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Bank Capital Regulations around the World: What Explains the Differences?*

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Abstract

Despite the extensive attention that the Basel capital adequacy standards have received internationally, significant variation exists in the implementation of these standards across countries. Furthermore, a significant number of countries increase or decrease the stringency of capital regulations over time. The paper investigates the empirical determinants of the variation in the data based on the theories of bank capital regulation. The results show that countries with high average returns to investment and a high ratio of government ownership of banks choose less stringent capital regulation standards. Capital regulations may also be less stringent in countries with more concentrated banking sectors.

JEL Classification Codes: G21, G28, F33

Keywords: Capital requirements, Basel capital accord, financial regulation, international policy coordination

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1 Introduction

The first Basel capital adequacy standard signed by Group of Ten, or G-10, countries in 1988 focused on creating a level playing field for internationally active banks and improving their stability. Somewhat unexpectedly, Basel bank capital adequacy standards received extensive attention from all around the world, and over 100 countries voluntarily adopted Basel I (Pattison, 2006). Basel I was updated in 2004 (popularly known as Basel II) with more sophisticated rules and principles, and again in 2010 with enhanced capital, liquidity, and leverage requirements following the global financial crisis (Basel III). A survey done by the Bank for International Settlements (BIS) in 2015 shows that all 27 Basel Committee on Banking Supervision (BCBS) member countries had implemented enhanced risk-based capital regulations by the end of 2013.¹ A separate survey by the Financial Stability Institute (FSI) shows that 95 out of 117 non-Basel Committee member jurisdictions that are monitored have adopted or are in the process of adopting Basel III as of mid-2015.² These interests suggest that Basel principles have become a model for capital regulation by national banking systems in both developed and developing countries.

The adoption of Basel principles by the majority of countries around the globe is an important fact; however, what is more important is how countries are actually implementing those principles in practice. The Basel principles for bank regulation are rich and complex in nature, which gives countries a substantial amount of leeway in their implementation (Concetta Chiuri et al., 2002). A country may announce the adoption of an 8 percent minimum capital ratio (the percentage of a bank's capital compared with its risk-weighted assets) that is required by Basel rules. However, the effective capital adequacy ratio will be determined by how the regulator of this country allows domestic banks to choose the numerator (equity capital) and the denominator (risk-weighted assets) of this ratio. For example, a regulator can loosely define the items that banks can include in their equity capital, or the risk weights in the denominator may not reflect a bank's market or credit risk, contrary to the Basel recommendations. The freedom in the implementation of Basel principles is expected to be larger, especially for the non-BCBS countries. Nevertheless, the data show a significant variation even among the BCBS member countries.

Fortunately, a carefully executed survey series by the World Bank allows us to compare the actual implementation of Basel bank capital regulations across over 100 countries. These surveys, conducted four times between 1999 and 2011, reveal that the stringency of bank capital regulations not only differs by significant amounts across countries (see figure 1), but also varies over time for a given country (see figure 2). The aim of this paper is to investigate the empirical determinants of this variation based on theories of capital regulation and previous empirical studies. I develop testable hypotheses from the literature to investigate the effects of the structure of the banking

¹Basel Committee on Banking Supervision, Implementation of Basel standards, November 2015, available at www.bis.org/bcbs/publ/d345.htm.

²FSI Survey – Basel II, 2.5 and III Implementation, July 2015, available at www.bis.org/fsi/fsiop2015.htm.

system and the economic, political and institutional characteristics of countries on the stringency of bank capital regulations.

Theoretical motivations for bank capital regulations are mainly focused on the role of capital in the creation of incentives for bank owners to take socially efficient levels of risk. Moral hazard and agency problems often cause bank owners and managers to take excessive risks. Incorrectly priced deposit insurance, created to prevent bank runs in the first place, and limited liability are widely blamed for distorting the risk behavior of bank owners (Kroszner, 1998; Allen and Gale, 2003). Deposit insurance and limited liability provide a safety net for bank owners by which they reap the benefits of excessive risk taking in “good times” but do not bear the full costs in “bad times”. Regulators expect bank owners to behave more prudently and responsibly if they have “skin in the game”, which happens when bank owners invest their own capital in the bank. Another justification for capital regulations is the existence of welfare-relevant pecuniary externalities (Allen and Gale, 2003; Lorenzoni, 2008; Korinek, 2011; Kara and Ozsoy, 2016). These studies show that in competitive markets, atomistic banks fail to internalize the effects of their portfolio choices, such as the sizes of their risky assets and liquidity buffers, on the fire sale price of assets during times of distress and, as a result, they take socially excessive amounts of risk. Hence, capital regulations can be used to implement a socially efficient level of risk-taking in the banking system.

In a recent study, Kara (2016) justifies capital regulations under the existence of fire sale externalities and shows that a country with higher returns on investment chooses a lower minimum regulatory capital ratio than a low-return country. In his model, less stringent capital regulations allow banks to invest more in risky assets and hence take a larger exposure to fire sale risk. Higher average returns on investment reduce both the social and private marginal cost of the fire sale risk and, as a result, regulators relax capital requirements. I test this hypothesis and show that a negative relationship exists between returns on investment and the stringency of bank capital regulations.

Dell’Ariccia and Marquez (2006) use limited liability and the existence of deposit insurance to justify capital regulations and show that regulators who are more concerned about the profits of the banking sector than about financial stability choose less stringent capital regulations. They consider a two-country model with a single bank in each country. Regulators of the two countries compete by setting the minimum capital ratios. Regulators choose capital ratios to maximize expected domestic social welfare, which is a weighted average of bank profits and a measure of financial stability. Regulators can differ in terms of the weight that they attach to bank profits in their objective functions. This weight reflects the degree to which regulators are captured by the financial institutions under their control. The authors show that the country with a higher regulatory capture chooses a less stringent capital requirement. The results in this paper confirm this hypothesis.

Additionally, I test whether the stringency of capital regulations is significantly related to

the competitiveness of the banking sector. Because one main theoretical justification for capital requirements is to limit excessive risk-taking by banks, one would expect regulators to respond to measures that affect how much risk banks are willing to take.³ The competitiveness of the banking sector has been considered one of the main determinants of the risk-taking incentives of banks (Allen and Gale, 2004).

There are two contradictory views on the relationship between concentration and financial stability. The conventional view, which is also called the “concentration-stability” hypothesis by Berger et al. (2004), posits that more concentrated financial sectors with a few large banks are more stable. On the opposite side, the “concentration-fragility” view asserts that there is a negative relationship between concentration and financial stability: An increase in concentration reduces the stability of the banking sector. If regulators respond to higher concentration by tightening capital regulations they must be perceiving higher risks in the sector as a result of higher concentration. Therefore, in the regressions, a positive relationship between the stringency of bank capital regulations and concentration ratio will support the concentration-fragility hypothesis, and a negative relationship between the two will support the concentration-stability hypothesis. In this paper, I obtain some evidence for a negative relationship between concentration ratio and the stringency of bank capital regulations; hence, my results favor the concentration-stability hypothesis.

Furthermore, the theory points out that the experience of a recent financial crisis is a driving force for more stringent capital regulations. Aizenman (2009) considers a dynamic model in which agents are subject to idiosyncratic uncertainty regarding their exposure to financial crisis incidence. The agents, at each point in time, update their perceived probability of a financial crisis in the next period in a Bayesian manner. Aizenman shows that a longer spell of “good times,” a run with no financial crises, reduces the perceived mean of a crisis in the next period, which in turn reduces the regulation intensity. In addition to the channel suggested by Aizenman, the incidence of financial crisis generates social and political capital for bank regulators to enact more stringent prudential reforms. The recent global financial crisis provides a good real-world example, as it paved the way for stronger bank regulations all around the world, such as the introduction of Basel III rules in 2010 and, in the United States, the implementation of enhanced financial regulations under the 2010 Dodd-Frank Wall Street Reform and Consumer Protection Act. Therefore, I also test whether there is a negative relationship between the time since the most recent systemic banking crisis a country has experienced and the intensity of bank capital regulations. However, I do not find any evidence to support this hypothesis.

In the regressions, I also control for the depth, size and efficiency of financial markets, but I do not find statistically significant effects of these variables on the stringency of capital regulations. I find some evidence that capital regulations are less stringent in countries where the deposit insurer has more power. Additionally, I control for the political structure and institutional quality

³Both theoretical and empirical literature produce mixed predictions on the effectiveness of capital regulations in limiting the risk-taking behavior of banks. See VanHoose (2007) for an extensive survey of this literature.

of countries and find that countries with competitive and democratic political systems choose more stringent capital regulations. However, I do not find any statistically significant effect of the independence of the legal system and the quality of institutions that protect property rights on the stringency of capital regulations.

The paper proceeds as follows. Section 2 provides a brief review of the related literature. Section 3 describes the data and provides descriptive statistics for the dependent and independent variables. Section 4 explains the econometric methodology and presents the results for the benchmark model. Section 5 contains the robustness checks, including the estimation of a dynamic model. Section 6 concludes. The appendix contains the figures and tables.

2 Literature review

This paper is part of the broader literature that investigates the determinants of bank regulations in general. To the best of my knowledge, this paper is the first to investigate the empirical determinants of cross-country and over-time variation in the stringency of bank capital regulations in particular. [Barth et al. \(2006\)](#) assess whether cross-country differences in political institutions explain national choices of supervisory and regulatory policies. They use cross-sectional data from the 1999 World Bank survey of bank regulations (one of the four surveys that is used in this study) and show that the organization and operation of political systems shape bank supervisory and regulatory practices.

This study is different from [Barth et al. \(2006\)](#) in several ways. First, the aim of this study is to explain the cross-country and over-time variation in the stringency of capital regulations in particular, whereas [Barth et al. \(2006\)](#) focus on the cross-country variation in broader bank supervisory and regulatory practices, such as bank activity restrictions, the strength of private monitoring, and the power of banking supervisors. Second, the focus of this study is to explain the variation seen in the data based on the economic and financial structure of countries, while [Barth et al. \(2006\)](#) are mainly interested in investigating the institutional and political determinants of bank regulations. In this study, I explicitly or implicitly control for such political and institutional characteristics of countries. Third, unlike [Barth et al. \(2006\)](#), I employ a panel data set that allows me to explain not only the cross-country differences in capital regulations but also the change that occurs over time in these regulations.

