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Global Post-Crisis Banking Supervision:
Supervisory Powers and Institutional Changes in the Banking Sector

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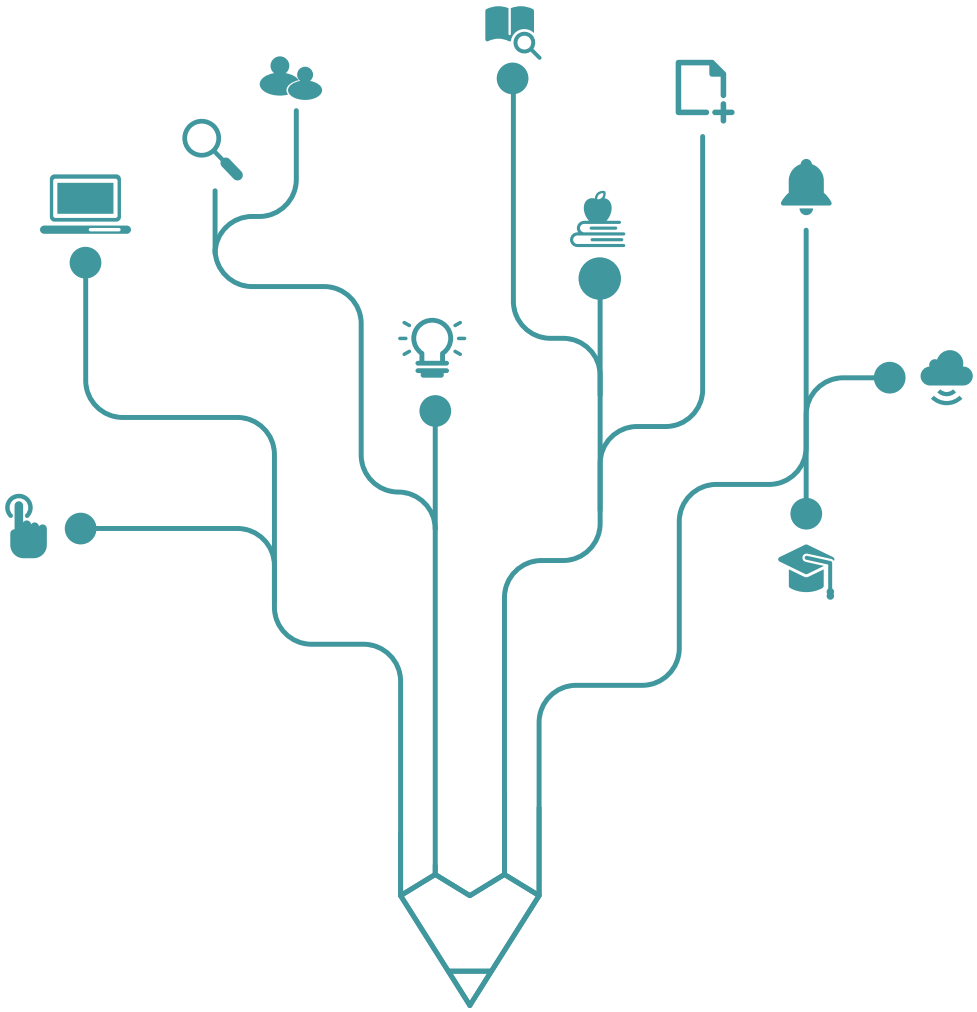

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Abstract

This study utilizes new data across countries on bank supervision for the years 1999-2016 to examine the impact of supervisory powers and institutional changes in supervision. It examines key characteristics of the banking sector, such as banking sector fragility, bank stability, activity restrictions, capital regulation stringency, and banking supervision independence. We find that an increase in supervisory power, accompanied by a change in a central bank's involvement in banking supervision, led to a decrease in banking sector fragility and an increase in the stability of banking sector. We also find that capital regulation stringency and the independence of banking supervisory authorities weakened in countries where an increase in supervisory power was accompanied by institutional changes in supervision following the global financial crisis. These results shed light on the importance of bank supervisory authorities and institutional changes in the soundness of the banking sectors.

JEL classification: G21, G28, E58

Keywords: Banking supervision, Supervisory powers, Supervisory architecture, Central bank involvement, Banking crisis

1. Introduction

The global financial crisis (GFC) of 2007–2009, which was the last severe financial crisis, was not unique in its pre-determinants, or terms of public attention and authorities' responses, only in its magnitude. In addition, it was exacerbated by fragile financial regulation requirements and weak supervisory standards at the regional and international levels (Anginer et al., 2019).[1] Ex-post, governments worldwide acknowledged the pitfalls in safeguarding systems shown by GFC and addressed these issues. As a result of the consequent comprehensive reforms, the operational principles of the financial system and the framework of financial regulation and supervision have been substantially revised, starting from mandates, powers, instruments, and architectures of financial regulatory and supervisory institutions to participants' market behaviors and specific changes in risk management and accounting standards.

Nonetheless, long before policies were relaxed because of the worldwide coronavirus pandemic, the reforms slowed and were even reversed in some jurisdictions (e.g., parts of the Glass–Steagall and Dodd–Franc acts in the US were repealed). In practice, requirements for banks' capital instruments have been eased, deposit guarantee schemes have become more generous and there is still a gap between regulatory complexity and supervisory institutions' capacities and capabilities (Anginer et al., 2019). Moreover, the changes in supervisors' powers and capacities indicate that this may lead to a repeat of the same problems that we experienced during GFC (Ampudia et al., 2019a). The independence of central banks has been under fire in recent years, particularly in countries where populist political parties have gained ground (The Economist, 2019). Therefore, there is a risk of returning to the habits and behaviors of the pre-crisis era.

[1] For more on GFC outcomes, refer to (Anginer et al., 2019; World Bank, 2019). In addition, GFC has often been studied from different perspectives (Arnold, 2009; Claessens et al., 2010; Mishkin, 2011; Shiller, 2012).

The study of bank supervision and its main features was intensified after GFC, though the main focus was on bank regulation. A vast number of studies examined bank supervision empirically, at both single and multiple country levels, and identified key debates around banking supervision from various perspectives (Doumpos et al., 2015; Fraccaroli, 2019; Hirtle, 2020). However, there is still a lack of awareness of the current state of affairs following GFC and ambiguity in some of the results. In addition, previous studies paid less attention to the nexus between supervisory powers and institutional architecture and their influence on the banking sector. Therefore, this study aims to address all of these issues.

Currently, we believe that the resilience of the banking system greatly depends on the powers yielded by supervisory authorities and overall institutional supervisory frameworks. Therefore, we focus on examining the impact of changes in banking supervision related to supervisory powers and institutional changes based on certain key features of the banking sector from the years 1999-2016, across approximately 190 countries. To analyze these factors, we utilized the five-round survey of the World Bank's Bank Regulation and Supervision Survey (World Bank, 2019a), the database on bank regulation and supervision by Barth, Caprio, and Levine (Barth et al., 2013b) including our extension to it, and the November 2021 version of the World Bank's Global Financial Development Database (World Bank, 2019b). We also used central banks' involvement in bank supervision data (Fraccaroli, 2019) and the International Monetary Fund (IMF) Financial Development Index database (Sahay et al., 2015; Svirydzenka, 2016). In addition, we applied our data from the classification of supervisory frameworks (Sohn & Vyshnevskyi, 2020).

We show that on average an increase in supervisory power, accompanied by a change in the central bank's involvement in banking supervision, led to a decrease in banking sector fragility. In

addition, we find that the stringency of supervisory power in countries where the central bank's involvement in supervision was changed, has a positive effect on the stability of the banking sector. Furthermore, we investigate that the capital regulation stringency weakened in countries where an increase in supervisory power was accompanied by institutional changes in supervision after GFC. Finally, we find that the independence of banking supervisory authorities decreased in response to an increase in supervisory power in countries where institutional changes in supervision occurred after GFC.

