Government ownership, economic development, regulatory environment and bank stability: Bank-level evidence from 101 countries.

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Abstract

This paper employs system GMM estimation to examine government ownership of banks and bank-level stability over 1997-2010 across a sample of 101 countries. Using continuous variable to proxy for government ownership, we find that higher degree of government ownership is significantly associated with lower bank stability. This relationship, however, depends on a country's economic development land regulatory quality. In other words, the negative impact of government ownership on bank stability is less in countries with higher economic development and better regulation. We further observe that more government ownership is associated with larger banks in less competitive markets.

JEL classification: G21; G28; G32; G38; C33

Keywords: Government ownership; Bank stability; Economic development; Regulation quality; Z-score

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1. Introduction

The frequency of banking crises over the last decades, including the global financial crisis of mid-2007, has raised considerable concerns about bank stability among regulators, central bankers and other bank stakeholders. They are well aware that bank instability may trigger a severe economic downturn and impose large negative externalities on their countries.

Besides preventive and redemdial measures[1] to enhance bank stability, governments may favour ownership, completely or partially, in order to control bank operations. Indeed, government ownership is claimed to be an easier way to correct market failures and perhaps less costly (Clarke et al., 2005; Sappington and Stiglitz, 1987). So while many governments have privatized their banks, others have resisted this trend. A few have even renationalized previously privatized banks, believing that such ownership affords some important policy tools (Borisova et al., 2012).

The prior empirical literature on government ownership (see La Porta et al., 2002; Micco et al., 2007; Olivero et al., 2011) document that such ownership of banks was once common in both developed and developing countries. After 1995, privatization and openness to foreign participation in many countries resulted in the share of government-owned banks in developing countries to drop dramatically from approximately 30 per cent to 20 per cent over 1997 -2000 (Yildirim and Philippatos, 2007).

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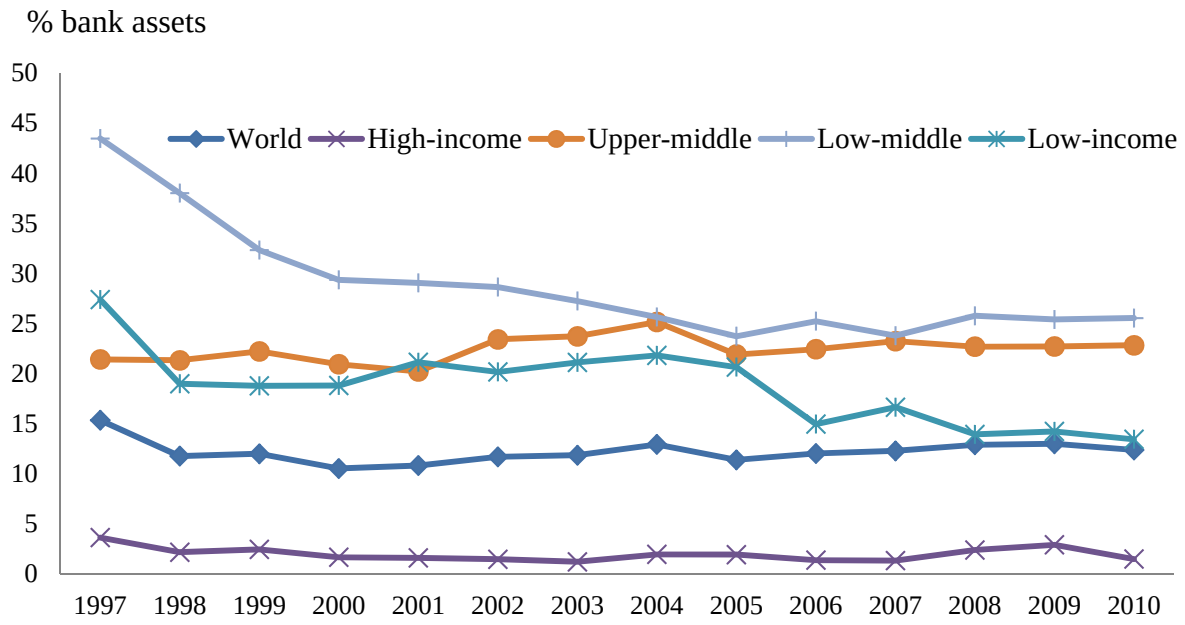
[1] Preventive measures include regulatory restrictions, prudential regulations or government ownership. Remedial measures are different types of government intervention in banking crisis including containment and resolution measures.

More recently, Taboada (2011) and Andrianova et al. (2012) note that this decline was slightly reversed due to partial nationalization programs in some developed countries. Our own analysis in Figure 1 shows that government ownership of banks is still most common in middle-income countries with 20-30% of bank assets and in low-income countries with 13-15% government-owned assets.

Figure 1: Share of bank assets held by government ownership by level of national income



Note: Lists of countries in each group in 2011 are indicated in Table 3 – Panel A. These classifications follow World Development Indicators (World Bank, 2011).

Source: Prepared from our sample using BankScope data and World Bank country classifications

The theoretical debate over government ownership and its impact on banks has been a long standing concern of both economists and regulators. The key aspect is whether government ownership enhances or worsens bank stability. On the one hand, some believe that when governments actually own or takeover banks, their political influence on resource allocation might result in riskier activities and threaten stability (Dinç, 2005; Sapienza, 2004). Banks with government ownership might experience more corruption, misallocation of resource and

severe agency costs than their counterparts (Banerjee, 1997). Some are simply hostile to the notion that governments might run banks effectively (Andrianova et al., 2012). On the other hand, some argue that when governments own banks, they achieve better risk sharing than their private counterparts (Megginson et al., 1994). As they also have the power to redistribute and collect information, these banks may more easily overcome asymmetry information, contracting and coordinating problems which might enhance bank stability.

Despite the extensive evidence on government ownership's negative effects on bank performance or economic development[2], limited empirical cross-country work exists on the relation between government-owned banks and stability. Studies such as Beck et al. (2009) or Berger et al. (2005) focus on only banks in one country (i.e. Germany, Argentina) and Iannotta et al. (2007) examine banks in some developed countries.

Our paper makes several contributions to the literature. It expands on previous studies by using a continuous variable to proxy government ownership to examine on a larger cross-country sample, and provides evidence on the impact of economic development and regulatory quality on the relation between government ownership and bank stability.

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[2] See Micco et al. (2007) and Shen and Lin (2012) for further review on literature about government ownership and bank performance. Andrianova et al. (2012) and Körner and Schnabel (2011) provide detail literature review government ownership and economic development. According to this literature, government-owned banks have lower profitability and higher cost (Micco et al., 2007) with poorer loan quality and higher insolvency risk (Iannotta et al., 2007) than other types of banks. Also, government ownership is associated with lower level of economic development (La Porta et al., 2002).

A continuous variable for government ownership within a dynamic panel model allow us to capture the impact of both the magnitude and changes of ownership on bank stability. Prior studies have only used a dummy variable with 50 per cent threshold to distinguish between government and private banks (Iannotta et al., 2007; Shen and Lin, 2012). They are also limited at certain point of time (1970, 1995, 2000 and 2005) (La Porta et al., 2002; Taboada, 2011) or to single country (Berger et al., 2009a). We argue that banks are often considered controlled if 10 per cent or more of their voting stock is held by a single party such as government (Vernon, 1970). In other words, a lower equity threshold may be adequate to experience the advantages or disadvantages of government ownership. In addition, a dummy variable does not capture degrees of government ownership [3] above the threshold as well as the dynamic effect of any ownership changes over time might have on bank stability. The use of a continuous variable should provide better insights on how bank distant to default might change when the ownership changes by even one per cent.

Our cross country approach makes it possible to study impact of government ownership on bank stability with different country-specific characteristics or compare the results among different country groups. It also allows us to examine differences in regulation environment and economic development impact on the possible relationship between government ownership and bank stability. Of the few single country studies, such as Berger et al. (2005) and Beck et al. (2009), on the relations between type of bank (government versus private or

[3] Degree of government ownership can be captured by the proportion of bank equity held by government (Saunders et al., 1990).

foreign banks) and bank risk-taking or credit quality, their results are also mixed[4]. We question whether differences in economic development levels and regulatory environment could be the cause and use a cross country study to examine such differences. To the best of our knowledge, no study has done so. Such comparison can offer important insights for policy makers and regulators among country groups when designing nationalization, restructuring or privatization programs.

Using a sample of 29,405 bank-year observations of 3,317 commercial banks from 101 countries over the period 1997-2010, this paper considers two main issues: (i) the association between government ownership and bank stability; (ii) the interaction impact of economic development level or regulation quality on the relationship between government ownership and bank stability.

The rest of the paper proceeds as follows. Section 2 summarizes the government ownership literature in relation to bank stability and other bank-level, country-level characteristics. Section 3 describes our sample and data sources. Section 4 explains the methodology including model specification and main variables. Section 5 presents summary statistics for

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[4] Government-owned banks are found to be riskier than privately owned ones with more loan losses and higher insolvency risks in some developed European countries[4] (Iannotta et al., 2007) and with higher non-performing loan ratios in Argentina[4] (Berger et al., 2005). Furthermore, government-owned banks in Italy seem favor to large firms and in depressed areas (Sapienza, 2004) and so threaten bank stability through this riskier lending. In contrast, government-owned saving banks in Germany are argued to be more stable than privately-owned due to their lower volatility in profits (Beck et al., 2009).

the main regression variables together with empirical results and various robustness tests. Section 6 concludes the paper and considers the implications of our findings.