A separate literature examines the variation in actual bank capital ratios but not the overall stringency of bank capital regulations. An important part of this literature discusses whether capital ratios in practice are pro-cyclical or counter-cyclical. Some studies focus on bank data from a single country, while others use bank data from several countries. Notable studies in this literature include [Bikker and Metzmakers \(2004\)](#), [Ayuso et al. \(2004\)](#), and [Andersen \(2011\)](#).

In a related study, [Brewer et al. \(2008\)](#) investigate the cross-country differences in the actual bank capital ratios of internationally active banks in 12 developed nations. Their explanatory

variables include bank-specific factors such as bank size, country-specific macroeconomic factors such as real GDP growth rate, country-specific public and regulatory policy factors, and control variables such as differences in accounting standards. This study differs from [Brewer et al. \(2008\)](#) mainly in its interest in explaining the regulatory choices of bank capital regulations, not the actual capital ratios of individual banks. Furthermore, their study includes only 12 developed countries, whereas I investigate the determinants of capital regulations using a sample of 21 developed and 45 developing economies.

3 Data and descriptive statistics

This study employs an unbalanced panel data set. The measure used for the stringency of bank capital regulations is the “Overall Capital Stringency” index created by James R. Barth, Gerard Caprio, and Ross Levine, which is based on extensive World Bank surveys on bank regulations initiated by these authors in the late 1990s. These surveys were conducted four times and represent the situation of bank regulations around the world at the ends of 1999, 2002, 2006, and 2011.⁴ The last survey includes around 300 questions, and 180 countries responded to at least one of the four surveys.

This study restricts attention to a smaller set of countries. My sample consists of 66 major countries that are also included in a recent study by [Gourinchas and Obstfeld \(2012\)](#). This smaller sample does not include low-income countries or very small countries, some of which are known as offshore financial centers, such as the British Virgin Islands or Mauritius. Using the classification in [Gourinchas and Obstfeld \(2012\)](#), there are 21 advanced and 45 emerging countries in our sample. Table 4 lists the names of the countries in each group according to the income categories defined by the World Bank (high income, upper-middle income, and middle income). All 21 advanced economies are in the high per capita income group. Of the 45 developing countries, 11 are in the high-income group, 25 are in the upper-middle-income group, and 9 are in the middle-income group.

World Bank regulation surveys were carefully executed. Surveys were sent to senior officers in the main regulatory agency of each country, and whenever there were conflicting or confusing answers to questions, the authors double-checked the information by both contacting regulators in the corresponding country and referring to other sources, including the information collected by the U.S. Office of the Comptroller of the Currency (OCC) and the Institute of International Bankers ([Barth et al., 2004](#)).

[Barth et al. \(2004\)](#) define the “Overall Capital Stringency” index as a measure of *“whether the capital requirement reflects certain risk elements and deducts certain market value losses from capital before minimum capital adequacy is determined”*. The index was originally based on the

⁴I use the recently compiled panel data from responses to all four surveys by the same authors. See [Barth et al. \(2013\)](#) for an extensive discussion of this panel data set.

responses to seven questions in the Capital Regulatory Variable section of the surveys. In this study, I create the index using six of the seven questions, which are given in table 1.⁵ A value of 1 is assigned to each “yes” answer, and a value of 0 is assigned to each “no” answer. The index therefore takes values between 0 and 6, and higher values of the index correspond to greater stringency of bank capital regulations.

The six questions used in the creation of the index are derived from Basel bank capital adequacy principles. The Basel capital adequacy ratio is equal to the equity capital divided by risk-weighted assets. The questions in Table 1 can be considered in two broad groups. The first group of questions (3.1.1, 3.2, and 3.3) measure a country’s compliance with Basel risk guidelines, and the second group concern the calculation of capital. In other words, the first group of questions concern the determination of the weights in the denominator of the capital ratio, whereas the second group deal with the determination of capital in the numerator of this ratio. Therefore, this index gives us a measure of the stringency of bank capital regulations that is comparable across countries and over time.

Table 1: Capital stringency index questions

3.1.1 Is the minimum capital ratio risk weighted in line with the Basel guidelines? Yes/No
3.2 Does the minimum ratio vary as a function of an individual bank’s credit risk? Yes/No
3.3 Does the minimum ratio vary as a function of market risk? Yes/No
3.9 Before minimum capital adequacy is determined, which of the following are deducted from the book value of capital?
3.9.1 Market value of loan losses not realized in accounting books? Yes/No
3.9.2 Unrealized losses in securities portfolios? Yes/No
3.9.3 Unrealized foreign exchange losses? Yes/No

Figure 1 shows the distribution of overall capital stringency indexes for each survey. The figure reveals that there is a significant variation in the stringency of bank capital regulations across countries for each of the four survey years. The mean of the index for each survey year is 3.4, 3.60, 3.39, and 5.11, respectively, with standard deviations of 1.66, 1.56, 1.75 and 1.40. The percentage of countries with an index value that is below the mean is 50 percent in 1999, 42 percent in 2002, 57 percent in 2006, and 28 percent in 2011. The average capital stringency index rises by a significant amount after the global financial crisis, and its standard deviation shrinks; however, the cross-country variation does not disappear. Figure 1 shows that after the global financial crisis, the distribution becomes significantly skewed to the right, indicating that there is an overall increase in the stringency of capital regulations around the world.

⁵I exclude the following question from the calculation of the index: “What fraction of revaluation gains is allowed as part of capital?”. First, answers to this question are not as objective as the answers to the other six questions, and hence, quantification of those answers poses a serious challenge. Second, including this question severely reduces the data availability.

Figure 2 shows that there is also a significant variation in the stringency of bank capital regulations over time. Each panel shows the distribution of the change in the capital stringency index for individual countries compared with the previous survey (that is, the distribution of $capital\ stringency_{it} - capital\ stringency_{i,t-1}$). Strikingly, the direction of the change in capital regulations is not positive for all countries over time. Among 47 countries in the sample that responded to both 2002 and 1999 surveys, 7 countries (15 percent) reduced the stringency of capital regulations compared with the previous survey, whereas 26 countries (55 percent) kept the regulation level the same, and 14 countries (30 percent) strengthened their regulations. A larger percentage of countries relaxed their regulatory standards between 2002 and 2006: Among 49 countries in the sample that responded to both 2002 and 2006 surveys, 15 countries (30 percent) relaxed the stringency of capital regulations compared with the previous survey, whereas 16 countries (33 percent) kept the regulation level the same and 18 countries (37 percent) strengthened their regulations. The distribution changes significantly after the recent financial crisis and becomes right-skewed. Among 51 countries in the sample that responded to the last two surveys, only 6 of them (11 percent) reduced the stringency of capital regulations; 12 countries (25 percent) kept the regulation at the same level, and 33 countries (64 percent) increased the stringency of bank capital regulations.

Which components drive the changes in the capital stringency index from one survey year to another? Looking at the changes in the components of the aggregate index, presented in figure 3, reveals that there is almost no variation in the number of countries that follow the Basel guidelines for capital ratio risk weights from one survey to another: Almost all countries in our sample claim that they follow these guidelines in all four surveys. Hence, the variations in the aggregate index over time are determined by the remaining five components. In 2002, an overwhelming majority (70 to 80 percent) of the countries kept individual components unchanged relative to the 1999 survey. Furthermore, the number of countries that relaxed each component was roughly equal to the number of countries that tightened it. The only exception was the component on the deduction of unrealized losses in security portfolios from the book value of capital (question 3.9.2 in table 1). About 20 percent of countries enacted this component, whereas only 9 percent stopped implementing it.

In 2006, the percentages of countries that kept individual components unchanged remained high despite decreasing somewhat compared with the previous survey. Additionally, more countries implemented components related to credit risk and market risk than disregarded such rules, whereas the opposite was true for components related to the determination of equity capital (questions 3.9.1, 3.9.2, and 3.9.3 in table 1). Apparently, the overall tendency toward relaxing the capital regulation stringency in 2006 was driven mainly by changes in these components.

Finally, in 2011, the general increase in the stringency of capital regulations were mainly driven by the components related to incorporating credit risk and market risk into capital risk weights. In particular, no countries disregarded implementing these two components. In fact, a larger number of countries enacted these rules than kept their current rulings. Meanwhile, a significant number

of countries (15 to 20 percent) abandoned deducting unrealized losses in loan values, security portfolios, and foreign exchange holdings. Nevertheless, the numbers of countries that started to implement these components were larger (22 to 41 percent), and even more countries kept these components unchanged compared with the previous survey (47 to 61 percent).

3.1 Discussion of variables

In this section, I introduce the explanatory variables to test the hypothesis developed in the introduction based on the theories of bank capital regulations. Table 2 provides the variable definitions along with data sources, and table 3 provides summary statistics for the dependent and independent variables.

To test the relationship between returns on investment and the intensity of bank capital regulations, stock market returns or real GDP growth rate can be used as a proxy for the average returns on investment. I choose the latter for several reasons. First, GDP growth rate is a good proxy for average returns on various types of investments in an economy and is the most important economic benchmark that policymakers base decisions upon. Second, there are many undercapitalized developing countries in our sample, and GDP growth rate is more representative of overall average returns than stock market gains for this group. Lastly, GDP growth rate data are more easily available for a large number of countries and much less volatile than stock market returns.⁶ I obtain the expected GDP growth rate from the Consensus Economic Forecast database. Expected GDP growth is the average of the surveyed forecasters' next-year GDP growth expectations for each country as of November or December of the survey year, based on data availability.

Even if two countries have the same asset returns, differences in the risk profile of these returns could potentially lead to a divergence in regulatory choices. To control for the risk profile of a country, I employ the Political Risk Services (PRS) country economic risk indicator.⁷ This is a monthly indicator that ranges from a high of 50 (least risk) to a low of 0 (highest risk), though in practice the lowest ratings are generally near 15.⁸ Table 3 shows that within the sample, the index varies between 24 and 47.5. In addition, I use the standard deviation of a 10-year rolling window of the standard deviation of real GDP growth rate as a measure of the economic risk of a country and obtain qualitatively similar results.⁹

I use the *government-owned banks* variable to test the relationship between regulatory capture and the stringency of capital regulations. Government-owned banks is the percentage of a banking system's assets in banks that are 50 percent or more owned by the government. These data are also obtained from the World Bank regulation surveys. Table 3 shows that the ratio of government

⁶I performed a robustness check using available stock market return data, and the qualitative results did not change.

