WHAT DETERMINES BANK PRODUCTIVITY? INTERNATIONAL EVIDENCE ON THE IMPACT OF BANKING COMPETITION, BANK REGULATION, AND THE GLOBAL FINANCIAL CRISIS

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ABSTRACT

This chapter examines the impact of banking competition, bank regulation, and the global financial crisis (GFC) of 2008−2009 on banks' productivity changes. For the empirical analysis, I apply a semi-parametric two-step approach of Malmquist index estimates and bootstrap regression to a cross-country panel data of 8,451 commercial banks from 82 countries over the period 2004−2012. Empirical results show that (1) banking competition and capital regulation significantly enhance bank productivity, (2) a tighter bank supervision have a positive impact on bank productivity, and (3) bank productivity decreases during the GFC, but starts to increase as the GFC recovers. I also present

consistent evidence that commercial banks in countries with better national governance have higher productivity growth before, during and after the GFC.

Keywords: Bank productivity; banking competition; bank regulation and supervision; global financial crisis

JEL classifications: D24; G21; G28

INTRODUCTION

The recent global financial crisis (GFC) of 2008−2009 and European Sovereign Debt Crisis (ESDC) of 2010−2012 have been observed to inflict some harmful impacts on global syndicated lending (de Haas & van Horen, 2012, 2013; Giannetti & Laeven, 2012), bank performance (Beltratti & Stulz, 2012; Fahlenbrach, Prilmeier, & Stulz, 2012), and competition (Sun, 2011) in global banking. This observation invoked a strong interest to academic researchers and policy makers in examining whether changes in banking competition and bank regulations enhance bank productivity, performance, and stability or not (Barth, Lin, Ma, Seade, & Song, 2013). There has been little consensus as to what consists of good regulation and supervision, or how specific regulations influence the performance and stability in the banking industry (see Barth, Caprio, & Levine, 2004; Barth et al., 2013; Beck, Demirgüç-Kunt, & Levine, 2006; Delis, Molyneux, & Pasoiras, 2011; Demirgüç-Kunt, Detragiache, & Tressel, 2008). Furthermore, there are very few research which show the substantial influences of bank competition, regulation and supervision on bank performance, particularly in the context of GFC. To do this end, this chapter aims to contribute to the literature by investigating the differential impacts of banking competition, national governance, bank regulations and supervision on banks' total factor productivity (TFP) growth in the global banking sector.

More specifically, we focus on examining the impacts of (1) regulatory and supervisory policies related to the three pillars of Basel II and (2) restrictions on bank activities, on TFP growth of commercial banks in global banking. The existing banking literature, such as Tirtiroglu, Daniels, and Tirtigoglu (2005), provides some findings that banking deregulation may help explain bank productivity growth, although other single-country studies find no such relationship (Grifell-Tatje & Lovell, 1996). There is also a lack of cross-country evidence in previous studies. This chapter, therefore,

attempts to not only link bank productivity to a number of both internal and external determinants, but also aim to shed some light on the effects of GFC on global banks' productivity (Casu, Girardone, & Molyneux, 2004).

Therefore, based on the study of Delis et al. (2011), we first apply the Malmquist index methodology to calculate the growth rate of TFP of 4,518 commercial banks operating in 82 countries from 2004 to 2012. We thus use a robust bootstrap procedure combining the approach presented in Simar and Wilson (2007) as well as Khan and Lewbel (2007) to regress the TFP growth on measures characterizing the banking regulatory conditions across countries. The bank regulatory conditions are associated closely with the Basel II framework of capital requirements (CAP) (Pillar 1), supervision by the authorities (Pillar 2), and market discipline (Pillar 3). Besides, we also examine the impact of restrictions to bank activities as a potential factor influencing banks' TFP changes.

Empirical results indicate that bank regulations enhancing private monitoring (PMON) have a positive impact on productivity growth of banks. Furthermore, restrictions on bank activities relating to securities, insurance, real estate, and ownership of nonfinancial firms, promote bank productivity as well. In contrast, CAP and official supervisory power (SPR) have a statistically significant effect on TFP growth over the whole sample period of 2004−2012. Especially their influences persist during and after GFC. It confirms that tougher standards of capital requirements and SPR matter in terms of influencing bank productivity during and after GFC. Empirical findings also suggest that regulations and their enforcement are contributed to shaping bank performance (Barth, Caprio, & Levine, 2007; Delis & Staikouras, 2011).

The remainder of the chapter is organized as follows. The second section presents a review of the related literature on bank performance in global banking. The third section provides the methodology for estimation and regression equation specification. The fourth section presents variables and data sources. The fifth section discusses some empirical results, and finally, the sixth section concludes.

RELATED LITERATURE

Exploring the association between bank's TFP growth and the regulatory environment broadly relates to twofold strands of the empirical banking literature. The first encompasses studies that examine the relationship

between regulatory reforms and productivity growth. The second includes studies that examine the impact of regulations on various aspects of bank performance in a cross-country setting. The following sections discuss these strands of the literature.

Determinants of Bank Productivity

The first strand of literature focuses on the impact of regulatory reform on productivity growth. Tirtiroglu et al. (2005) explore the impact of U.S. intrastate and interstate deregulations on bank TFP growth and find that intrastate branching liberalization has a positive long-run impact on productivity growth of banks. Isik (2007) empirically investigates financial reform programs that took place in Turkey during the 1980s and finds that the productivity of banks improved significantly as the reform process accelerated. Similar results are obtained by Aysan and Ceyhan (2008) who test Turkish banking-sector reforms (BSRs) post-2001. Additionally, Gilbert and Wilson (1998) indicate that Korean banks responded to privatization and deregulation during the 1980s and early 1990s by altering their mix of inputs and outputs, generating large changes in productivity.

In comparison to the above findings, Tırtıroglu, Daniels, and Tirtiroglu (1998) find a negative association between regulatory initiatives and TFP growth in U.S. commercial banking over the period 1946−1995. Regulatory changes in banking include the Federal Deposit Insurance Act of 1950, the Competitive Equality Banking Act of 1987, the Depository Institutions Act of 1982, and the Depository Institutions Deregulation and Monetary Control Act of 1980, as the most influential regulatory initiatives. Furthermore, Grifell-Tatje and Lovell (1996) remark that the relaxation and removal of regulatory constraints in the Spanish savings bank sector cause an increase in branching and merger activity, though this case could not explain the magnitude or nature of productivity decreasing, which was found over the study period.

