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Do Bank Regulation, Supervision and Monitoring Enhance or Impede Bank Efficiency?*

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Abstract

The recent global financial crisis has spurred renewed interest in identifying those reforms in bank regulation that would work best to promote bank development, performance and stability. Building upon three recent world-wide surveys on bank regulation (Barth et al., 2004, 2006, and 2008), we attempt to contribute to this assessment by examining whether bank regulation, supervision and monitoring enhance or impede bank operating efficiency. Based on an un-balanced panel analysis of more than 4,050 banks observations in 72 countries over the time period 1999-2007, we find that tighter restrictions on bank activities are negatively associated with bank efficiency while greater capital regulation stringency is marginally and positively associated with bank efficiency. In addition, we find that a strengthening of official supervisory power is positively associated with bank efficiency only in countries with independent supervisory authorities. Moreover, independence coupled with a more experienced supervisory authority tends to enhance bank efficiency. Finally, market-based monitoring of banks in terms of more financial transparency is positively associated with bank efficiency.
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Keywords: Bank regulation, Supervision, Operating efficiency
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1. Introduction

Well-functioning banking systems exert a first-order impact on economic growth and development (e.g., see Levine 1997 and 2005). Banking systems, however, do not always function in a beneficial manner and thus at times fall short of achieving this important goal. The recent global financial crisis only serves to well as a reminder of this unpleasant fact. The response of policymakers to this and similar situations in the past is typically an assessment of what went wrong and what regulatory reforms can be made to promote better functioning banking systems. The breadth and depth of the most recent crisis certainly underscores the importance of such assessments.

The purpose of this paper is to contribute to the assessment of the types of reforms in bank regulation that work best to achieve well-functioning banking systems. Our assessment specifically focuses on the extent to which regulation enhances or impedes the ability of banks in countries everywhere to operate efficiently. While this is just one aspect of a well-functioning banking system it is certainly an important one. Policymakers can surely make more informed decisions about the regulation of banks when they know the likely affect of those decisions on the performance of banks. Despite the extensive literature on bank efficiency (see Berger and Humphrey, 1997, and Berger, 2007, for thorough reviews of the literature), a comprehensive study on whether bank regulation, supervision and monitoring enhance or impede efficiency remains scarce. This is mainly due to limited data availability so as to obtain concrete measures on various aspects of international bank regulation and supervision schemes.

This data limitation has been recently addressed by the three worldwide surveys on bank regulation and supervision conducted by Barth, Caprio and Levine (2004, 2006 and 2008) under the auspices of the World Bank over the past decade. The relevant bank regulation and supervision databases are compiled from the answers provided by the official regulatory and supervisory authorities to the surveys. The original survey, Survey I, provides information for the year 1999 and covers 117 countries. The second survey, Survey II, characterizes the regulatory environment for 2002, and covers 152 countries. Survey III is for 2005/2006 and covers 142 countries. The surveys contain more than 300 questions regarding

a wide range of bank regulations and supervisory practices, such as capital regulation, entry regulation, activities restrictions, supervisory power and independence, external governance and private-sector monitoring. Overall, the three surveys provide a very comprehensive and detailed picture of differences in bank regulation and supervision in countries around the world over the past decade, thereby providing an excellent opportunity to examine whether bank regulation, supervision and monitoring enhance or impede bank efficiency.

From a theoretical perspective, the predictions about the effects of regulation and supervision on banks are not clear. There are two general views that provide conflicting predictions, as explained more fully by Barth et al. (2006), among others. The "public interest view" holds that the government acts in the interests of the public and regulates banks to promote efficient banking and ameliorate market failures. In contrast, the "private interest view" holds that regulation is often used to promote the special interests of the few, not the broader public. According to the "public interest view", well-structured regulation can enhance efficiency by fostering competition among banks and by encouraging effective governance of bank managers. But according to the "private interest view", one would expect regulation to impede efficiency since it would constrain banks to cater to the politically favored or well connected. This implies that bank regulation will not play an active role in improving bank efficiency, but rather constrain banks to channel resources to special interest groups, such as politicians or their cronies. Given these two opposing views, and with similar conflicting predictions based on economic theory about the impact of specific regulations like capital requirements on bank performance, empirical studies become all the more important in helping inform policy decisions.

Building on these recently available bank regulation datasets, we examine an extensive and changing set of regulations and supervisory practices on bank efficiency using data for more than 4,050 banks in a broad cross-section of 72 countries over the time period 1999-2007. The efficiency measures for the banks are constructed based on a widely adopted and non-parametric method to gauge the extent to which the performance of the individual banks deviates from that predicted for the "best practice" banks (i.e., efficiency frontier). We then use these measures to examine whether regulation, supervision, and monitoring enhance

or impede bank efficiency.

Briefly, we find the following main results. First, with respect to bank regulation, we find that tighter restrictions on bank activities are negatively associated with bank efficiency while greater capital regulation stringency is marginally and positively associated with bank efficiency. One should therefore be aware that when tightening bank activities restrictions and strengthening bank capital requirements, which are mainly designed to reduce bank risk, there may be some potential efficiency loss. Second, regarding bank supervision, strengthening official supervisory power is positively associated with bank efficiency only in countries with independent supervisory authorities. Furthermore, greater independence of the supervisory authority itself tends to enhance bank efficiency. This result is important as it suggests that greater independence of supervisory agencies from both politicians and banking firms enhances supervision effectiveness and bank efficiency. It also suggests that putting official supervisory power in the hands of independent supervisors might be helpful in improving the overall efficiency of banking systems. Finally, increased market-based monitoring of banks in terms of more financial transparency and better external audits is positively associated with bank efficiency, suggesting that the third pillar of Basel II can play an important and positive role in helping to improve bank efficiency. We obtain similar results in a dynamic setting, where we explore the impacts of *changes* in bank regulation and supervision schemes on the *change* of bank operating efficiency. Focusing on these changes is important to account for potential time-invariant unobservable factors that might affect both the regulation schemes and bank efficiency. Furthermore, as a check on potential endogeneity issues, we find our results to be robust to an instrumental variable analysis.

In addition to these major findings, we also obtain some other interesting results. We find that greater bank competition, as measured by an asset (deposit) concentration ratio, enhances bank efficiency. The results echo previous findings in the literature (e.g., Berger and Hannan, 1998). The existence and generosity of a deposit insurance system seems to be associated with lower bank efficiency, however. We also find that greater government ownership of the banking industry is associated with lower bank efficiency. Large banks, moreover, tend to have higher efficiency. In addition, we find that a better institutional

environment in terms of laws and regulations exerts significant impact on bank operating efficiency.

Our paper contributes in several important respects to the literature. First, the paper adds to the bank efficiency literature (as surveyed by Berger and Humphrey, 1997, and Berger, 2007) by providing comprehensive evidence on the relationship between regulation and supervision and efficiency using a large sample of banks covering 72 countries over the past decade. We also explore the effect of regulatory and supervisory changes on the changes in bank efficiency. Moreover, we conduct an instrumental variable (IV) analysis to address the possible endogeneity issue concerning the bank efficiency and regulatory schemes. Second, the paper contributes to the growing literature on international bank regulation and supervision (e.g., Demirguc-Kunt, Laeven, and Levine, 2004; Barth et al., 2006; Beck, Demirguc-Kunt, and Levine, 2006; Houston et al., 2009; Laeven and Levine, 2009) by examining the effects of bank regulation and supervision on bank operating efficiency. The efficiency measure can provide more comprehensive information about bank operation than does traditional financial ratio analysis because it summarizes performance in a single statistic that controls for differences among banks using a sophisticated multidimensional framework (Berger et al., 1997). The results, coupled with those from other related studies, may help countries in deciding upon appropriate regulatory reforms. Third, the paper adds to the literature on bank competition and performance (e.g., Berger and Hannan, 1998; Berger et al., 2004; Barth et al., 2009).

The rest of the paper is organized as follows. Section 2 summarizes the literature on the effect of bank regulations, supervisions, and market monitoring on bank efficiency. Section 3 presents our measures of bank efficiency, bank regulation and supervision, and market monitoring variables. It also discusses our data sources and summary statistics for our variables. Section 4 presents our empirical results and discusses their implications. Section 5 provides some robustness tests as checks on our findings. Finally, section 6 concludes the paper with a discussion of the policy implications.