⁷"Country Data Online." The PRS Group. <http://epub.prsgroup.com/the-countrydata-gateway>.

⁸I use the five-year average of the index to focus on medium to long-term economic risks for each country.

⁹These results are not presented here but available upon request from the author.

ownership of banks takes values between 0 and 80 percent in our sample, with mean 17 percent and standard deviation 20. This ratio varies significantly across countries but it fluctuates less over time for a given country. Advanced countries had very low or no government ownership in the banking sector before the recent crisis.¹⁰ The last survey reveals that this ratio is increasing for some advanced economies (Austria, Switzerland, United Kingdom, Ireland and the Netherlands) in the aftermath of the global recession in large part because of nationalizations and crisis-related capital injections.

I use the fraction of government-owned banks as a proxy for regulatory capture. If a country has a high ratio of government-owned banks, then one would expect the regulator of that country to be more concerned about banking-sector profits as opposed to financial stability and hence to choose less stringent regulations, as suggested by [Dell’Ariccia and Marquez \(2006\)](#). Therefore, I test whether there is a negative relationship between the stringency of capital regulations and government-owned banks.

In a similar vein, I also control for the involvement of the government in the overall economy of a country, as a government’s involvement in the economy may influence its preferences toward bank regulation. This variable is taken from the Economic Freedom of the World database and is the average of four variables that measure different aspects of a government’s involvement in the economy. The summary “government size” index takes values between 0 and 10, and higher values indicate a larger government role. The components of the index are government consumption as a percentage of total consumption; general government transfers and subsidies as a percentage of GDP; an index on the number, composition, and share of output supplied by state-operated enterprises and government investment as a share of total investment; and an index of the top marginal tax rate.¹¹ Government size is correlated with the variables that measure political and institutional characteristics of countries and hence can be considered a control variable in that regard, as well. In fact, in section 5.3, I replace the government size variable with specific variables that control for the political structure or institutional quality, and the results do not change.

To test the relationship between bank capital regulations and the competitiveness of the banking sector, I use the three-bank concentration ratio. This variable is obtained from the Financial Development and Structure Database ([Beck et al., 2009](#); [Čihák et al., 2012](#)). The variable is the ratio of the assets of a country’s three largest banks to the assets of all commercial banks in that country. The authors calculate this ratio from Bureau van Dijk’s BankScope database.¹² Table 3 shows that the concentration ratio varies between 15.28 and 100 percent, with mean 57 percent and standard deviation 19.¹³ The intensity of competition in the banking sector, which is usually

¹⁰Germany, Portugal, Greece, and Switzerland are exceptions in that regard with 40 percent, 25 percent, 23 percent, and 11.5 percent government-owned bank ratios, respectively, according to the last figures before the crisis.

¹¹I use the three-year averages of this variable to smooth out potential short-term volatility government expenditures.

¹²Bankscope. Bureau van Dijk. <https://bankscope.bvdinfo.com/>

¹³Similarly to the government size variable, I use the three-year averages of this variable as well to smooth out

measured by the inverse of the concentration ratio, has always been considered one of the major determinants of bank risk-taking.

The conventional concentration-stability predicts that large banks in concentrated markets are more efficient and better diversified, and that they have larger charter values at stake. Therefore, they are less inclined to take excessive risks. Furthermore, it is easier for regulators and market participants to monitor the health of a few large banks than many small banks. In short, the conventional view asserts that there is a negative correlation between competition and financial stability. [Keeley \(1990\)](#), [Allen and Gale \(2000\)](#), [Hellmann et al. \(2000\)](#), [Acharya \(2001\)](#), and [Repullo \(2004\)](#) provide theoretical support for this view. This argument is also supported by the empirical evidence provided in [Rhoades and Rutz \(1982\)](#) (using a sample of 6,500 unit banks in the United States between 1969 and 1978); [Keeley \(1990\)](#); [Dick \(2006\)](#); and [Beck et al. \(2006\)](#) (using data on 69 countries from 1980 to 1997). The latter study shows that crises are less likely in more concentrated banking systems even after controlling for differences in commercial bank regulatory policies, national institutions affecting competition, macroeconomic conditions, and shocks to the economy.

The conventional framework also creates a justification for bank regulation because the only way to remove the tradeoff between competition and financial stability would be a government intervention into the financial sector. Regulation of bank capital has been one of the most common instruments used by regulators around the world to ensure the existence of competition and financial stability at the same time ([Allen and Gale, 2003](#)).

[Acharya \(2001\)](#) establishes a direct theoretical connection between optimal capital regulations and the intensity of competition in the deposit market. He considers both single and multi-country models and shows that as the competition in the deposit market becomes more stringent, banks take on more risk. He measures competition by the number of banks in the deposit market, where more banks corresponds to a more competitive banking sector.¹⁴ Therefore, it may be optimal for the regulator to tighten the stringency of capital regulations as a response to increasing competition in the deposit market.

On the opposite side, the concentration-fragility view asserts that there is a negative relationship between concentration and financial stability: An increase in concentration reduces the stability of the banking sector. In other words, this view predicts that more competitive banking sectors are more stable. [Boyd and De Nicolo \(2005\)](#) show that the tradeoff between competition and financial stability supposed by the conventional view depends crucially on the assumption that banks' optimal asset allocations are determined by solving a portfolio problem that takes asset prices and return distributions as given. They show that when the same number of banks are allowed to compete in the loan market as well as the deposit market, and if banks are facing moral

potential short-term volatility in bank concentration mainly due to mergers and acquisitions.

¹⁴Number of banks is used, in a similar way to the concentration ratio, as a proxy for competitiveness by some other studies as well such as [Boyd and De Nicolo \(2005\)](#).

hazard from borrowers in the loan market, then the banking sector becomes less risky as it gets more competitive. They measure competitiveness by the number of banks. Proponents of this view also argue that the existence of a few large banks generates an implicit “too-big-to-fail” guarantee and creates incentives for banks to take excessive risks. [Jayaratne and Strahan \(1998\)](#), using U.S. bank data from between 1975 and 1992; [De Nicoló \(2000\)](#); [De Nicoló et al. \(2004\)](#); [Boyd et al. \(2006\)](#); [De Nicolò and Loukoianova \(2007\)](#); and [Schaeck et al. \(2009\)](#) provide empirical support for the concentration-fragility view.

In addition to studies that take a particular view in this discussion, some studies argue that the relationship between competition and financial stability is too complex to take a particular position. [Allen and Gale \(2004\)](#) consider a series of models and show that different models provide different predictions. The models considered include general equilibrium models of financial intermediaries and markets, agency models, and models of spatial competition, Schumpeterian competition, and contagion. Their analysis suggests that general equilibrium and Schumpeterian competition models require the coexistence of competition and financial stability for efficiency, as opposed to the tradeoff between those two that is conventionally supposed.

To summarize, the theoretical and empirical evidence with respect to the relationship between concentration ratio and the riskiness of the banking sector is mixed: A higher concentration ratio may increase or decrease banks’ incentive to take excessive risks. A priori, my study does not take a particular side on this theoretical and empirical divide. If regulators respond to higher concentration in the banking sector by relaxing capital regulations, they must be perceiving lower risks in the sector as a result of higher concentration. Hence, a negative relationship between the stringency of bank capital regulations and concentration ratio in our regressions will support the conventional concentration-stability hypothesis. Similarly, a positive relationship between the stringency of bank capital regulations and concentration ratio will support the concentration-fragility hypothesis.

Additionally, I test the relationship between the experience of a recent financial crisis and the intensity of bank capital regulations. [Aizenman \(2009\)](#) shows that tranquil time, when a crisis does not take place, reduces the bank regulation intensity. His results suggest a negative relationship between the number of years since the last financial crisis and the stringency of bank regulations. To test this relationship, I calculate the number of years since the last systemic banking crisis for each country at each survey year using the Systemic Banking Crisis Financial Crisis Database of [Laeven and Valencia \(2012\)](#). This variable is called the *crisis history*. For example, the United States had two systemic banking crises in 1988 and 2007. Therefore, for the United States, the crisis history variable takes a value of 11 in 1999, 14 in 2002, 18 in 2006, and 4 in 2011 (because the most recent crisis in 2011 was the Great Recession, which started in 2007).¹⁵

¹⁵For countries that have no systemic banking crisis shown in the database, I choose 1900 as an arbitrarily distant crisis date. Results of the paper are robust to choosing more or less distant arbitrary crisis dates for these countries.

3.2 Relationships between the variables

Table 5 presents the pairwise correlation coefficients between the dependent variable and the explanatory variables in the benchmark model: return on investment, government-owned banks, concentration ratio, economic risk, government size and the last crisis. Table 5 shows that the capital stringency index has a significant mild negative correlation with the average asset returns and with government-owned banks, although the significance of the latter relationship is much smaller. The index has a positive correlation with the remaining explanatory variables, while this correlation is only significant with economic risk and government size. Table 5 also shows that some of the independent variables are correlated with each other; however, these correlation coefficients are not large.

Figure 4 shows the mean of the capital stringency index for advanced and emerging countries separately for each survey. In all surveys, the average capital stringency index for the advanced economies is larger than the average for the emerging economies. The difference is larger in the 1999 and 2006 surveys. Following the world business cycle downturns in the early 2000s and late 2000s, the gap between advanced and emerging country capital regulations shrinks. A t -test for the null hypothesis that the difference of the means for the advanced and emerging country groups is equal to zero against the alternative hypothesis that the difference is greater than zero is rejected for the 1999 and 2006 surveys, but it could not be rejected at the 90 percent confidence level for the 2002 and 2011 surveys. The mean of the index for the pooled sample is 4.3 and 3.7 for the advanced and emerging countries, respectively, and the difference is significantly greater than zero even at the 99 percent confidence level. I also perform the Wilcoxon rank test for the equality of the medians for these two groups of countries for the pooled sample. The test significantly rejects the equality of medians with a p -value of about 4 percent.