Typically, the literature that focuses on regulations and productivity tends to (1) examine individual countries, (2) evaluate overall regulatory reforms (usually captured by dummy variables) and productivity change over deregulation periods, and (3) generally yield conflicting findings. Regarding some studies on bank performance in transition countries, these studies, many of which focus on the new EU member states, explore various issues including the impact of ownership and privatization on bank efficiency (Bonin, Hasan, & Wachtel, 2005) and profitability (Naaborg &

Lensink, 2008), efficiency convergence (Mamatzakis, Staikouras, & Koutsomanoli-Filippaki, 2008), whether technical progress reduces bank costs (Kasman & Kirbas-Kasman, 2006), how competition impacts bank efficiency and TFP growth (Brissimis, Delis, & Papanikolaou, 2008), and whether BSRs influence efficiency (Fries, Neven, Seabright, & Taci, 2006; Koutsomanoli-Filippaki, Mamatzakis, & Staikouras, 2009) or TFP growth (Brissimis et al., 2008).

In general, the findings of the aforementioned literature are rather mixed. Only Brissimis et al. (2008) consider the impact of regulations on Banks' TFP growth. Using time dummies and the European Bank for Reconstruction and Development (EBRD) BSR index, they find that in the newly acceded 10 EU economies productivity is only positively affected in the latter stages of regulatory reform.

Cross-Country Impacts of Banking Regulations on Bank Performance

There is a relatively new literature examining the impact of supervision and regulatory policies on bank performance using cross-country data. Barth, Dopico, Nolle, and Wilcox (2002) focus on how regulatory features impact on various components of the CAMELS model − a bank-rating systems where supervisory authorities rate institutions according to six factors: capital adequacy, asset quality, management quality, earnings, liquidity, and sensitivity to market risks (Barth, Caprio, & Levine, 2003), or net interest margins and overhead costs (Demirgüç-Kunt, Laeven, & Levine, 2004). Moreover, Barth et al. (2004) show complete theoretical and empirical findings and focus on how the regulatory environment influences both banking industry development, the incidence of crises, via using a variety of conventional measures on bank performance.

More recent studies apply some frontier techniques to investigate the impacts of banking regulations and supervision on bank efficiency (Barth et al., 2013; Gaganis & Pasiouras, 2013; Pasiouras, 2008; Pasiouras, Tanna, & Zopounidis, 2009). However, others consider more general indicators such as bank credit ratings (Demirgüç-Kunt et al., 2008; Pasiouras, Gaganis, & Zopounidis, 2006). Generally, these studies suggest that banking regulations, empowering private sector monitoring, pose a positive impact on performance. Some empirical evidence regarding the impact of other key regulations, however, appears mixed in previous related studies. For example, Barth et al. (2004) indicate that there is no strong association between banking-sector development, performance, and official SPR. Other studies

show that the presence of more powerful government supervisors is linked to higher levels of nonperforming loans (NPLs) (Barth et al., 2002) and the former could be harmful to the banking-sector development in countries with closed political systems (Barth et al., 2003). In contrast, Pasiouras (2008) presents a positive and statistically significant impact of SPR on bank technical efficiency, and Pasiouras et al. (2009) confirm this finding as cost and profit efficiency. These results suggest that tougher supervisory regimes result in more efficient banking systems.

Regarding the effects of activity restrictions (ACTR), Barth et al. (2004, 2006) find that ACTR negatively impact banking-sector development and stability. The impact of ACTR on bank-level indicators of performance, however, seems inconclusive. For instance, Demirgüç-Kunt et al. (2004) indicate that ACTR boost net interest margins while Barth, Caprio, and Levine (2001) present mixed results on their impact on margins and over-heads. Besiades, Pasiouras et al. (2009) argue that ACTR on banks appear to reduce cost but improve profit efficiency, although Pasiouras (2008) show no significant relation with technical efficiency.

Furthermore, Barth et al. (2004) suggest that CAP do not appear to have a robust impact on banking-sector development, the incidence of banking crises, margins, or bank overhead costs. Yet, more stringent capital regulations are associated with lower levels of NPLs. Evidence from the bank efficiency literature also provides conflicting results, indicating that stricter CAP improve bank cost and technical efficiency, although they tend to reduce profit efficiency (Barth et al., 2013; Gaganis & Pasiouras, 2013; Pasiouras, 2008; Pasiouras et al., 2009).

Finally, Delis et al. (2011) recently indicate that various aspects of regulation and supervision can be important determinants of bank performance. However, a certain deal of ambiguity still remains given the different banking systems and time periods examined, as well as the variation in performance measures employed.

METHODOLOGY

Stage 1: Estimation of Bank's Total Factor Productivity

To investigate the impact of regulations on bank productivity growth, we use a two-stage approach. In the first stage, we derive output-oriented Malmquist indices to measure bank TFP growth. As a sensitivity analysis,

we also use input-oriented scores. Productivity scores are estimated using separate frontiers for each country (productivity growth is relative to each country's own frontier), so as to avoid incorporating the effects of different countries economic environments in the estimated measures. As a robustness check, we also estimate TFP growth for the pooled cross-country sample. In the second stage, the productivity growth measures are regressed against a variety of regulatory and other control variables.

In order to apply TFP growth measures in the first stage, we adopt the output-oriented Malmquist method, which was introduced by Caves, Christensen, and Diewert (1982) and estimated using data envelopment analysis (DEA) methodology by Färe, Grosskopf, and Weber (2004). This approach is the most popular nonparametric method used to obtain TFP growth estimates. Based on Delis et al. (2011), we also use the output-oriented method for the estimation for two reasons. First, regulators are more concerned about bank outputs (risk-related asset-based variables) rather than inputs. Also some of our inputs (in particular those relating to physical capital) are sticky downward in the short run, while banks are more likely to expand outputs than reduce inputs in order to increase productivity.

Consistent with Färe, Grosskopf, Norris, and Zhang (1994), a mixture of constant and variable returns to scale (CRS and VRS, respectively) are used. To introduce some notation, we assume that for N observations there exist P inputs producing Q outputs. Hence, each observation n uses a nonnegative vector of inputs denoted $\boldsymbol{x}^n = (x_1^n, x_2^n, ..., x_k^n) \in R_+^P$ to produce a nonnegative vector of outputs, denoted $\boldsymbol{y}^n = (y_1^n, y_2^n, ..., y_l^n) \in R_+^Q$. Production technology $F = \{(y, x): x \text{ can produce } y\}$ defines the set of feasible input−output vectors, and the input sets of production technology $PT(y) = \{x: (y, x) \in F\}$ defines the sets of input vectors that are feasible for each output vector. TFP change is then estimated in the spirit of Färe et al. (1994) defining the Malmquist index as:

$$\Phi_0(y_T, x_T, y_t, x_t) = \left[\frac{d_0^T(y_t, x_t)}{d_0^T(y_T, x_T)} \times \frac{d_0^t(y_t, x_t)}{d_0^t(y_T, x_T)} \right]^{1/2} \tag{1}$$

where Φ_0 measures the productivity change between periods T (base period) and t, and $d_0^T(y_t, x_t)$ represents the distance from the period t observation to the period T technology. $\Phi_0 > 1$ indicates positive TFP growth from period s to period t, $\Phi_0 < 1$ indicates a decline, and $\Phi_0 = 1$ indicates constant TFP growth.