2. The relevant literature discussion

This section briefly summarizes relevant literature pertaining to the effect of bank regulation, supervision, and market monitoring on bank efficiency.

2.1. Capital regulation and bank efficiency

Capital regulation is considered to affect bank performance insofar as it specifies the required amount of capital that bank owners must have at risk. If bank owners are required to have more capital at risk, the upside gains that they would enjoy from greater risk taking would be countervailed by the potential downside loss of their capital (Barth et al., 2006). Therefore, official capital adequacy regulations are believed to play a crucial role in aligning the incentives of bank owners with depositors and other creditors, which results in more careful lending and better bank performance (Keeley and Furlong, 1990; Kaufman, 1991; Barth et al., 2006). However, this belief seems to be based on the public interest view and tends to ignore possible regulatory costs in the form of a higher barrier to entry and greater rent extraction by governments that result from higher capital requirements (Barth et al., 2006). In addition, adherents of a private interest view tend to oppose stringent regulations unless it can be shown that the benefits exceed the costs, and there is little hope of finding an alternative solution to adverse incentive problems. Thus, they generally would oppose reliance on stringent capital regulation given these mixed views about the outcome of a higher capital requirement. These arguments lead one to suspect that more stringent capital regulations lead to an efficiency loss in banking.

2.2. Activity Restrictiveness and bank efficiency

As summarized in Barth et al. (2006), there are different views on the effects of activity restrictions. On the one hand, regulatory restrictions on bank activities can limit the exploitation of economies of scope and scale in gathering and processing information about firms, building reputational capital and providing various types of services to customers (Barth, Brumbaugh, and Wilcox, 2000; Laeven and Levine, 2007). By limiting a bank‘s activities, regulatory restrictions could also impede its ability to diversify income streams and

reduce the franchise value of a bank, which might limit the incentive for efficient behavior (Barth et al., 2006). Moreover, the private interest view would generally argue that the restrictions can be structured so as to give discretion to the regulators, and thus their bargaining power for rent seeking (Djankov et al., 2002). These arguments seem to imply a negative relationship between activity restrictiveness and bank efficiency. On the other hand, board financial activities might intensify moral hazard problems and provide more opportunities for banks to increase risk taking (Boyd, Chang and Smith, 1998). Moreover, broad financial activities may lead to the formation of extremely large and complex entities that are extraordinarily difficult to monitor and ―too big to discipline" (Laeven and Levine, 2007; Barth et al., 2006). Therefore, the overall effect of activity restrictions on bank efficiency is an empirical question that we will explore in this study.

2.3. Official supervisory power, its independence and bank efficiency

As argued in Beck et al. (2006), the public interest view argues that bank supervisors have the incentives and expertise to overcome market failures due to imperfect information. Therefore, a powerful supervisory agency that directly monitors and disciplines banks can enhance the corporate governance of banks and boost bank efficiency. In this regard, supervisory power is expected to be positively associated with bank efficiency However, the private interest view argues that powerful regulators/supervisors will not focus on overcoming market failures; rather, they will focus on promoting their private interests. As Beck et al. (2006) point out, if bank supervisory agencies have the power to discipline non-compliant banks, the supervisors may use this power to induce or force banks to allocate credit so as to generate private or political benefits. In this regard, supervisor power might be negatively associated with bank efficiency.

Supervisory independence also plays a crucial role in the formation of a well functioning banking system. As Barth et al. (2006) point out, supervisory independence enables the supervisors to be insulated from, or able to resist, pressure and influence to modify supervisory practices in order to cater to narrow political or business interests. In other words, supervisory independence allows bank supervisors to monitor the financial

condition of banks in a strictly professional and consistent manner. Moreover, supervisory independence allows supervisors to elicit the banks‘ views, including constructive criticism, of the guidance and advice they give to banks. Both the public interest and private views of regulation point to the need for independent regulatory agencies to improve bank efficiency. Despite the importance, very little is known about the relationship between supervision independence and bank performance. We provide the first comprehensive empirical analysis of this important issue in the following sections. In addition, we explore the interplay effect between supervisory power and supervisory independence to assess whether independent supervisors make better use of supervisory power in enhancing bank efficiency.

2.4. Market monitoring and bank efficiency

It is argued that bank supervisory policies should focus on strengthening the ability and incentives of private investors to overcome information barriers so that they can exert effective monitoring and governance over banks (Beck et al., 2006). Many economists over the years have advocated greater reliance on the private sector and expressed misgivings over the heavy emphasis placed on official supervision of banks. One important reason for this concern is that supervisors do not have an ownership stake in banks, which might generate different incentives than private creditors when it comes to monitoring and disciplining banks (Barth et al., 2006). Furthermore, the private interest view of regulation holds that banks will pressure politicians to unduly influence regulators/supervisors to take actions that mainly serve the special interests of the banks. Consequently, placing a greater reliance on market discipline to promote better functioning banks is important. In line with these arguments, Barth et al. (2006) document that supervisory agencies in many countries compel banks to produce reliable, comprehensive and consolidated information on the full range of bank activities and risk management procedures and hold the bank management legally accountable for accurate information disclosure. Nevertheless, great cross-country variation remains in the supervisory schemes empowering private monitoring. We will explore the effect of these supervisory schemes on bank efficiency in our following analysis.

3. Sample and Variables

3.1. The Sample

The dataset used in this study is compiled from two main sources:

(1) The BankScope database provided by Bureau van Dijk and Fitch Ratings. This database has comprehensive coverage of banks in a large number of countries and accounts for over 90% of all banking assets in each country. The information for each bank consists of detailed balance sheet and income statement data, with up to 200 items and 36 pre-calculated financial ratios.

(2) The Barth et al. (2004, 2006 and 2008) datasets on bank regulation, supervision and monitoring covering more than 100 countries. Their most comprehensive database is compiled from the answers provided by the official regulatory and supervisory authorities to three world-wide surveys on bank regulation and supervision.

In this study, we match the bank-level information with the bank regulation measures to explore the link between bank regulation, supervision and monitoring and bank efficiency. Since the regulation data span nearly a decade, we focus on the time period 1999-2007. Specifically, the values of regulatory variables for the period of 1999 to 2001 are taken from the first survey for 1999. The values of regulatory variables for the period of 2002 to 2004 are taken from the second survey that assesses the state of regulation as of 2002. The regulatory measures for the period of 2005 to 2007 are taken from the third survey for 2005/2006[1]. Accordingly, we calculate the average bank efficiency scores across these same three periods, respectively. Also, the inputs/outputs data used in estimating bank efficiency scores as well as the independent variables are based on the corresponding three-year averages.

One advantage of using data averaged over the three-year period is that we smooth variables that vary over time (Demirguc-Kunt et al., 2004). Furthermore, due to the incomplete overlap among the three datasets and missing firm-level and banking-sector variables, the final sample used in our study contains an unbalanced panel of 4,053 banks (8,115 bank-period

[1] We tried some alternative ways to assign values, such as moving all the thresholds one year before or one year later and found the results to be quite robust. Another way was to try a longer time period but consistent results were obtained in this case as well.

observations) in 72 countries over the time period 1999-2007. The list of the countries can be found in table 3.

In addition to the three datasets mentioned above, we rely on two other data sources, the World Development Indicator (WDI, 2004) and the World Governance Indicator compiled by Kaufmann et al. (2006). Variables from these datasets are used to control for macroeconomic and institutional factors that might affect the overall level of bank efficiency in a country. Tables 1 and 2 identify the data sources and provide brief descriptions and summary statistics for the key variables.

[Tables 1 and 2 here]

3.2. Bank Efficiency

Our measures of bank efficiency are obtained using a non-parametric method, namely data envelope analysis (DEA)[2]. The envelopment of data for the entire sample of banks using this approach enables one to identify the best practice banks that form the non-parametric efficient frontier. The advantage of a non-parametric technique like DEA relative to parametric techniques, such as the stochastic frontier or production function approaches, is that the latter require one to assume a particular functional form, thereby imposing a specific structure on the shape of the efficient frontier. This means that the deviations in efficiency measures between individual banks and the best practice banks on the efficient frontier will be dependent on how accurately the chosen functional form captures the true relationship. As DEA is non-parametric and envelops the multiple inputs/outputs data of the sample banks, the derived efficiency measures do not suffer from this problem of functional form dependency (e.g., see Drake et al., 2006).