2. Literature review and hypothesis development

The following sections develop the hypotheses associated with the possible impact of government ownership on bank stability and the interaction impact of economic development level or regulation quality on relation between government ownership and bank stability.

2.1 Government ownership and bank stability

Theories that justify government ownership include the political, agency and development views. The political view suggests that a key goal of any government is to maintain its political support. Governments therefore use firm ownership to channel and direct benefits to their supporters as well as pursue their goals (Shleifer, 1998; Shleifer and Vishny, 1994). Such influence is even greater in banking than in other industries (Dinç, 2005). This is because the political motivation behind a loan can be disguised due to asymmetric information between the lending banks and outsiders. Moreover, they can increase their power through controlling financial resources. Although government ownership may help banks to overcome informational and contracting problems, politicians might, nevertheless, use this centralized information and enforcement power for their own benefits (Acemoglu et al., 2008). This leads to misused information, corruption and misallocation of resources. As a result, banks with more government ownership might be riskier due to their politicized resource allocation.

The agency point of view, like the political view, states that agency problems in banks with more government ownership are worse than in other banks (Banerjee, 1997). The separation of ownership and control may create conflicts between owners and managers. While private or partially government-owned banks (with lower degree of government ownership) can reduce the agency problems by using bonus plans or stock compensation schemes to ensure the agents (bank managers) act in the best interest of the shareholders, this is harder to do for government-owned banks (Eckel and Vermaelen, 1986). As an owner, government may also use implicit guarantees to secure their banks, but this could discourage monitoring and allow further agency problems to develop (Borisova and Megginson, 2011).

The development view argues that government ownership of banks is used to maximize economic welfare. Such banks may lend more to firms in depressed areas or to politically related ones, which are higher risk customers (Khwaja and Mian, 2005). Also, creditworthiness becomes no longer the bank's major concern due to this directed credit process. Hence, banks with more government ownership may fund riskier projects than private banks.

Therefore, we argue that although government ownership might originally be designed to achieve different goals, including development and political influences, the misallocation of resources coupled with poor management quality, corruption and other agency problems might hamper their stability. This has driven to our first hypothesis:

H1: The higher degree of government ownership is associated with lower individual bank stability.

2.2 Economic development, regulatory environment and the relation between government ownership and bank stability

It is argued that government in less developed countries might use their ownership of banks to develop certain strategic industries through both direct credit and control over finance (Gerschenkron, 1962). In these countries, bank government ownership typically plays a development role and they must respond to a social mandate (Andrianova et al., 2012). Hence, the politicized, corruption and misallocation resource problems might be worse in less developed countries and so threaten bank stability. In more developed countries, however, government ownership has ceased to play a development role (Micco et al., 2007). Moreover, higher income countries should be better equipped to address such distortions and so mitigate this negative impact. In addition, Acemoglu et al. (2008) demonstrate that difference economic development level might lead to the different impacts of government ownership. These arguments lead to our hypothesis:

H2.1: The negative relation between government ownership and bank stability is mitigated by a higher level of economic development.

Besides possible negative effects of government ownership on banks as discussed in part 2.1, there are also advantages from this form of ownership, known as better risk sharing opportunities, information advantages and other supports from government as an owners (Megginson et al., 1994). The government can create regulations that can positively or negatively affect an institution. Its role as an owners provides opportunities for management improvements through widespread monitoring and direct enforcement of recommended policies (Borisova et al., 2012).

We argue that when the politics of government ownership and its drawbacks, such as corruption, agency problem or misallocation of resources, are effectively controlled through a better regulatory environment, the advantages of government ownership might be able to limit its negative impacts. It is argued that strict institutional controls on government behaviour and a better regulation environment help government ownership to become more effective. We hypothesize that:

H2.2: The negative relation between government ownership and bank stability is mitigated by a higher level of regulatory quality.

3. Data source and sample:

Our data are compiled from different sources as detailed in Table 1. Bank-specific data are obtained from the BankScope database. This database covers 90% bank assets in each country (Houston et al., 2010). Government ownership is the percentage of bank equity held both directly and indirectly by the government as presented in BankScope. Further bank ownership information is obtained from previous studies and relevant bank websites. Country-specific data are retrieved from World Development Indicators, Index of Economic Freedom, International Financial Statistics, and Global Competitiveness Report. The crisis information is from the International Monetary Fund crisis database and the previous studies of Laeven and Valencia (2008, 2010).

[Insert Table 1 here]

As shown in Table 2, sample banks must have unconsolidated statements available in the BankScope database.[5] They must also have at least five continuous years of data.

[Insert Table 2 here]

The availability of bank-specific and country-specific data leads to a sample of 3,317 commercial banks over the period 1997-2010 from 101 countries. Table 3 lists the countries in the sample, along with developed/developing countries divisions as well as level of income for each.

[Insert Table 3 here]

4. Model specification:

This section explains the model used to test the main hypothesis on whether more government ownership of banks reduces bank stability. The different measures of bank stability, government ownership and other bank- and country-specific control variables are also shown.

4.1 Model specification

This study uses a System Generalized Method of Moment (System GMM)[6] estimation developed in Arellano and Bover (1995) and Blundell and Bond (1998). It combines the

[5] We follow Micco et al (2007) and use the unconsolidated statements because using consolidated ones might lead to duplicating the data, especially with ownership information

equation of interest expressed in first differences and in levels to test the impact of government ownership on bank stability. System GMM estimation is a common choice in the literature to measure the impact of different factors on bank stability (Berger et al., 2009b; Favero and Rovelli, 2003; Tabak et al., 2011). It is an appropriate method here for three reasons. Firstly, it controls for the possible problem that higher government ownership may be influenced by government characteristics or macroeconomic conditions as well as previous bank performance and stability. Secondly, it does not require a distributional assumption on the error term and is more efficient than two-stage least squares (2SLS) because it accounts for heteroskedasticity (Hansen, 1982). Thirdly, this model is suitable for a relatively large number of cross-section observations compared to time series observations (Hansen, 1982). There are 3,317 cross-sections as opposed to 14 time-series in this study.

This estimator combines the standard equations in first differences with lagged level as instruments to control explicitly for potential biases arising from country specific effects in other dynamic panel settings and to address the potential reverse causality between the dependent variable and some of the explanatory variables (Becerra et al., 2012). Following Tabak et al. (2011), we also use correction to the standard errors in the two-step estimations. The Arellano-Bond test for zero autocorrelation in first-difference errors is applied. It is shown that at order 2 and 3, there is no evidence of serial correlation. We apply the Durbin-Wu-Hausman test of endogeneity to our sample with potential endogenous regressor,

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[6] The System GMM estimator combines the equation of interest expressed in first differences (using lagged levels of the regressors as internal instruments), and in levels (using lagged differences as instruments).

government ownership (*BGO*) instrumented by some macroeconomic and specific control variables. It strongly rejects the null hypothesis that government ownership is exogenous thereby allowing us to conclude that it is endogenous. Hansen-Sargan test of overidentification is then conducted to see if these instruments are valid. The result does not reject the null hypothesis and so the overidentifying restriction is met. Our weak instrument concern is also verified with diagnostic tests proposed by Stock and Yogo (2005). We are able to reject the null hypothesis of weak instruments.[7]

The standards errors of panel data estimators also need to be adjusted because each additional time period of data is not independent of previous periods (Cameron and Trivedi, 2010). We fit the model using two-step GMM and report robust standard errors. The strictly exogenous variables appear as regular regressors. The predetermined and endogenous variables are instead given as options.

The equation *(EQ1)* is formulated to estimate the impact of the main variable of interest (government ownership) and other bank-specific and country-specific conditions on bank stability:

$$BDR_{ijt} = \alpha_1 + \beta_1 BDR_{ijt-1} + \gamma_1 BGO_{ijt} + \gamma_2 BGO_{ijt} * INC_{jt} + \gamma_3 * RI_{ijt} + \tau_1 BB_{1ijt} + \delta_1 M_{1ijt} + \varphi_1 D_{ijt} + \varepsilon_{it}$$

(EQ 1)

where, subscripts *i,j* and *t* denote bank, country and year respectively; *BDR,* a proxy for bank stability*,* is the logarithm of the bank *z-score* explained in Table 1; α_1 is the intercept; γ_1, γ_2,

[7] These results are available from the author upon request.

τ_1 , δ_1, φ_1 are coefficients to be estimated and ε_{it} is the disturbance term; BDR_{t-1} indicates the value of *BDR* in the previous year ; *BGO* reflects the degree of government ownership at the bank level; *INC* is a vector of control variables on country economic development; *RI* is a vector of regulation quality; BB_1 is a vector of control variables on bank specific conditions; M_1 is a vector of control variables on country-specific conditions; *D* is systemic-crisis dummy variable; ε is an error term. Details on these variables, definitions and data sources are presented in Table 1.

4.2 Measuring bank stability

The literature uses a number of proxies for bank stability. The natural logarithm of *z-score*, which measures the distance to default[8], is used here to proxy for bank stability. A higher *z-score* (ln) value implies a more stable bank. Since the *z-score* is highly skewed, a natural logarithm of *z-score* which is normally distributed is used instead (Following Demirgüç-Kunt and Huizinga, 2010; Houston et al., 2010).