Stage 2: Determinants of Bank Productivity Change

In the second stage, we use the TFP growth scores as the dependent variable in the estimation of the following equation:

$$\Phi_{i,j,t} = \alpha_0 + \sum_{j=1}^{k} \alpha_j \times Z_{k,j,t} + \sum_{l=1}^{m} \alpha_l \times M_{l,j,t} + \sum_{s=1}^{q} \alpha_s \times B_{i,j,t} + \varepsilon_{i,j,t} \qquad (2)$$

where the TFP change, $\Phi_{i,j,t}$, of bank i operating in country j at year t is specified as a function of time-dependent banking sector in terms of regulation variables, Z; some variables that capture the macroeconomic conditions common to all banks, M; a vector of bank level variables, B; and the error term, ε.

Next, we investigate interactive impacts of banking competition, national governance, and regulatory variable before, during, and after GFC, namely, on bank productivity changes, using the following specification.

$$\Phi_{i,j,t} = \beta_0 + \sum_{T=1}^{3} \sum_{k=1}^{4} \beta_{T,j} \times GFC_{T,t} \times W_{k,j,t} + \sum_{l=1}^{4} \beta_l \times M_{l,j,t} + \sum_{s=1}^{q} \beta_s \times B_{i,j,t} + \varepsilon_{i,j,t} \quad (3)$$

where *GFC* is the dummy variable with T periods, defining before GFC ($T=1$), during GFC ($T=2$), and after GFC ($T=3$). W is a number of variables of interest with banking competition, country governance, and regulatory indicator (CAP, SPR, PMON, and ACTR).

For estimating Eqs. (2) and (3), we pool the data across banks, countries, and years and then regress the TFP growth measures on range of variables, including banking competition, governance, and the regulatory indicators that are of central interest in this chapter. The panel regression with fixed effects is used for estimation and conducted in terms of a bootstrapping procedure (Simar & Wilson, 2007).

VARIABLES AND DATA

Variables of Bank's Inputs and Outputs

We select inputs and outputs for the estimation applying Malmquist index on the basis of the intermediation approach, which assumes that banks

collect funds, using labor and physical capital, to transform them into loans and other earning assets (OEA). Accounting for the increasing involvement of banks in fee-generating services, we also include noninterest income (NII) as an additional output. Thus, we assume that banks have three outputs, respectively: (1) net loans (NL) (gross loans net of reserves for impaired loans/NPLs), (2) OEA, and (iii) NII. The three inputs used to generate the above outputs are (1) fixed assets (FA), (2) customer deposits and short-term funding (DEP), and (3) overhead expenses (OH).

Key Measures on Banking Regulation and Supervision

For the construction of the CAP, power of supervisory agencies (SPR), market discipline and PMON, and ACTR indices, we use the information from the database provided by World Bank, compiled and updated by Barth, Caprio, and Levine (2013), which provides regulator responses to a series number of questions by central bankers. We discuss briefly these indices below and provide detail information shown in the appendix.

CAP is an index of capital requirements accounting for both initial and overall capital stringency. This index is measured by considering the sources of funds used as capital and taking into account various issues that emerge during the calculation of the capital-to-assets ratio. The index can take values between 0 and 8, with higher values indicating greater capital stringency. SPR is a measure of the power of SPR indicating the extent to that these authorities can take specific actions against bank management and directors, shareholders, and bank auditors. This index shows values between 0 and 14 with higher values, indicating more SPR. PMON is an indicator of market discipline and means the degree to which those banks are enforced to disclose accurate information to the public and whether there are incentives to increase market discipline. This index ranges from 0 and 8 with higher values showing greater PMON. Finally, ACTR is a proxy for the level of restrictions on banks' activities in each country. It is determined by considering whether participation in securities, insurance, real estate activities, and ownership of nonfinancial firms are unrestricted, permitted, restricted, or prohibited. ACTR shows values between 1 and 4 with higher values indicating higher restrictions.

We include average values for these variables for all 82 countries included in panel data. These values indicate that Denmark, Dominican Republic, Japan, Swaziland, and Turkey have the strictest CAP while Netherlands is the least. Official SPR appears to be greater in Indonesia, Hungary, Malta,

United States, Panama, and Slovenia, although Swaziland and Sweden record the lowest indicators. DeYoung, Hughes, and Moon (2001) find a similar trade-off across the United States, suggesting that supervisors allow banks with high productive efficiency more flexibility in their investment strategies and risk-taking activities. Moreover, PMON appears to be higher in Indonesia, Japan, Paraguay, Peru, and Ukraine, but lowest in Belgium, Qatar, Sweden, United Kingdom, and Uruguay. Finally, restrictions on bank activities (ACTR) are the most onerous in Bangladesh, Nigeri, and Lithuania, but the most liberal in United Kingdom and Nicaragua.

Control Variables

To control for other potential determinants of bank productivity, we use a number of bank- and country-specific variables. Country averages for these variables indicate that global banking systems are relatively highly capitalized (average ratio of equity to total assets up to 14%) and less competitive (Boone Index averaging −0.003), have lower levels of foreign ownership (11.38% of banking-sector assets across the sample), and nearly all experienced relatively high levels of inflation (INF) (averaging 7.02%) and real GDP growth (GDPG) (2.20%) over 2004−2012. In particular, we employ the ratio of equity to total assets as a proxy for bank capitalization. Capitalization is expected to be positively related to productivity growth to the extent that capital is used for productive purposes.

Note, however, that in 82 countries banks have inherited high capitalization levels; this can harm future productivity because accumulated capital is an expensive source of financing. To capture potential nonlinearity, we additionally use the squared term of ratio of equity to total assets in our empirical specification. Next, we control for bank size by using the natural logarithm of real total assets and again we also consider a nonlinear relationship between size and productivity by introducing the squared term of the bank size variable among all regressors. Generally, the effect of bank size on bank performance has been proved to be positive up to a certain extent although for banks that become extremely large, productivity growth could be negative due to bureaucratic and other reasons.

Following previous studies that focus on bank performance (Barth et al., 2004; Demirgüç-Kunt et al., 2004; Fries & Taci, 2002; Pasiouras, 2008; Pasiouras et al., 2006), We additionally control for cross-country differences in structural and macroeconomic conditions. First, we control

for the national governance using the composite indicator from "World Governance Indicators." We use this variable because in the countries considered, many general policies aiming at increased ECFR may have affected country productivity, including banking. Thus, we want to prevent our indices of bank regulation capturing the effects of these general economic reforms. Besides, we use (1) Boone index for the degree of banking competition, and (2) the percentage of assets held by foreign (FOR) banks. In the banking literature, the expected effect of banking competition on bank performance is ambiguous, while it is generally expected that higher foreign and less government ownership are associated with higher bank productivity growth. In the countries considered, foreign ownership increased substantially during the sample period, so we anticipate the impact of FOR on TFP growth to be highly significant.