Regarding the model specification, we use the standard financial intermediation approach to evaluate the relative efficiency of banks. This approach was originally developed by Sealey and Lindeley (1977) and posits that total loans and securities are outputs, whereas deposits along with labor and physical capital are inputs[3]. This approach to modeling financial

[2] The non-parametric efficiency approach was originally developed by Farrell (1957) and subsequently has been widely used in the bank efficiency literature (please see section 4 for detailed discussion).

[3] We have also used the *profit approach* to measure bank operation efficiency, along the lines of Drake et al. (2006), and find the results to be robust.

intermediation has been widely adopted and used in the literature. Following more recent applications (e.g., Casu, Girardone and Molyneux, 2004; Drake, Hall and Simper, 2006), we posit an intermediation model that has four inputs and three outputs. The three basic inputs (Xi) are: X1 (total deposits + total money market funds + total other funding); X2 (personnel expenses-labor input); and X3 (total fixed assets - physical input). We also include another input X4 (loan loss provisions) to capture the risk/potential costs in making loan decisions. As Drake et al. (2006) point out, it has long been argued in the literature that the incorporation of risk/loan quality is vitally important in studies of bank efficiency. More specifically, Laeven and Majnoni (2003) argue that risk should be captured in an efficiency analysis through the inclusion of loan loss provisions, which could be viewed as a cost or an input. As stated by them, ‗‗…loan loss provisions required to build up loan loss reserves should be considered and treated as a cost. A cost that will be faced with certainty over time but that is uncertain as to when it will materialize.'' (p. 181). Based on these considerations, we include loan loss provisions as a fourth input in our model.

With respect to the three outputs (Yi), they are: Y1 (total customer loans + total other lending); Y2 (total other earning assets— other interest generating or fee yielding assets such as bonds and investment securities); and Y3 (other, non-interest, income). The inclusion of the latter output is included so as not to penalize those banks with a relatively large share of non-traditional bank activities. The efficiency scores are obtained from these inputs and outputs using the DEA method described in detail in section 4.

3.3 Activity Restrictiveness

This variable indicates whether bank activities in (a) underwriting, brokering and dealing in securities, and all aspects of the mutual fund industry, (b) insurance underwriting and selling, and (c) real estate investment, development, and management are (1) Unrestricted, (2) Permitted, (3) Restricted, or (4) Prohibited. The aggregate indicator therefore ranges from four to sixteen with higher values indicating greater activity restrictiveness.

3.4. Capital Stringency

This variable indicates whether the capital requirement incorporates certain risk elements and deducts certain market value losses when capital adequacy is determined. Specifically, it is an indicator based on a summation of the answers to the following questions (Yes=1, No=0): 1. Is the minimum capital-asset ratio requirement risk weighted in line with the Basle guidelines? 2. Does the minimum ratio vary as a function of an individual bank's credit risk? 3. Does the minimum ratio vary as a function of market risk? 4. Before minimum capital adequacy is determined, which of the following are deducted from the book value of capital: a) Market value of loan losses not realized in accounting books; b) Unrealized losses in securities portfolios? c) Unrealized foreign exchange losses? Higher values of this variable indicate greater stringency.

3.5. Supervision

We use three variables to measure the strength, independence and experience of the bank supervisor. These are as follows:

(1) The variable Official Supervisory Power is constructed from 14 dummy variables that indicate whether bank supervisors can take specific actions against bank management, bank owners, and bank auditors both in normal times and times of distress. This includes information on whether the supervisory agency can force a bank to change its internal organizational structure, suspend dividends, stop bonuses, halt management fees, force banks to constitute provisions against actual or potential losses as determined by the supervisory agency, supersede the legal rights of shareholders, remove and replace managers and directors, obtain information from external auditors, and take legal action against auditors for negligence. (The exact definition and construction of Official Supervisory Power is provided in the data appendix.) The first principal component indicator of these variables is used, with higher values indicating broader and greater authority for bank supervisors.

(2) The variable Supervisory Independence is an aggregate indicator which measures the degree to which the supervisory authority is independent from the government and legally protected from the banking industry. Specifically, the variable is constructed based on the following three questions. First, are the supervisory bodies responsible or accountable to a)

Prime Minister, b) the Finance Minister or other cabinet level official, or c) a legislative body, such as parliament of congress? The indicator equals one if the supervisory bodies are responsible to a legislative body and zero otherwise. Second, are the supervisors legally liable for their actions (i.e., if a supervisor takes actions against a bank, can the supervisor be sued)? The variable equals one if the supervisors are not legally liable for their actions, and zero otherwise. Third, does the head of the supervisory agency (and other directors) have a fixed term and, if so, how long? The index equals one if the fixed term is equal or greater than four years, and zero otherwise. The aggregate indicator may therefore vary between 0 and 3, with a higher number indicating more independent supervisory agencies.

(3) The variable Supervisor Tenure measures the average tenure of a professional bank supervisor. It indicates the experience of the current bank supervisors.

3.6. Monitoring

We use four variables to measure the degree of monitoring by external auditors and the public (through information disclosure). First, the variable Certified Audit Required is an index which measures whether an external audit by licensed auditors is a compulsory obligation for banks. Second, the variable Strength of External Audit measures the effectiveness of external audits of banks. It is an indicator based on answers to the following questions (Yes=1, No=0): 1. Is an external audit a compulsory obligation for banks? 2. Are specific requirements for the extent or nature of the audit spelled out? 3. Are auditors licensed or certified? 4. Do supervisors get a copy of the auditor's report? 5. Does the supervisory agency have the right to meet with external auditors to discuss their report without the approval of the bank? 6. Are auditors required by law to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in illicit activities, fraud, or insider abuse? 7. Can supervisors take legal action against external auditors for negligence? Higher values of the indicator indicate that more information is provided by the external audit. Third, the variable Bank Accounting is an index which measures whether the income statement includes accrued or unpaid interest or principal on nonperforming loans and whether banks are required to produce consolidated financial statements. Higher values indicate more informative bank

financial statements. Better information disclosure can facilitate the monitoring of banks by both the auditor and the public. And fourth, the variable Deposit Insurance Coverage is the ratio of deposit insurance coverage to deposits per capita. Barth et al. (2006) point out that deposit insurance intensifies the moral hazard problem in banking because depositors do not face the risk of losses, which diminishes the incentive to and effort at monitoring bank activities. Hence, higher values of this index indicate less private monitoring.

3.7. Other controls

We also control for banking sector concentration. Specifically, we use the Herfindahl Hirschman Index (HHI), which is equal to the sum of the squares of the market shares (deposits) of each individual bank in the individual countries. The bank level data are from the BankScope database. The (normalized) Herfindahl-Hirschman Index ranges from 0 to 1, with a higher value indicating greater monopoly power[4]. We expect greater banking concentration to be negatively associated with bank efficiency. This is because a concentrated banking market potentially allows a few powerful banks to dominate and thereby stymie competition with deleterious effect on efficiency (e.g., Berger et al., 2004; Demirgu-Kunt et al., 2004). More concentrated power allows bank managers to relax their efforts on improving performance, whereas the pressure of a competitive market provides incentives to managers to perform better and also provides information for the use of appropriate incentive schemes (e.g., Schaferstein, 1988; Berger and Hannan, 1998; Allen and Gale, 2000).

In addition, we control for banking-sector state ownership. It is well known that state ownership of firms is usually associated with lower firm efficiency because the government tends to pursue non-profit driven goals, such as supporting employment and maintaining social stability (e.g., Megginson and Netter, 2001). La Porta et al. (2002) argue that state-owned banks[5] are controlled by politicians who use the banks to maximize their own political and personal objectives, such as providing jobs for political supporters and bailing out

[4] Other concentration measures such as the top 5 bank asset/deposit concentration ratios yield very similar results.

[5] According to La Porta et al. (2002), state ownership of banks is common in countries other than the United States. Based on the 10 largest banks in 92 countries, they document that 42% of bank assets in these countries are controlled by the state-owned banks.

poorly performing state-owned enterprises (SOEs). We therefore include a variable to measure the ownership structure of the banking industry. In particular, the variable State Owned Bank is included and is the fraction of the banking system's assets in banks that are 50% or more owned by the government.