Z-score reflects the number of standard deviation units by which profitability would have to decline before bank capitalization is depleted (Turk Ariss, 2010). This bank stability indicator increases with higher profitability and capitalization levels but declines with unstable earnings reflected by a higher standard deviation of return on assets. A higher *z-score* implies

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[8] Distant to default captures the number of standard deviations a bank is away from the default barriers, or the point at which losses eliminate equity (z-index, Boyd and Runkle, 1993) . Hence, the longer distance from the default barriers implies a more stable bank (Barry et al., 2011; Berger et al., 2009b; Boyd and Runkle, 1993; Iannotta et al., 2007).

that a bank is farther from default and hence more stable (Boyd and Runkle, 1993). *Z-score* is defined as:

$$z - score = \frac{(ROA + \frac{E}{A})}{\sigma(ROA)} \qquad \textit{(EQ 2)}$$

where *ROA* is the bank return on average assets, *E/A* denotes bank's equity to asset ratio and *σ(ROA)* is the standard deviation of return on average assets computed for a five-year rolling window. A rolling time window for *σ(ROA)* allows for variations in the denominator for the *z-score* and so avoids that *z-score* being exclusively driven by changes in *ROA* and *E/A* (Barry et al., 2011).

Other proxies, such as risk-adjusted net interest margin (*NIM/σ(NIM)*), risk-adjusted return on assets (*ROA/σ(ROA)*), risk-adjusted return on equity (*ROE/σ(ROE)*)[9], non-performing loan ratios and loan loss provisions (ln), are used later for robustness test purposes (following Iannotta et al., 2007; Turk Ariss, 2010). The higher values of these measures, except for non-performing loan ratios, implies more bank stability.

4.3 Measuring government ownership

GOVERNMENT OWNERSHIP - The main variable of interest in the equation is *BGO (Government ownership)*, which captures the percentage of bank equity held both directly

[9] *NIM, ROA* and *ROE* are bank net interest margin, bank return on average assets and bank return on average equity, respectively; *σ(NIM), σ(ROA), σ(ROE),* are the standard deviation of *NIM*, *ROA* and *ROE* computed for a five-year rolling window.

and indirectly by the government. Other variables, including *D20*, *Majority* and *Wholly* are dummy variables on whether the share of equity held by government is more or equal to 20 per cent, 50.01 per cent and 98.01 per cent.

4.4 Bank-level controls

The following control variables at bank level (as components of the BB_{1it} vector) are employed:

MARKET POWER – The market share variable measures market power of banks within the loan market of a banking system. There is no concensus about the impact of market power on bank stability. The charter-value view proposes that banks with greater market power exhibit higher stability, lower risk taking and are less prone to banking crises (Beck et al., 2006). In contrast, the competition-stability view emphasizes that higher market power drives banks to increase interest rates which enhances moral hazard and bank risk-taking (Boyd and De Nicolo, 2005; Uhde and Heimeshoff, 2009). This in turn increases bank default risk and makes banks less stable. Note that the empirical support of the charter-value view as mostly from studies in the United States or other advanced markets, whereas competition-stability results were generally for less developed markets in Eastern Europe.

AUDIT QUALITY: A dummy variable which proxies for bank audit quality, it takes a value of 1 if a bank is audited by one of the big four reputable auditors (Deloitte, PricewaterhouseCoopers, Ernst and Young, and KPMG) and 0 otherwise. Banks audited by reputable auditors are believed to be more stable with lower probability of failure (Jin et al., 2011). In line with this argument, we expect a positive coefficient for this variable.

LISTED – A dummy variable that equals 1 if the bank is listed on the stock exchange, and zero otherwise. It serves as a proxy for ownership dispersion. As in previous studies, we have no clear expectation for the sign of the coefficient. On the one hand, it is argued that banks with publicly traded share are positively affected by market discipline (Iannotta et al., 2007). If so, listed banks might be more stable. On the other hand, since the separation of ownership and control becomes greater when ownership is more dispersed (Taboada, 2011), bank stability might be negatively affected by listing.

DIVERSITY (Income) – Bank income diversity index, computed as explained below with a higher value indicating greater diversification, is employed to capture diversification in bank operation. More diversified banks are expected to have less risk and to be more stable. Income rather than assets diversity is used because it can capture diversity in both on and off balance sheet activities. Following Elsas et al. (2010), income diversity is computed across different sources of income employing Hirschman Herfindahl Indices (HHI) measure:

$$Diversity = 1 - \left(\left(\frac{Gross\ Int\ revenue}{Total\ operating\ income}\right)^2 + \left(\frac{Net\ comission\ revenue}{Total\ operating\ income}\right)^2 + \left(\frac{Net\ trading\ revenue}{Total\ operating\ income}\right)^2 + \left(\frac{Other\ net\ revenue}{Total\ operating\ income}\right)^2\right)$$

(EQ 3)

NET INTEREST MARGIN - Net interest margin is defined as the difference between bank net interest income in relation to average total earning assets (Maudos and Fernández de Guevara, 2004).

MANAGEMENT QUALITY (efficiency): Cost to income ratio, defined as the operating cost necessary to generate one unit of gross income, is used to proxy for management efficiency (Shehzad et al., 2010). A higher value implies lower efficiency and lower management quality which might hamper bank stability. In other words, a negative sign is expected for the coefficient.

LIQUIDITY (Assets) – Liquid asset ratio, defined as the ratio of liquid assets over total bank assets, is employed to capture the impact of bank liquidity on bank stability. The usual regulatory view is that more liquid assets enhance bank stability as they are less vulnerable to liquidity shocks as well as reducing the level of risk on bank balance sheets. Nevertheless, it is argued from a theoretical perspective that higher asset liquidity can increase bank instability and is associated with bank failures (see Wagner, 2007 for further discussion). This is because banks with more liquid assets have more incentive to take additional risks in order to offset the low income from holding liquid assets. This new risk offsets the positive impact on stability.

CAPITALIZATION – The ratio of equity over assets proxies for the book value of bank capitalization. A well-capitalized bank with higher book value of equity to total assets might have less incentives to engage in excessive risk taking (Laeven and Levine, 2007). Thus, this variable is expected to display a positive correlation with bank stability.

BANK SIZE - Total operating income is included as a measure of bank size. Total operating income is used to measure bank size rather than total assets as this captures both on and off balance sheet activities (Laeven and Levine, 2007). We control for bank size because small banks might behave differently from large banks, particularly in respect to bank risk-taking

and hence stability (Cornett et al., 2011; Shehzad et al., 2010). Bigger banks are expected to be more stable because they have more opportunity and resources to diversify their assets and liabilities as well as to cover individual losses.

4.5 Country-level controls

The following variables are included to control for macroeconomic and banking systemic conditions

REGULATION QUALITY: This index measures the government's ability to formulate and implement sound policies and regulations that promote market competition and facilitate private sector development with values from 1 to 100. Higher quality of regulatory environment is expected to enhance bank stability.

ECONOMIC DEVELOPMENT: Economic development is mainly proxied by logarithm of GDP per capital. A higher value implies the country has a higher level of economic development. For robustness test and comparison purposed, an income index, valued from 1 to 4, indicates country level of economics development based on its average income per capita is also employed.

CONCENTRATION: A Herfindahl–Hirschman Index (HHI), valued from 0 to 100, is employed as a measure of market concentration. A higher value indicates more concentrated or less competitive markets. By country, this index is constructed as the sum of squared share of total assets of each bank in systemic total assets. Total market share of the 3 largest banks and the 5 largest banks is also used to measure concentration as robustness tests.

SYSTEMIC CRISIS: A dummy variable, equals 1 if the banking system is in a systemic crisis and 0 otherwise, is to control for those years when the banking system is in distress and so might impact on individual bank stability A systemic banking crisis is defined as a situation in which significant segments of the banking sector become either insolvent or illiquid or cannot continue without special government assistance, including emergency measures, and large-scale nationalization (Demirgüç-Kunt and Detragiache, 2002). Such crisis episodes are when non-performing assets reach at least ten per cent of total assets at the peak of the crisis, or if the rescue cost was at least two per cent of GDP (Demirgüç-Kunt and Detragiache, 2002). This definition, widely used in most banking crisis studies, will be used here in accordance with the available banking crisis datasets.

FINANCIAL FREEDOM: An index of market financial freedom from the Heritage Foundation is included to control for the impact of financial market openness on bank stability (Demirgüç-Kunt and Huizinga, 2010).

5. Empirical analysis

5.1 Summary statistics

Table 4 presents the summary statistics for the key variables. The mean value of logarithm of *z-score* of banks in the whole sample is 3.53, and the standard deviation is 1.22. Specially, this value in developed countries (3.76) is higher than those of developing countries (3.35). Similarly, mean value of bank *z-score* (ln) in high income group (3.76) is higher than banks in middle (3.37) and low income country groups (3.16). On average, banks in country group

with higher level of economic development have higher mean values of *z-score* (ln), imply more stability.

The mean of government ownership in sample is 5.54 per cent with fairly high standard deviation (19.67 per cent). This suggests considerable cross-sectional variation. This value for developing countries is 9.07 per cent, compared to only 1.06 per cent for the developed group. The average government ownership in high income countries (1.64 per cent) is also lower than in middle income (7.64 per cent) and low income countries (14.11 per cent). Other bank specific variables such as management quality, net interest margin, market share, bank size also show significant differences across different country groups.

[Insert Table 4 here]

The correlation matrix for the main regression variables is presented in Table 5. Bank stability, as measured by logarithm of *z-score*, is highly correlated with the government ownership, equity to assets ratio, cost to income ratio and financial freedom variables. The other regressors are also weakly correlated with each other. Hence, as discussed in section 4.1 with necessary tests, government ownership is used as an endogenous variable in our system GMM model.

[Insert Table 5 here]

Table 6 shows the pairwise correlation among dummy variables on developing/developed countries and economic and regulation indicators. There are significantly positive correlated between economic development and other variables proxied for regulation environment such as corruption free (0.83), property rights (0.76), financial free (0.57), trade freedom (0.70). Since these variables are highly correlated, they are not included in same model. Instead, we

test them one by one and use the others for robustness test purposes (see Table 7 and Table 8 in part 5.2).