Figure 5 shows that the mean of the capital stringency index for all countries has a negative correlation with average returns on investment across these countries, where the latter is measured by the average expected GDP growth rates at the end of each survey year. Most remarkably, high returns in 1999 and 2006 are associated with lax capital regulations, on average, and the lower expected returns in 2002 and following the global financial crisis of 2007–09 are associated with tighter capital regulations. The stringency of capital regulations increases for both advanced and emerging countries after the financial crisis. This graph could also indicate the effect of a financial crisis on the behavior of the regulator: A recent strong financial crisis makes the society and policymakers more concerned about the financial stability and hence empowers regulators.

4 Methodology and results

This study estimates the following panel data specification

$$CS_{it} = \beta_1 R_{it} + \beta_2 GB_{it} + \beta_3 Con_{it} + \beta_4 CH_{it} + \gamma X_{it} + \alpha_i + \varepsilon_{it} \quad (1)$$

where the time variable (t) denotes survey years and the cross-sectional index (i) denotes countries. The dependent variable is the aggregate capital stringency index. R_{it} is the expected real GDP growth rate, which is a proxy for overall return on investment. GB_{it} is government-owned banks, which is the percentage of banking system’s assets in banks that are 50 percent or more government owned; it is a proxy for regulatory capture—the degree to which regulators are captured by the financial institutions under their control. Con_{it} is the three-bank concentration ratio, which indirectly captures the risk-taking incentives in the banking sector. CH_{it} measures the time since last systemic banking crisis. Lastly, X_{it} is the other control variables, such as government size and economic risk. In section 5.3, X_{it} includes additional control variables for financial, political and institutional structures of countries.

A fixed effects model is the natural choice for estimation of this model for several reasons. First, it is quite likely that unobserved country-specific heterogeneity, captured by α_i terms, is correlated with the regressors R_{it} , GB_{it} , CH_{it} , Con_{it} , and other control variables. A fixed effects model yields consistent estimates of the model parameters under this type of correlation. Second, the fixed effects model is mainly identified through over-time (within) variation in the data because the model is estimated after transforming each variable by subtracting time-average for each country from the original variable. For that reason, the fixed effects model is also called the *within* model. In our sample, the within variation dominates the between variation for the dependent variable and returns on investment. There is also a significant amount of within variation in the other explanatory variables. Third, the fixed effects model is recommended when the sample is an exhaustive list of the population (which mostly occurs in cross-country studies such as ours) rather than a random draw from a large population (which mostly occurs when individuals from a large population are sampled).

The fixed effects model assumes $\varepsilon_{it} \sim IID(0, \sigma_\varepsilon^2)$ and considers α_i ’s as fixed parameters that can be estimated alongside other parameters. In that regard, the fixed effects capture the institutional and political characteristics of countries, such as legal origin and government type, that are more or less stable within the almost decade-long period studied in this paper. The within transformation eliminates any variables that do not change over time, including α_i terms and other observed country-specific characteristics, such as institutional characteristics.

4.1 Results

Table 6 presents the estimation of the model given by equation (1) using the fixed effects strategy. The benchmark fixed effects model in the first column predicts a significant and negative effect of returns on investment, government-owned banks, and concentration ratio on the stringency of bank capital regulations. The remaining three explanatory variables (economic risk, government size, and crisis history) do not have any significant effects on the stringency of capital regulations. The particularly strong negative coefficient on the return on investment variable indicates that high return countries choose less stringent bank capital regulation. This result could be explained if higher returns allow a country to take on more risk through less stringent regulations because lax capital regulations translate into larger losses from bank defaults and fire sales during distress times, as in Kara (2016).

Estimation of the fixed effects model shows that a 1 percentage point increase in the average rate of return on investment reduces the stringency of the capital regulation index by 0.4 point. This coefficient is not only statistically highly significant, but it is also economically strong. The following exercise helps us to see the economic significance of the coefficient: What change in the GDP growth rate would be necessary for an emerging country to have the capital stringency level of an advanced country? The mean of the index is 4.3 for the advanced countries and 3.7 for the emerging countries. Because the difference between the two means is equal to 0.6, the coefficient on the return variable implies that, holding everything else constant, if emerging countries had lower return rates, by 1.5 percentage points, on average, they would choose the same level of bank capital stringency as the developed countries ($0.6/0.4 = 1.5$). This number is reasonable, as the actual difference in GDP growth ratios between these two groups of countries in the sample is 1.9 percentage points.

The negative coefficient on government-owned banks indicates that a regulator that is more concerned about banking-sector profits than financial stability will choose less stringent capital regulations. I use government ownership of banks as a proxy for the weight on bank profits in a regulator's objective function. Therefore, this result supports the regulatory-capture hypothesis suggested by Dell'Araccia and Marquez (2006). The fixed effects results show that a 1 percentage point increase in the government ownership of banks ratio leads to a 0.04 point decrease in the stringency of bank capital regulations.

The negative coefficient on the concentration ratio shows that regulators lower the stringency of bank capital regulations as the banking sector becomes more concentrated. This outcome could arise if the regulators tend to associate a higher concentration ratio with fewer incentives for excessive risk-taking in the banking sector. Therefore, the result supports the concentration-stability hypothesis in the theoretical and empirical divide about the effect of concentration in the banking sector on financial stability. The fixed effects result shows that a 1 percentage point increase in the concentration ratio reduces the stringency of capital regulations index by 0.026 point.

To compare the economic magnitude of these coefficients, we can look at the effects of a one standard deviation change in the independent variables on the capital stringency index. Multiplying the coefficients from the fixed effects regression with the standard deviation of these variables presented in table 3, we obtain negative 0.79 point for asset returns, negative 0.83 point for government-owned banks, and negative 0.50 point for the concentration ratio. Given that the standard deviation of the index is 1.75, all these effects are economically strong.

One particular concern about the results in the first column is that they could be driven by the effect of the 2007–09 financial crisis on the stringency of capital regulations, return on investment, and other variables. In particular, many countries responded to the crisis by tightening their capital regulations, and at the same time, the crisis hit the real economy and lowered expected returns on investment around the world, as measured in this paper by expected GDP growth rates. To address this concern, I estimate the model first by including time fixed effects in the estimation and separately by excluding the data from the last survey. The results are presented in the second and third columns, respectively, and they do not change qualitatively compared with the benchmark model. But the effect of the asset returns on the stringency of capital regulations becomes smaller in absolute value. Furthermore, the coefficient of the dummy for the survey after the crisis (2011) is positive and highly significant, indicating that there was an overall increase in the stringency of capital regulations after the crisis that cannot be explained by our control variables alone.

Additionally, exclusion of the crisis year leads to a negative and significant coefficient for the government size variable, indicating that greater involvement of the government in the overall economy is associated with less stringent capital regulations in the pre-crisis period. The coefficient is also economically sizable, as it indicates that a one point increase in the government size variable leads to a 0.33 point decrease in the capital regulation stringency index. However, this effect is not robust as it disappears when we use the entire sample or include time fixed effects (as shown in the first two columns) and under additional robustness checks (presented in the next section).

5 Robustness

In this section, I subject the results of the benchmark model to various robustness tests. For the first robustness measure, I estimate a dynamic panel data model, in which I allow for a richer endogeneity structure for the right-hand-side variables by using instruments appropriately. Second, I reconstruct the capital stringency index using the principal component analysis and estimate the static and dynamic models using the first principal component of the index as the dependent variable. Third, I estimate the benchmark model by explicitly controlling for the financial, political and institutional structures of countries. Lastly, I estimate logit regressions for individual index questions instead of using the aggregate index as the dependent variable.

5.1 Dynamic model

Regulatory choices may contain some degree of inertia. Regulators may not want to make large changes in the stringency of capital regulations at once so as not to cause a large and uncontrollable reaction in markets. They may also face political pressure or difficulties as they try to change regulation levels. Even more, they may not know how to best react to changing economic dynamics and, instead, choose simply to do nothing. Actually, figure 2 shows that in each survey, a large fraction of countries keep the stringency of capital regulations the same compared with the previous survey. To capture this highly possible inertia in capital regulations and address the potential endogeneity problems, I introduce the following dynamic model:

$$CS_{it} = \beta_0 CS_{i,t-1} + \beta_1 \bar{R}_{it} + \beta_2 GB_{it} + \beta_3 Con_{it} + \beta_4 CH_{it} + \gamma X_{it} + \alpha_i + \varepsilon_{it} \quad (2)$$

where $\varepsilon_{it} \sim IID(0, \sigma_\varepsilon^2)$. The only difference between the dynamic model and the static model given by Equation (1) is the introduction of the lagged dependent variable, $CS_{i,t-1}$, on the right-hand side as an explanatory variable. However, this seemingly small change requires a significant alteration of the estimation technique, because the lagged dependent variable is correlated with the unobserved heterogeneity, captured by α_i . The within transformation, or taking the first difference, will not eliminate the endogeneity issue; hence, the fixed effects model will yield inconsistent parameter estimates for the dynamic model. To see this inconsistency, consider the equation in the first-difference form below:

$$\Delta CS_{it} = \beta_0 \Delta CS_{i,t-1} + \beta_1 \Delta \bar{R}_{it} + \beta_2 \Delta GB_{it} + \beta_3 \Delta Con_{it} + \beta_4 \Delta CH_{it} + \gamma \Delta X_{it} + \Delta \varepsilon_{it} \quad (3)$$

Here, the error term, $\Delta \varepsilon_{it}$, is correlated with $\Delta CS_{i,t-1}$ among the right-hand-side variables because $\varepsilon_{i,t-1}$ in $\Delta \varepsilon_{it}$ is correlated with $CS_{i,t-1}$ in $\Delta CS_{i,t-1}$. Therefore, equation (3) can only be consistently estimated with an appropriate set of instruments that are correlated with the endogenous regressor, $\Delta CS_{i,t-1}$, but are not correlated with the error term, $\Delta \varepsilon_{it}$. [Arellano and Bond \(1991\)](#) show that $CS_{i,t-s}$ for $s \geq 2$ are uncorrelated with $\Delta \varepsilon_{it}$ and can be used as instruments. Similarly, if there is any other endogenous variable among regressors, second- and higher-order lags of that variable can be included in the instrument set. When a regressor is predetermined but not strictly exogenous, its lagged values of order one or higher are valid instruments. If the regressor is strictly exogenous, then current and all lagged values are valid instruments. This estimation technique is also called the difference GMM estimation.