We control for bank size to capture the potential size effect on bank lending behavior (e.g., Berger et al., 2005).The variable *Bank Size* equals the logarithm of total bank assets in millions of U.S. dollars. We also control for *Bank Equity*, which is the ratio of the book value of equity to total assets.

3.9. Country Controls

The empirical analysis also includes several country-level variables to control for differences in economic development and institutions across countries. We include GDP per capita to capture the economic development of a region/country. Also, we include the natural logarithm of GDP to capture the size of an economy and we control for inflation in an economy. Lastly, we include a series of political and institutional quality indexes as a check on the robustness of the results. These are the World Governance Indexes (Kaufmann et al., 2006), which are constructed from 276 individual variables taken from 31 different sources produced by 25 different organizations. The indexes measure different dimensions of governance, which include *Government effectiveness*, *Political stability*, *Regulatory quality*, *Rule of law*, *Voice and accountability*, and *Control of Corruption*. The detailed definition can be found in table 1. Higher values of the indexes indicate higher quality institutions. We expect that banks tend to be more efficient in more developed countries and in countries with higher quality institutions.

4. Methodology

4.1. Data envelopment analysis (DEA)

We apply a widely used non-parametric method, data envelopment analysis (DEA), to obtain bank efficiency scores and then perform second-stage regressions to examine the relationship between bank regulation, supervision and monitoring and bank efficiency. There are four major advantages of applying this approach in our context.

First, DEA is a nonparametric approach and does not impose an assumption about a specific production functional form. It is an extension of the earlier nonparametric analysis of productivity by Afriat (1972) and Varian (1984) to allow individual banks to deviate from their profit maximization frontier and therefore to exhibit some degree of inefficiency (Banker and Maindiratta, 1988). In other words, the DEA approach measures a bank‘s performance relative to a 'best practice' frontier derived from its peer group (Farrell, 1957). Such a measure is superior to traditional techniques, such as a financial ratio analysis because it summarizes performance in a single statistic that controls for differences among banks using a sophisticated multidimensional framework. This type of analysis can be used to assist a bank in evaluating whether it is performing better or worse than its peer group in terms of technology, scale, cost minimization and revenue maximization and thus in directing management efforts to the areas that need the most improvement (Habib and Ljungqvist, 2005). The DEA approach, moreover, is a standard nonparametric estimation method that has been well-established in the econometrics literature (e.g., see Banker and Maindiratta, 1988, Färe and Grosskopf, 1995, Chambers et al., 1998, Kuosmanen et al., 2007, Simar and Wilson, 2007). Indeed, a special issue of *Journal of Econometrics* (Lewin and Lovell 1990, eds.) has been devoted to the development and analysis of DEA. Furthermore, Banker and Natarajan (2008) show that a two-stage DEA-based approach comprising a DEA model followed by a maximum likelihood estimation yields a consistent estimator that performs at least as good as parametric methods in the estimation of the impact of the contextual variables on the efficiency scores. The DEA method has also been employed widely in top economics journals (e.g., Färe et al., 1994, Ray and Desli, 1997, and Kumar and Russell, 2002). In addition, it has been increasingly applied in the finance literature, including the banking and financial institution efficiency literature (e.g., Berger and Humphrey, 1997, Seiford and Zhu, 1999, Wheelock and Wilson, 1995 and 2000, Copper et al., 2004, Cummins and Ruio-Misas, 2006). Second, DEA focuses on individual observations rather than on the population average, as compared with regression analysis. According to Banker and Natarajan (2008), the simulation results indicate that DEA-based procedures perform better than parametric methods in the estimation of an individual decision-making unit (individual bank in our case) productivity. Third, DEA

compares bank performance to the revealed best-practice frontier, rather than on the central-tendency properties of the frontier.

In the first-stage estimation, the DEA methodology computes an operational efficiency score for each bank in the sample. The second-stage estimation then examines the determinants of the efficiency scores.

The operational efficiency score for a bank is estimated as the fraction of actual inputs that is required for the bank to be located on the efficient frontier to produce the same level of output. Suppose the sample size is n and there are m inputs and s outputs for each bank. Denote $x_k = (x_{1k}, x_{2k}, \ldots, x_{mk})$ as a $m\times1$ vector of inputs for bank k, $X=(x_1, x_2, \ldots, x_n)$ as a $m \times n$ matrix of inputs, $y_k =(y_{1k}, y_{2k}, \ldots, y_{sk})$ as a $s\times1$ vector of outputs for bank k, and $Y=(y_1, y_2, \ldots, y_n)$ as a $s\times n$ matrix of outputs, respectively. The variable returns to scale DEA model can be expressed with the following n linear programming problems for each bank k (k=1, 2,…n):

$$\text{Max}(\varphi_k \geq 1 \mid x_k, y_k, X, Y)=\text{Max}(\varphi_k \geq 1 \mid \varphi_k y_k \leq Y\lambda_k, X\lambda_k \leq x_k, \lambda_k \geq 0, I_1'\lambda_k=1) \qquad (1)$$

where I_1 denotes an $n\times1$ vector of ones, φ_k denotes a scalar parameter, and $\lambda_k =(\lambda_{1k}, \lambda_{2k}, \ldots, \lambda_{nk})'$ denotes a $n\times1$ non-negative vector of parameters.

The DEA model in (1) has an intuitive interpretation. For each bank k, a virtual output $Y\lambda_k$ is constructed as a weighted output of all the banks by choosing some nonnegative weights $\lambda_k \geq 0$, $I_1'\lambda_k=1$. It then seeks to expand the virtual output $Y\lambda_k$ as much as possible, subject to the inputs constraint of bank k: $X\lambda_k \leq x_k$. The virtual output $Y\lambda_k$ is then compared with the actual output y_k of bank k. If the maximized virtual output $Y\lambda_k$ is above the actual output of bank k by a scalar factor of $\varphi_k>1$, then the bank k is inefficient. Otherwise, the bank k is located at the efficient frontier since $\varphi_k=1$.

The input-oriented efficiency score is defined as ek=1/φk (0≤ ek≤1) for bank k. Under the DEA method, a bank with an efficiency score of unity (100%) is located on the efficient frontier in the sense that its outputs cannot be further expanded without increasing its inputs. A bank with an efficiency score below 100% is relatively inefficient, suggesting that a bank can attain its current output level with fewer inputs. As discussed in Section 3.2 above, in the

first-stage estimation, we have four inputs and three outputs to estimate efficiency scores for each bank in the sample based on model (1).

In the second stage, we estimate the following equation to identify the determinants of the banking efficiency score e_k :

$$e_k = X_k\beta + u_k \qquad (2)$$

where e_k is the efficiency score for bank k. X_k is a vector of explanatory variables including a constant term, which represent bank regulation, supervision and monitoring as well as other control variables, such as bank industry characteristics and macroeconomic environment, as discussed in Section 3. u_k is an error term with a standard error of σ_u. Since efficiency scores e_k are truncated below from zero and above from unity, u_k is an error term with double-truncation. As a result, Simar and Wilson (2007) argue that the truncated regression estimation permits valid inference. We apply the standard maximum likelihood estimation with heteroskedasticity robust standards errors clustered by countries to allow for possible cross-section correlations. When clustering the standard errors by country, observations are not restricted to be independent within countries; rather, observations are required to be independent across countries (Beck et al., 2006). We therefore follow them with clustering the standard errors by country[6].

5. Empirical results

5.1 Main results

Table 3 summarizes the bank efficiency scores. The second and third columns give un-weighted and weighted mean (by total loans) of individual bank efficiency measures within each country, respectively. The table covers a sample of 72 countries at different income levels. More developed countries usually have higher bank efficiency measures. For example, developed countries such as Luxembourg, Switzerland, United Kingdom, and United States, generally have measures higher than 0.8 or even 0.9, while middle-income countries such as Hungary, Russia, and Malaysia tend to have efficiency scores close to the mean level. Less

[6] The empirical results will be highly robust and even more significant without the country clustering effect.

developed countries such as Sudan, Senegal, and Nigeria tend to have measures much lower than the mean level. Column 3 presents the standard deviation of the efficiency measures within each country. As shown, the magnitude of the standard deviations of the measures for most countries is small relative to its mean, suggesting that within each country, there is not substantial variation of bank efficiency. A country‘s specific institutional and regulatory framework may be the major determinants of its banking firms‘ efficiency. Finally, columns 4 and 5 present lower and upper bounds of the efficiency measures based on a bootstrapping method at a confidence level of 95%.