[Insert Table 6 here]

5.2 Empirical results

The regression results for model (*EQ1)*, testing the impact of government ownership on bank stability and the interaction impact of economic development, regulatory environment on this relation, are presented in Table 7 and Table 8. Table 9 presents those results for subsample of banks in different country groups classified by economic development level. Table 10 shows further results on the different impact of bank and banking system characteristics on degree of government ownership. Table 11 and Table 12 display the robustness test results with alternative measures of bank stability of estimation approaches. The statistical significances of the reported coefficients shown in these tables are calculated using robust standard errors.

Generally, the regressors reported in Table 7 and Table 8 are jointly statistically significant. Also, by using a two-sided test at 1% significant level, all main interested regressors are individually statistically significant. More important is the economically significance of coefficients, meaning the measured impact of regressors on bank distant to default (*z-score*). In *(EQ1)*, the regression is in logs, which means that parameters need to be interpreted as semielasticities[10].

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[10] For the regression of ln(y) on x, the coefficients beta measures the effect of a change in regressor x on E(ln(y)/x), but ultimate interest lines instead on the effect on E(y/x). Some algebra shows that beta measures

For each of the reported specifications, we consistently find that higher degree of government ownership is associates with lower bank stability (lower estimated *z-score* implies more bank stability). As can be seen from the tables, the coefficients of government ownership are negative and statistically significant. A one standard deviation increase in degree of government ownership is associates with a change in *z-score* of about – 0.48 (= 0.025 *19.67) (Table 7). When we control for different ownership thresholds, known as 20, 50.01 and 98.01 per cent, the magnitude of negative coefficients are significantly higher with high levels of government ownership (Table 8). As discussed in part 2.2, these results support our expectation of a significant negative impact of government ownership on bank stability. This is consistent with the political view in government ownership literature (Borisova and Megginson, 2011; Iannotta et al., 2007).

Specially, the presence of regulatory quality variable and economic development in the model with their interaction term with government ownership reduce the magnitude of government ownership impact on bank stability (from 0.025 to 0.015, 0.011 respectively – Table 7). We also find that higher regulatory quality and higher economic development is associated with higher bank stability. The coefficient on regulatory quality and economic development is 0.0085 and 0.2104. This means that regulatory is associated with 0.85% and 21.04% rise in bank distant to default (*z-score*). The interaction of regulatory quality and economic development not only reduce the absolute value of coefficient on government

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the proportionate change in E(y/x). For example if beta=0.02, then a one-unit change in x is associated with a proportionate increase of 2% in E(y/x) (Cameron and Trivedi, 2010).

ownership but also have statistically positive impact on bank stability, which explain 0.03 and 0.47% change in *z-score*. These support our predictions about the interaction impact of economic development and regulatory quality on the relation between government ownership and bank stability.

Other control variables have the sign and significance as expected in section 4.4 and 4.5. The coefficients on listed, audit quality and diversity are about 0.54, 0.02 and 0.22, respectively. This means that distant to default for listed banks are 0.64% lower than those for non-listed banks after controlling for other characteristics. Diversity is associated with a 22% higher proportionate rise in bank distant to default. Similarly, large effects are obtained for the systemic crisis and concentration measures.

[Insert Table 7, Table 8 here]

Table 9 - column 1 and 2 report the analysis results for banks in developing and developed country group. Column 3 to 5 show regression for banks in high, middle and low income group of countries. In more developed economies (developed and high income groups) government ownership and bank stability is significantly and positively correlated (0.0062 and 0.0077) whereas that relation remains negative in developing (-0.0592), middle (-0.0492) or low income countries (-0.0518).

[Insert Table 9 here]

Table 10 reports the regression results when government ownership is treated and endogenous variable in two-step system GMM estimation. The results show that more government ownership is significantly associated with more highly concentrated markets, and countries with low level of income. Banks with more government ownership are more likely

a large bank, less likely to have a reputable auditor, have lower cost to income ratio, and higher capitalization.

[Insert Table 10 here]

5.3 Robustness checks

Some additional robustness test results are summarized in table 11 and table 12 concerning other measures of bank stability and alternative estimation techniques. Our concern over others measures of bank stability are addressed by substituting four common proxies instead: bank R*isk-adjusted NIM*, *Risk-adjusted ROA*, *Risk-adjusted ROE*, bank *nonperforming loan ratio*; and *loan loss provisions (ln)*. Table 11 shows the estimations of the regression model (*EQ1*) using these alternative measures of bank stability are consistent those reported in Table 7. The coefficient estimates show the expected sign and significance. *Government ownership* is found negatively associated with bank *Risk-adjusted NIM* (-0.0172), R*isk-adjusted ROA* (-0.0111) and *Risk-adjusted ROE* (-0.0100) and *Loan loss provisions* (-0.0103). These results are statistically significant at 1%. Similarly, more *government ownership* is associated with higher *non-performing loan ratio* (0.0941).

[Insert Table 11 here]

Although we have verified the validity of system GMM estimator with different tests as described in part 4.1, alternative estimation technologies were also used to test whether GMM estimation results are robust. Those for the baseline specification are reported in Table 12. Estimations for panel data, including 2-Stages Least Squares, Pooled Ordinary Least Squares, Fixed Effect and Random Effect models are used. In all cases, the coefficient estimates have the expected signs and significance while variables used for this estimation

are the same as those in the cross-section estimations. A lagged term is included to address the persistence of the bank stability over time.

[Insert Table 12 here]

6. Conclusion

This study examined government ownership in relation to bank stability. We then assessed whether the impact of government ownership on bank stability differed across varying levels of economic development and regulatory characteristics. We also noted how banks with more government ownership are characterized by their size, importance of market share and other individual and banking system characteristics.

Our findings, consistent with the political and agency view, show that more government ownership is associated with lower bank stability. This negative relationship, however, can change depending on a country's economic development and regulation quality. Higher levels of economic development and regulation quality appear to mitigate the negative impact of government ownership and bank stability. Robustness checks using different bank stability measures and estimation methods support our initial findings.

We also show that banks with more government ownership are significantly associated with larger size, higher market share, higher capitalization and lower net interest margin in market with higher concentration, less financial freedoms, monetary freedoms and protection rights.

These findings should have important implications for policymakers, regulators, taxpayers, bank shareholders, depositors and creditors. Policymakers should consider the impact of government ownership on bank stability in the design of restructuring, privatization or

nationalization programs. Taxpayers, who bear the costs of bank ownership or government funded crisis intervention, may gain better insights from the potential benefits and whether their money is used effectively. Bank shareholders may avoid bad investment decisions when they are aware of how bank stability is impacted. Depositors might also reduce the risk of losing their saving through bank insolvency from better understanding of bank stability. Creditors with better understanding might also have more chances for repayment by just dealing with more stable banks.

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Table 1: Variable definition and data source

This table provides a description of the variables used in our study, their definitions with the expected sign and data source. Panel A presents the dependent and main independent variables. Panel B presents other bank-specific variables. Panel C presents the country-specific variables.

Variable		Definitions/Expected sign	Source
Panel A: Dependent and main independent variables			
BDR	*Z-score* (ln)	Equals logarithm of *z-score*. *Z-score =(ROA+E/A)/σ(ROA)*, measures the number of standard deviations a return realization has to fall in order to deplete equity	Prepared by author using BankScope
	Risk-adjusted NIM (ln)	Equals to *NIM/σ(NIM)*, measure the risk-adjusted of net interest margin.	Prepared by author using BankScope
	Risk-adjusted ROA (ln)	Equals to ROA*/σ(ROA),* measure the risk-adjusted of returns on assets	Prepared by author using BankScope
	Risk-adjusted ROE (ln)	Equals to *ROE/σ(ROE)*, measure risk-adjusted of returns on assets	Prepared by author using BankScope
	Non-performing loan ratio	Equal to bank non-performing loan over gross loan	BankScope
	Loan loss provisions (ln)	Logarithm of loan loss provisions in Mil USD	Prepared by author using BankScope
BGO	*Government ownership*	The proportion of equity held by government **(-)**	Prepared by author using BankScope
	D20	Dummy variable, value 1 if share of equity held by government is more or equal to 20%	Prepared by author using BankScope
	Majority	Dummy variable, value 1 if share of equity held by government is more or equal to 50.01% (Majority government-owned)	Prepared by author using BankScope
	Wholly	Dummy variable, value 1 if share of equity held by government is more or equal to 98.01% (Wholly government-owned)	Prepared by author using BankScope
Panel B: Bank-specific variables			
BB_1	*Market power*	Employed as a measure of bank market power, which is calculated by dividing bank loans over aggregate bank loans in a country	Prepared by author using BankScope
	Audit quality	Dummy variable on whether bank is audited by one of big four reputable auditors (E&Y, PricewaterhouseCooper, Deloitte, KPMG) (+)	Prepared by author using BankScope
	Listed	Dummy variable on whether bank is listed in the stock exchange or not	Prepared by author using BankScope
	Diversity	Income diversity index: employing HHI measure across different sources of income (+)	BankScope
	NIM	Value of net interest revenue over interest-bearing assets (-)	BankScope
	Management quality	Ratio of cost over total income (-)	BankScope
	Liquidity	Ratio of bank liquid assets over total assets (Liquid assets ratio) (-)	BankScope
	Capitalization	Ratio of equity divided by bank total assets (Equity/Assets) (-)	BankScope
	Bank size	Natural logarithm of total bank operating income (+)	Prepared by author using BankScope
	Too big to fail	Dummy variable, value 1 if bank is one of three banks having largest total assets in a country banking system	Prepared by author using BankScope
Panel C: Country-level specific conditions			
M_1	*Concentration*	To control for competition, this study employs Herfindahl Hirschman Index, defined as the sum of the squared shares of bank assets to total assets within a country (-)	Prepared by author using BankScope
	Gov. spending	Considers the level of government expenditures as a percentage of GDP. Scale from 0 to 100, higher value indicates a lower percentage of government expenditure over GDP	The Heritage Foundation

