

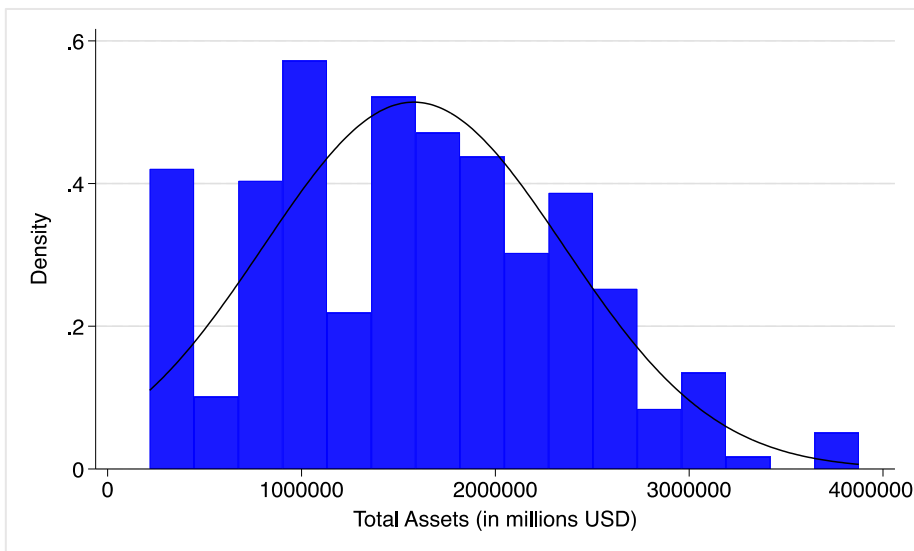


Figure 10. Distribution of bank's total assets untransformed

This Figure shows the histogram of the bank's total assets in millions of USD in their untransformed form. The black line represents the normal distribution.

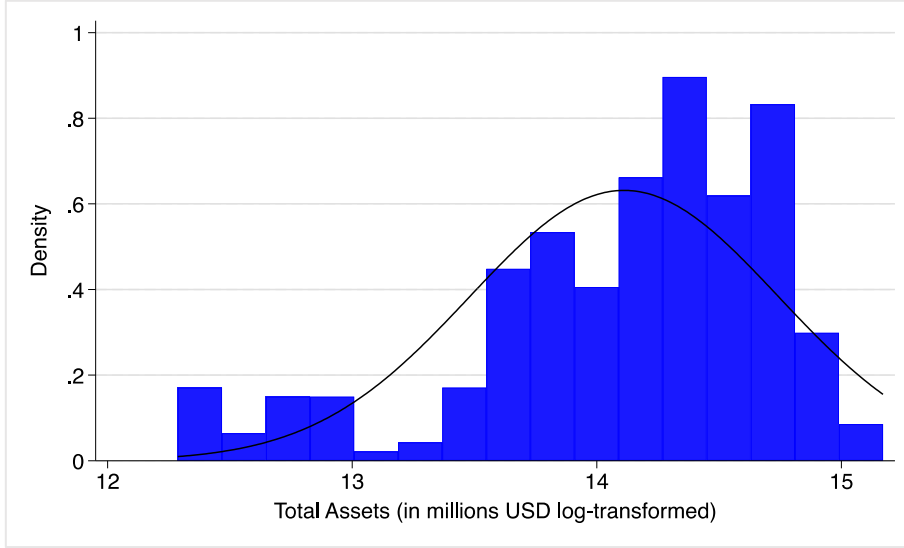


Figure 11. Distribution of bank's total assets log-transformed
This figure shows the histogram of the log-transformed total assets. The black line represents the normal distribution.

7.3 Technical Notes

Technical Note 1: Rescaling Penaltyasset variable

$$\begin{aligned}
\widehat{Stability}_{it} &= \widehat{\beta}_0 + \left(\frac{1}{1000}\widehat{\beta}_1\right) (1000 * Penaltyasset_{usit}) + \widehat{\beta}_2 controls_{it} \\
&= \widehat{\beta}_0 + \left(\frac{1}{1000}\widehat{\beta}_1\right) (Penaltyasset_{it}) + \widehat{\beta}_2 controls_{it} \quad (A1)
\end{aligned}$$

where *Stability* stands for one of the dependent variables (T1CR, ROA or Z-Score), *Penaltyasset* represents the independent variable, which divides the respective penalty by the bank's total assets and *controls* for all the chosen control variables for the respective dependent variable. The subscript *i* specifies the bank, *t* the respective year and *us* means unadjusted, so the respective variable before it is rescaled. The hat (^) over a variable indicates estimated coefficients. The rescaling has no impact on the statistical significance or the R² value (Wooldridge 2012). The data scaling facilitates the interpretation without affecting the statistical relationship (Wooldridge 2012).