Estimation of the dynamic model using the difference GMM method is presented in table 7. All four specifications are estimated using a two-step procedure in which the first-step results are used to calculate the optimal weighting matrix for the second-step estimation. [Windmeijer \(2005\)](#) corrected robust standard errors for the two-step GMM estimation are used in all four specifications.

Using the first-difference of each variable significantly reduces the number of observations avail-

able for estimation. Therefore, in the first column, I estimate the dynamic model using only the variables that have significant coefficients in the static fixed effects model. The results in the first column confirm the economic and statistical effects of these variables on the stringency of bank capital regulations. If anything, estimation of a dynamic model yields a larger economic effect of asset returns, government-owned banks, and concentration ratios on the stringency of capital regulations, where the differences between estimated economic effects are particularly strong for the latter two variables.

In the second column, I add the crisis history variable as an additional control. The coefficient of this variable remains insignificant in this dynamic estimation; however, introduction of this variable reverses the statistical significance of the concentration ratio and somewhat reduces the statistical significance and magnitude of the coefficient of government-owned banks. In the third column, I add economic risk and government size as additional control variables. These additional variables enter the model with insignificant coefficients, as in the static model. Their addition also somewhat reduces the statistical significance of asset returns and government-owned banks, while the coefficient of the concentration ratio remains insignificant, as in the second column.

Estimation of a dynamic system using GMM methods allows us to model a richer endogeneity structure than what the static fixed effects model allows. I make use of this feature of the GMM method by estimating the first, second, and third columns under the assumption that all independent variables are predetermined. The error term, ε_{it} , is uncorrelated with the current and lagged values of predetermined variables, but ε_{it} can be correlated with future values of the regressors. In other words, estimations in the last two columns allow time-varying shocks to regulatory standards to affect the current and future expected asset returns and other independent variables. In the last column, I exploit an even richer endogeneity structure offered by the GMM estimation of the dynamic panel data model. In particular, I treat return on investment as endogenous and all other independent variables as predetermined. This richer endogeneity structure captures the potential effects of current capital regulations on the current expected returns on investment. Note that all specifications still allow regressors to be correlated with country-specific time-unvarying heterogeneity captured by α_i terms, which are eliminated by the first-difference transformation. Estimation of this richer structure yields qualitatively similar results to those presented in the second and third columns. Also, the Hansen test of overidentifying restrictions shows that the null hypothesis of the validity of instruments is not rejected for all specifications in table 7. The p -values of the Hansen test are reported under each estimation in table 7.

Estimation with dynamic panel data models conserves the signs obtained with the static fixed effects model for all variables. The coefficients of return on investment and government-owned banks are, in general, estimated with a similar precision to static models, but they are consistently larger in absolute value under dynamic models. The coefficient of concentration ratio turns out to be statistically significant only in the first specification. Insignificance of this coefficient in dynamic

panel data estimations when we add additional control variables could also be a result of the small-sample bias: Even though the dynamic panel data model offers more reasonable modeling of the change in regulatory choices, we must note that the results of the dynamic model could be weakened by the small time dimension of our data set, especially when we add additional control variables. We observe each country for about three surveys, on average. As a result, after applying the first difference to our variables, we end up with two observations for each country, on average.

5.2 Principal component analysis

In the benchmark model, I used the capital stringency index, obtained by aggregating the answers to the six components, as the dependent variable. Therefore, I implicitly assume that all questions that enter into the calculation of the index have equal weights in determining the stringency of bank capital regulation. However, some of the regulation dimensions measured by the index can more easily be adopted by regulators and, hence, vary less across countries, whereas implementation of some other components could be more challenging and hence, vary more across countries. For example, on average, 99 percent of countries answered question 3.1.1 (“Is the minimum capital ratio risk weighted in line with the Basel guidelines?”) in table 1 with “Yes”, whereas only 52 percent of them did so for question 3.3 (“Does the minimum ratio vary as a function of market risk?”).

In that regard, one may prefer an index that attaches greater weights to components of regulation that vary more across countries and smaller weights to components that vary less. Principal component analysis (PCA) does exactly that. PCA is an orthogonal transformation of (possibly) correlated variables—here, the index components—into a number of linearly uncorrelated variables, called principal components. This transformation is defined in such a way that the first principal component is the “most informative,” which means it accounts for as much of the variability in the data as possible. The first principal component in this case explains about 43 percent of the variation in the index data.

I estimate both the static and dynamic models using the first principal component of the capital stringency index as the dependent variable. The results of the static model are presented in table 8. The results do not change qualitatively compared with the results in table 6, where the simple aggregate value of the index is used. Estimation of the fixed effects model yields negative and significant effects of asset returns, government-owned banks, and concentration ratio on the stringency of capital regulations. These results are robust to controlling for year fixed effects and excluding the 2011 survey. The other variables remain insignificant except, similarly to the benchmark model, for the coefficient of government size when we exclude the 2011 survey from the estimation. Given that the range of the principal component is $[-3.24, 1.82]$ with mean 0 and standard deviation 1.6, the economic magnitudes of the coefficients are similar to those obtained in table 6.

Table 9 presents the results of dynamic panel data models using PCA. Similar to table 7,

the first, second, and third columns are estimated under the assumption that all regressors are predetermined with respect to the time-varying heterogeneity (ε_{it}), and the last column is estimated under the richer endogeneity structure that treats the return on investment variable as endogenous and other independent variables either as predetermined or strictly exogenous. Also, the Hansen test of overidentifying restrictions shows that the null hypothesis of the validity of instruments is not rejected for all specifications in table 7. The p -values of the Hansen test are reported under each estimation in table 7.

The coefficient of return on investment is highly significant across all specifications. The other significant coefficient is obtained for the government size index under the full model presented in the third column. However, introducing the richer endogeneity structure in the fourth column reestablishes the significance of this coefficient. In contrast to the results with the aggregate index in table 7, the coefficient of the concentration ratio is not significant in any of the specifications when we use PCA. Another difference is the coefficient of the government size variable, which now becomes positive and significant at the 90 percent confidence level in the third and fourth columns. Economic risk and crisis history are not significantly different from zero in any of the specifications, as in the benchmark model. Overall, the results are qualitatively the same as the results obtained with the standardized value of the index in table 7. Furthermore, the quantitative effects of the coefficients also do not change significantly when the first principal component of the index is used.

5.3 Controlling for Financial and Institutional Development

There are significant differences in the financial development level and institutional structure of the countries in our sample. These differences might affect the design of capital regulations and the ways in which the regulations change over time. In this section, I control for financial structure and institutional background variables. Most of the variables that measure structure, size, depth, and openness of financial sectors are obtained from the Financial Structure Database, as described in Čihák et al. (2012) and Beck et al. (2009). I also make use of the Economic Freedom of the World, Polity IV and Worldwide Governance Indicators databases to gather information on political and institutional structures. The variable definitions are presented in table 2.

5.3.1 Controlling for the financial structure

I start by controlling for the size, depth, and efficiency of financial markets. I perform only fixed effects regressions in this section. The results are presented in table 10. To minimize the potential multicollinearity issue—and given the small sample size—I do not control for government size in these regressions, and I add one control at a time. The results in the main section do not change at all when we include controls for the financial structure. However, most of the financial structure control variables have insignificant coefficients in these regressions.

Because a main traditional justification for capital regulations is the moral hazard created by

the existence of deposit insurance, in the first column, I control for a measure for the size of the deposit insurance fund relative to total bank assets. The coefficient of this variable turns out to be statistically insignificant; however, the addition of it does not affect the magnitude or significance of other control variables. In the second column, I control for the power of the deposit insurer. I obtain a negative and significant coefficient for this variable, indicating that capital regulations are less stringent in countries where the deposit insurance authority has more power. This relationship could arise if bank regulators consider the expected cost of bank failures to the taxpayers to be smaller when the deposit insurance authority has more power.

In the third column, I control for *Liquid liabilities to GDP*, which is a traditional indicator of financial depth. This is the broadest available indicator of financial intermediation, since it includes all banks and bank-like and nonbank financial institutions. Liquid liabilities to GDP has a positive but insignificant coefficient. Although not presented, using the *Bank deposits to GDP* ratio instead to focus specifically on the intermediation through the banking sector yields identical results.

Theoretical studies on bank capital regulations generally assume that the savings of the economy are turned into socially profitable investments through the intermediation of the financial sector. In particular, studies from which some of the main explanatory variables are derived—namely, [Kara \(2016\)](#), [Dell’Ariccia and Marquez \(2006\)](#), and [Acharya \(2001\)](#)—consider such models. In practice, there are large cross-country differences in the efficiency of banking sectors in turning society’s savings into profitable investments, as documented by [Beck et al. \(2009\)](#). In the fourth column, I use *Bank credit to bank deposits* to control for the differences in banking-sector efficiency. I do not find a statistically significant effect of this variable on the stringency of capital regulations, either. Additionally, in the fifth column, I control for the financial structure using *Structure-size*. Higher values of this indicator correspond to more market-based systems, as opposed to bank-based systems. However, this coefficient is not statistically different from zero at conventional significance levels.

In the last column, I control for the degree of financial openness. Financially open countries have larger exposures to shocks coming from other countries, and therefore they may have stronger incentives to set strict capital regulations. Higher values of the *Capital controls* variable correspond to fewer controls on capital and hence to a greater degree of financial openness. Although not reported, I also use the Chinn-Ito index of financial openness ([Chinn and Ito, 2006](#)). However, I do not find any statistically significant evidence using either variable that financially more open countries impose stricter capital regulations.

To summarize, the results in table 10 show that the findings in the main section are robust to controlling for differences in financial structure. However, in general, I do not find statistically significant effects of the size, depth, or efficiency of financial markets on the stringency of capital regulations.

5.3.2 Controlling for institutional and political background

Barth et al. (2006) show that international differences in institutional and political structure influence the choice of bank regulatory and supervisory policies such as activity restrictions for banks, entry requirements to the banking sector, the strength of private monitoring, and the powers of the official banking supervisors. However, they do not analyze whether political and institutional structure have any effects on bank capital regulations in particular. In this section, I control for political and institutional structure variables for their potential effect on the stringency of bank capital regulations.

I mainly use the same institutional control variables that are used by Barth et al. (2006) in their regressions along with a few other indicators from commonly used databases. These indicators—executive constraints, executive competition, and executive openness variables from the Polity IV Database—measure the degree to which the political system is an open, competitive democracy that is accountable to the broad population, as opposed to an autocratic regime that is only accountable to a small group of leaders.