	Income level	Scale from 1 to 4, the lower value indicate lower income group, value changes for each country every year	World Development Indicators
	System weight	Value of 1/number of banks in each country examined in author's sample	Prepared by author using BankScope
RI	*Financial Freedom*	Financial freedom is a measure of banking efficiency and independence from government control and interference in the financial sector. It is measured over a scale of 0 to 100 with the higher value indicate less government interference in the financial sector (-).	The Heritage Foundation
	Monetary Freedom	Combines a measure of price stability with an assessment of price controls. The score for the monetary freedom component is based on two factors: The weighted average inflation rate for the most recent three years and Price controls. Scale from 0 to 100 where higher value indicates more freedom.	The Heritage Foundation
	Corruption Free	Scale from 0 to 10 where a score of 10 indicates very little corruption and a score of 0 indicates a very corruption government (-)	The Heritage Foundation
	Property Rights	Measures the degree to which a country's laws protect private property rights and the degree to which its government enforces those laws. Scaled from 0 to 100 where higher value indicates more legal protection of property.	The Heritage Foundation
	Regulatory quality	Measure the quality of regulation environment, higher value represents the higher quality of regulation	World Governance Indicators
D_1	*Systemic crisis*	Dummy variable, value 1 if banking system experience crisis and 0 otherwise (-)	Laeven and Valencia (2008, 2010)
M_2	*Election*	Dummy variable value 1 if country experienced election in that year	IFES Election Guide
	GDP growth	Gross Domestic Product (GDP) change (in %) **(+)**	World Development Indicators
	Economic development	Logarithm of GDP per capita in Mil US dollars **(+)**	World Development Indicators
	Developing	Dummy variable on whether a country belongs to developing country group	World Economic Outlook
	High income	Dummy variable on whether a country belongs to high income country group	World Development Indicators
	Middle income	Dummy variable on whether a country belongs to middle income country group	World Development Indicators
	Upper middle	Dummy variable on whether a country belongs to upper-middle income country group	World Development Indicators
	Low middle	Dummy variable on whether a country belongs to low-middle income country group	World Development Indicators
	Low income	Dummy variable on whether a country belongs to low income country group	World Development Indicators
	Inflation	Rate of inflation **(-)**	World Development Indicators
	Real interest rate	Short-term real interest rate **(-)**	World Development Indicators
	M2 to total reserves	Ratio of M2 over total reserves(+)	World Development Indicators

Table 2: Sampling procedure and sample size

This table outlines the sample selection criteria and total number of sample countries/banks considered in this study. The data for bank-specific and country-specific level are sourced from BankScope database and World Development Indicators, World Economic Outlook, International Financial Statistics and Index of Economic Freedom.

BANK SELECTION PROCESS	
Description	**No.**
Initial sample (list of commercial banks obtained from BankScope)	16,430
Exclude:, bank with insufficient data on ownership and other main regression variables	9,816
Sample after first step	4,614
Exclude: Banks with less than five continuous year reports	1,730
Sample after this step	4,884
Exclude: Banks insufficient country-specific data	1,567
Final Sample	**3,317**

Table 3: List of countries and their classifications

PANEL A								
HIGH INCOME			MIDDLE INCOME					LOW INCOME
			UPPER-MIDDLE			LOW-MIDDLE		
Austria	Hungary	Slovenia	Algeria	Jordan	Tunisia	Armenia	Pakistan	Bangladesh
Bahamas	Israel	Spain	Argentina	Latvia	Turkey	Bolivia	Paraguay	Benin
Bahrain	Italy	Sweden	Azerbaijan	Lebanon	Uruguay	Egypt	Philippines	Burkina Faso
Belgium	Japan	Switzerland	Belarus	Lithuania	Venezuela	El Salvador	Senegal	Ethiopia
Canada	Korea	Trinidad & Tobago	Bosnia-Herzegovina	Macedonia		Georgia	Sri Lanka	Kenya
Croatia	Kuwait	UAE	Botswana	Malaysia		Ghana	Sudan	Malawi
Cyprus	Luxembourg	United Kingdom	Brazil	Mauritius		Guatemala	Swaziland	Nepal
Czech	Netherlands	United States	Bulgaria	Mexico		Honduras	Ukraine	Tanzania
Denmark	Norway		China	Panama		Indonesia	Uzbekistan	Uganda
Estonia	Oman		Colombia	Peru		India	Vietnam	
France	Poland		Costa Rica	Russian		Moldova	Zambia	
Germany	Portugal		Dominican	Serbia		Nicaragua		
Greece	Saudi Arabia		Ecuador	South Africa		Nigeria		
Hong Kong	Slovakia		Jamaica	Thailand				

Note: In panel A, countries are divided into three groups (high, middle and low income) according to their annual GNI per capita, calculated using the World Bank Atlas method. The groups include low income ($1,005 or less); middle income ($1,006 - $12,276); and high income, ($12,276 or more). In the middle income group, two sub-groups are lower middle ($1,006 - $3,975) and upper middle ($3,976 - $12,275). This table reports classifications follow World Development Indicators (World Bank, 2011).

PANEL B						
DEVELOPED COUNTRIES		**DEVELOPING COUNTRIES**				
Austria	Norway	Algeria	Costa Rica	Kuwait	Peru	Ukraine
Belgium	Portugal	Argentina	Croatia	Latvia	Philippines	UAE
Canada	Slovakia	Armenia	Dominican Rep	Lebanon	Poland	Uruguay
Cyprus	Slovenia	Azerbaijan	Ecuador	Lithuania	Russian	Uzbekistan
Czech	Spain	Bahamas	Egypt	Macedonia	Saudi Arabia	Venezuela
Denmark	Sweden	Bahrain	El Salvador	Malawi	Senegal	Vietnam
Estonia	Switzerland	Bangladesh	Ethiopia	Malaysia	Serbia	Zambia
France	United Kingdom	Belarus	Georgia	Mauritius	South Africa	
Germany	United States	Benin	Ghana	Mexico	Sri Lanka	
Greece		Bolivia	Guatemala	Moldova	Sudan	
Hong Kong		Bosnia-Herzegovina	Honduras	Nicaragua	Swaziland	
Israel		Botswana	Hungary	Nepal	Tanzania	
Italy		Brazil	India	Nigeria	Thailand	
Japan		Bulgaria	Indonesia	Oman	Trinidad & Tobago	
Korea		Burkina Faso	Jamaica	Pakistan	Tunisia	
Luxembourg		China	Jordan	Panama	Turkey	
Netherlands		Colombia	Kenya	Paraguay	Uganda	

Note: In panel B, countries are divides into two groups: developed and developing countries, following country classification in the World Economic Outlook.

Table 4: Summary statistics of main regression variables

Panel A: Entire sample and developing versus developed country groups

	Full sample					Developed countries					Developing countries				
	Obs	Mean	Min	Max	Std.	Obs	Mean	Min	Max	Std.	Obs	Mean	Min	Max	Std.
Z-score (ln)	29,405	3.53	-4.28	6.21	1.22	14,047	3.76	-4.11	6.21	1.24	15,358	3.35	-4.28	6.21	1.18
Risk-adj NIM	26,395	2.31	-6.76	8.08	1.1	11,426	2.55	-6.76	8.08	1.12	14,969	2.11	-5.22	7.21	1.03
Risk-adj ROA	26,395	1.24	-6.65	4.63	1.32	11,426	1.32	-6.24	4.5	1.34	14,969	1.17	-6.65	4.63	1.31
Risk-adj ROE	26,395	1.25	-7.57	8.37	1.36	11,426	1.34	-6.66	8.37	1.39	14,969	1.18	-7.57	7.07	1.33
NPL ratio	18,540	5.86	0	264.04	9.44	7,261	3.57	0	246.27	6.11	11,279	7.33	0	264.04	10.81
Loan loss prov.	23,601	2.71	-9.59	10.7	2.5	8,991	3.57	-4.51	10.7	2.44	14,610	2.18	-9.59	10.15	2.39
Gov. ownership	29,405	5.54	0	100	19.67	14,047	1.06	0	100	8.53	15,358	9.07	0	100	24.62
D20	29,405	0.08	0	1	0.27	14,047	0.02	0	1	0.12	15,358	0.13	0	1	0.34
Wholly	29,405	0.03	0	1	0.16	14,047	0	0	1	0.06	15,358	0.04	0	1	0.2
Majority	29,405	0.03	0	1	0.16	14,047	0	0	1	0.07	15,358	0.05	0	1	0.21
Listed	29,405	0.26	0	1	0.44	14,047	0.19	0	1	0.39	15,358	0.32	0	1	0.47
Diversity	29,405	0.54	0	1	0.27	14,047	0.5	0	1	0.27	15,358	0.57	0	1	0.27
Audit quality	29,405	0.43	0	1	0.5	14,047	0.46	0	1	0.5	15,358	0.41	0	1	0.49
Capitalization	29,405	14.19	0	100	13.89	14,047	12.4	0.01	100	14.17	15,358	15.61	0	100	13.49
NIM	29,405	4.77	0	128.33	5.17	14,047	2.77	0	111.84	2.74	15,358	6.35	0	128.33	6.02
Management qual.	29,405	65.43	0	980	37.36	14,047	65.58	0	980	36.09	15,358	65.3	0.16	950	38.34
Liquidity	29,405	27.78	0	100	22.09	14,047	24.88	0	100	25.38	15,358	30.07	0	100	18.77
Too big to fail	29,405	0.16	0	1	0.37	14,047	0.07	0	1	0.26	15,358	0.22	0	1	0.42
Bank size	29,405	6.8	-4.02	14.94	2.31	14,047	7.67	0.19	14.94	2.25	15,358	6.1	-4.02	14.52	2.11
Systemic crisis	101	0.21	0	1	0.41	26	0.26	0	1	0.44	75	0.18	0	1	0.38
Concentration	101	0.19	0	1	0.17	26	0.21	0.05	1	0.18	75	0.18	0	1	0.15
Market share	101	5.89	0	100	13.66	26	2.65	0	100	9.25	75	8.42	0	100	15.85
Regulatory Quality	101	65.84	0.49	100	26.35	26	90.81	58.82	100	6.94	75	45.84	0.49	97.06	17.67
Eco. development	101	16.05	11.29	18.6	1.51	26	17.39	15.15	18.6	0.41	75	14.99	11.29	18.19	1.18
Financial Freedom	101	58.23	10	90	19.89	26	71.77	30	90	16.5	75	47.22	10	90	15.03
Monetary Freedom	101	77.32	0	95.4	11.41	26	84.65	62.3	94.3	4.21	75	71.35	0	95.4	11.92