We believe that this study complements current banking supervision literature as follows: First, we study the link between supervisory powers and the banking sector and account for institutional changes in supervision after GFC to assess possible direct and indirect relationships. Second, we utilized a dataset of more than 190 countries and used all five rounds of data from the World Bank Survey. Overall, the results of this study contribute to both the theoretical and practical fields of banking supervision.

The paper is structured as follows: Section 2 includes background information and a description of the hypothesis and research questions. Section 3 provides an overview of the data and applied methodology. The empirical results are presented in Section 4 and a discussion on the conclusions and policy implications are presented in Section 5.

2. Background and hypotheses

Theoretical and empirical studies up until the 1990s did not concentrate on issues related to banking supervision. According to Masciandaro and Quintyn (2013), inquiries into banking supervision as a part of total financial supervision peaked globally after the 1997 Asian crisis for the first time. Furthermore, the first localized peak occurred in the US at the time of the Savings

and Loans crisis.[2] Interest again peaked after GFC, however, it was limited to banking supervision with a major focus on banking regulations. Accordingly, the evidence shows that crises are the main drivers of scholars paying attention to banking supervision.[3]

The first studies to provide overviews of banking supervision from an economic perspective were Kane (1985) who examined deposit insurance and the supervision of deposit-collecting institutions, Gardener (1986) who examined UK banking supervision issues, and Benston (1986) who examined prudential supervision in the US.

In the early 1990s, the question of whether the supervision function should be removed from a central bank appeared for the first time.[4] There were two opposing views on combining a central bank's monetary and supervisory power under the same roof (Masciandaro & Quintyn, 2016). The integration perspective highlighted the economies of scale and informational benefits obtained by placing all the functions under a central bank (Greenspan, 1994; Peek et al., 1999). In contrast, pro-splitting views emphasized the increased risk of policy failures, because concerns over financial stability could obstruct the execution of optimum monetary policies. Goodhart (1995) stated that the relationship between banking supervision and monetary policy and centralizing their functions might be advantageous and disadvantageous. Historically, after the division of central banking's associated functions from those of the government, both models were used, and the reasons for following a particular model often depended on tradition or political reasons rather

[2] The collapse of 1043 out of 3234 savings and loan associations in the United States from 1986 to 1995.

[3] For more information on banking supervision from a historical perspective, as well as the rationale for banking supervision, see Ampudia et al. (2019a), Hall (1999), Masciandaro and Quintyn (2013) and Mayes and Wood (2007).

[4] For example, (Barth et al., 2003).

than efficiency. Moreover, empirical research on the relative benefits of entrusting banking sector supervision to central banks provides conflicting results (Peia & Romelli, 2019).

Responding to massive changes in the financial system environment during the 1990s, discussions moved from regulatory toward supervisory issues (Crockett, 2001), including the issue of an optimal supervisory model. The start of this discussion is generally measured from the UK, where, in the late 1990s the new model of integrated supervision was introduced to change the traditional sectoral approach. Prior to this, Taylor (1995) developed a model named the "Twin Peaks" model, that proved to have some advantages (Sohn and Vyshnevskyi, 2017) and was later used as an alternative to the UK model. Masciandaro and Quintyn (2009) presented an empirical summary on the development of different countries' regulatory and supervisory models during this stage (1998–2009). They found a trend of structural changes in financial regulations and supervision models with a transition from the traditional to the unified model. These reforms increasingly diversified the supervision landscape across countries. GFC revealed this issue, urging a search for an architecture that would be able to address at least the major issues raised by the financial sector. Consequently, changes to central banks' institutional designs resulted in monetary policy gaining more independence (Romelli, 2018).[5] In addition, in many countries, this was followed by a decrease in central banks' involvement in bank supervision (Peia & Romelli, 2019). As a consequence, supervision became more decentralized and central banks were less involved in financial sector supervision (Masciandaro & Romelli, 2018; Melecky & Podpiera, 2013).

[5] Romelli (2018) showed that the transitions to more independent central banking were one of the main causes of changes in central banking designs. Furthermore, external factors such as support from the international monetary fund increased the likelihood of reforms, whereas political concerns and crises had little impact.

Masciandaro and Quintyn (2013) identified the governance of banking supervisory bodies, including another highly debated issue concerning supervisory independence and powers. Starting from Kane (1985) and Benston and Kaufman (1988), and leading up to today, the inadequate levels of banking supervisory governance (a lack of independence and/or power) were considered to be part of the main reasons for banking crises. However, this discussion is changing because central banks are once again fulfilling bank supervisory roles. Masciandaro and Romelli (2018) observed that after GFC, many countries returned to a system whereby central banks supervised the financial sector, thereby reversing integrated prudential supervision to a large extent. In addition, they found a clear trend toward giving central banks additional supervisory authority after GFC, mostly due to past systemic banking crises.[6] More crucially, the crises were linked to central bank reforms that expanded the central bank's participation in financial sector supervision rather than those that diminished it. Furthermore, it was noted that in the absence of a shock, a country may still reform its banking supervision architecture by following peer countries that implemented reforms after they experienced crises (i.e., peer effect) (Masciandaro & Romelli, 2018). Fraccaroli (2019) stated that sharing bank supervision between a central bank and a special supervisory body may have a greater impact on financial stability than other supervisory governance models such as a single central bank or supervisory body. However, in economic theory, whether allocating supervisory duties to central banks or other independent bodies is socially optimal remains undetermined (Peia & Romelli, 2019).

[6] Melecky and Podpiera (2013) found that integrating financial system supervisions were more likely in countries that previously suffered financial crises.

Several studies have examined the implications of granting more power to banking supervisory authorities (Doumpos et al., 2015; He et al., 2021; Shehzad & De Haan, 2015), including the role of central banks as supervisors (Masciandaro & Romelli, 2018). Similarly, Barth et al. (2004) stated the benefits and drawbacks of expanding supervisors' powers. The issue of financial supervision architecture has been extensively covered in the literature (Mayes & Wood, 2007a; Melecky & Podpiera, 2013; Sohn & Vyshnevskyi, 2020). However, the related studies paid less attention to the nexus of supervisory power and institutional architecture as an influence on the banking sector and its supervision.

Essentially, reforms in banking supervisors' powers and institutional changes in supervision after GFC substantially changed the landscape of the banking sector. Simultaneously, we are of the opinion that these changes have an ambiguous effect on the banking sector and financial systems. Accordingly, our main research question is whether the reforms in banking supervision in terms of supervisors' powers and institutional changes, directly after GFC, has an observable positive effect, based on specific key characteristic of the banking sector and its supervision, namely banking sector fragility, banks' stability, restrictions on activities, banking supervision independence and capital regulation stringency.

Our main premise is that the effect of banking authorities' supervisory powers on specific key characteristics of the banking sector and its supervision depends on a variety of factors, such as institutional changes in supervision which we believe may multiply the effect of the changes to supervisor's powers. Although a vast number of macro and bank-level factors have been examined at both single and multiple country levels, our goal is to study this issue from different perspectives by testing the following hypothesis:

Hypothesis 1. The effect of authorities' supervisory powers on banking sector fragility is negatively associated with institutional changes in supervision.

This hypothesis is a continuation of studies on the causes of financial and banking crises and their predictions (Barth et al., 2008; Demirgüç-Kunt & Detragiache, 2005; Jin et al., 2011; Laeven & Valencia, 2018).

As mentioned in Stigler (1971), there are some advantages to a powerful supervisory authority because there are more incentives for possible failures to be corrected (i.e., the public interest view). Accordingly, our opinion is that the particular effect of a banking authority's supervisory power on the probability of a systemic banking crisis is nonlinear and differs depending on the institutional changes that accompany changes in the supervisor's power.