Additionally, we control for the impact of macroeconomic and monetary conditions using real GDPG and the INF rate, respectively (Barth et al., 2003; Pasiouras, 2008). In economies with favorable macroeconomic and stable monetary conditions, productivity growth of banks would be higher. Finally, to cope with the impact of the financial crisis from 2007 to 2009, we include an indicator of credit risk, the country-level ratio of NPLs to total loans in all regressions.

Data

The panel data in this chapter is unbalanced and consists of a maximum of 21,420 observations from 4,518 commercial banks operating in 82 countries over the period 2004−2012. Following the suggestion by Delis et al. (2011), we focus on commercial banks for two main reasons. First, this provides a more homogenous sample in terms of services and consequently inputs and outputs, which in turn enhances the comparability of banking markets. Second, as mentioned in Demirgüç-Kunt et al. (2004), because regulatory data of the World Bank database are for commercial banks, it is more appropriate to use bank-level data only for these types of banks.

We collect related information from various sources. All bank-level data are obtained from the *BankScope* database of Bureau van Dijk and converted to U.S. dollars and reported in real 2000 terms using country-specific GDP deflators. Information on bank regulations and supervision are obtained from the World Bank database on "Bank Regulation and Supervision" developed and updated by Barth et al. (2013). Data for proxies for the financial crisis are collected from the 2012 version of the

World Bank database on "Financial Development and Structure," which was initially constructed by Beck, Demirgüç-Kunt, and Levine (2000). Information on macroeconomic conditions is collected from the World Bank database. Data for composite index of national governance are collected from the World Bank's "Worldwide Governance Indicators" database (Kaufmann, Kraay, & Mastruzzi, 2010), including six indicators of "voice and accountability," "government effectiveness," "rule of law," "political stability," "quality of regulation," and "control of corruption," respectively.

EMPIRICAL RESULTS

Bank Productivity Changes Before, During, and After GFC

We obtain TFP change estimates by country before, during, and after GFC. Table 1 shows the mean values of the estimates of TFP changes. As already mentioned, an index greater than one indicates a positive TFP growth while a value less than one suggests a decline. The results indicate that over the sample period most countries experienced significant TFP growth, representative of banking systems experiencing major bank regulation. In particular, average TFP growth has been substantial in Ireland, Australia, Belgium, Spain, Netherlands, and Luxembourg, while it has been declining in Ecuador, Ghana, Lesotho, Dominican Republic, and Paraguay.

Sharply declining in TFP growth before and after GFC are observed in Thailand, Russian Federation, Indonesia, Lesotho, and Paraguay; while a noticeable upward trend is observed for Vietnam, Czech Republic, India, United Arab Emirate, Lebanon, and Norway. Overall, transition banking systems appear to exhibit relatively high TFP growth (Casu et al., 2004).

Differences in Key Variables Before, During, and After GFC
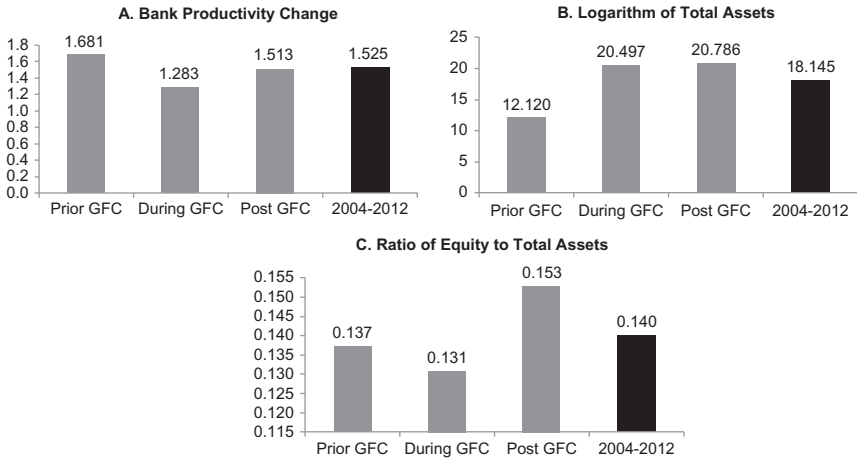
We further test whether key variables are statistically significantly different before, during, and after GFC using analysis of variance (ANOVA). Table 1 reports the statistically significant difference in bank's TFP change, financial characteristics, banking market structure, regulation, and macroeconomic conditions before, during, and after GFC. Fig. 1 shows that

Table 1. Mean Valus and Test of Key Variables Before, During, and After GFC on Bank Productivity Change.

Variables	All Period	Global Financial Crisis (GFC)			Mean Difference	(*p*-Value)
	(2004–2012)	Prior (2004–2006)	During (2007–2009)	Post (2010–2012)	*F*-statistics	
Bank's total factor productivity (TFP) change	1.525	1.681	1.283	1.513	5***	(0.008)
Bank financial characteristics						
Logarithm of total assets	18.145	12.120	20.497	20.786	13,573***	(0.000)
Ratio of equity to total assets	0.140	0.137	0.131	0.153	4**	(0.028)
Banking market structure						
Bank competition (Boone Index)	−0.030	−0.022	−0.022	−0.042	14***	(0.000)
Foreign ownership (%)	11.382	10.978	11.034	11.915	53***	(0.000)
National governance	0.976	0.843	0.996	1.016	247***	(0.000)
Proxies for the financial crisis						
Ratio of nonperforming loans (NPLs) to total loans	84.078	119.820	79.969	72.505	13,716***	(0.000)
Banking-sector Z-score (Z)	19.545	19.061	18.671	20.641	703***	(0.000)
Macroeconomic conditions						
GDP Growth (%)	2.204	4.272	0.613	2.852	11,009***	(0.000)
Inflation (%)	7.018	5.175	11.453	3.415	11***	(0.000)
Bank regulation						
Capital requirements (CAP)	7.145	6.106	6.893	7.461	5,431***	(0.000)
Supervisory power (SPR)	0.899	0.777	0.923	0.931	2,061***	(0.000)
Market discipline and private monitoring (PMON)	4.290	3.188	4.153	4.940	6,046***	(0.000)
Activity restrictions (ACTR)	7.522	7.208	6.912	8.282	10,004***	(0.000)

Note: ** and *** denote statistical significance at the 5% and 1% levels, respectively.