Additionally, I use *Rule of law* from the World Governance Indicators Database and *Legal system and property rights* from the Economic Freedom of the World database. Rule of law “captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence” (Kaufmann et al., 2011). *Legal system and property rights* is obtained by combining nine different indicators, including judicial independence, military interference in law and politics, legal enforcement of contracts, and protection of property rights.

Barth et al. (2006) argue that open, competitive, and democratic political systems support banking regulations that maximize the welfare of society at large. However, when it comes to bank capital regulations in particular, the level of stringency that maximizes welfare may not be the most stringent regulations at all times for all countries. For example, Kara (2016) shows that high return countries optimally choose less stringent capital regulations. Therefore, the theory does not necessarily predict a positive relationship between more democratic political systems and the stringency of capital regulations. Nevertheless, the results in the first three columns in table 11 show that countries with competitive and democratic political systems choose less stringent capital regulations. However, I do not find any significant effect of the strength and independence of the legal system or institutions that protect property rights on the stringency of capital regulations, as shown in the last two columns. Furthermore, the results of the benchmark model are robust to controlling for the political structure and institutional quality.

5.4 Logit regressions for individual index questions

In previous sections, I used an aggregate index to measure the stringency of capital regulations. The index is aggregated either by summing the values of individual questions, which implicitly attaches

the same weight to all questions, or by using PCA, which attaches greater weights to questions that vary more across countries and over time. In this section, I analyze how the individual questions that make up the aggregate index change in response to changes in the independent variables. This analysis helps us go into the “black box” of the aggregate index to see which dimensions of capital regulations mainly differentiate across countries and drive the results that were obtained in the previous sections.

The dependent variables in this section are the individual index questions that are presented in table 1. Because the dependent variables are binary, I use panel data logistic regressions (panel logit) in this section. The unobserved country-specific heterogeneity is still highly likely to be correlated with the explanatory variables. Therefore, the consistent estimator in this case is the conditional fixed effects logit model.

The results are presented in table 12. The conditional fixed effects logit model is identified through within (over-time) variation. Therefore, the estimation technique drops the countries from the sample for which the index answers do not change over time. There is very little over-time variation for the first question (“Is the minimum capital ratio risk weighted in line with the Basel guidelines?”) for the majority of the countries. Only three countries answer “No” to this question, each in one of the surveys, and hence we do not have enough observations to estimate the determinants of the first index question. As a result, it is omitted from table 12.

There is sufficient variation in the remaining five questions, which can be seen from the fact that they are estimated using the majority of the countries in the sample. The “number of countries” row shows how many countries were used to estimate the coefficients for each regression. The coefficient of the return on investment is negative and statistically significant at the 95 percent confidence level for all five remaining questions. Therefore, the fixed effects logit regression shows that a country’s average asset returns have a significant negative effect on all dimensions of the capital regulation stringency; hence, the results in the previous section are not driven by any particular aspect of capital regulations.

The coefficient of government-owned banks is significant only for the question on the exclusions of loan losses from the regulatory capital. The negative coefficient implies that higher government ownership of banks significantly reduces the probability that a country requires loan losses not realized in accounting books to be deducted from the book value of capital before minimum capital adequacy is determined.

The coefficient of concentration ratio is significant only for the two components of the index that deal with the determination of capital (exclusion of the market value of loan losses not realized in accounting books and unrealized foreign exchange losses from the calculation of regulatory capital). This result indicates that the negative and significant sign of the concentration ratio in the aggregated index fixed effects regressions is driven by the variation in answers to these two questions. Countries with more concentrated banking sectors are more lenient in the way banks

are allowed to calculate the equity capital (the numerator of the capital ratio).

The other independent variables have no significant effect on the components of the capital stringency index, with one exception: a positive coefficient for the crisis history variable on the question that deals with the exclusion of unrealized losses in securities portfolios from the regulatory capital. A positive sign for the crisis history variable indicates that as a banking crisis moves further back in time, countries are more likely to choose more stringent regulations in that direction. This result is counterintuitive and in contrast with the predictions of [Aizenman \(2009\)](#). However, note that the coefficient is significant only at the 90 percent confidence level, and we do not obtain a significant coefficient for this variable in other components of the index or for the regressions that use aggregated index values in previous sections.

6 Conclusion

Despite the extensive attention that the Basel capital adequacy standards received internationally, significant variation exists in the implementation of these standards across countries. Furthermore, a significant number of countries increase or decrease the stringency of capital regulations over time. In this paper, I have investigated the empirical determinants of the variation seen in the data based on the theories of bank capital regulation.

I measure the stringency of capital regulations using an index created from responses to the World Bank surveys on bank regulations. The capital stringency index shows whether the capital requirement reflects certain risk elements and deducts certain market value losses from capital before minimum capital adequacy is determined. The sample of this study includes 66 major developed and developing countries. I have estimated a panel data model with fixed effects and performed various robustness tests, including the estimation of a dynamic panel data model.

I show that countries with high average returns to investment or a higher ratio of government ownership of banks choose less stringent capital regulation standards. Government ownership of banks is used as a proxy for regulatory capture: the degree to which regulators are captured by the financial institutions under their control. Therefore, this result implies that the stringency of capital regulations decreases with regulatory capture. I also find some evidence that capital regulations are less stringent in countries with more concentrated banking sectors: This variable has significant negative coefficients in the static fixed effects model, but its coefficient is statistically insignificant under some specifications in the dynamic panel data model. A negative relationship between the stringency of capital regulations and concentration ratio would be obtained if regulators expect the banking sector to become more stable as it becomes more concentrated. Additionally, I do not find statistically significant effects of the depth, size, or efficiency of financial markets or of institutional quality on the stringency of capital regulations. However, I find some evidence that countries with competitive and democratic political systems choose more stringent capital regulations.

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7 Appendix

Figure 1: Distribution of the capital stringency index for each survey

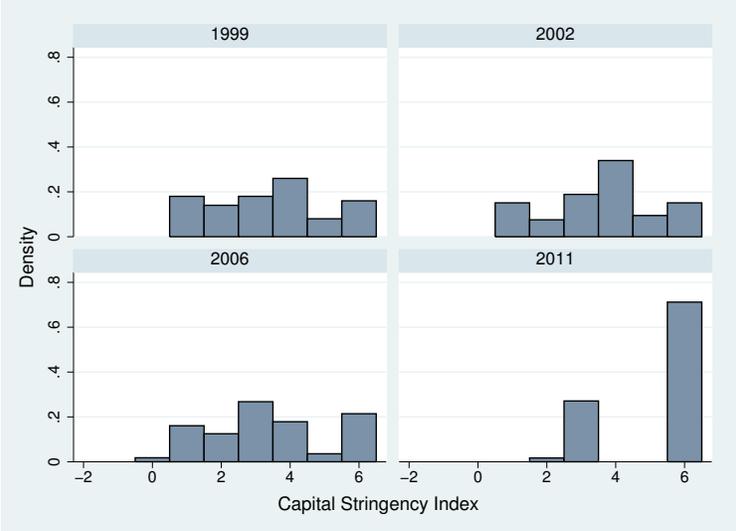


Figure 2: Distribution of the change in the capital stringency index

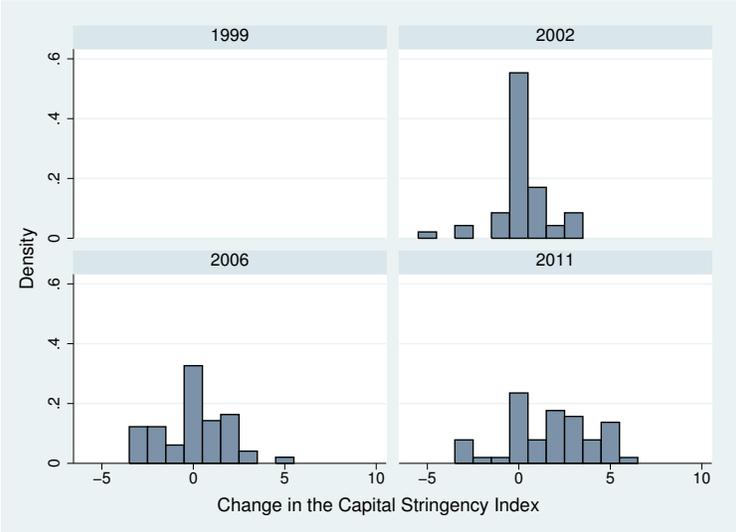


Figure 3: Distribution of the change in the components of the capital stringency index