[Tables 3 here]

We also checked the correlations among the bank regulation, supervision and other control variables and found that multicollinearity is not a serious problem. Most of the correlation coefficients are below 0.3, which makes us comfortable with simultaneously including these variables in the estimated models. The correlation matrix for the variables is presented in Table 4.

[Tables 4 here]

Table 5 presents our main regression results. The dependent variable is the DEA bank efficiency measure or score based on truncated ML estimation. The first column summarizes the regression of the efficiency score on regulatory variables, such as activity restrictiveness, overall capital stringency, and a number of control variables, such as the Herfindal Index (HHI), government ownership of banks, bank size, bank equity (ratio), and a country‘s GDP and inflation. It is clear that more stringent bank activity restrictions are associated with less bank efficiency, as indicated by its negative and significant (at the 5% level) coefficient. A one standard deviation increase in activities restrictiveness decreases bank efficiency by 3.4%. The overall capital stringency is positive and marginally significantly (at the 10% level) related to bank efficiency. This result suggests the potential offsetting effects of more stringent capital regulation on bank efficiency. Stringent capital regulation may help reduce bank risk, but at the expense of some efficiency loss. Overall, the effect is positive and marginally significant.

As for the control variables, less bank competition, as measured by the HHI, is indeed negatively and significantly related to bank efficiency. The government ownership of banks is

also negatively related to bank efficiency, as indicated by the negative and significant coefficient. A 10% increase in government ownership of the banking sector reduces bank efficiency by 3%. These results support our earlier arguments that bank competition enhances bank efficiency while government ownership may distort bank operations and hence reduce bank efficiency. We also find that large banks tend to have higher bank efficiency scores. This may be due to scale/scope economies in banking. A higher equity to asset ratio is also positively associated with bank efficiency. This suggests that well-capitalized banks may also have higher efficiency. A country‘s inflation is negatively associated with bank efficiency, suggesting that a lower inflationary environment is more conducive to efficient bank operations. A more developed country, as measured by a higher GDP per capita, tends to have more efficient banking. Finally, a larger market, as measured by a larger GDP level, is also associated with more efficient banks.

Columns 2 and 3 present regressions of bank efficiency measures with official supervisory power and its independency as main regulatory variables. In both columns 2 and 3, we find that official supervisory power is not significant in explaining bank efficiency. In contrast, the average tenure of supervisors and the independence of the supervisory authority are both statistically and positively significant. This result suggests that strengthening supervisory power itself does not necessarily lead to higher bank efficiency. Instead, increasing the independence of the authority with supervisory power helps enhance bank efficiency. In addition, in column 3, the interaction term of official supervisory power and supervisory independence is positive and statistically significant at the 5% level, suggesting that strengthening supervisory power is effective in improving in bank efficiency in countries with more independent regulators/supervisors. To better understand the economic significance of our findings, consider the set of coefficients reported under column (3) of Table 5. Those estimates imply that one-standard deviation increase in supervisory power increases operating efficiency of banks in countries with the most independent regulators by 5.5% more than a similar increase in supervisory power for banks in countries with the least independent regulators. Finally, the control variables all show similar coefficients as in the regression in Column 1.

Column 4 of Table 5 summarizes the regression results with variables related to market monitoring, the third pillar of Basel II. In particular, we find that the strength of external audit, certified audit required, and bank accounting informativeness, are all positively and statistically significant in explaining bank efficiency. This suggests that the market monitoring mechanisms of Basel II help to enhance bank efficiency. In addition to other control variables used in first three regressions, in column 4, we also report the coefficient of deposit insurance coverage/deposits per capita on bank efficiency to be negative and highly significant. This result suggests that the existence and generosity of deposit insurance may induce more adverse selection and moral hazard problems associated with it and hence producing a negative effect on bank efficiency (Barth et al., 2006).

Columns 5 presents the overall results with a more complete set of regulatory variables, including those for all three pillars of Basel II. We find that the major regulatory variables retain their signs and significance as before, suggesting the main predictions of our model are quite robust when including these additional variables. The control variables also yield similar effects on bank efficiency as in previous regressions. Finally, the pseudo R2 are all above 0.3, suggesting good explanatory power of our regressions.

5.2. Robust checks: Instrumental Variables

In this section, we provide some robustness checks of our main results indicating that the type of regulatory environment matters for bank efficiency. In particular, we address a possible endogeneity problem that may be associated with our previous regressions and also try to control for more country-specific institutional variables.

A potential endogeneity problem could exist insofar as the main results in Table 5 may be due to reverse causality. A more efficient bank may influence regulatory policies in the direction of being more accommodative to the growth and development of the bank. In other words, the regulatory framework may be endogenous to the structure of the banking system in each country. To address this concern, we use an Instrument Variable (IV) approach. Following previous studies (Beck et al., 2006; Barth et al., 2009), we select the instrumental variables based on the theoretical and empirical work in the law, institutions, and finance

literature (Acemoglu and Johnson, 2005; Beck, Demirguc-Kunt, and Levine, 2003; Easterly and Levine, 1997; La Portal et al., 1998 and 1999). From the law and finance perspective, La Portal et al. (1999) and Beck et al. (2003) show that historically determined differences in legal traditions help explain international financial institutions today. Furthermore, legal origin can be thought of as "exogenous" because it was imposed by colonial power in many emerging countries (Acemoglu and Johnson, 2005; La Porta et al., 1999). It is not very likely that legal origin itself would have a direct impact on banking performance today. Instead, it may exert an indirect impact through the channels of various institutions and regulations. We also take into account the endowment theory, which focuses on the roles of geography and the disease environment in shaping the political and financial institutional development. Studies (e.g., Acemoglu et al., 2001; Beck, Dimirguc-Kunt, and Levine, 2003) find strong evidence that geographical endowment has substantial impacts on the formation of long-lasting institutions that shape financial development. Based on the above discussion, we use legal origin (English, French), latitude as instrumental variables for the bank regulatory variables in that country. We also include the ethnic fractionalization as an instrumental variable because it has been found that economies with greater ethnic diversity tend to choose institutions that facilitate expropriation (Easterly and Levine, 1997). Finally, we follow Beck et al. (2006) and include the percentage of years that the country has been independent since 1776 as an additional instrumental variable because countries that gained their independence earlier had more opportunity to modify colonial institutions and adopt policies more conducive to economic development..

Following the literature (e.g., Beck et al., 2006), we conduct two tests to assess the appropriateness of the instruments. First, we employ overidentifying tests, which assess whether the instrumental variables are associated with the dependent variable beyond their effects through media-sector ownership and structure or the other explanatory variables. We refer to this analysis as the "Overidentifying Test" and report the p-value of the test of the overidentifying restrictions. Failure to reject the null hypothesis implies a failure to reject the validity of the instruments. As can be seen from Table 6, we cannot reject the null hypothesis that the instruments are valid in all model specifications, suggesting that these instruments only

exert an impact on bank efficiency through their effect on the bank regulation and supervision measures. In addition, we conduct an F-test of the excluded exogenous variables in the first-stage regressions. The null hypothesis of the test is that the instruments do not explain cross-sectional differences in banking regulation measures. We reject the null hypothesis at the 1% confidence level in all model specifications[7].

Our main empirical results are robust to the IV regression analysis. In Table 6, the coefficients of main regulatory variables, the capital requirement, supervisory power and supervisory independence, and market monitoring, are all statistically significant and their signs are the same as in the regressions in Table 5. Furthermore, the IV coefficients are larger than the OLS coefficients, indicating the existence of potential measurement error, which would tend to ―attenuate" the coefficient estimates toward zero (Barth et al., 2009). Similar results also obtain for the control variables. Taken altogether, the results for our IV estimations imply that our findings are robust to potential endogeneity concerns.