Hypothesis 2. The effect of supervisory powers on bank-level financial stability is positively associated with institutional changes in supervision.

Most studies related to banks' risk-taking assessments (Laeven & Levine, 2009; Shehzad & De Haan, 2015) use banks' Z-scores to measure a variety of things (e.g., risk-management quality, bank soundness, accounting distance to default or from insolvency). In our study, we utilize the Z-score as a measure of banks' stability, which may be affected by changes in the supervisory power of banking authorities and specific institutional changes in financial supervision. Accordingly, we follow Doumpos et al. (2015) by acknowledging and testing the nonlinear relationship between bank stability and the factors that influence it.

Hypothesis 3. The impact of supervisory authority on bank activity restrictions is positively related to institutional changes in supervision.

Following the discussion (Agoraki et al., 2011; Danisman & Demirel, 2019; Laeven & Levine, 2009), on the role of restricting banks' activities in bank risk-taking, we slightly shifted

the emphasis to assume that restricting activities may depend on the supervisory power of banking authorities and specific institutional changes in financial supervision. We expect that the relationship is ambivalent because, on one hand, some countries may compensate for the increase in supervisors' power by easing activity restrictions. On the other hand, institutional changes in financial sector supervision may cause the lifting of restrictions (e.g., the establishment of a new supervisory body may directly or indirectly limit a bank's activities).

Hypothesis 4. The effect of an authority's supervisory power on capital regulatory stringency is positively associated with institutional changes in supervision.

The relationship between bank capitalization and a variety of bank-, sector-, and macro-level factors, as well as their implications on the economy, are the major subjects of many theoretical and empirical studies in the field (Altunbas et al., 2007; Demirguc-Kunt et al., 2013; Diamond & Rajan, 2000; Kim & Sohn, 2017; Santos, 2001). It is well-known that capital regulation is one of the most effective tools for motivating banks to maintain prudent standards in their business dealings. Simultaneously, our concern that certain requirements for bank capital instruments have been eased in places (Anginer et al., 2019), leads us to determine whether the increase in supervisors' powers accompanied by institutional changes in financial sector supervision may be offset by banking sector authorities' easing of capital regulation stringency.

Hypothesis 5. The effect of authorities' supervisory powers on supervisors' independence is positively associated with institutional changes in supervision.

Many scholars studied the independence of banking authorities, especially central banks, from different perspectives (Berger et al., 2001; Doumpos et al., 2015; Fischer, 1995; Fraccaroli et al., 2020). Our goal is to complement these studies by investigating whether and how supervisors'

independence is influenced by changes to their powers when accompanied by institutional changes to financial sector supervision. We expect that the influence will be positive.

To summarize, we hypothesize that post-GFC reforms have a significant and positive impact on the development of bank supervision and the stability of the banking sector. We are of the opinion that the fragility of the banking sector, its stability, and the independence and quality of bank supervisors have been substantially improved (the five hypotheses are summarized in Table 1).

(Table 1)

3. Data and methodology

3.1 Data

Due to data limitations, it was challenging to study issues related to bank supervision worldwide because data spanning multiple countries did not exist until the early 2000s (Barth & Levine, 2001). In 1998, the World Bank, with assistance and guidance from financial economists and bank supervisors, set up the first of its kind, extensive banking regulatory and supervisory survey across countries—the Bank Regulation and Supervision Survey (BRSS) (World Bank, 2019a). Subsequently, the World Bank has conducted the survey five more times (see Table 2 for a summary on each round of the survey).[7] Altogether, the survey contains information on approximately 143 countries, including all the G-20 members and all the member countries in developing regions. It covers expansive country-specific characteristics related to bank regulation

[7] All related information (questionnaires, datasets, and reports) and details on each survey are freely available at https://www.worldbank.org/en/research/brief/BRSS.

and supervision. Several studies have utilized data from this survey to create proxies for bank regulation and supervision (Doumpos et al., 2015; He et al., 2021).

(Table 2)

In our study, we utilized the multiple-country database of J. R. Barth, Caprio, and Levine (2013a)[8] who developed the database from four rounds of BRSS. This dataset includes extensive information on banking regulations and supervision in up to 180 countries for particular years from 1999-2011. The information includes proper activities for banks, restrictions on bank ownership, external auditing requirements, the creation of new banks, licensing of banking activities, liquidity and diversification requirements, governance of banks, asset classifications, loan-loss provisioning practices, capital requirements, accounting and information disclosure requirements, deposit guarantee schemes, supervisory powers, information about supervisory agencies, characteristics of banking systems, and issues related to systemic risk mitigations and consumer protections. Compared to the raw survey files, the database was built on revived, cleaned, and updated information. The respondent countries' answers were transformed into scores and aggregated to construct more than 52 indexes on different aspects of bank regulations and supervision. Two types of indexes were constructed for each variable. First is the general type, which is calculated only if corresponding answers are available. Second is the average scaled type, which is calculated as an average of the available answers weighted by the total number of questions in a particular index (when at least 50% of the responses are available and at least three or more questions are used in

[8] Available online at http://faculty.haas.berkeley.edu/ross_levine/Regulation.htm.

a particular index).[9] We mostly used the average scaled indexes related to bank supervision (such as the powers of supervisors, supervisory structures, and transparency of financial statements).

Because the database of J. R. Barth, Caprio, and Levine (2013a) contains information from only four rounds of BRSS, we updated this database with results from the fifth round, published in late 2019 and updated in May 2021, which includes the most recent bank supervision developments from 2011–2016. It also includes additional questions related to the Basel III capital and liquidity requirements, bank resolution mechanisms, and macroprudential supervision (Anginer et al., 2019).[10] We replicated the approach[11] of J. R. Barth, Caprio, and Levine (2013a) to create indexes related to bank supervision for the fifth round of the survey. Consequently, we were able to compare the state of, and changes in, bank supervision over almost two decades and across several countries, including the period directly before GFC and several years afterward. Studies applied the linear interpolation method to BRSS data to extend the period of their data (He et al., 2021), and others utilized data from each survey for a specified number of years before and after a particular survey (Agoraki et al., 2011). We believe that the advantages of having data across a longer time span outweighs any limitations in the methods used to obtain the data.

[9] For detailed information on this database, data cleaning, and index creation processes, please see J. R. Barth, Caprio, and Levine (2013a).

[10] Anginer et al. (2019) mentioned that the fourth round of BRSS still contains only minor, immediate changes in bank supervision. In contrast, the fifth round provides an opportunity to examine wide scale reforms worldwide, including supervision, regulations, cross-border cooperation, and resolution mechanisms.

[11] We used the same method to quantify the answers to the same questions across all five rounds and then aggregated them into indexes. Accordingly, we can compare the data across all the rounds of the survey.

In addition, we utilize banking sector and macroeconomic data from the World Bank's Global Financial Development Database (November 2021 version) (World Bank, 2019b), data on central banks' involvement in bank supervision (Fraccaroli, 2019) and the IMF Financial Development Index database (Sahay et al., 2015; Svirydzenka, 2016). In addition, we used information on the classification of supervisory frameworks obtained from Sohn and Vyshnevskyi (2020).

(Table 3)

Using these databases, we constructed our sample of 970 observations for 194 countries, territories, and unions across five periods. We initially considered over 70 variables, which characterized each country's information such as bank supervision, banking sector development, main macroeconomic characteristics, the efficiency of government, and rule of law. Taking into account the short observation period for some data series, due to missing values, and after checking our data for correlation and multicollinearity between variables,[12] we utilized 21 variables in total (see Table 3 for the list of the main variables and their descriptions). Further, we checked all variables for outliers to determine if they existed, and then to minimize their influence.