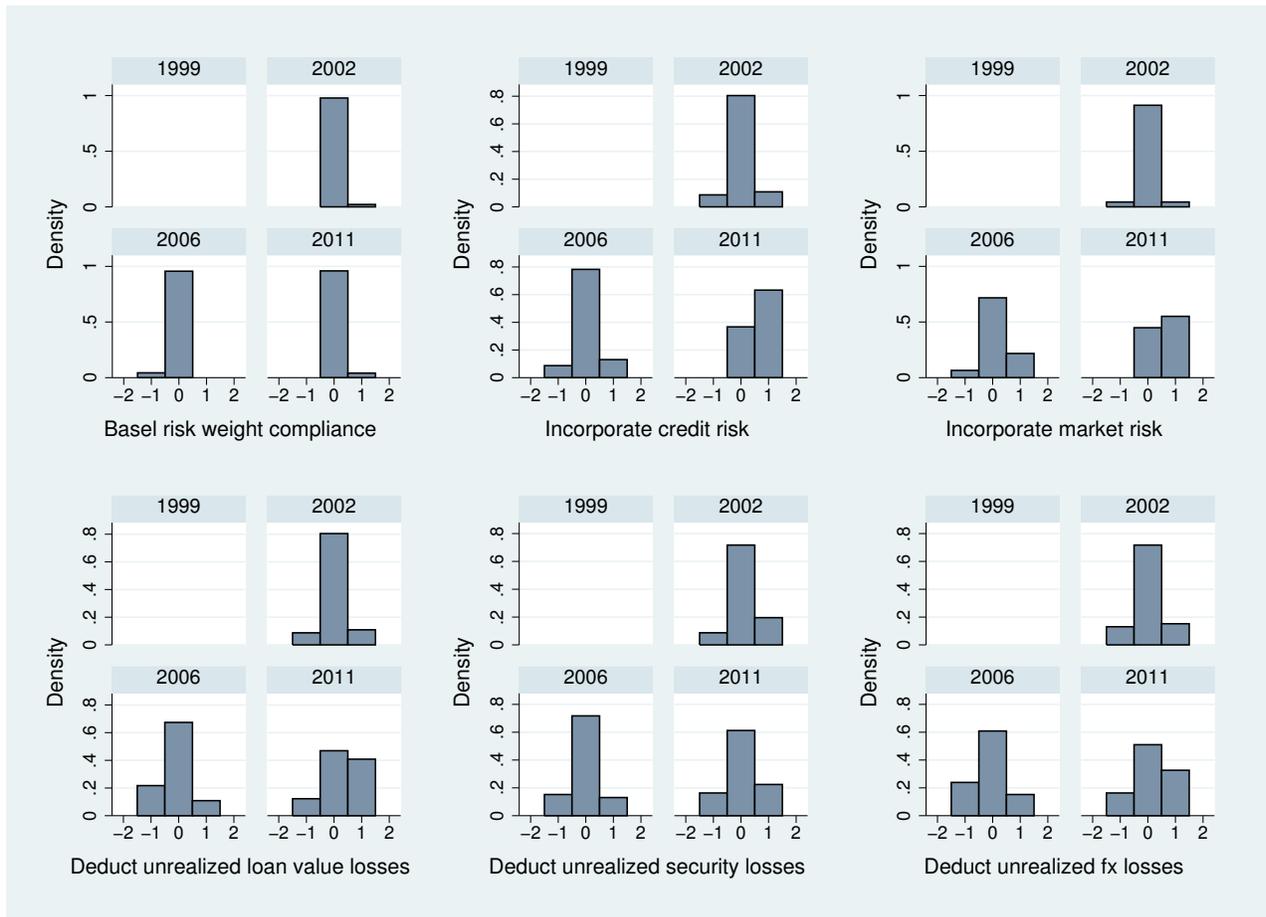


Figure 4: Average stringency of bank capital regulations

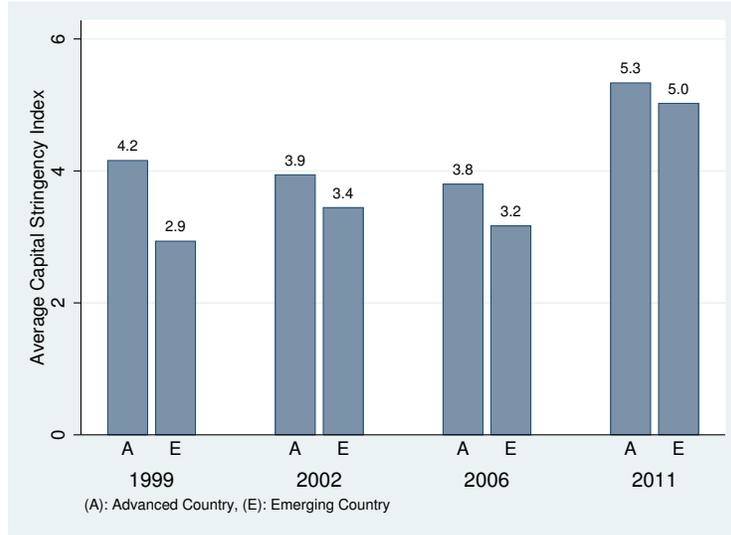


Figure 5: Average capital stringency and return on investment

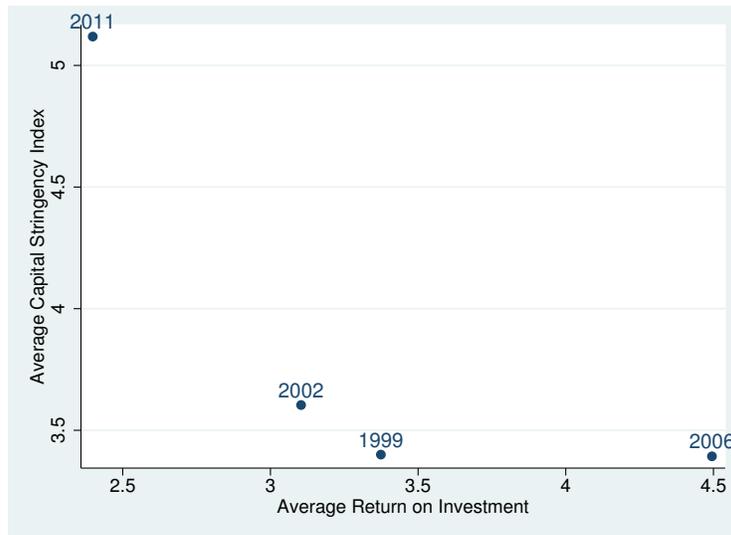


Table 2: Variable definitions

Variable	Definition	Range	Source	Notes
Capital stringency	Whether the capital requirement reflects certain risk elements and deducts certain market value losses from capital before minimum capital adequacy is determined.	0 to 6	World Bank surveys on bank regulation	Higher values indicate more stringent regulations
Return on investment	Expected GDP growth rate for the next year	number	Consensus Economic Forecast	Average of the forecasters' next-year GDP growth expectations.
Government-owned banks	Percentage of banking system's assets in banks that are 50 percent or more government owned.	0 to 100	World Bank surveys on bank regulation	
Concentration ratio	Ratio of the assets of three largest banks to the assets of all commercial banks in a country.	0 to 100	World Bank Financial Development and Structure Dataset. Calculated from Bureau van Dijk's BankScope database.	
Crisis history	Number of years since the previous systemic banking crisis	0 to 111	Systemic Banking Crisis Financial Crisis Database	Crisis year is set to 1900 for countries for which there is no systemic banking crisis reported in this database.
Economic risk	Index of economic risk	0 to 50	PRS	Higher values indicate less economic risk.
Government size	Index of government size	0 to 100	Economic Freedom of the World Database	Higher values indicate larger government spending, transfers and tax rates.
Deposit insurance fund	The size of the deposit insurance fund relative to total bank assets.	number	World Bank surveys on bank regulation	
Deposit insurer power	Whether the deposit insurance authority has the authority to make the decision to intervene in a bank, take legal action against bank directors or officials, and has ever taken any legal action against bank directors or officers.	0 to 4	World Bank surveys on bank regulation	Higher values indicate more power.
Liquid liabilities to GDP	Currency plus demand and interest-bearing liabilities of banks and other financial intermediaries divided by GDP.	number	Financial Development and Structure Database	A traditional indicator of financial depth.
Bank credit to bank deposits	Private credit by deposit money banks as a share of demand, time, and saving deposits in deposit money banks.	number	Financial Development and Structure Database	Measures the extent to which banks intermediate society's savings into private sector credits.
Structure-size	Stock Market Capitalization to GDP divided by Bank Credit to GDP.	number	Financial Development and Structure Database	Higher values of the indicator correspond to more market-based systems as opposed bank-based systems.
Capital controls	The percentage of capital controls not levied as a share of the total number of capital controls listed by IMF multiplied by 10.	0 to 10	Economic Freedom of the World Database	The index is calculated based on the 13 types of international capital controls included in the International Monetary Fund's Annual Report on Exchange Arrangements and Exchange Restrictions.
Executive constraints	The extent to which institutionalized constraints on the decision making powers of chief executives, whether individuals or collectivities	1 to 7	Polity IV Database	Higher values correspond to greater constraints on executive power.
Executive competition	The extent that prevailing modes of advancement give subordinates equal opportunities to become superordinates.	0 to 3	Polity IV Database	Higher values imply greater competition for the executive position.
Rule of law	Captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.	-1.93 to 1.99	World Governance Database	Higher values indicate stronger rule of law.
Legal system and property rights	Composite index of institutional and legal quality.	0 to 10	Economic Freedom of the World Database	Higher values indicate stronger and more independent legal systems.

Table 3: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Capital stringency	3.91	1.75	0	6	218
Return on investment	3.33	1.95	-3.94	8.5	218
Government-owned banks	16.96	20.98	0	80	210
Concentration ratio	57	19.12	15.28	100	216
Economic risk	37.11	4.28	24	47.48	217
Government size	6.01	1.42	1.75	9.22	209
Crisis history	38.78	42.99	1	111	213
Deposit insurance fund	0.04	0.16	-0.06	1.06	105
Deposit insurer power	1.32	1.22	0	4	149
Liquid Liabilities / GDP	71.51	49.57	10.34	320.8	202
Bank Credit / Bank Deposits	110.72	50.07	37.72	368.83	205
Structure-size	1	0.8	0.02	4.76	194
Capital controls	4.73	2.94	0	10	205
Executive Competition	1.95	7.77	-88	3	215
Executive Openness	3.15	7.88	-88	4	215
Executive Constraints	5.32	8.21	-88	7	215
Rule of Law	0.53	0.99	-1.63	1.99	218
Legal system and property rights	6.39	1.74	1.6	9.6	205

Table 4: Countries by income group and development level

	Advanced	Emerging
High Income	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States	Croatia, Cyprus, Czech Republic, Estonia, Hong Kong, Hungary, Israel, Poland, Saudi Arabia, Singapore, Slovenia
Upper-Middle Income		Argentina, Belarus, Bosnia and Herzegovina, Brazil, Bulgaria, Chile, China, Colombia, Dominican Republic, Ecuador, Kazakhstan, Latvia, Lithuania, Malaysia, Mexico, Panama, Peru, Romania, Russia, Serbia, South Africa, Thailand, Turkey, Uruguay, Venezuela
Middle Income		Egypt, El Salvador, India, Indonesia, Nigeria, Pakistan, Philippines, Sri Lanka, Ukraine

Table 5: Pairwise correlations between variables

Variables	Capital strin- gency	Return on Inv	Govt banks	Concen- tration	Crisis history	Economic risk	Govt size
Capital strin- gency	1.000						
Return on in- vestment	-0.212 (0.002)	1.000					
Government- owned banks	-0.119 (0.084)	0.151 (0.029)	1.000				
Concentration ratio	0.006 (0.929)	-0.016 (0.817)	-0.112 (0.107)	1.000			
Crisis history	0.101 (0.142)	-0.040 (0.558)	-0.313 (0.000)	0.135 (0.050)	1.000		
Economic risk	0.122 (0.074)	-0.010 (0.887)	-0.416 (0.000)	0.118 (0.083)	0.421 (0.000)	1.000	
Government size	0.139 (0.045)	0.340 (0.000)	0.028 (0.693)	-0.063 (0.368)	-0.014 (0.839)	-0.048 (0.495)	1.000

¹ p -values in parentheses.