Panel B: Country groups by income classification															
	Low income					Middle income					High income				
	Obs	Mean	Min	Max	Std.	Obs	Mean	Min	Max	Std.	Obs	Mean	Min	Max	Std.
Z-score (ln)	1,263	3.16	-4.28	6.19	1.22	12,874	3.37	-3.8	6.21	1.17	15,268	3.76	-4.11	6.21	1.23
Risk-adj NIM (ln)	1,233	2.13	-5.22	5.59	1.01	11,616	2.08	-5.04	7.11	1.03	13,546	2.55	-6.76	8.08	1.12
Risk-adj ROA (ln)	1,233	1.27	-6.65	4.63	1.37	11,616	1.13	-6.53	4.6	1.29	13,546	1.34	-6.24	4.5	1.34
Risk-adj ROE (ln)	1,233	1.25	-7.03	5.8	1.34	11,616	1.14	-7.57	7.07	1.33	13,546	1.36	-6.66	8.37	1.38
NPL ratio	1,812	10.49	0	117.02	12.49	8,927	6.72	0	264.04	10.45	7,792	3.78	0	246.27	6.28
Loan loss prov (ln).	2,309	1.43	-6.33	7.05	1.87	11,692	2.23	-9.59	10.15	2.44	9,550	3.61	-4.51	10.7	2.41
Gov. ownership	1,263	14.11	0	100	29.77	12,874	7.64	0	100	23.19	15,268	1.64	0	100	9.77
D20	1,263	0.21	0	1	0.41	12,874	0.1	0	1	0.31	15,268	0.03	0	1	0.16
Wholly	1,263	0.07	0	1	0.26	12,874	0.04	0	1	0.19	15,268	0	0	1	0.06
Majority	1,263	0.07	0	1	0.25	12,874	0.04	0	1	0.19	15,268	0.01	0	1	0.1
Listed	1,263	0.38	0	1	0.49	12,874	0.29	0	1	0.45	15,268	0.21	0	1	0.41
Diversity	1,263	0.64	0	1	0.25	12,874	0.55	0	1	0.27	15,268	0.5	0	1	0.27
Audit quality	1,263	0.39	0	1	0.49	12,874	0.39	0	1	0.49	15,268	0.47	0	1	0.5
Capitalization	1,263	11.71	0	90.35	8.35	12,874	16.36	0	100	14.35	15,268	12.66	0.01	100	14.09
NIM	1,263	6.47	0	114.25	5.31	12,874	6.48	0	128.33	6.26	15,268	2.79	0	111.84	2.72
Management qual.	1,263	57.97	4.39	716.67	30.25	12,874	68.23	0.16	950	39.89	15,268	64.36	0	980	36.01
Liquidity	1,263	32.07	0.08	91.28	18.45	12,874	29.92	0	100	18.94	15,268	24.81	0	100	24.98
Too big to fail	1,263	0.42	0	1	0.49	12,874	0.17	0	1	0.38	15,268	0.09	0	1	0.28
Bank size (ln)	1,263	5.53	-1.89	12.41	1.58	12,874	6.15	-4.02	14.52	2.17	15,268	7.68	0.19	14.94	2.23
Systemic crisis	9	0.05	0	1	0.21	56	0.21	0	1	0.41	36	0.25	0	1	0.43
Concentration	9	0.26	0	1	0.2	56	0.16	0	1	0.13	36	0.21	0.05	1	0.18
Market share	9	15.61	0	100	20.53	56	6.48	0	100	13.56	36	3.14	0	100	10.19
Regulatory Quality	9	32.05	0.49	76.96	13.28	56	47.78	1.47	97.06	16.7	36	89.76	6.7	100	8.5
Eco. development	9	13.05	11.29	14.1	0.51	56	15.31	13.15	16.53	0.74	36	17.38	16.08	18.6	0.39
Financial Freedom	9	39.69	10	70	14.05	56	48.68	10	90	15.12	36	70.82	30	90	16.66
Monetary Freedom	9	70.86	0	90.4	11.05	56	71.14	0	95.4	12.19	36	84.35	62.3	94.3	4.54

Table 5: Pairwise correlation matrix of the key dependent variables and regressor variables

1	*Z-score (ln)*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2	*Gov. ownership*	-0.12															
3	*Market power*	-0.09	0.21														
4	*Audit quality*	-0.04	-0.01	0.12													
5	*Listed*	-0.07	0.11	0.17	0.08												
6	*Diversity*	-0.04	0.03	0.14	0.08	0.08											
7	*Net interest margin*	-0.08	0.00	0.03	-0.05	0.00	0.00										
8	*Management quality*	-0.17	-0.02	-0.07	-0.05	-0.04	-0.01	-0.03									
9	*Liquidity*	-0.07	0.00	0.01	0.17	-0.13	0.10	0.00	0.05								
10	*Capitalization*	0.14	-0.05	-0.12	-0.06	-0.14	-0.09	0.24	0.08	0.19							
11	*Bank size*	-0.07	0.11	0.22	0.10	0.28	0.05	-0.14	-0.20	-0.26	-0.37						
12	*Systemic crisis*	0.03	-0.03	-0.10	-0.04	-0.04	-0.07	0.00	0.08	-0.01	0.02	0.06					
13	*System weight*	-0.15	0.15	0.50	0.15	0.15	0.17	0.04	-0.05	0.09	-0.04	-0.07	-0.15				
14	*Gov Spending*	-0.14	0.16	0.10	-0.17	0.06	-0.05	0.09	-0.02	-0.06	0.04	-0.03	-0.02	0.18			
15	*Financial Freedom*	0.16	-0.17	-0.09	0.10	-0.17	-0.08	-0.09	-0.01	-0.03	-0.04	0.08	0.06	-0.15	-0.28		
16	*Concentration*	0.10	0.04	0.32	0.15	-0.02	0.01	-0.02	0.00	0.15	0.05	-0.14	-0.09	0.24	-0.14	0.13	
17	*Regulation quality*	0.20	-0.27	-0.20	0.25	0.35	-0.14	0.14	0.02	-0.10	-0.09	-0.27	0.05	-0.38	-0.33	0.77	-0.31

Table 6: Pairwise correlation matrix of some country-level regressor variables

	Economic development	*High income*	*Low income*	*Low-middle income*	*Upper middle income*	*Corruption free*	*Property Rights*	*Financial Free*	*Investment Free*	*Gov. Spending*	*Monetary freedom*	*Fiscal Freedom*
Economic development												
High income	0.84											
Low income	-0.43	-0.20										
Low middle	-0.51	-0.35	-0.08									
Upper middle	-0.35	-0.71	-0.16	-0.28								
Corruption free	0.83	0.86	-0.23	-0.35	-0.56							
Property Rights	0.76	0.82	-0.20	-0.32	-0.55	0.89						
Financial free	0.57	0.58	-0.16	-0.26	-0.37	0.64	0.68					
Investment Freedom	0.52	0.57	-0.17	-0.23	-0.37	0.61	0.70	0.65				
Gov. Spending	-0.56	-0.64	0.22	0.29	0.38	-0.54	-0.46	-0.28	-0.33			
Monetary Freedom	0.47	0.52	-0.02	-0.10	-0.46	0.55	0.45	0.35	0.28	-0.20		
Fiscal Freedom	-0.41	-0.55	0.09	0.13	0.45	-0.50	-0.48	-0.24	-0.35	0.69	-0.23	
Trade Freedom	0.70	0.62	-0.21	-0.25	-0.39	0.62	0.54	0.49	0.47	-0.42	0.46	-0.30

Table 7: Government ownership, economic development, regulatory environment and bank stability

The dependent variable is logarithm of *z-score*. Higher value of *z-score* indicates more stable bank. The main independent variables of interest are government ownership, economic development, regulatory quality and their interaction terms. The estimation is based on system GMM estimator. Robust absolute *t* statistic values are presented in brackets. ***, **, * represent statistical significance at 1%, 5%, and 10% level, respectively.
Gov ownership is the share of equity held by government in a bank. *Listed* is a dummy variable on whether bank is listed in the stock exchange market. *Diversity* is the HHI index of different bank sources of income. *Audit quality* is a dummy variable on whether bank is audited by a reputable auditor. *Capitalization* is the ratio of bank equity over total assets. *Net interest margin* is the ratio of bank net interest income over total earning assets. *Management quality* is the cost to income ratio. *Liquidity* is the ratio of bank liquid assets over total bank assets. *Systemic crisis* is a dummy variable on whether a systemic crisis happened in a country at certain year. *Concentration* is the HHI index of bank assets in banking industry. *Market share* is the percentage of bank loan over total loan in banking system. *Regulation* quality is an index measuring the quality of regulation environment. *Monetary freedom* is an index used to measure the freedom in price and inflation controls by government. *Economic development* is the logarithm of GDP per capita in Mil US dollars.