3.2 Methodology

Following existing literature in the field and the recent developments and applications of econometrics analyses, we adopted several techniques to address our research questions and hypotheses, considering the short period of the data (Barth et al., 2008; Danisman & Demirel, 2019; Demirgüç-Kunt & Detragiache, 2005; Doumpos et al., 2015). We applied econometrics tools such

[12] The results are not included but can be provided on request.

as a linear probability model, ordered logit model, and fixed-effect estimators, which are widely used in this type of research, to fully address the research question and examine our hypotheses.

To validate our hypotheses, we developed the following empirical strategy: First, each of the five applicable dependent variables is regressed on the bank's supervisory powers, institutional changes in the sector's supervision, and a set of banking-sector and country-specific variables:

$$Y_{itl} = \beta_0 + \beta_1 Supervisory\ power_{it} + \beta_2 Change\ in\ supervision_{itk} + \gamma Controls_{it} + \sum_{j=1}^{5} \theta_j S_j + \alpha_i + \varepsilon_{it} \quad (1)$$

where i = 1, 2,……N denotes the countries, t = 1, 2, 3,……T refers to the survey number, k stands for two measures of changes in financial sector supervision, and l is a particular dependent variable.

Thereafter, we add a square term for the supervisory power measure to test for non-linearity, as stated in Eq. (2):

$$Y_{itl} = \beta_0 + \beta_1 Supervisory\ power_{it} + \beta_2 Change\ in\ supervision_{itk} + \beta_3 Supervisory\ power_{it}^{2} + \gamma Controls_{it} + \sum_{j=1}^{5} \theta_j S_j + \alpha_i + \varepsilon_{it} \quad (2)$$

Finally, we add an interaction term between the bank's supervisory power and institutional changes in the sector's supervision, as stated in Eq. (3):[13]

[13] Although, some studies apply centering to reduce multicollinearity between variables (Agoraki et al., 2011), we did not center or standardize the variables because according to (Brambor et al., 2006), algebraically, the centered and uncentered models are equal because "we can unequivocally state that centering does not change the statistical certainty of the estimated effects and, therefore, cannot really mitigate any multicollinearity issues that exist. Scholars should stop justifying the use of centered variables or the omission of constitutive terms in interaction models by claiming that this reduces multicollinearity" (p. 71).

$$Y_{itl} = \beta_0 + \beta_1 Supervisory\ power_{it} + \beta_2 Change\ in\ supervision_{itk} +$$
$$\beta_3 Supervisory\ power_{it}^2 + \beta_4 Supervisory\ power_{it} * Change\ in\ supervision_{itk} +$$
$$\gamma Controls_{it} + \sum_{j=1}^{5} \theta_j S_j + \alpha_i + \varepsilon_{it} \quad (3)$$

To determine if our hypotheses are supported, we utilize five dependent variables (Y_{itl}). The first dependent variable is the indicator of a systemic banking crisis for country i during the time of the survey t (i.e., a binary variable), where one indicates a crisis.[14] Accordingly, by utilizing this variable, we can observe the change in crisis probability (i.e., banking sector fragility) provided there is a change in the supervisory power and institutional changes in the sector's supervision.[15]

For the second dependent variable, based on (Doumpos et al., 2015; Laeven and Levine, 2009), we use the logarithm of the bank's Z-score (World Bank, 2019b) as a proxy for banking system soundness, to determine if there is a change in the bank's level of financial stability due to changes in supervisory powers and institutional changes in supervision. The Z-score is widely used as an indicator of banks' default risks or as a proxy to measure the credit quality of different entities.

[14] According to the explanation from the World Bank data catalog, "A banking crisis is defined as systemic if two conditions are met: a. Significant signs of financial distress in the banking system (as indicated by significant bank runs, losses in the banking system, and/or bank liquidations), b. Significant banking policy intervention measures in response to significant losses in the banking system. The first year that both criteria are met is considered as the year when the crisis start becoming systemic. The end of a crisis is defined the year before both real GDP growth and real credit growth are positive for at least two consecutive years." https://datacatalog.worldbank.org/banking-crisis-dummy-1banking-crisis-0none.

[15] The distribution of systemic banking crises for each survey period is presented in the appendix, Table A1.

The third and fourth dependent variables are the averaged scale indexes of the overall limitations of banks' activities and capital regulatory stringency determined by extending the data from J. R. Barth, Caprio, and Levine (2013a) based on BRSS (World Bank, 2019a), where higher values indicate greater stringency and restrictive practices respectively. The index of activity restrictions indicates whether or not banks are allowed to engage in non-traditional businesses (e.g., real estate, security, or insurance). The capital regulatory stringency index measures the bank's capital regime in terms of minimum capital requirements and requirements for capital components and deductions (i.e., initial, and overall capital stringency). Accordingly, we examine the implications of supervisory powers and institutional changes in supervision on the supervisors' capacity for activity restriction and capital regulation. Both indexes are discrete and range from zero to twelve and zero to ten respectively, though a few values are single-digit decimal numbers.

Finally, supervisors' independence is measured by the index of the supervisory authority's overall independence by extending the data of J. R. Barth, Caprio, and Levine (2013a) based on BRSS (World Bank, 2019a), where higher values indicate greater independence. The index shows the authority's independence in three dimensions: (i) independence from political influence with respect to accountability and responsibility; (ii) independence from the banking sector in terms of the legal protection of the sectors' supervisors; and (iii) decision-making independence from any political-related considerations, related to the existence of the fixed-term appointment of top management of the supervisory body. As such, we determine the impact of supervisory powers and institutional changes in supervision, on the extent to which the supervisory authority, whether it is a central bank or any other supervisory institution, is free from political or government influences. The index is discrete and ranges from zero to three.

There are two key explanatory variables that are relevant. First, $Supervisory\ power_{it}$, is the averaged scale index (greater powers are indicated by higher values) of the official supervisory power by extending the data used in Barth, Caprio, and Levine (2013a) based on BRSS (World Bank, 2019a), which shows whether supervisory agencies have the authority to demand a change in a bank's internal organizational structure, implement procedures to avoid and resolve issues, and sanction the bank's management, shareholders, or external auditors. Second, institutional changes in supervision ($Change\ in\ supervision_{itk}$), which is measured by two separate indicators. The first, k, is a binary indicator of changes in financial sector supervisory architecture during 2007–2016 (where one indicates establishing a new or closing an old agency after GFC) based on (Sohn and Vyshnevskyi, 2020). The second is a binary indicator of changes in a central bank's involvement in bank supervision (where one indicates that a central bank is either uninvolved or shares involvement, or that a central bank was turned into a monopoly after GFC) based on Fraccaroli (2019). These variables allow us to determine whether institutional changes in supervision are significantly connected to changes in banking supervision powers. We applied these two indicators of institutional changes in supervision, separately in our regression analyses.

However, we are mainly concerned with the coefficient of (β_4) on the interaction term of supervisory agencies' official supervisory powers and institutional changes in financial sector supervision. As expected the effect of changes in supervisory powers on banking crisis probability is associated with the changes in sector supervision, which means that the expected sign is negative. In addition, we expect to see a negative sign in the measure of the banking authority's independence. For the remaining three dependent variables, we foresee them having individual positive effects on the relevant factors.

Following the literature and considering data availability, we further utilized bank, sector specific, and macroeconomic explanatory variables as controls. They are included in the vector $Controls_{it}$ to improve the accuracy of our model. All the variables are specified in Table 3.

In addition, $\propto_i$ is a country-level fixed effect that captures unobserved country characteristics, and S_j is a dummy variable for surveys to capture a survey fixed effect. These variables greatly reduce the chance of omitted variable bias problems. ε_{it} is a vector of the residuals. Furthermore, we lagged all the independent variables by one period to mitigate the possible reverse causality issue, despite this method reducing the sample size.