Table 6: Results for the static model

VARIABLES	(1) Base case	(2) Time FE	(3) Exclude crisis
Return on investment	-0.403*** (0.000)	-0.261*** (0.004)	-0.260*** (0.001)
Government-owned banks	-0.040** (0.018)	-0.036** (0.014)	-0.028** (0.020)
Concentration ratio	-0.026** (0.031)	-0.019* (0.096)	-0.030* (0.054)
Crisis history	0.001 (0.899)	0.008 (0.310)	0.006 (0.347)
Economic risk	0.061 (0.375)	0.029 (0.631)	0.096 (0.325)
Government size	-0.034 (0.836)	-0.026 (0.893)	-0.332* (0.054)
Year = 2002		-0.187 (0.523)	
Year = 2006		-0.171 (0.600)	
Year = 2011		1.169** (0.012)	
Constant	5.322** (0.049)	5.081** (0.047)	4.770 (0.175)
Observations	196	196	142
R-squared	0.203	0.330	0.154
Number of countries	62	62	59

¹ Robust standard errors. p -values in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

² Estimation in the second column includes time fixed effects in addition to country fixed effects.

³ Estimation in the third column excludes the data from the last survey.

Table 7: Results for the dynamic Model

VARIABLES	(1) Diff GMM	(2) Diff GMM	(3) Diff GMM	(4) Diff GMM
L. Capital Stringency	-0.573** (0.013)	-0.261 (0.446)	-0.300 (0.121)	-0.265 (0.221)
Return on Investment	-0.494*** (0.002)	-0.662*** (0.000)	-0.520** (0.015)	-0.654** (0.021)
Government-owned banks	-0.100** (0.016)	-0.077** (0.035)	-0.063* (0.073)	-0.076*** (0.010)
Concentration ratio	-0.124** (0.035)	-0.034 (0.594)	0.022 (0.510)	0.014 (0.750)
Crisis history		0.008 (0.554)	0.000 (0.978)	0.003 (0.784)
Economic risk			-0.195 (0.548)	-0.129 (0.686)
Government size			0.881 (0.267)	0.995 (0.316)
Hansen test of overid. restrictions	0.189	0.148	0.372	0.251
Number of instruments	18	23	33	31
Observations	76	75	72	72
Number of countries	43	42	40	40

¹ All columns are estimated using a two-step difference GMM estimation. Lag of the capital stringency index on the right-hand side is endogenous, and lags of second order are used as instruments for the difference equation. In the first three columns, all independent right-hand-side variables are treated as predetermined variables with respect to time-varying heterogeneity, ε_{it} . In the fourth column, return on investment is treated as an endogenous variable along with the lag of the dependent variable, and other independent variables are treated as predetermined variables.

² Standard errors are Windmeijer corrected robust. p -values in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 8: Results for the static model with principal component analysis

VARIABLES	(1) Base case	(2) Time FE	(3) Exclude crisis
Return on investment	-0.362*** (0.000)	-0.259*** (0.006)	-0.240*** (0.002)
Government-owned banks	-0.036** (0.015)	-0.034** (0.015)	-0.025** (0.033)
Concentration ratio	-0.026** (0.018)	-0.021* (0.066)	-0.033** (0.016)
Crisis history	0.003 (0.664)	0.008 (0.293)	0.005 (0.387)
Economic risk	0.055 (0.378)	0.036 (0.537)	0.083 (0.355)
Government size	-0.068 (0.665)	-0.037 (0.844)	-0.334** (0.045)
Year = 2002		-0.177 (0.545)	
Year = 2006		-0.237 (0.444)	
Year = 2011		0.754 (0.102)	
Constant	1.531 (0.537)	1.139 (0.654)	1.543 (0.628)
Observations	196	196	142
R-squared	0.191	0.264	0.163
Number of countries	62	62	59

¹ The dependent variable is the first principal component of the capital stringency index. The range of the principal component is $[-3.25, 1.82]$ with mean 0 and standard deviation 1.6.

² Robust p -values in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 9: Results for the dynamic model with principal component analysis

VARIABLES	(1) Diff GMM	(2) Diff GMM	(3) Diff GMM	(4) Diff GMM
L.Capital Stringency PC1	-0.318 (0.378)	-0.155 (0.668)	-0.411** (0.026)	-0.394** (0.041)
Return on investment	-0.416*** (0.009)	-0.606*** (0.002)	-0.493** (0.012)	-0.687*** (0.008)
Government-owned banks	-0.079* (0.062)	-0.080** (0.010)	-0.059 (0.188)	-0.076** (0.040)
Concentration ratio	-0.044 (0.627)	-0.013 (0.857)	0.026 (0.432)	0.015 (0.755)
Crisis history		0.010 (0.413)	0.004 (0.782)	0.005 (0.547)
Economic risk			-0.228 (0.303)	-0.119 (0.646)
Government size			1.220* (0.098)	1.390* (0.086)
Hansen test of overid. restrictions	0.119	0.130	0.304	0.247
Number of instruments	18	23	33	31
Observations	76	75	72	72
Number of countries	43	42	40	40

¹ The dependent variable is the first principal component of the capital stringency index. The range of the first principal component is $[-3.24, 1.82]$ with mean 0 and standard deviation 1.6.

² All columns are estimated using a two-step difference GMM estimation. Lag of the capital stringency index on the right-hand side is endogenous, and lags of second order are used as instruments for the difference equation. In the first three columns, all independent right-hand-side variables are treated as predetermined variables with respect to time-varying heterogeneity, ε_{it} . In the fourth column, return on investment is treated as an endogenous variable along with the lag of the dependent variable, and other independent variables are treated as predetermined variables.

³ Standard errors are Windmeijer corrected robust. Robust p -values in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 10: Fixed effects with financial structure controls

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Return on investment	-0.47*** (0.00)	-0.31** (0.02)	-0.31*** (0.00)	-0.30*** (0.00)	-0.29** (0.02)	-0.41*** (0.00)
Government banks	-0.07*** (0.01)	-0.05*** (0.01)	-0.04** (0.03)	-0.03** (0.03)	-0.05*** (0.00)	-0.04*** (0.01)
Concentration ratio	-0.04* (0.06)	-0.03** (0.02)	-0.03** (0.03)	-0.02* (0.06)	-0.03*** (0.00)	-0.03** (0.04)
Crisis history	0.01 (0.75)	0.00 (0.95)	0.00 (0.89)	-0.00 (0.86)	-0.00 (0.58)	0.00 (0.81)
Economic risk	0.08 (0.29)	-0.02 (0.83)	0.12* (0.06)	0.07 (0.31)	0.11* (0.08)	0.07 (0.31)
Deposit insurance fund	1.76 (0.20)					
Deposit insurer power		-0.57* (0.09)				
Liquid Liabilities to GDP			0.01 (0.15)			
Bank Credit to Bank Deposits				0.01 (0.13)		
Structure-size					-0.28 (0.26)	
Capital controls						-0.07 (0.43)
Constant	6.17** (0.02)	9.40** (0.03)	1.64 (0.54)	3.53 (0.17)	3.79 (0.12)	5.10* (0.06)
Observations	97	140	188	191	181	192
R-squared	0.36	0.24	0.18	0.20	0.23	0.21
Number of countries	47	56	63	63	61	61

¹ Robust standard errors. p -values in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 11: Fixed effects estimation with institutional and political structure controls

Variables	(1)	(2)	(3)	(4)	(5)
Return on investment	-0.34*** (0.00)	-0.34*** (0.00)	-0.34*** (0.00)	-0.33*** (0.00)	-0.42*** (0.00)
Government-owned banks	-0.03** (0.02)	-0.03** (0.03)	-0.03** (0.02)	-0.03** (0.01)	-0.04** (0.01)
Concentration ratio	-0.03** (0.02)	-0.03** (0.02)	-0.03** (0.02)	-0.03** (0.03)	-0.02* (0.05)
Crisis history	-0.00 (0.87)	-0.00 (0.87)	-0.00 (0.87)	-0.00 (0.87)	0.00 (0.93)
Economic risk	0.10 (0.12)	0.10 (0.12)	0.10 (0.12)	0.10 (0.14)	0.05 (0.43)
Executive Competition	0.01*** (0.00)				
Executive Openness		0.02*** (0.00)			
Executive Constraints			0.01*** (0.00)		
Rule of Law				0.69 (0.55)	
Legal system and property rights					0.16 (0.41)
Constant	3.39 (0.20)	3.34 (0.20)	3.33 (0.21)	3.38 (0.18)	4.39 (0.13)
Observations	199	199	199	202	192
R-squared	0.17	0.17	0.17	0.17	0.21
Number of countries	62	62	62	63	61

¹ Robust standard errors. p -values in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 12: Logit regressions for individual index questions

VARIABLES	(1) credit risk	(2) market risk	(3) loan losses	(4) sec losses	(5) fx losses
Return on Investment	-0.391** (0.027)	-0.451** (0.015)	-0.358** (0.032)	-0.389** (0.017)	-0.354** (0.021)
Government-owned banks	-0.030 (0.185)	-0.029 (0.209)	-0.053** (0.046)	-0.029 (0.210)	-0.033 (0.141)
Concentration ratio	0.000 (0.992)	-0.019 (0.522)	-0.042* (0.092)	-0.028 (0.325)	-0.060** (0.018)
Economic risk	0.074 (0.536)	0.110 (0.376)	-0.029 (0.816)	0.033 (0.799)	0.080 (0.509)
Government size	0.200 (0.527)	0.248 (0.460)	-0.237 (0.474)	-0.060 (0.848)	-0.247 (0.402)
Crisis history	-0.011 (0.228)	-0.014 (0.233)	0.004 (0.639)	0.020* (0.061)	0.010 (0.275)
Observations	144	132	128	117	134
Number of countries	41	38	36	34	39

¹ The dependent variables are individual questions that make up the capital stringency index. See table 1 for question definitions.

² Robust standard errors. p -values in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$