5.3. Robust checks: Bank Regulation Changes

As Barth et al. (2008) point out, a large number of banking regulatory reforms have occurred in various countries over the past decade. Since these reforms arguably have had a meaningful effect on the regulatory environment, it is interesting to explore how international bank flows have responded to these regulatory changes. We follow Barth et al. (2008) to make comparisons on the bank regulatory environment in year 1999 (using Survey I) and year 2006 (using Survey III). These comparisons are illustrated in Figures 1-6.

[Figures 1 to 6 here]

Changes in activities restrictiveness are presented in Figure 1. A change in a positive direction indicates a move towards greater restrictiveness. As can be seen, most countries tightened restrictions during the past decade. The activities restrictiveness in many developing countries, such as Nicaragua, Kazakhstan, and Costa Rica, increased dramatically over this period. At the same time, restrictions have eased in such countries as Mauritius, Belgium, and

[7] Similar to the claim in Beck et al. (2006), we are not claiming that these variables are the best instrumental variables. Instead, we hold that the instruments are reasonably exogenous and have decent explanatory power of bank regulation and supervision measures, as the literature points out.

Romania. Figure 2 highlights changes in capital regulations. As can be seen, most countries in our sample have undergone some change in capital regulations. A change in a positive direction indicates a move towards greater stringency. In our sample, the countries easing capital requirements are less numerous than those moving towards greater stringency. More specifically, countries like Belgium, Jordan, Slovenia, and Argentina have eased capital regulations, whereas Ecuador, Tunisia, Uganda, Slovak and Nigeria have dramatically tightened capital regulations over the past decade.

Figure 3 shows changes in the strength of the external audit. In our sample, many countries have gone through some changes in the information disclosure requirements. As can be seen from Figure 3, the strength of the external audit has been improved in most countries. The improvements are more prominent in developing countries. Figure 4 shows the changes in the informativeness of bank accounting information, with many countries having undergone some reforms. Figure 5 shows the changes of Official Supervisory Power. As can be seen, most countries in our sample have moved to strengthen official supervision, or at least provide supervisors with more explicit power, most notably in countries such as Turkey, Ecuador, Nigeria and many other developing countries. Interestingly, countries like Australia, Botswana, Czech Republic, and the U.K. moved in the opposite direction. In fact, the U.K. authorities have established a working group to address concerns about excessive regulation and supervision (Barth et al., 2008). Overall, the figures show that many countries have followed the Basel II guidelines to strengthen capital regulations, to empower supervisory agencies to a greater degree, and to improve financial statement transparency (Barth et al., 2008). Finally, Figure 6 shows the changes of supervisory independence. As can be seen, about half of the countries have moved towards a more independent supervisory system and another half of the countries have moved towards a less independent supervisory system.

To examine the effects of regulatory changes on international bank flow changes, we use the first differencing estimation with three time periods (corresponding to the three surveys). Specifically, we examine the effect of the regulatory changes on the changes of the bank efficiency changes. The sample thus contains observations for at least two consecutive

observations and its size drops to between 4,053 and 4,090. The empirical results are presented in table 7.

[Table 7 here]

As can be seen from the table, the empirical results are highly robust to our previous findings. We find that the changes in the gaps of activity restrictiveness, capital regulatory stringency, strength of external audit, certified audit requirement, bank accounting informativeness, supervisor tenure, and independence of supervisory authorities are positively associated with the changes in bank efficiency. We also find that the change of supervisory strength results in positive bank efficiency changes in countries with independent supervisory authorities. The control variables also yield similar results.

5.4. Robustness Tests: More Macro controls

We now address the issue of potential omitted variables. In addition to regulatory and macro-economic variables, we include a series of macro-institutional indexes in our model to test the robustness of the results.

We include the World Governance Indexes complied by Kaufmann et al. (2006) to control for the effect of other country-specific institutional variables on bank efficiency. In particular, these indexes include a country‘s control of corruption, government effectiveness, political stability, quality and regulation, rule of law, and voice and accountability. The detailed definition of the indexes is discussed in Section 3. Because some indexes are highly correlated with each other, we include the indexes individually in the models. The empirical results are consistent with our previous findings. All major explanatory variables and control variables maintain their sign and significance as before. The new control variables, the Kaufmann indexes, also show expected signs. In particular, we find that all indexes are positive and Quality of Regulation, Rule of Law, and Voice and Accountability have statistically significant effects on bank efficiency. This result suggests that a better institutional environment in terms of law and regulations is generally conducive to more efficient banking in the countries studied.

We also conduct some other robustness checks. For instance, recent development of the two-stage bootstrapping DEA (e.g., Simar and Wilson, 2007) introduces a random disturbance into the model. We test the robustness of the results using this new approach and find the results highly consistent. For brevity, the results are not reported but available from the authors upon request.

6. Conclusion

The recent global financial crisis has spurred renewed interest in assessing the appropriate regulatory reforms to mitigate, if not prevent, future banking crises. More generally, effort is being devoted to identifying the bank regulatory regime that works best to promote a well-functioning banking system. Such a system would be one that improves bank efficiency. In this regard, and building upon a recent world-wide survey on bank regulation across 152 countries (Barth et al., 2008), we examine the important effects of bank regulation and supervision on bank operating efficiency. Based on an analysis of a sample with more than 8,000 bank-year observations in 72 countries over the time period 1999-2007, we find bank regulation, supervision and market monitoring all exert significant impacts on bank efficiency. Regarding bank regulation, we find in particular that tighter bank activity restrictions exert negative impacts on bank efficiency while the greater capital regulation stringency exerts marginally positive effects on bank efficiency. The results imply there are potential tradeoffs between bank safety/soundness and efficiency. In addition, we find that a strengthening of official supervisory power, the second pillar of Basil II, is not significantly related to greater bank efficiency. However, greater independence of the supervisory authority tends to enhance bank efficiency. In addition, there is a strong interaction and positive effect of official supervisory power and supervisory independence on bank efficiency. This result is important as it suggests that independence of supervisory agencies from both politicians and banking firms is conducive to improved bank efficiency. It also suggests that putting the official supervisory power in the hands of independent supervisors might be helpful to improve the efficiency of the banking system. We also find supervisor experience is positively related to bank efficiency. Finally, market-based monitoring of banks in terms of more financial

transparency is positively associated with bank efficiency. We find that an external auditor requirement, the strength of external auditor, and bank information disclosure are positively associated with bank operating efficiency while generous deposit insurance coverage is negatively associated with bank operating efficiency. These results suggest the positive role that can be played by the third pillar of Basel II in improving banking efficiency.

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Table 1: Variable definitions and data sources

Variables	Definition	Original Sources
Financial intermediation model		
Outputs of Banks		
Total Loans	Loans and total other lending (mil USD)	BankScope
Other Earning Assets	Total other earning assets (mil USD)	BankScope
Other Operating Income	Other operating income (mil USD)	BankScope
Inputs of Banks		
Total Deposits	The sum of total deposits, total money market funding, and total other funding (mil USD)	BankScope
Labor Input	Personnel expenses (mil USD)	BankScope
Capital Input	Fixed assets (mil USD)	BankScope
Loan Loss Provisions	Loan Loss Provisions and other provisions (mil USD)	BankScope
Other variables		
Bank Efficiency	Technical efficiency of the bank with the range between 0 and 1	Authors‘ calculation
HHI	To control for competition we use a Herfindahl index, defined as the sum of the squared shares of bank deposits to total deposits within a given country, averaged over the period 2004 to 2006.	BankScope
Bank Size	Natural logarithm of total assets	BankScope
Bank Equity	The book value of equity divided by total assets times 100	BankScope
Activities restrictions	The extent to which banks may engage in (a) underwriting, brokering and dealing in securities, and all aspects of the mutual fund industry, (b) insurance underwriting and selling, and (c) real estate investment, development, and management. Unrestricted=1: full range of activities can be conducted directly in the bank; Permitted=2: full range of activates can be conducted, but some or all must be conducted in subsidiaries; Restricted=3: less than full range of activities can be conducted in the bank or subsidiaries; and Prohibited=4: the activity cannot be conducted in either the bank or subsidiaries. Higher values indicate greater restrictiveness	Barth et al. (2006)