First, we applied a linear probability model (LPM) estimator with robust standard errors clustered at the country level to assess banking sector fragility. The reason for this is that we have a binary dependent variable (systemic bank crises across countries). It gives us a chance to observe the probability of a banking crisis at the current level of bank supervision. The probability of a crisis occurring is theoretically a function of a vector of explanatory variables in this method (Demirgüç-Kunt & Detragiache, 2000, 2005). Although a multivariate fixed-effects logistic regression method (fixed effects logit model for panel data) might be a good method to use in this case, due to sample size, the model did not converge.

Second, given the discrete ordinal nature of the measures of the supervisory authority's independence (the index takes only zero, one, two, and three as values), the bank's activity restrictions, and capital regulatory stringency, we utilized a fixed effects (conditional) ordered logistic methodology by applying the "blow-up and cluster" (BUC) estimator (Baetschmann et al., 2015) with robust standard errors clustered at the country level. This allows us to account for the dependent variables' nature and country-specific correlated unobserved heterogeneity. Similarly, we applied LPM estimation to test the robustness of this method.

Finally, to assess Hypothesis 5, we applied a panel data, fixed effect estimator, to fully take advantage of the longitudinal structure of our data, with robust clustering at the country level.

4. Empirical results

Table 4 presents the regression analysis results related to the first hypothesis on the banking sector's fragility. Different specifications are included in our model as follows: columns (1) and (4) include separate specifications for two measures of institutional changes in banking supervision (Eq. (1)). We added a supervisory power quadratic term (Eq. (2)) to the model specifications, the results are shown in columns (2) and (5). Columns (3) and (6) display the results of adding in the interactions between supervisors' power and institutional changes (Eq. (3)). These six specifications include banking sector and country-specific controls as well as time and country fixed effects.

(Table 4)

The LPM regression results presented in Table 4 confirm the expected results that supervisory power has a decreasing effect on the likelihood of a systemic banking crisis, though this effect is not statistically significant. This aligns with Doumpos et al. (2015), who also showed that increases in supervisory powers mitigated crises impacts. Simultaneously, our results show that the quadratic term of supervisory power is not meaningful across all the related specifications (columns 2, 3, 5, and 6). In addition, the coefficient of the interaction term, shown in column (6) indicates that if a country experienced institutional changes in supervision (measured by changes in a central bank's involvement in bank supervision) and an increase in supervisory power, it is less likely that a banking crisis will happen in the following period, ceteris paribus. In other words, if a central bank's involvement equals one, and supervisory power increases by one unit, the

probability of a systemic banking crisis occurring will decrease by 0.067. This finding is statistically significant, though only at 10%. Simultaneously, the total diminishing effect of a supervisory power on the probability of a banking crisis occurring is approximately 0.083, (-0.016 + 2*0.001*1 - 0.067*1 = - 0.083). The interaction term from the specification shown in column (3) is unfortunately irrelevant. Generally, our approach was based on that of (Demirgüç-Kunt and Detragiache, 2000), however, we applied LPM instead of a multivariate logit model.

Table 5 presents the empirical results of banks' stability levels as measured by their Z-scores. These results allow us to determine if our second hypothesis is supported. The specifications were modeled in accordance with the specifications previously described and most of them prove that the direct relationships between supervisory powers and banks' stability are positive, though statistically significant only in the specifications shown in columns (2) and (3) at 10%. Furthermore, the quadratic terms' coefficients of supervisory power are negative across all the specifications, and two of them are statistically significant at 10%. As such, the specifications shown in columns (2) and (3) demonstrate that there is a nonlinear relationship between banking sector stability and supervisory powers. This result means that an increase in supervisory powers will affect the banking sector's stability to a certain point, and thereafter further increases in supervisory powers will be less effective. Moreover, the specification shown in column (6), which is based on Eq. (3), shows that the supervisory power's stringency in the countries, where the central bank's involvement in supervision has been changed, has a positive relationship with the bank's level of stability at 5%. In other words, when a central bank's involvement equals one and supervisory power is increased by one unit, the bank's Z-score will increase by 0.63. This confirms the findings of Doumpos et al. (2015).

(Table 5)

The results of the regression analysis to test our third hypothesis on limiting banks' activities are shown in Table 6. Unfortunately, these results do not allow us to confirm the related hypothesis or derive any meaningful implications. However, this does not mean that there is no actual relationship. The signs of the supervisory power coefficient, across all the specifications which were modeled in accordance with the specifications previously described, are diverse. Therefore, the relationship between supervisory powers and banks' activity limitations is ambiguous and there is no direct effect. Moreover, applying LPM with the same specifications did not reveal any meaningful results either.[16]

(Table 6)

Table 7 shows the empirical results on capital regulatory stringency which allows us to test the validity of our fourth hypothesis. The six specifications were modeled in accordance with the specifications previously described. The specification shown in column (3), which is based on Eq. (3), proves that the stringency of supervisory power, in countries where institutional changes in supervision occurred after GFC, has a negative relationship with the capital regulatory regime, though only at 10%. In other words, when supervisory architecture equals one and supervisory power increases by one unit, capital regulatory stringency will decrease by 4.993 (in the ordered log-odds scale). This finding is aligned with observations of Anginer et al. (2019). Simultaneously, the specification shown in column (3) indicates that if the total impact of supervisory power increases by one unit, capital regulatory stringency will decrease by 2.014 (in the ordered log-odds scale), (5.085 - 2*1.053*1 - 4.993*1 = -2.014). In addition, the specifications shown in columns 4 and 5, where we utilize changes in a central bank's involvement in supervision to measure

[16] The results of the robustness test using LPM are shown in the appendix, Table A2.

institutional changes in supervision, show mixed results. The robustness test using LPM confirms most of the estimates.[17]

(Table 7)

Finally, Table 8 presents the results of our regression analysis, used to test the validity of our fifth hypothesis, related to supervisory authority independence. The specifications, which were modeled in accordance with the specifications previously described, show that the coefficients of supervisory power are negative, indicating an inverse relationship between power and the independence of supervisors. Most of the coefficients are statistically significant at either 5% or 10%. Furthermore, the quadratic term of supervisory power is significant across all the related specifications (see columns 2, 3, 5, and 6), which proves the presence of non-linearity. Moreover, the interaction term coefficient of the specification shown in column (3) reveals that if a country experienced institutional changes in supervision during 2007–2016 (measured by changes in financial sector supervisory architecture during that period) and an increase in supervisory power, the independence of a banking supervisor in the subsequent period will be lower, ceteris paribus. This means that reforming the banking sector supervision architecture, after GFC, may cause a powerful supervisory authority to have even less independence than at other times. In other words, when supervisory architecture equals one and supervisory power increases by one unit, the supervisory authority's independence will decrease by 12.645 (in the ordered log-odds scale). This finding is statistically significant at 5%. This result is aligned with previous findings which stated that higher central bank independence results in a decline in its macro-supervisory powers (Masciandaro, 2020; Masciandaro and Volpicella, 2016). The interaction term from the

[17] The results of the robustness test using LPM are shown in the appendix, Table A3.

specification shown in column (6) has the same sign, however, it is not significant. In addition, the robustness tests confirm most of the estimates.[18]

(Table 8)

5. Conclusions and policy implications

The years following GFC have been marked by intense discussion and debates on banking supervision from various perspectives. However, few studies have determined if a change in the supervisory powers of banking authorities has a nonlinear impact on the banking sector and supervision per se.

In this study, we analyzed the direct and indirect relationships between banking authorities' supervisory powers and banking sector fragility, the stability of the banking sector, restricting banks' activities, capital regulation stringency, and the independence of supervisory authorities, while accounting for the institutional changes in supervision. We utilized a dataset spanning more than 190 countries and five rounds of BRSS.