A. Bank Productivity Change

1.681

1.283

1.513

1.525

Prior GFC   During GFC   Post GFC   2004-2012

B. Logarithm of Total Assets

12.120

20.497

20.786

18.145

Prior GFC   During GFC   Post GFC   2004-2012

C. Ratio of Equity to Total Assets

0.137

0.131

0.153

0.140

Prior GFC   During GFC   Post GFC   2004-2012

Fig. 1. Bank Productivity Change and Financial Characteristics Prior, During, and Post GFC.

increasing trend in bank size before, during and after GFC while bank's capital ratio slightly decreased during GFC but jumped after GFC. Regarding the change in banking competition, Fig. 2 demonstrates the increasing competition in global banking industry while the foreign bank shares remarkably increase after GFC.

In addition, national governance shows steady trend over the period 2004−2012 while banking stability deteriorated during GFC but NPL ratio decreased sharply. It is noted that GDP fell significantly during GFC but recovers after GFC. The inflation rate also experienced a higher level during GFC but immediately decreased after GFC. Finally, as shown in Fig. 3, besides ACTR, the trend in major regulatory variables present the upward over the period 2004−2012. This implies that the global banking industry have undergone a higher standard of banking regulation as result from Basel II. Interestingly, ACTR fell during GFC but sharply increased after GFC.

Determinants of Banks' Productivity Changes

For the estimation of the second empirical specification, we use the bootstrap procedure described in Brissimis et al. (2008). The bootstrap

A. Degree of Banking Competition (Boone Index)

Prior GFC: −0.0216
During GFC: −0.0220
Post GFC: −0.0416
2004-2012: −0.0297

B. Foreign Bank Share (%)

Prior GFC: 10.98
During GFC: 11.03
Post GFC: 11.92
2004-2012: 11.38

C. National Governance

Prior GFC: 0.843
During GFC: 0.996
Post GFC: 1.016
2004-2012: 0.976

D. Banking-Sector Z-score

Prior GFC: 19.061
During GFC: 18.671
Post GFC: 20.641
2004-2012: 19.545

E. Ratio of Nonperforming Loans (NPLs) to Total Loans (%)

Prior GFC: 120
During GFC: 80
Post GFC: 73
2004-2012: 84

F. GDP Growth (%)

Prior GFC: 4.272
During GFC: 0.613
Post GFC: 2.852
2004-2012: 2.204

G. Inflation Rate (%)

Prior GFC: 5.175
During GFC: 11.453
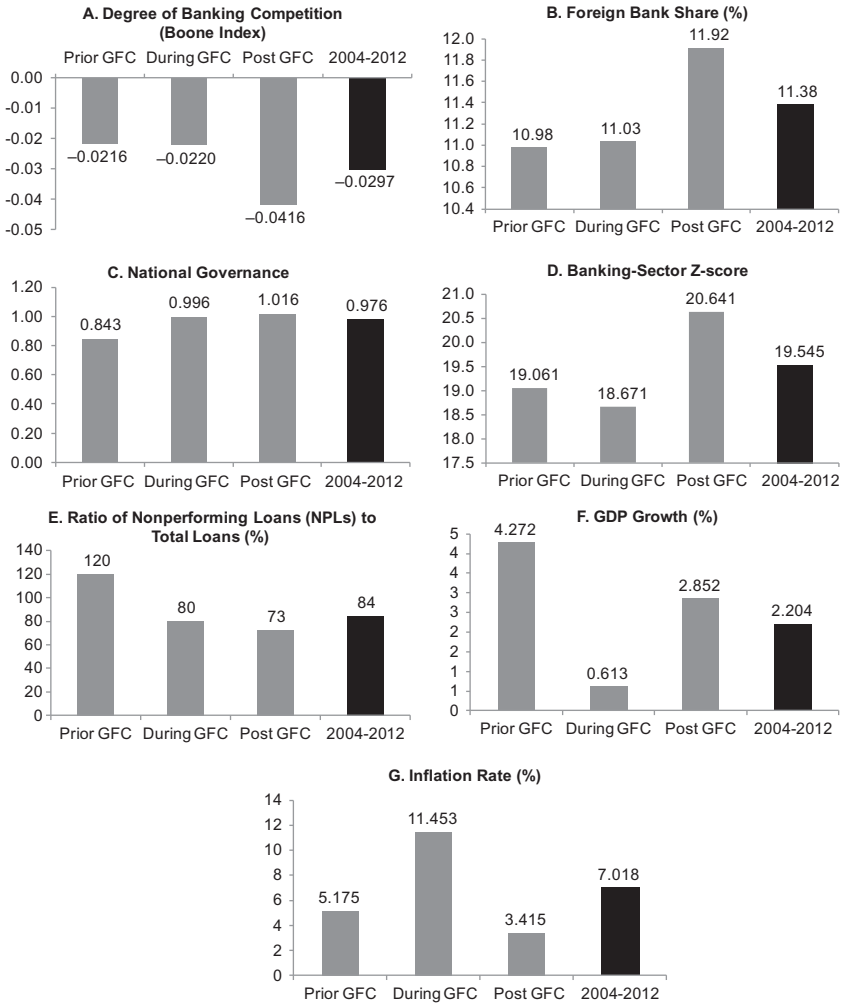Post GFC: 3.415
2004-2012: 7.018

Fig. 2. Banking Market Structure, Goveranance Macroeconomic, and National Conditions Prior, During, and Post GFC.

procedure accounts for potential endogeneity of some of right-hand-side variables, which are in our case the capital ratio and the squared term of capital ratio. The main results of the second-stage analysis are reported in Table 2. We estimate various models, where we control for alternative
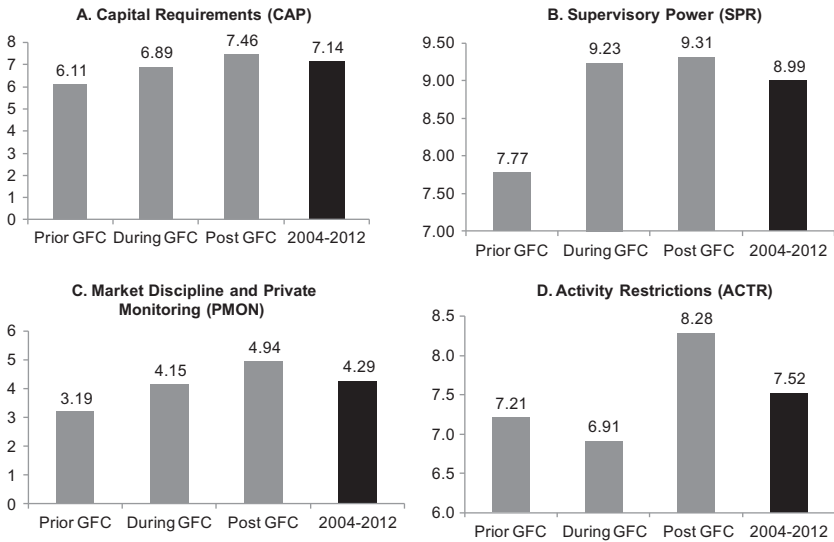
A. Capital Requirements (CAP)