	1	2	3	4	5
Gov. ownership	-0.0250***	-0.0157***	-0.0151***	-0.0108***	-0.0740***
	(11.56)	(7.03)	(15.33)	(10.61)	(9.62)
Listed	-0.7190***	-0.5488***	-0.0418	-0.3366***	-0.1684
	(12.30)	(9.35)	(0.53)	(4.55)	(1.92)
Diversity	0.0451	0.3294***	0.2251**	0.2767***	0.1280
	(0.75)	(5.27)	(3.12)	(4.31)	(1.62)
Audit quality	-0.0208***	-0.0157***	-0.0182***	-0.183***	0.3215***
	(-4.03)	(-3.36)	(-3.73)	(-3.70)	(8.30)
Capitalization	0.0211***	0.0274***	0.0228***	0.0231***	0.0258***
	(13.79)	(17.51)	(14.28)	(14.90)	(15.63)
Net interest margin	-0.0388***	-0.0195***	-0.0333***	-0.0209***	-0.0386***
	(13.26)	(6.17)	(10.27)	(6.02)	(11.92)
Management quality	-0.0089***	-0.0079***	-0.0073***	-0.0073***	-0.0073***
	(22.82)	(20.25)	(17.76)	(17.71)	(17.89)
Liquidity	-0.0097***	-0.0067***	-0.0117***	-0.0105***	-0.0121***
	(11.93)	(8.02)	(13.43)	(12.17)	(13.65)
Systemic crisis	-0.3395***	-0.2904***	-0.2530***	-0.3983***	-0.3935***
	(23.37)	(19.76)	(14.37)	(24.25)	(20.69)
Concentration	0.2466**	-0.3727***	0.4334***	0.1324	0.4671***
	(3.23)	(4.31)	(5.23)	(1.65)	(5.44)
Market share	-0.0025*	-0.0002	-0.0063***	0.0039**	-0.0040**
	(1.96)	(0.15)	(4.54)	(2.77)	(2.97)
*Govown*Regulation*	0.0003***	0.0001*			
	(6.12)	(2.32)			
Regulatory Quality		0.0085***			
		(14.47)			
Monetary Freedom			0.0073***		
			(7.63)		
Economic Development				0.2104***	
				(15.04)	
Govown Development*					0.0047***
					(9.09)
Constant	4.5706***	3.5728***	3.6055***	0.7530**	4.2049***
	(72.57)	(38.54)	(32.42)	(2.85)	(54.03)
No. observations	29,405	29,405	29,405	29,405	29,405
No. banks	3,317	3,317	3,317	3,317	3,317

Table 8: Z-score and different level of government ownership

The dependent variable is logarithm of *z-score*. Higher *z-score* implies more stability. The estimation is based on system GMM estimator. Robust absolute *t* statistic values are presented in brackets. ***, **, * represent statistical significance at 1%, 5%, and 10% level, respectively.
Government ownership is the percentage of equity held by government, valued from 0 to 100(%). *D20, Majority* and *Wholly* are dummy variables on whether the share of equity owned by government is more or equal to 20%, 50% and 98.1%, respectively.

	1	2	3	4
Gov. ownership	-0.0136***			
	(7.62)			
*Gov ownership*D20*		-0.0139***		
		(7.62)		
*Gov.ownership *Majority*			-0.0502***	
			(6.41)	
*Gov.ownership*Wholly*				-0.0220***
				(7.49)
Listed	0.0282*	0.0196	0.1256***	-0.0404**
	(1.99)	(1.40)	(4.97)	(2.72)
Diversity	0.0950***	0.0943***	0.0896***	0.0813***
	(4.32)	(4.28)	(3.57)	(3.60)
Capitalization	0.0059***	0.0059***	0.0055***	0.0058***
	(12.79)	(12.76)	(10.21)	(12.35)
Net interest margin	-0.0141***	-0.0141***	-0.0133***	-0.0147***
	(11.78)	(11.79)	(9.75)	(11.92)
Management quality	-0.0043***	-0.0043***	-0.0045***	-0.0042***
	(26.01)	(25.90)	(22.85)	(24.93)
Liquidity	-0.0012***	-0.0012***	-0.0008*	-0.0015***
	(4.30)	(4.39)	(2.34)	(5.10)
Audit quality	-0.0845***	-0.0864***	-0.0626***	-0.1038***
	(6.71)	(6.80)	(4.51)	(7.50)
Too big to fail	0.1085***	0.1081***	0.0874**	0.1124***
	(4.19)	(4.17)	(3.13)	(4.18)
L.Z-score (ln)	0.5885***	0.5880***	0.5879***	0.5856***
	(121.02)	(120.16)	(104.96)	(114.57)
Systemic crisis	-0.1934***	-0.1950***	-0.1893***	-0.1935***
	(12.75)	(12.78)	(11.01)	(12.44)
Concentration	0.0055	0.0047	-0.0482	0.0313
	(0.14)	(0.12)	(1.06)	(0.77)
Constant	1.8355***	1.8388***	1.8365***	1.8572***
	(56.16)	(55.81)	(48.68)	(53.24)
No. observations	29,405	29,405	29,405	29,405
No. banks	3,317	3,317	3,317	3,317

Table 9: Z-score and government ownership in different country groups

The independent variable is logarithm of *z-score*. The estimations are based on system GMM estimator. Column 1 and 2 presents the results for sub-sample of banks in developing and developed group. Column 3-5 presents those estimations for banks in high income, middle income and low income country group. Robust absolute *t* statistic values are presented in parentheses. ***, **, * indicates statistical significance at 1%, 5%, and 10% level, respectively.

	1 Developing	2 Developed	3 High income	4 Middle income	5 Low income
Gov. ownership	-0.0592***	0.0062***	0.0077***	-0.0492***	-0.0518***
	(10.81)	(10.63)	(22.17)	(14.26)	(85.11)
Bank size	0.0048	-0.0005	-0.0088***	0.0076	0.0350***
	(0.62)	(0.40)	(4.53)	(1.03)	(106.83)
Gov. Spending	0.0036***	0.0009***	0.0017***	0.0047***	-0.0021***
	(5.01)	(10.95)	(28.91)	(7.78)	(44.26)
Financial Freedom	0.0030***	-0.0027***	-0.0029***	0.0018**	0.0013***
	(5.65)	(33.98)	(57.02)	(2.83)	(20.01)
Concentration	-0.0673	-0.0223**	0.0755***	-0.3146*	-0.2956***
	(0.47)	(2.60)	(8.85)	(2.04)	(37.11)
Regulatory Quality	-0.0030***	0.0166***	0.0156***	-0.0004	-0.0022***
	(3.92)	(129.98)	(75.15)	(0.53)	(41.32)
Market share	0.0001	0.0062***	0.0041***	-0.0005	-0.0008***
	(0.10)	(37.28)	(34.68)	(0.36)	(14.82)
Audit quality	-0.0981*	0.2268***	0.0828***	0.0237	-0.2262***
	(2.05)	(22.14)	(9.02)	(0.51)	(46.34)
Listed	-0.0104	-0.0267***	0.0310***	-0.0086	-0.1046***
	(0.20)	(4.42)	(4.20)	(0.20)	(16.11)
Diversity	0.1968***	0.3223***	0.2669***	0.1896***	-0.0895***
	(5.84)	(94.09)	(93.95)	(5.51)	(42.03)
Net interest margin	-0.0115***	-0.0101***	-0.0121***	-0.0161***	-0.0272***
	(4.55)	(12.98)	(13.86)	(9.45)	(120.92)
Management quality	-0.0046***	-0.0050***	-0.0051***	-0.0050***	-0.0086***
	(12.45)	(198.06)	(106.17)	(15.46)	(243.46)
Liquidity	-0.0033***	-0.0054***	-0.0038***	-0.0036***	-0.0010***
	(5.11)	(169.42)	(60.32)	(6.03)	(17.74)
Capitalization	0.0261***	0.0294***	0.0294***	0.0244***	0.0280***
	(19.87)	(242.91)	(123.80)	(19.62)	(161.24)
L.Z-score (ln)	0.5794***	0.5704***	0.5750***	0.5826***	0.4453***
	(135.05)	(1052.66)	(838.83)	(91.71)	(588.79)
Systemic crisis	-0.2092***	-0.3274***	-0.3318***	-0.0961***	-0.7349***
	(7.35)	(291.49)	(91.87)	(4.20)	(101.51)
Constant	1.2250***	0.3520***	0.4694***	1.0961***	2.6237***
	(10.83)	(18.57)	(17.75)	(10.83)	(245.03)
No. observations	15,358	14,047	15,268	12,874	1,263
No. banks	1,878	1,439	1,555	1,620	142

Table 10: Predictors for government ownership

The dependent variable is government ownership, which is used as endogenous variable in *(EQ1)*. This table reports first step in the two-step regression on *z-score*. Robust absolute t statistic values are presents in brackets. ***, **, * represent statistical significance at 1%, 5%, and 10% level, respectively.
Economic development is an index, valued from 1 to 4 with high value indicates a more developed economy. *Election* is a dummy variable on whether there is any national election in a country. *Gov spending* is the percentage of government expenditure over total GDP.