Our findings have implications for policymakers and supervisory agencies. The results indicate that an increase in supervisory power, accompanied by a change in a central bank's involvement in banking supervision, led to a decrease in banking sector fragility. In other words, a change in supervisory power must be accompanied by institutional changes in supervision to lower the probability of banking crises occurring. Furthermore, we find that the stringency of supervisory powers, in countries where their central bank's involvement in supervision was changed, had a positive effect on the stability of the banking sector. In addition, we found that

[18] The results of the robustness test using LPM are shown in the appendix, Table A4

capital regulation stringency weakened in countries where an increase in supervisory powers was accompanied by institutional changes in supervision after GFC. This shows that capital stringency on average weakened, however, institutional changes and increases in supervisory powers compensated for this. Nevertheless, we are of the opinion that any reduction in capital requirements must be approached with caution. Finally, our investigation revealed that the independence of banking supervisory authorities decreased in response to an increase in supervisory powers in countries where institutional changes in supervision happened after GFC. This may prove that governments prefer to maintain a balance between supervisors' power and independence. For example, some countries may compensate for an increase in supervisors' powers by limiting the independence of banking authorities. Moreover, the direct relationship between supervisory powers and the independence of authorities is indeed nonlinear and diminishing.

Our study has several limitations. The largest one is the nature and size of our data sample, which limits our identification strategy to a certain extent. Furthermore, although we have mitigated possible endogeneity by utilizing lagged independent variables, another possible source of endogeneity might be an omitted variable bias issue. A natural way of dealing with this is the instrumental variable (IV) technique. However, finding an acceptable instrument in an empirical study related to banking and finance is challenging.[19]

[19] This is because of the large interconnectedness between variables. The usual way is to utilize lagged independent variables as instruments, however, because of the short number of periods, this option is unavailable to us.

Future studies can confirm the generality of our findings by gathering more data on more countries for longer periods. In addition, future studies can include more banking supervision characteristics in their examinations.

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Table 1. Tested hypotheses.

No.	Tested hypotheses	Description	Expected sign
1	Banking sector fragility	Banking system fragility after changes in supervisor powers, accompanied by the institutional changes in supervision, decreased	(-)
2	Banks' stability	Bank-level financial stability after changes in supervisor powers, accompanied by the institutional changes in supervision, increased	(+)
3	Bank activity restrictions	Bank activity restrictions after changes in supervisor powers, accompanied by institutional changes in supervision, increased	(+)
4	Capital regulation stringency	Capital regulatory stringency after changes in supervisor powers, accompanied by institutional changes in supervision, increased	(+)
5	Banking supervision independence	Supervisors' independence after changes in supervisor powers, accompanied by institutional changes in supervision, increased	(+)

Table 2. World Bank - Bank Regulation and Supervision Survey a summary of all five rounds.

Round	Year		Number of	
	Base	Released	Participant Countries	Questions (over)
1	1999	2001	118	300
2	2002	2003	151	275
3	2006	2007	143	300
4	2011	2012	142	300
5	2016	2019	160	361

Notes: Authors' compilations based on World Bank's data and information (https://www.worldbank.org/en/research /brief/BRSS).

Table 3. Summary statistics of variables used.

Variable	N	Mean	Std. Dev.	Min	Max	Definition
Dependent variables						
Banking crisis dummy	910	0.04	0.20	0.00	1.00	Systemic banking crisis indicator
Index of overall independence of supervisory authorities	672	1.82	0.81	0.00	3.00	The degree to which the supervisory authority is legally protected from the banking sector and is independent of the government
Banking activity restrictions index	740	7.37	2.18	0.00	12.00	Overall limitations on banks' activities
Capital regulatory index	732	6.71	1.94	1.00	10.00	Overall capital regulatory stringency
Bank Z-score logged	814	2.39	0.74	-4.09	4.11	Financial stability indicator at banks' levels
Key independent variables						
Official supervisory power index	788	10.99	2.64	0.00	16.50	Measure of supervisor's authority to implement corrective actions on banks
Supervisory architecture change	970	0.07	0.25	0.00	1.00	Binary indicator of changes in financial sector supervisory architecture from 2007-2016
Central bank involvement change	970	0.07	0.25	0.00	1.00	Binary indicator of changes in central banks' involvement in bank supervision
Control variables						
Banking sector level						
Financial statement transparency index	802	4.77	1.12	0.00	6.00	Bank's transparency in financial statement practices
Value of deposit money banks' assets to GDP ratio (%)	910	48.55	50.85	0.00	709.19	Measure of banking sector size
Concentration ratio (%)	709	69.12	19.92	18.39	100.00	Banking sector concentration
Cost to income ratio (%)	815	57.43	16.62	19.90	218.09	Banking sector cost-efficiency
Noninterest income to total income ratio (%)	813	38.59	14.80	0.11	86.67	Banking sector operational diversification
Overhead costs to total assets (%)	812	3.88	3.11	0.04	28.64	Banking sector non-operating cost-efficiency
ROA (%)	812	1.32	2.09	-21.77	15.11	Banking sector financial performance
Country level						
GDP growth (annual, %)	869	3.95	4.43	-12.71	34.47	Economic growth/conditions
Log of GDP per capita	864	8.49	1.54	5.26	11.59	Indicator of economic performance
Exports of goods and services to GDP ratio (%)	801	41.76	29.60	0.10	228.04	Measure of economy openness
Central bank assets to GDP ratio (%)	779	5.83	11.07	0.00	170.57	Central bank involvement
Financial development index	845	0.30	0.23	0.02	0.98	Measure of country's financial system development
Rule of law index	881	-0.01	0.98	-2.24	2.04	Captures perceptions of the extent to which agents have confidence in, and abide by the rules of society

Table 4. Linear probability model regression results: Systemic banking crises.

	(1)	(2)	(3)	(4)	(5)	(6)
Superv. power	-0.002	-0.019	-0.031	-0.002	-0.018	-0.016
	(0.006)	(0.029)	(0.030)	(0.006)	(0.029)	(0.029)
Superv. power sqrt.		0.001	0.001		0.001	0.001
		(0.001)	(0.001)		(0.001)	(0.001)
Superv. architecture change	0.026	0.024	-0.414			
	(0.083)	(0.083)	(0.269)			
Superv. architecture change * Superv. power			0.043			
			(0.029)			
Central bank involvement				0.085	0.084	0.857*
				(0.073)	(0.073)	(0.465)
Central bank involvement * Superv. power						-0.067*
						(0.037)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Survey FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	130	130	130	130	130	130
R^2 adj.	0.139	0.138	0.146	0.142	0.141	0.160
Observations	432	432	432	432	432	432

Notes: Dependent variables: Crisis, is the banking crisis dummy (1=banking crisis, 0=none) from the World Bank Global Financial Development dataset. Superv. power is the Official supervisory power index based on rounds 1–5 of the World Bank's survey on bank regulations. Superv. architecture change is a dummy variable indicating the changes in financial sector supervisory architecture during 2007-2016 (1=new or old closed agencies) based on Sohn and Vyshnevskyi (2020). Central bank involvement is a binary indicator of changes in a central bank's involvement in bank supervision based on Fraccaroli (2019). Controls include the Financial statement transparency index, bank concentration ratio, bank cost to income ratio, bank overhead costs to total assets, bank non-interest income ratio, bank after-tax ROA, annual GDP growth, log of GDP per capita, deposit money bank assets to GDP ratio, exports of goods and services to GDP ratio, Financial development index, and Rule of law index. All independent variables are lagged for 1 period. All specifications are based on a linear probability model, account for fixed effects (FE), and control for time fixed effects. The quadratic term for Superv. power is included (Superv. power sqrt.). A constant is not reported but included in all the specifications. Robust standard errors are in parentheses and clustered at the country level. *, **, and *** denote significance at 10%, 5%, and 1%, respectively.

Table 5. Panel fixed effects regression results: banks' Z-score.