Overall capital stringency	Whether the capital requirement reflects certain risk elements and deducts certain market value losses from capital adequacy is determined. Specifically, it is an indicator developed based on the following questions (Yes=1, No=0): 1. Is the minimum capital-asset ratio requirement risk weighted in line with the Basle guidelines? 2. Does the minimum ratio vary as a function of an individual bank's credit risk? 3. Does the minimum ratio vary as a function of market risk? 4. Before minimum capital adequacy is determined, which of the following are deducted from the book value of capital: a) Market value of loan losses not realized in accounting books; b) Unrealized losses in securities portfolios? c) Unrealized foreign exchange losses? Higher values indicating greater stringency.	Barth et al. (2006)
Average tenure of supervisors	The average number of years current supervisors have been appointed	Barth et al. (2006)
Strength of external audit	The effectiveness of external audits of banks. It is an indicator developed based on the following questions (Yes=1, No=0) : 1. Is an external audit a compulsory obligation for banks? 2. Are specific requirements for the extent or nature of the audit spelled out? 3. Are auditors licensed or certified? 4. Do supervisors get a copy of the auditor's report? 5. Does the supervisory agency have the right to meet with external auditors to discuss their report without the approval of the bank? 6. Are auditors required by law to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in illicit activities, fraud, or insider abuse? 7. Can supervisors take legal action against external auditors for negligence? Higher values indicate better strength of external audit.	Barth et al. (2006)
Certified Audit Required	Whether there is a compulsory external audit by a licensed or certified auditor. (Yes=1; No=0)	Barth et al. (2006)
State Owned Bank	The fraction of the banking system's assets in the banks that are 50 percent or more owned by government. The data are compiled based on a survey of banking regulators in 150 countries in 2003.	Barth et al. (2006)
Deposit insurance coverage / deposit per capita	Ratio of deposit insurance coverage to deposits per capita	Demirgüç-Kunt, et al. (2008)
Bank Accounting Informative	Whether the income statement includes accrued or unpaid interest or principal on performing and nonperforming loans and whether banks are required to produce consolidated financial statements. Higher value indicates more informative bank account.	Barth et al. (2006)
Official Supervisory Power	Principal component indicator of 14 dummy variables: 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 required by law to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in elicit activities, fraud, or insider abuse? 3. Can supervisors take legal action against external auditors for negligence? 4.Can the supervisory authority force a bank to	Barth et al. (2006)

	change its internal organizational structure? 5. Are off-balance sheet items disclosed 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 the directors' decision to distribute: a) Dividends? b) Bonuses? c) Management fees? 8. Can the supervisory agency legally declare-such that this declaration supersedes the rights of bank shareholders-that a bank is insolvent? 9. Does the Banking Law give authority to the supervisory agency to intervene that is, suspend some or all ownership rights-a problem bank? 10.Regarding bank restructuring and reorganization, can the supervisory agency or any other government agency do the following: a) Supersede shareholder rights? b) Remove and replace management? c) Remove and replace directors?	
Supervisory Independence	The degree to which the supervisory authority is independent from the government and legally protected from the banking industry. The indicator is constructed based on the following three questions. 1. Are the supervisory bodies responsible or accountable to a) Prime Minister, b) the Finance Minister or other cabinet level official, c) a legislative body, such as parliament of congress? 2. Are the supervisors legally liable for their actions (i.e. if a supervisor takes actions against a bank, the supervisor cannot be sued)? 3. Does the head of the supervisory agency (and other directors) have a fixed term and how long? (=1 if the term>=4). Higher value means a more independent supervisory agency.	Barth et al. (2006)
Inflation	3-year average percentage inflation, GDP deflator.	World Development Indicators (WDI)
GDP per Capita	Logarithm of 3-year average gross domestic product per capita.	World Development Indicators (WDI)
GDP	Natural logarithm of 3-year average gross domestic product.	World Development Indicators (WDI)
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. The value of year 2005 is used in this study. Higher values mean greater political rights.	Kaufmann et al. (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. The value of year 2005 is used in this study. Higher values mean higher quality of public and civil service.	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. The value of year 2005 is used in this study. Higher values mean	Kaufmann et al. (2006)

	stronger law and order.	
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. The value of year 2005 is used in this study. Higher values mean more stable political environment.	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. The value of year 2005 is used in this study. Higher values mean higher quality of regulation.	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. The value of year 2005 is used in this study. Higher values indicate better control of corruption.	Kaufmann et al. (2006)

Table 2: Summary statistics for variables

Variable	Mean	Median	SD	No. of observations
Panel A: Bank level data				
Outputs of banks				
Total loans	5.68	5.59	2.36	8143
Other earning assets	5.24	5.18	2.36	8143
Other operating incomes	1.85	1.35	1.80	8143
Inputs of banks				
Total deposit	6.16	6.07	2.35	8143
Labor input	2.50	2.14	1.73	8143
Capital input	2.43	2.09	1.83	8143
Loan loss provisions	1.55	1.05	1.61	8143
Bank characteristics				
Bank size	6.33	6.24	2.26	8143
Bank equity	13.26	10.08	9.80	8143
Panel B: Banking Sector Variables				
Activities restrictions	6.71	6	1.88	8143
Overall capital stringency	4.55	5	1.47	8115
Average tenure of supervisors	6.45	7	4.92	8143
Independence of Supervisory Authority - Overall	1.80	2	0.81	8069
Official Supervisory Power	11.01	12	2.52	8143
Strength of external audit	5.89	6	0.92	8143
Certified Audit Required	0.96	1	0.20	8143
Bank accounting informative	3.46	4	0.76	8143
Deposit insurance coverage/ deposit per capita	5.10	2.43	8.46	8143
State Owned Bank	18.67	11.56	20.53	8143
Panel C: Other Control Variables				
HHI	0.15	0.11	0.16	8143
Inflation	5.86	3.28	7.19	8143
Log GDP per capita	9.21	9.13	1.35	8143
Log GDP	26.85	26.85	2.05	8143
Control of Corruption	0.54	0.41	1.12	8143
Government Effectiveness	0.69	0.62	1.02	8143
Political Stability	0.12	0.43	0.83	8143
Quality of Regulation	0.60	0.85	0.95	8143
Rule of Law	0.48	0.50	1.14	8143
Voice and Accountability	0.48	0.91	0.94	8143

Note: The sample consists of 4,053 banks in 72 countries for a 3-period panel. Definitions of all the variables are reported in Table 1.

Table 3: Bank efficiency scores for countries

Country	Mean	Standard Deviation	95% C. I. lower bound	95% C. I. upper bound
Algeria	0.58	0.24	0.49	0.78
Argentina	0.66	0.28	0.45	0.76
Armenia	0.34	0.25	0.25	0.44
Australia	0.81	0.05	0.78	0.84
Austria	0.81	0.21	0.64	0.92
Azerbaijan	0.49	0.26	0.25	0.80
Belgium	0.92	0.17	0.66	0.95
Bolivia	0.59	0.26	0.46	0.69
Botswana	0.69	0.23	0.49	0.76
Brazil	0.75	0.22	0.68	0.82
Bulgaria	0.57	0.28	0.49	0.72
Burkina Faso	0.47	0.27	0.38	0.57
Canada	0.88	0.15	0.83	0.91
Chile	0.71	0.23	0.58	0.86
Colombia	0.62	0.21	0.48	0.80
Costa Rica	0.59	0.26	0.39	0.74
Croatia	0.54	0.25	0.53	0.76
Czech Republic	0.70	0.17	0.53	0.79
Denmark	0.76	0.22	0.59	0.89
Ecuador	0.53	0.28	0.41	0.64
El Salvador	0.58	0.28	0.51	0.74
France	0.89	0.19	0.78	0.88
Germany	0.87	0.21	0.79	0.92
Greece	0.75	0.16	0.59	0.86
Hong Kong	0.82	0.20	0.72	0.89
Hungary	0.78	0.21	0.64	0.88
India	0.70	0.20	0.61	0.82
Italy	0.83	0.17	0.78	0.86
Japan	0.85	0.14	0.69	0.97
Jordan	0.66	0.25	0.53	0.79
Kazakhstan	0.59	0.27	0.45	0.84
Kenya	0.56	0.23	0.42	0.69
Korea, Rep.	0.87	0.09	0.81	0.91
Latvia	0.56	0.25	0.45	0.71
Lithuania	0.47	0.27	0.43	0.57
Luxembourg	0.91	0.19	0.84	0.96
Macao	0.76	0.21	0.58	0.94
Macedonia, FYR	0.68	0.29	0.55	0.86
Malaysia	0.76	0.12	0.71	0.79
Mauritius	0.76	0.26	0.62	0.91
Moldova	0.44	0.26	0.34	0.53
Morocco	0.65	0.14	0.54	0.75
Netherlands	0.81	0.17	0.74	0.84
New Zealand	0.75	0.04	0.71	0.78
Nigeria	0.49	0.24	0.34	0.65
Pakistan	0.56	0.24	0.51	0.68