Government ownership	1	2
Economic development	-3.4922***	-4.2835***
	(31.92)	(20.65)
Election	0.0933	-0.4623*
	(1.25)	(2.46)
English legal origin	1.4964***	-0.1699
	(11.65)	(0.66)
Gov. spending	-0.0424***	0.0055
	(-16.63)	(0.98)
Listed	-0.8318***	-0.6518*
	(7.34)	(2.39)
Diversity	-1.3234***	-2.2164***
	(8.58)	(5.66)
Net interest margin	-0.0754***	-0.2252***
	(4.52)	(6.26)
Management quality	0.0045***	0.0024
	(3.36)	(0.91)
Liquidity	-0.0023	-0.0025
	(1.37)	(0.54)
Capitalization	-0.0045	0.0287**
	(1.37)	(3.28)
Too big to fail	-0.2576	1.2089**
	(1.30)	(2.69)
Concentration	4.6002***	6.3480***
	(11.78)	(8.40)
Bank size	0.2516***	1.1325***
	(11.23)	(18.67)
Audit quality	-1.0753***	-2.3790***
	(11.99)	(10.94)
Market power	0.0368***	0.1249***
	(4.12)	(6.54)
Monetary Freedom	0.0260***	-0.0696***
	(4.69)	(4.84)
Systemic crisis	0.2072*	-1.2740***
	(2.54)	(5.89)
System weight	-8.6476***	-6.4472
	(4.39)	(1.50)
Govown x Development	0.27.92***	
	(45.27)	
Regulatory quality	-0.1510***	
	(22.40))	
L.gov ownership	-0.4232***	-1.3487***
	(9.71)	(12.51)
	(18.68)	(16.51)
No. observations	29,405	29,405
Adjusted R-square	0.8654	0.2026

Table 11: Alternative measures of bank stability

The dependent variables are *Risk-adjusted NIM* in column 1 and 2; *Risk-adjusted ROA* for column 3 and 4; *Risk-adjusted ROE* for column 5 and 6; non-performing loan ratio for column 7 and 8; and loan loss provisions for column 9 and 10. The estimation is based on system GMM regression. Robust absolute *t* statistic values are presented in parentheses. ***, **, * represent statistical significance at 1%, 5%, and 10% level, respectively.

	1	2	3	4	5	6	7	8	9	10
	Risk-adjusted NIM		*Risk-adjusted ROA*		*Risk-adjusted ROE*		*Non-performing loan ratio*		*Loan loss provisions(ln)*	
Gov. ownership	-0.0495***	-0.0172***	-0.0880***	-0.0111***	-0.0708***	-0.0100***	0.7198***	0.0941***	-0.1323***	-0.0103***
	(6.71)	(8.16)	(9.06)	(3.95)	(7.02)	(3.43)	(13.05)	(5.32)	(18.85)	(4.56)
Listed	0.3103***	0.2811***	0.0742	-0.6602***	-0.3319**	-0.9436***	2.6299***	6.4450***	1.6326***	2.6422***
	(3.74)	(5.08)	(0.71)	(9.29)	(3.14)	(13.01)	(4.48)	(16.58)	(21.19)	(44.00)
Diversity	-0.0865	-0.3388***	0.4307***	0.6037***	0.6515***	0.9352***	-3.0318***	-8.1593***	-0.7515***	-2.0914***
	(1.19)	(6.02)	(4.39)	(8.53)	(6.54)	(12.95)	(6.13)	(20.43)	(10.92)	(34.03)
Capitalization	0.0043**	-0.0062***	0.0048*	0.0030	-0.0304***	-0.0272***	0.1999***	0.1340***	-0.0059***	-0.0362***
	(2.70)	(4.25)	(2.31)	(1.57)	(14.19)	(14.01)	(14.33)	(10.23)	(3.59)	(20.97)
Net interest margin	-0.0129***	-0.0229***	-0.0281***	-0.0112**	-0.0247***	0.0026	0.0484	-0.0853***	-0.1106***	-0.1353***
	(4.28)	(8.36)	(6.39)	(2.86)	(5.52)	(0.67)	(1.88)	(3.78)	(36.78)	(41.95)
Management quality	-0.0081***	-0.0085***	-0.0149***	-0.0148***	-0.0137***	-0.0129***	0.0105**	0.0136***	-0.0071***	-0.0093***
	(20.35)	(22.10)	(24.64)	(27.36)	(22.49)	(23.52)	(3.02)	(4.11)	(18.62)	(21.47)
Liquidity	-0.0129***	-0.0147***	-0.0091***	-0.0069***	-0.0068***	-0.0027**	0.0842***	0.0352***	-0.0260***	-0.0351***
	(15.43)	(19.06)	(8.16)	(6.96)	(6.02)	(2.73)	(11.65)	(5.52)	(31.18)	(39.77)
Systemic crisis	-0.1039***	-0.1297***	-0.5854***	-0.5301***	-0.5807***	-0.5183***	1.1102***	0.3080**	0.7560***	0.4199***
	(5.84)	(9.45)	(23.59)	(28.54)	(22.99)	(27.34)	(7.44)	(2.66)	(40.06)	(25.09)
Concentration	-0.0856	0.1189	-0.0145	-0.3710***	0.0328	-0.4669***	1.5237	6.5169***	-1.6778***	-1.1899***
	(1.06)	(1.65)	(0.14)	(3.91)	(0.30)	(4.82)	(1.42)	(6.76)	(19.01)	(12.80)
*Govown*Development*	0.0030***		0.0056***		0.0044***		-0.0462***		0.0096***	
	(6.08)		(8.58)		(6.60)		(12.76)		(20.58)	
Market share	-0.0040**	-0.0070***	0.0010	0.0045**	-0.0023	0.0003	0.0869***	0.0221	0.0167***	0.0070***
	(3.15)	(5.81)	(0.61)	(2.81)	(1.35)	(0.19)	(6.83)	(1.83)	(12.80)	(4.80)
*Govown*Regulation*		0.0002***		0.0001		0.0001		0.0001		0.0003***
		(4.15)		(1.93)		(1.83)		(0.21)		(5.58)
Constant	3.2506***	3.6695***	2.3570***	2.3779***	2.6959***	2.4387***	0.1100	3.3859***	4.3684***	5.7883***
	(44.32)	(61.12)	(23.63)	(31.39)	(26.59)	(31.67)	(0.20)	(7.63)	(62.31)	(87.32)
No. observations	29,405	29,405	29,405	29,405	29,405	29,405	18,109	18,109	23,019	23,019

Table 12: Robustness test with different estimations

The dependent variable is logarithm of *z-score*. The estimation in column 1, 2, 3, 4, 5 is based on system GMM, 2SLS, pooled OLS, Fixed effect and Random effect estimation, respectively. Robust absolute *t* statistic values are presented in parentheses. ***, **, * indicates statistical significance at 1%, 5%, and 10% level.

	1 GMM	2 Two SLS	3 Pooled OLS	4 Fixed	5 Random
Gov. ownership	-0.0740***	-0.0850***	-0.0266***	-0.0152*	-0.0213***
	(9.62)	(7.47)	(7.02)	(2.00)	(3.80)
Listed	-0.1684	-0.0117	-0.0619***	-0.0970	-0.0633*
	(1.92)	(0.88)	(3.81)	(1.24)	(2.16)
Diversity	0.1280	0.0905***	0.0373	0.0925**	0.0683*
	(1.62)	(4.18)	(1.42)	(2.71)	(2.29)
Capitalization	0.0258***	0.0062***	0.0107***	0.0252***	0.0171***
	(15.63)	(13.10)	(18.92)	(25.23)	(23.42)
Net interest margin	-0.0386***	-0.0131***	-0.0339***	-0.0047*	-0.0181***
	(11.92)	(10.94)	(23.69)	(2.26)	(10.51)
Management quality	-0.0073***	-0.0043***	-0.0078***	-0.0057***	-0.0063***
	(17.89)	(25.72)	(41.41)	(29.16)	(34.15)
Liquidity	-0.0121***	-0.0013***	-0.0056***	-0.0051***	-0.0053***
	(13.65)	(4.64)	(16.70)	(9.19)	(12.22)
Systemic crisis	-0.3935***	-0.1761***	-0.1659***	-0.4533***	-0.3537***
	(20.69)	(12.24)	(9.54)	(25.83)	(21.67)
Concentration	0.4671***	0.0866*	0.1487**	-0.6720***	-0.3165***
	(5.44)	(2.09)	(3.04)	(8.24)	(4.91)
*Govown*Income*	0.0047***	0.0057***	0.0016***	0.0008	0.0012**
	(9.09)	(7.42)	(6.12)	(1.61)	(3.19)
Market share	-0.0040**	-0.0007	-0.0036***	0.0017	-0.0014
	(2.97)	(1.36)	(5.83)	(1.31)	(1.55)
Audit quality		-0.0910***	-0.1456***		-0.1226***
		(7.26)	(10.00)		(4.53)
Constant	4.2049***	1.7611***	4.3299***	3.9428***	4.1216***
	(54.03)	(60.66)	(171.10)	(96.88)	(122.01)
No. observations	29,405	29,405	29,405	29,405	29,405
No. banks	3,317	3,317	3,317	3,317	3,317