	(1)	(2)	(3)	(4)	(5)	(6)
Superv. power	-0.001	0.916*	1.447*	0.015	0.478	0.503
	(0.109)	(0.500)	(0.848)	(0.119)	(0.547)	(0.519)
Superv. power sqrt.		-0.213*	-0.327*		-0.108	-0.123
		(0.117)	(0.184)		(0.132)	(0.127)
Superv. architecture change	0.377*	0.392*	1.249			
	(0.211)	(0.211)	(0.914)			
Superv. architecture change * Superv. power			-0.364			
			(0.345)			
Central bank involvement				0.119	0.118	-1.381*
				(0.156)	(0.157)	(0.833)
Central bank involvement * Superv. power						0.630**
						(0.311)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Survey FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	121	121	121	121	121	121
R^2 adj.	0.072	0.072	0.073	0.040	0.038	0.045
Observations	389	389	389	389	389	389

Notes: Dependent variables: log of Bank Z-score from the World Bank's Global Financial Development Database. Superv. power is the Official Supervisory Power index based on rounds 1-5 of the World Bank's survey on bank regulations. Superv. architecture change is a dummy variable indicating changes in financial sector supervisory architecture during 2007-2016 (1=new or old closed agencies) based on Sohn and Vyshnevskyi (2020). Central bank involvement is a binary indicator of changes in a central bank's involvement in bank supervision based on Fraccaroli (2019). Controls include the Financial statement transparency index, central bank assets to GDP ratio, bank concentration ratio, bank cost to income ratio, bank noninterest income to total income ratio, annual GDP growth, log of GDP per capita, exports of goods and services to GDP ratio, deposit money bank assets to GDP ratio, Financial development index, and Rule of law index. All independent variables are lagged for 1 period. All specifications are based on linear probability methodology, account for fixed effects (FE), and control for time fixed effects. The quadratic term for Superv. power is included (Superv. power sqrt.). A constant is not reported but included in all the specifications. Robust standard errors are in parentheses and clustered at the country level. *, **, and *** denote significance at 10%, 5%, and 1%, respectively.

Table 6. Ordered logit regression results: Overall limitations for bank activities index.

	(1)	(2)	(3)	(4)	(5)	(6)
Superv. power	1.193*	-1.603	0.322	1.169*	-0.911	-0.907
	(0.623)	(4.910)	(5.567)	(0.600)	(4.802)	(4.805)
Superv. power sqrt.		0.651	0.236		0.484	0.482
		(1.141)	(1.273)		(1.126)	(1.129)
Superv. architecture change	-0.951	-0.978	3.004			
	(0.652)	(0.647)	(3.459)			
Superv. architecture change * Superv. power			-1.663			
			(1.514)			
Central bank involvement				-0.406	-0.391	-0.647
				(0.863)	(0.861)	(3.631)
Central bank involvement * Superv. power						0.108
						(1.581)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Survey FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	98	98	98	98	98	98
Pseudo-R^2	0.243	0.244	0.246	0.236	0.236	0.236
Log-likelihood	-344.398	-343.976	-343.006	-347.620	-347.386	-347.384
Observations	337	337	337	337	337	337

Notes: Dependent variables: Overall limitations for bank activities index (by type of activity) based on rounds 1-5 of the World Bank's survey on bank regulation (higher values indicate more restrictions). Superv. power is the Official supervisory power index based on rounds 1-5 of the World Bank surveys on bank regulation. Superv. architecture change is a dummy variable for changes in financial sector supervisory architecture during 2007-2016 (1=new or old closed agencies) based on Sohn and Vyshnevskyi (2020). Central bank involvement is a binary indicator of changes in a central bank's involvement in bank supervision based on Fraccaroli (2019). Controls include the Financial statement transparency index, central bank assets to GDP ratio, bank concentration ratio, bank cost to income ratio, bank noninterest income to total income ratio, annual GDP growth, log of GDP per capita, exports of goods and services to GDP ratio, deposit money banks' assets to GDP ratio, Financial development index, and Rule of law index. All specifications are based on multivariate ordered logit methodology, account for fixed effects (FE), and control for time fixed effects. The quadratic term for Superv. power is included (Superv. power sqrt.). Robust standard errors are in parentheses and clustered at the country level. *, **, and *** denote significance at 10%, 5%, and 1%, respectively.

Table 7. Ordered logit regression results: Capital regulatory stringency.

	(1)	(2)	(3)	(4)	(5)	(6)
Superv. power	0.203	0.446	5.085	0.068	-2.108	-1.810
	(0.546)	(5.007)	(6.363)	(0.573)	(4.609)	(4.674)
Superv. power sqrt.		-0.057	-1.053		0.518	0.435
		(1.208)	(1.504)		(1.107)	(1.126)
Superv. architecture change	1.314	1.329	13.019*			
	(0.919)	(1.026)	(6.883)			
Superv. architecture change * Superv. power			-4.993*			
			(2.909)			
Central bank involvement				0.974	0.982	-3.548
				(0.906)	(0.896)	(8.166)
Central bank involvement * Superv. power						1.815
						(3.352)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Survey FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	103	103	103	103	103	103
Pseudo-R^2	0.399	0.399	0.405	0.396	0.397	0.397
Log-likelihood	-842.366	-842.358	-833.884	-846.678	-845.907	-844.847
Observations	353	353	353	353	353	353

Notes: Dependent variables: the Capital Regulatory index based on rounds 1-5 of the World Bank's survey on bank regulation (higher values indicate greater stringency). Superv. power is the Official supervisory power index based on rounds 1-5 of the World Bank's survey on bank regulation. Superv. architecture change is a dummy variable indicating changes in financial sector supervisory architecture during 2007-2016 (1=new or old closed agencies) based on Sohn and Vyshnevskyi (2020). Central bank involvement is a binary indicator of changes in a central bank's involvement in bank supervision based on Fraccaroli (2019). Controls include the Financial statement transparency index, central bank assets to GDP ratio, bank concentration ratio, bank cost to income ratio, bank noninterest income to total income ratio, annual GDP growth, log of GDP per capita, exports of goods and services to GDP ratio, deposit money banks' assets to GDP ratio, Financial development index, and Rule of law index. All specifications are based on multivariate ordered logit methodology, account for fixed effects (FE), and control for time fixed effects. The quadratic term for Superv. power is included (Superv. power sqrt.). Robust standard errors are in parentheses and clustered at the country level. *, **, and *** denote significance at 10%, 5%, and 1%, respectively.

Table 8. Ordered logit regression results: Supervisory authorities' independence.

	(1)	(2)	(3)	(4)	(5)	(6)
Superv. power	-0.605	-13.292**	-12.522*	-0.758	-13.228**	-12.951*
	(0.782)	(6.621)	(6.407)	(0.788)	(6.731)	(6.721)
Superv. power sqrt.		2.867*	2.711*		2.821*	2.768*
		(1.510)	(1.475)		(1.538)	(1.533)
Superv. architecture change	0.401	0.480	31.830**			
	(0.820)	(0.816)	(12.989)			
Superv. architecture change * Superv. power			-12.645**			
			(5.192)			
Central bank involvement				-2.142***	-2.154***	0.090
				(0.734)	(0.724)	(4.253)
Central bank involvement * Superv. power						-0.948
						(1.789)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Survey FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	78	78	78	78	78	78
Pseudo-R^2	0.277	0.288	0.293	0.299	0.309	0.310
Log-likelihood	-97.578	-96.089	-95.394	-94.644	-93.243	-93.178
Observations	365	365	365	365	365	365

Notes: Dependent variables: Independence of Overall supervisory authority index based on rounds 1-5 of the World Bank's surveys on bank regulation. Superv. power is the Official supervisory power index based on rounds 1-5 of the World Bank's survey on bank regulation. Superv. architecture change is a dummy variable for changes in financial sector supervisory architecture during 2007-2016 (1=new or old closed agencies) based on Sohn and Vyshnevskyi (2020). Central bank involvement is a binary indicator of changes in a central bank's involvement in bank supervision based on Fraccaroli (2019). Controls include the Financial statement transparency index, central bank assets to GDP ratio, bank concentration ratio, bank cost to income ratio, bank noninterest income to total income ratio, annual GDP growth, log of GDP per capita, exports of goods and services to GDP ratio, deposit money bank assets to GDP ratio, Financial development index, and Rule of law index). All specifications are based on multivariate ordered logit methodology, account for fixed effects (FE), and control for time fixed effects. The quadratic term for Superv. power is included (Superv. power sqrt.). Robust standard errors are in parentheses and clustered at the country level. *, **, and *** denote significance at 10%, 5%, and 1%, respectively.