Technical Note 2: Rescaling ROA

$$\widehat{ROA}_{usit} * 100 = \widehat{\beta}_0 * 100 + \widehat{\beta}_1 * 100 * penalty_{it} + \widehat{\beta}_2 * 100 * controls_{it} \quad (A2)$$

where ROA stands for return on assets, *penalty* for one of the three penalty specifications (Inpenalty, penaltyasset or dummpenalty) and *controls* for all the chosen control variables for the respective dependent variable. The subscript *i* specifies the bank, *t* the respective year and *us* means unadjusted, so the respective variable before it is rescaled. The hat (^) over a variable indicates estimated coefficients. The rescaling has no impact on the statistical significance or the R² value (Wooldridge 2012).

Technical Note 3: Calculation of coefficient of variation

$$CV = \frac{\sigma_{within}}{\mu} \quad (A3)$$

$$\text{Expense Efficiency: } CV_{Expense\ Efficiency} = \frac{0.003}{0.021} = 0.143 \quad (A4)$$

Capitalization:
$$CV_{Capitalization} = \frac{0.073}{0.072} = 0.101 \quad (A5)$$

where σ is the standard deviation and μ is the mean. “within” means that I take the within standard deviation, which stands for the variation within the units (banks). CV is the coefficient of variation and measures the relative variation. Therefore, it is suitable to compare standard deviations with different measurement units (Santos and Dias 2021; Stephens 2006).

Technical Note 4: Calculation of demeaned regression equation

Model (1) can be obtained by subtracting (3) from (2):

$$(1) \text{Stability}_{it}^* = \beta_1(\text{penalty}_{it})^* + \beta_2\text{controls}_{it}^* + \varepsilon_{it}^*$$

$$(2) \text{Stability}_{it} = \beta_0 + \beta_1(\text{penalty}_{it}) + \beta_2\text{controls}_{it} + \alpha_i + \varepsilon_{it}$$

$$(3) \overline{\text{Stability}_i} = \beta_0 + \beta_1(\overline{\text{penalty}_i}) + \beta_2\overline{\text{controls}_i} + \alpha_i + \overline{\varepsilon_i}$$

where Stability stands for one of the dependent variables, penalty for one of the three penalty specifications, controls for all the chosen control variables for the respective dependent variable, α for the bank-specific fixed effect and ε is the error term. The subscript i specifies the unit and t the respective year. The * indicates that this is a demeaned variable and a bar over a symbol indicates a cluster mean (Bou and Satorra 2018).

Technical Note 5: All twelve regression models for each dependent variable

$$1. \text{Stability}_{it} = \beta_0 + \beta_1(\text{Log} - \text{Penalty}_{it}) + \beta_2\text{controls}_{it} + \varepsilon_{it}$$

$$2. \text{Stability}_{it} = \beta_0 + \beta_1(\text{Log} - \text{Penalty}_{it}) + \beta_2\text{controls}_{it} + \gamma_t + \varepsilon_{it}$$

$$3. \text{Stability}_{it}^* = \beta_1(\text{Log} - \text{Penalty}_{it})^* + \beta_2\text{controls}_{it}^* + \varepsilon_{it}^*$$

$$4. \text{Stability}_{it}^* = \beta_1(\text{Log} - \text{Penalty}_{it})^* + \beta_2\text{controls}_{it}^* + \gamma_t^* + \varepsilon_{it}^*$$

$$5. \text{Stability}_{it} = \beta_0 + \beta_1(\text{Penaltyasset}_{it}) + \beta_2\text{controls}_{it} + \varepsilon_{it}$$

$$6. \text{Stability}_{it} = \beta_0 + \beta_1(\text{Penaltyasset}_{it}) + \beta_2\text{controls}_{it} + \gamma_t + \varepsilon_{it}$$

$$7. \text{Stability}_{it}^* = \beta_1(\text{Penaltyasset}_{it})^* + \beta_2\text{controls}_{it}^* + \varepsilon_{it}^*$$

$$8. \text{Stability}_{it}^* = \beta_1(\text{Penaltyasset}_{it})^* + \beta_2\text{controls}_{it}^* + \gamma_t^* + \varepsilon_{it}^*$$

$$9. \text{Stability}_{it} = \beta_0 + \beta_1(\text{Penalty_Y/N}_{it}) + \beta_2\text{controls}_{it} + \varepsilon_{it}$$

$$10. \text{Stability}_{it} = \beta_0 + \beta_1(\text{Penalty_Y/N}_{it}) + \beta_2 \text{controls}_{it} + \gamma_t + \varepsilon_{it}$$

$$11. \text{Stability}_{it}^* = \beta_1(\text{Penalty_Y/N}_{it})^* + \beta_2 \text{controls}_{it}^* + \varepsilon_{it}^*$$

$$12. \text{Stability}_{it}^* = \beta_1(\text{Penalty_Y/N}_{it})^* + \beta_2 \text{controls}_{it}^* + \gamma_t^* + \varepsilon_{it}^*$$

where Stability stands for one of the dependent variables, Log-Penalty for the log-transformed annual penalty, Penaltyasset for the relative size of the penalty compared to total assets, Penalty_Y/N for the dummy variable of the penalty, controls for all the chosen control variables for the respective dependent variable, γ for the year - specific fixed effect and ε is the error term. The subscript i specifies the unit and t the respective year. The * indicates that this is a demeaned variable.