B. Supervisory Power (SPR)

C. Market Discipline and Private Monitoring (PMON)

D. Activity Restrictions (ACTR)

Fig. 3.   Bank Regulation Prior, During, and Post GFC.

bank regulatory-specific factors. In all cases, we control for bank-specific characteristics and country effects using dummy variables. Model 1 is the base model where we examine the impact of banking market structure on bank productivity change, while controlling for bank-specific characteristics, macroeconomic conditions and the NPLs to total loans ratio. The coefficients on foreign ownership (FOR) and banking competition (Boone index) are positive, statistically significant, and holds across all specifications (Models 1−7). These results indicate that increasing foreign bank ownership in domestic banking industry and higher banking competition would enhance bank productivity.

In Model 2, we include additional variables in the regression equation, which represent various aspects of national governance. The coefficient on national governance shows a positive sign and statistically significance and this finding holds across all specifications (Models 2−7). This empirical evidence is consistent to the findings of Barth et al. (2013) and also confirms that banks in better national governance demonstrate better productivity growth. In Models 3−6, we individually control for bank regulation measures of CAP, SPR, PMON, and ACTR. In Model 3, CAP has a positive and statistically significant coefficient, suggesting higher bank capital

Table 2. Determinant of Bank Productivity Change: The Impacts of Banking Competition, National Governance, and Bank Regulation.

Independent Variables	Dependent Variable: Bank Total Factor Productivity (TFP) Change						
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)
Banking market structure							
Foreign ownership (FOR)	1.911***	1.522***	1.539***	1.563***	1.372***	1.555***	1.460***
	(10.799)	(8.510)	(9.022)	(8.788)	(7.833)	(8.718)	(8.641)
Bank competition (Boone Index)	0.889**	1.474***	1.403***	1.236***	0.858**	1.211***	0.900***
	(2.436)	(4.024)	(4.017)	(3.392)	(2.389)	(3.308)	(2.592)
National governance		1.583***	1.464***	1.458***	1.730***	1.487***	1.517***
		(12.479)	(12.099)	(11.538)	(13.918)	(11.722)	(12.578)
Bank regulation							
Capital requirements (CAP)			0.164***				0.141***
			(41.124)				(33.932)
Supervisory power (SPR)				0.625***			0.192***
				(14.212)			(4.439)
Market discipline and private monitoring (PMON)					0.181***		0.115***
					(27.078)		(16.857)
Activity restrictions (ACTR)						0.065***	0.013**
						(9.924)	(1.970)
Bank financial characteristics							
Logarithm of total assets	−5.227***	−5.324***	−4.386***	−5.166***	−4.947***	−5.250***	−4.215***
	(−33.627)	(−34.362)	(−29.343)	(−33.457)	(−32.474)	(−33.941)	(−28.427)
(Logarithm of total assets)^2	0.169***	0.170***	0.142***	0.165***	0.159***	0.168***	0.137***
	(42.347)	(42.666)	(36.797)	(41.523)	(40.494)	(42.234)	(35.747)
Ratio of equity to total assets	1.525***	1.385***	1.291***	1.376***	1.341***	1.361***	1.269***
	(13.848)	(12.570)	(12.285)	(12.556)	(12.426)	(12.382)	(12.189)

Table 2. (*Continued*)

Independent Variables	Dependent Variable: Bank Total Factor Productivity (TFP) Change						
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)
(Ratio of equity to total assets)^2	0.024***	0.022***	0.020***	0.022***	0.021***	0.022***	0.020***
	(12.790)	(11.700)	(11.487)	(11.688)	(11.588)	(11.750)	(11.454)
Proxies for the financial crisis							
Ratio of nonperforming loans (NPLs) to total loans	−0.011***	−0.010***	−0.008***	−0.010***	−0.009***	−0.010***	−0.007***
	(−30.026)	(−27.506)	(−21.509)	(−27.379)	(−24.284)	(−26.685)	(−20.011)
Banking-sector Z-score (Z)	0.016***	0.015***	0.019***	0.012***	0.018***	0.013***	0.019***
	(3.602)	(3.521)	(4.565)	(2.751)	(4.267)	(3.034)	(4.559)
Macroeconomic conditions							
GDP growth (GDPG)	0.009***	0.013***	0.005**	0.014***	0.011***	0.011***	0.005**
	(3.579)	(5.244)	(2.242)	(5.612)	(4.767)	(4.494)	(2.284)
Inflation (INF)	−0.051***	−0.046***	−0.050***	−0.047***	−0.043***	−0.045***	−0.048***
	(−15.806)	(−14.299)	(−16.231)	(−14.724)	(−13.708)	(−14.174)	(−15.695)
Constant	1.985***	1.999***	1.920***	1.985***	1.964***	1.990***	1.903***
	(129.908)	(131.067)	(130.919)	(130.644)	(131.022)	(130.583)	(130.715)
Observations	21420	21420	21420	21420	21420	21420	21420
Number of bank	4518	4518	4518	4518	4518	4518	4518
Adjusted R^2	0.196	0.203	0.276	0.213	0.236	0.208	0.290
Sigma	1.137	1.132	1.079	1.125	1.108	1.128	1.068

Note: *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

requirement standard do influence bank productivity. In Model 4, SPR shows a positive and statistically significant coefficient, indicating more powerful supervisors do influence bank productivity as well. This is, however, inconsistent to the result of Delis et al. (2011).

Moreover, PMON has a positive and statistically significant coefficient. This result strongly supports the view that empowering PMON, through disclosure requirements that allow private agents to overcome information and transaction costs (Hay & Shleifer, 1998) as well as other incentives such as the use of subordinated debt and the absence of deposit insurance, increases bank's productivity.

In Model 6, empirical results also confirm that ACTR has a positive and significant impact on bank's productivity growth. Barth et al. (2003) argued that fewer restrictions could provide greater profit opportunities, but banks may systematically fail to manage a diverse set of financial activities beyond traditional banking, and hence experience lower profitability. Finally, in Model 7, we include all bank regulatory measures in the regression and find that all coefficients of those measures are positive and statistically significant, the same results as in individually specified regressions. It is interesting that SPR has relatively higher influence on banks' productivity changes.

The effect of the control variables is shown to be as expected. Bank size is positively and significantly related to TFP growth, which is intuitive since large banks, especially in global banking industry, are likely to benefit from economies of scale. The same holds for bank capitalization, indicating that those banks with a sound capital position are able to pursue business opportunities more effectively, thus achieving higher productivity growth. Similar to the findings on bank size, the impact of capital ratio on TFP growth is also positive and statistically significant at the 1% level, indicating that high levels of capital tend to enhance TFP growth.