Appendix

Table A1. Systemic banking crises over each survey.

Banking crisis dummy (1=banking crisis, 0=none)	World Bank Survey number					
	1	2	3	4	5	Total
0	168	178	182	167	179	874
1	14	4	0	15	3	36
Total	182	182	182	182	182	910

Table 2A. Robustness check of Table 7 LPM regressions' results: capital regulatory index.

	(1)	(2)	(3)	(4)	(5)	(6)
Superv. power	0.189	-2.385	2.816	0.273	-3.349	-3.320
	(0.451)	(4.214)	(3.648)	(0.456)	(4.521)	(4.490)
Superv. power sqr.		0.600	-0.516		0.844	0.833
		(0.985)	(0.872)		(1.046)	(1.038)
Superv. architecture change	0.701	0.659	8.982***			
	(0.505)	(0.493)	(1.853)			
Superv. architecture change * Superv. power			-3.534***			
			(0.817)			
Central bank involvement				1.470**	1.486**	0.691
				(0.643)	(0.636)	(2.700)
Central bank involvement * Superv. power						0.329
						(1.183)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Survey FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	120	120	120	120	120	120
R^2 adj.	0.360	0.359	0.372	0.369	0.369	0.368
Observations	377	377	377	377	377	377

Notes: The dependent variable: Capital Regulatory Index based on the 1-5 waves of the World Bank surveys on bank regulation (higher values indicate greater stringency). Superv. power stands for the index of Official Supervisory Power based on the 1-5 waves of the World Bank surveys on bank regulation; Superv. architecture change is a dummy of Changed in financial sector supervisory architecture in 2007-2016 (1=new agencies or closed old ones) based on (Sohn & Vyshnevskyi, 2020); Central bank involvement is a binary indicator of changes in central bank involvement into bank supervision based on (Fraccaroli, 2019). Controls include the index of Financial Statement Transparency, central bank assets to GDP, bank concentration ratio, bank cost to income ratio, bank noninterest income to total income ratio, annual GDP growth, log of GDP per capita, exports of goods and services to GDP ratio, deposit money bank assets to GDP ratio, financial development index, Rule of Law index). All specifications are based on LPM methodology, account for fixed effects and controlled for time fixed effects. Quadratic term for Superv. power is included (Superv. power sqr.). A constant is not reported but included in all specifications. Clustered on countries robust standard errors in parentheses. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Table 3A. Robustness check of Table 8 LPM regressions' results: Supervisory Authority Independence.

	(1)	(2)	(3)	(4)	(5)	(6)
Superv. power	-0.147	-1.097	-1.829	-0.170	-1.054	-1.055
	(0.155)	(1.550)	(1.479)	(0.153)	(1.518)	(1.521)
Superv. power sqr.		0.221	0.378		0.206	0.207
		(0.364)	(0.346)		(0.358)	(0.360)
Superv. architecture change	0.026	0.010	-1.195			
	(0.156)	(0.157)	(0.942)			
Superv. architecture change * Superv. power			0.511			
			(0.391)			
Central bank involvement				-0.474*	-0.470*	-0.436
				(0.281)	(0.280)	(1.153)
Central bank involvement * Superv. power						-0.014
						(0.460)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Survey FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	118	118	118	118	118	118
R^2 adj.	0.183	0.181	0.181	0.194	0.192	0.190
Observations	362	362	362	362	362	362

Notes: The dependent variable: Index of Independence of Overall Supervisory Authority based on the 1-5 waves of the World Bank surveys on bank regulation. Superv. power stands for the index of Official Supervisory Power based on the 1-5 waves of the World Bank surveys on bank regulation; Superv. architecture change is a dummy of Changed in financial sector supervisory architecture in 2007-2016 (1=new agencies or closed old ones) based on (Sohn & Vyshnevskyi, 2020); Central bank involvement is a binary indicator of changes in central bank involvement into bank supervision based on (Fraccaroli, 2019). Controls include the index of Financial Statement Transparency, central bank assets to GDP, bank concentration ratio, bank cost to income ratio, bank noninterest income to total income ratio, annual GDP growth, log of GDP per capita, exports of goods and services to GDP ratio, deposit money bank assets to GDP ratio, financial development index, Rule of Law index). All specifications are based on LPM methodology, account for fixed effects and controlled for time fixed effects. Quadratic term for Superv. power is included (Superv. power sqr.). A constant is not reported but included in all specifications. Clustered on countries robust standard errors in parentheses. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Table 4A. Robustness check of Table 6 LPM regressions' results: Overall limitations for bank activities index.

	(1)	(2)	(3)	(4)	(5)	(6)
Superv. power	0.513	-1.337	0.448	0.501	-0.317	-0.277
	(0.437)	(4.052)	(4.468)	(0.420)	(3.669)	(3.663)
Superv. power sqr.		0.431	0.048		0.190	0.175
		(0.945)	(1.027)		(0.861)	(0.862)
Superv. architecture change	-0.882	-0.913	1.948			
	(0.564)	(0.577)	(2.464)			
Superv. architecture change * Superv. power			-1.215			
			(1.065)			
Central bank involvement				0.168	0.171	-0.924
				(0.519)	(0.521)	(2.753)
Central bank involvement * Superv. power						0.453
						(1.105)
2.survey	reference					
3.survey	0.786***	0.789***	0.754***	0.773***	0.774***	0.772***
	(0.212)	(0.212)	(0.209)	(0.211)	(0.210)	(0.211)
4.survey	-0.280	-0.270	-0.321	-0.294	-0.290	-0.298
	(0.357)	(0.355)	(0.339)	(0.352)	(0.350)	(0.353)
5.survey	-0.030	-0.027	-0.096	-0.193	-0.194	-0.198
	(0.418)	(0.412)	(0.398)	(0.405)	(0.404)	(0.404)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Survey FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	119	119	119	119	119	119
R^2 adj.	0.160	0.158	0.159	0.148	0.146	0.144
Observations	378	378	378	378	378	378

Notes: The dependent variable: Overall limitations for bank activities index (by type of activity) based on the 1-5 waves of the World Bank surveys on bank regulation (higher values indicate more strictive). Superv. power stands for the index of Official Supervisory Power based on the 1-5 waves of the World Bank surveys on bank regulation; Superv. architecture change is a dummy of Changed in financial sector supervisory architecture in 2007-2016 (1=new agencies or closed old ones) based on (Sohn & Vyshnevskyi, 2020); Central bank involvement is a binary indicator of changes in central bank involvement into bank supervision based on (Fraccaroli, 2019). Controls include the index of Financial Statement Transparency, central bank assets to GDP, bank concentration ratio, bank cost to income ratio, bank noninterest income to total income ratio, annual GDP growth, log of GDP per capita, exports of goods and services to GDP ratio, deposit money bank assets to GDP ratio, financial development index, Rule of Law index). All specifications are based on LPM methodology, account for fixed effects and controlled for time fixed effects. Quadratic term for Superv. power is included (Superv. power sqr.). A constant is not reported but included in all specifications. Clustered on countries robust standard errors in parentheses. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.