Turning to the country-specific control variables, we find that, as expected, FOR has a positive sign which supported by the literature that suggests a number of benefits from foreign bank entry in the international banking industry. For example, Levine (1996) mentions three major benefits from the presence of foreign banks: (1) improvements in the quality and availability of financial services in the domestic market as result from increased bank competition, the adoption of modern banking skills, and better technology, (2) development in the domestic bank supervisory and legal framework, and (3) enhancement of the country's access to international financial markets.

Furthermore, the presence of foreign banks may encourage nonfinancial foreign firms to invest in the host country since in many cases foreign banks follow their customer's abroad (Brealey & Kaplanis, 1996). Lensink and Hermes (2004) confirmed that foreign banks may also enhance the quality of human capital in the banking system, not only by importing high skilled bank managers to work in their branches, but also by training local employees. The effects of GDPG on TFP growth are also positive and show that favorable macroeconomic conditions benefit substantially banks' TFP growth. In addition, Banking-sector Z-score also carries a positive sign, indicating that higher financial stability in the banking industry significantly increases the productivity of banks, which is consistent with findings in the efficiency literature of Pasiouras (2008). Finally, as expected, INF and the NPLs ratio, are all negatively correlated with TFP growth.

Impacts of Banking Competition, Governance, and Regulation Before, During, and After GFC

Table 3 reports the results from impacts of banking competition, national governance, and bank regulation before, during and after GFC on bank productivity changes. Regarding the effect of banking competition on bank productivity, higher banking competition before and during GFC significantly enhances bank productivity, while this effect becomes negative, indicating decreased productivity of bank. Moreover, banks in better country governance present higher productivity regardless before, during and after GFC. This implies that national governance have beneficial impacts on increasing bank productivity. However, banks which have the stringent standard of bank capital requirements substantially increase bank's productivity during and after GFC, while banks in a country with more stringent CAP would decline the productivity of bank.

Finally, we find the similar results from SPR, PMON, and ACTR, indicating that stringent bank regulation is beneficial to bank's productivity growth, especially when banks are hit by financial crises. One of the most important policy implications of these findings is that bank regulations play the crucial role in enhancing banks' productivity during the GFC of 2008−2009.

Table 3. The Impacts of Banking Competition, National Governance, and Bank Regulation Before, During, and After GFC on Bank Productivity Change.

Independent Variables	Dependent Variable: Bank Total Factor Productivity (TFP) Change					
	Interactions of Key Variables (W) with Global Financial Crisis (GFC)					
	Banking competition	National governance	Capital requirements (CAP)	Supervisory power (SPR)	Market discipline and private monitoring (PMON)	Activity restrictions (ACTR)
Global financial crisis (GFC)						
Prior GFC*W	49.841***	2.436***	−0.223***	−1.291***	−0.216***	−0.177***
	(54.530)	(20.580)	(−26.841)	(−27.639)	(−23.036)	(−23.085)
During GFC*W	9.369***	2.848***	0.044***	0.129***	0.052***	0.030***
	(20.823)	(23.929)	(8.847)	(3.306)	(6.852)	(4.022)
Post GFC*W	−5.880***	3.599***	0.231***	1.642***	0.274***	0.191***
	(−15.492)	(29.334)	(61.468)	(42.730)	(43.503)	(26.529)
Bank financial characteristics						
Logarithm of total assets	4.342***	3.888***	3.484***	2.513***	3.095***	2.051***
	(30.941)	(26.613)	(25.720)	(19.011)	(21.830)	(16.223)
(Logarithm of total assets)^2	−0.132***	−0.134***	−0.115***	−0.088***	−0.105***	−0.071***
	(−36.127)	(−35.877)	(−32.678)	(−25.552)	(−28.571)	(−21.637)
Ratio of equity to total assets	0.848***	1.532***	1.163***	1.164***	1.364***	1.098***
	(8.535)	(15.043)	(12.299)	(12.789)	(13.934)	(12.679)
(Ratio of equity to total assets)^2	−0.012***	−0.025***	−0.018***	−0.018***	−0.020***	−0.017***
	(−7.300)	(−14.376)	(−11.544)	(−12.038)	(−12.218)	(−11.354)
Proxies for the financial crisis						
Ratio of nonperforming loans (NPLs) to total loans	−0.005***	−0.005***	−0.007***	−0.002***	−0.006***	−0.003***
	(−15.067)	(−15.586)	(−22.109)	(−8.036)	(−17.233)	(−9.246)

Table 3. (*Continued*)

Independent Variables	Dependent Variable: Bank Total Factor Productivity (TFP) Change					
	Interactions of Key Variables (W) with Global Financial Crisis (GFC)					
	Banking competition	National governance	Capital requirements (CAP)	Supervisory power (SPR)	Market discipline and private monitoring (PMON)	Activity restrictions (ACTR)
Banking-sector Z-score (Z)	0.008**	−0.014***	−0.015***	−0.009**	0.002	−0.024***
	(2.001)	(−3.421)	(−3.868)	(−2.411)	(0.573)	(−6.554)
Macroeconomic conditions						
GDP growth (GDPG)	0.008***	0.001	−0.007***	−0.019***	−0.010***	−0.010***
	(3.479)	(0.460)	(−3.303)	(−8.808)	(−4.338)	(−4.179)
Inflation (INF)	−0.053***	−0.068***	−0.065***	−0.064***	−0.050***	−0.037***
	(−17.971)	(−22.496)	(−23.911)	(−24.309)	(−17.799)	(−12.412)
Banking market structure						
Foreign ownership (FOR)	1.423***	1.372***	1.603***	1.976***	1.393***	1.833***
	(8.967)	(8.228)	(10.568)	(13.478)	(8.822)	(13.139)
Constant	1.965***	1.854***	1.861***	1.771***	1.818***	1.748***
	(143.094)	(128.737)	(140.574)	(137.623)	(131.565)	(142.427)
Observations	21,420	21,420	21,420	21,420	21,420	21,420
Number of bank	4,518	4,518	4,518	4,518	4,518	4,518
Adjusted R^2	0.354	0.319	0.409	0.452	0.365	0.504
Sigma	1.019	1.046	0.975	0.938	1.010	0.893

Note: *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

CONCLUDING REMARKS

This chapter empirically investigates how banks' productivity are affected by country-level bank regulations of CAP, official SPR, market discipline, and restrictions on bank activities at various different stages of financial crises. For the empirical analysis, we first use the Malmquist index to estimate the TFP growth of 582 banks operating in 82 countries during the period 2004−2012. Then, we apply a robust bootstrap procedure to utilize the estimated TFP growth scores from the first stage which are regressed on a number of key variables including regulatory, governance, and banking market structure, while controlling for country- and bank-specific characteristics.

Empirical results suggest that commercial banks in countries with better national governance have higher productivity growth before, during and after the GFC. Furthermore, all three pillars of Basel II are shown to have a positive and significant impact on productivity growth during GFC. These findings suggest that policy makers should direct their efforts toward ensuring adequate and timely disclosure of information and promote a framework of adequate bank surveillance which incorporates an incentive system of market discipline and PMON in the banking sector during financial crises, in particular.

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APPENDIX: VARIABLE DESCRIPTION AND DATA SOURCES

Variable	Description	Data Sources
Stage 1: Estimation of total factor productivity		
Bank inputs		
Fixed assets (FA)	Assets related to physical capital	Bankscope
Deposits and short-term funding (DEP)	Incoming funds used to generate bank outputs	Bankscope
Overheads (over)	Operating expenses used in the production process of bank outputs	Bankscope
Bank outputs		
Net loans (NL)	Bank gross loans net of reserves for impaired loans/NPLs	Bankscope
Other earning assets (OEA)		Bankscope
Noninterest income (NII)		Bankscope
Stage 2: Determinants of total factor productivity change		
Internal determinants		Bankscope
Logarithm of total assets (LNTA)	Proxy for bank size	Bankscope
Ratio of equity to total assets (EQTA)	Proxy for bank capitalization	
External determinants		
Regulatory conditions		
Capital requirements (CAP)	This variable is determined by adding 1 if the answer is yes to questions 1−6 and 0 otherwise, and the opposite occurs for questions 7 and 8 (i.e., yes = 0, no = 1). The questions are: (1) Is the minimum required capital asset ratio (risk weighted) in line with Basel guidelines? (2) Does the ratio vary with market risk? (3−5) Before determining minimum capital adequacy, are any of the following are deducted from the book value of capital? (a) Market value of loan losses not realized on the financial	Bank Regulation and Supervision Database, World Bank, Barth et al. (2013)

Appendix.   (*Continued*)

Variable	Description	Data Sources
	statements, (b) unrealized losses on securities portfolios, and (c) unrealized foreign exchange losses. (6) Have regulatory/ supervisory authorities verified the sources of funds to be used as capital? (7) Can assets other than cash or government securities provide the initial or subsequent injections of capital? (8) Can borrowed funds provide the initial disbursement of capital?	
Supervisory power (SPR)	This variable is determined by adding 1 if the answer is yes and 0 otherwise, for each of the following 14 questions: (1) Does the supervisory agency have the right to meet with external auditors to discuss their report without the approval of the bank? (2) Are auditors legally required to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in illicit activities, fraud, or insider abuse? (3) Can supervisors take legal action against external auditors for negligence? (4) Can the supervisory authorities force a bank to change its internal organizational structure? (5) Does the institution disclose off-balance-sheet items to supervisors? (6) Can the supervisory agency order the bank's directors or management to constitute provisions to cover actual or potential losses? (7) Can the supervisory agency suspend directors' decisions to distribute dividends? (8) Can the supervisory agency suspend directors' decisions to distribute bonuses? (9) Can the supervisory agency suspend directors' decisions to distribute management fees? (10) Can the supervisory agency supersede bank shareholder rights and declare the bank insolvent? (11) Does banking law allow a supervisory agency or any other government agency (other than a court) to suspend some or all ownership rights at a problem bank? (12) Regarding bank restructuring and reorganization,	Bank Regulation and Supervision Database, World Bank, Barth et al. (2013)

can the supervisory agency or any other government agency
(other than a court) supersede shareholder rights? (13)
Regarding bank restructuring and reorganization, can the
supervisory agency or any other government agency (other than
a court) remove and replace management? (14) Regarding bank
restructuring and reorganization, can the supervisory agency or
any other government agency (other than a court) remove and
replace directors?

Market discipline and private monitoring (PMON)	This variable is determined by adding 1 if the answer is yes to questions 1−7 and 0 otherwise, and the opposite occurs for questions 8 and 9 (i.e., yes = 0, no = 1). (1) Is subordinated debt allowed (or required) capital? (2) Are financial institutions required to produce consolidated accounts covering all bank and any nonbank financial subsidiaries? (3) Are off-balance-sheet items disclosed to the public? (4) Must banks disclose their risk-management procedures? (5) Are directors legally liable for erroneous/misleading information? (6) Do regulations require credit ratings for commercial banks? (7) Is an external audit by certified/licensed auditor mandatory for banks? (8) Does accrued, unpaid interest/principal on nonperforming loans appear on the income statement? (9) Is there an explicit deposit-insurance protection system?	Bank Regulation and Supervision Database, World Bank, Barth et al. (2013)
Activity restrictions (ACTR)	The score for this variable is determined on the basis of the level of regulatory restrictiveness for bank participation in: (1) securities activities, (2) insurance activities, (3) real estate activities, and (4) bank ownership of nonfinancial firms. These activities can be unrestricted, permitted, restricted, or prohibited and receive values of 1, 2, 3, or 4, respectively. We create an overall index by calculating the average value of the four categories.	Bank Regulation and Supervision Database, World Bank, Barth et al. (2013)

Appendix. (*Continued*)

Variable	Description	Data Sources
Banking market structure		
Banking competition	I use Boone index as the proxy of degree of banking competition	Author's estimation
Foreign ownership (FOR)	Asset share of foreign-owned banks in percent	Author's estimation
Macroeconomic conditions		
GDP growth (GDPG)	Real GDP growth	World Bank
Inflation (INF)	CPI inflation	World Bank
Proxies for the financial crisis		
Ratio of nonperforming loans (NPLs) to total loans	Proxy for credit risk	Financial
		Development and structure database, World Bank
Banking-sector Z-score (Z)	Indicator of the overall soundness of the banking sector. It is calculated as $(ROA + (equity/assets))/sd(ROA)$, with the standard deviation of ROA, sd(ROA), being estimated over a five-year moving window	Financial
		Development and structure database, World Bank
National goveranance measures		
Voice and accountability	The indicator measures the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and free media.	Kaufmann, Kraay, and Mastruzzi (2006)
Government effectiveness	The indicator measures the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.	Kaufmann et al. (2006)

Rule of law	The indicator measures the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence.	Kaufmann et al. (2006)
Political stability	The indicator measures the perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including political violence and terrorism.	Kaufmann et al. (2006)
Quality of regulation	The indicator measures the ability of the government to formulate and implement sound policies and regulations that permit and promote market competition and private-sector development.	Kaufmann et al. (2006)
Control of corruption	The indicator measures the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.	

Note: All information is mainly adopted from Delis et al. (2011).