Panama	0.70	0.24	0.62	0.86
Paraguay	0.45	0.30	0.30	0.63
Peru	0.57	0.24	0.40	0.71
Philippines	0.51	0.21	0.39	0.66
Poland	0.59	0.23	0.47	0.70
Portugal	0.84	0.19	0.71	0.94
Romania	0.60	0.26	0.38	0.70
Russian Federation	0.73	0.27	0.57	0.85
Senegal	0.49	0.27	0.45	0.65
Singapore	0.86	0.09	0.63	0.87
Slovak Republic	0.63	0.25	0.53	0.93
Slovenia	0.65	0.27	0.53	0.76
South Africa	0.72	0.22	0.60	0.86
Spain	0.91	0.17	0.85	0.89
Sudan	0.55	0.33	0.39	0.78
Sweden	0.79	0.19	0.55	0.85
Switzerland	0.92	0.11	0.74	0.99
Thailand	0.78	0.20	0.67	0.86
Trinidad and Tobago	0.64	0.23	0.45	0.87
Tunisia	0.64	0.22	0.59	0.86
Turkey	0.75	0.25	0.62	0.88
Ukraine	0.63	0.26	0.51	0.80
United Kingdom	0.94	0.14	0.90	0.96
United States	0.83	0.18	0.82	0.95
Uruguay	0.65	0.26	0.48	0.97
Venezuela	0.44	0.27	0.37	0.52
Total	0.76	0.25	0.67	0.86

Table 4. Correlation matrix

	Banking Efficiency Score	Activities restrictions	Overall capital stringency	Average tenure of supervisors	Independence of Supervisory Authority - Overall	Official Supervisory Power	Strength of external audit	Certified Audit Required
Activities restrictions	-0.11***	1.00						
Overall capital stringency	0.04	-0.16**	1.00					
Average tenure of supervisors	0.12**	0.18**	-0.08**	1.00				
Independence of Supervisory Authority - Overall	0.03**	-0.01	0.04*	-0.08*	1.00			
Official Supervisory Power	0.04	0.25***	-0.06**	0.33**	0.21***	1.00		
Strength of external audit	0.07**	-0.09*	0.05*	0.28**	-0.05**	0.30**	1.00	
Certified Audit Required	0.10**	-0.15**	0.17**	0.19**	0.14**	0.22**	0.25***	1.00
Bank accounting informative	0.11***	0.23***	-0.27**	0.34***	0.12**	0.35**	0.18**	-0.03*
Deposit insurance coverage / deposit per capita	-0.12**	0.16**	-0.01	0.08**	-0.11**	0.10*	0.03	0.03
HHI	-0.15**	-0.21**	0.06*	0.15**	-0.10**	0.00	0.31*	0.01
State-owned bank	-0.23**	-0.04*	0.07**	-0.16**	-0.11**	-0.20**	-0.21**	0.08**
Bank size	0.34**	0.12**	-0.11**	0.36**	-0.01	0.09**	0.18**	-0.07**
Bank equity	0.08*	-0.05*	0.03	-0.17**	0.02	0.01	-0.12	0.03*
Inflation	-0.28**	0.11**	-0.01	-0.27**	0.06*	0.03*	-0.15*	0.08**
GDP per capita	0.25**	-0.24**	0.16**	0.20**	0.05*	-0.01	0.19**	-0.03*
GDP	0.22**	-0.02	0.22**	0.08*	0.13**	-0.02	-0.20**	-0.04*

	Bank accounting informative	Deposit insurance coverage/ deposit per capita	HHI	State Owned Bank	Bank size	Bank equity	Inflation	GDP per capita
Deposit insurance coverage / deposit per capita	0.05*	1.00						
HHI	0.04**	0.04**	1.00					
State Owned Bank	-0.37***	0.02	-0.16**	1.00				
Bank size	0.21**	0.08*	0.07*	-0.27**	1.00			
Bank equity	-0.07*	-0.04**	-0.01	0.15*	-0.35**	1.00		
Inflation	-0.06**	0.24***	-0.21**	0.31**	-0.32**	0.21**	1.00	
GDP per capita	0.05*	-0.11**	0.19**	-0.39**	0.33**	-0.20**	-0.36***	1.00
GDP	-0.11**	-0.08**	-0.26**	-0.10**	0.22**	-0.11**	-0.20*	0.38***

Note: *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Table 5. Regulation, Supervision, Private Monitoring and Bank Efficiency

	1	2	3	4	5
Activities restrictions	-0.0192				-0.0126
	[0.024]**				[0.034]**
Overall capital stringency	0.0032				0.0027
	[0.076]*				[0.148]
Average tenure of supervisors		0.0038	0.0039		0.0051
		[0.025]**	[0.042]**		[0.031]**
Independence of Supervisory Authority		0.0312	0.0328		0.0294
		[0.018]**	[0.014]**		[0.037]**
Official Supervisory Power		0.0053	0.0058		0.0042
		[0.124]	[0.351]		[0.380]
Independence of Supervisory Authority × Official Supervisory Power			0.0042		0.0036
			[0.018]**		[0.025]**
Strength of external audit				0.0146	0.0110
				[0.027]**	[0.031]**
Certified Audit Required				0.0395	0.0389
				[0.038]**	[0.048]**
Bank accounting informative				0.0120	0.0119
				[0.016]**	[0.025]**
Deposit insurance coverage/ deposit per capita				-0.0218	-0.0133
				[0.020]**	[0.018]**
HHI	-0.0127	-0.0122	-0.0121	-0.0127	-0.0116
	[0.018]**	[0.040]**	[0.046]**	[0.036]**	[0.027]**
Government owned banks	-0.0032	-0.0030	-0.0035	-0.0032	-0.0025
	[0.041]**	[0.056]*	[0.030]**	[0.259]	[0.035]**
Log total Assets	0.0509	0.0474	0.0473	0.0492	0.0474
	[0.073]*	[0.054]*	[0.030]**	[0.015]**	[0.019]**
Equity / Total Assets	0.0055	0.0053	0.0055	0.0054	0.0052
	[0.011]**	[0.062]*	[0.018]**	[0.105]	[0.077]*
Inflation	-0.0036	-0.0031	-0.0032	-0.0034	-0.0029
	[0.016]**	[0.071]*	[0.059]*	[0.053]*	[0.031]**
Log GDP per capita	0.0238	0.0256	0.0258	0.0233	0.0194
	[0.024]**	[0.079]*	[0.026]**	[0.066]*	[0.030]**
Log GDP	0.0071	0.0068	0.0070	0.0087	0.0084
	[0.043]**	[0.071]*	[0.059]*	[0.053]*	[0.033]**
Observations	8,115	8,069	8,069	8,143	8,069
Countries	71	70	70	72	70
Pseudo_R2	0.298	0.298	0.299	0.302	0.304

Note: See Table 1 for variable definitions. The dependent variable is the bank efficiency score. The estimation is based on truncated regression proposed by Simar and Wilson (2007). The sample is a 3-period panel based on the average values of 1999-2001, 2002-2004, and 2005-2007, respectively. A constant is included but not reported. The coefficient estimates are transformed to represent the marginal effects evaluated at the means of the independent variables. The marginal effect of a dummy is calculated as the discrete change in the expected value of the dependent variable as the dummy variable changes from 0 to 1. P-values are computed by the heteroskedasticity-robust standard errors clustered for banks and are presented in brackets. *, **, *** represent statistical significance at the 10%, 5% and 1% level, respectively.

Table 6. Instrumental variables regression results

	1	2	3	4
Activities restrictions	-0.0391			-0.0272
	[0.004]***			[0.016]**
Overall capital stringency	0.0057			0.0046
	[0.061]*			[0.129]
Average tenure of supervisors		0.0073		0.0091
		[0.013]**		[0.024]**
Independence of Supervisory Authority		0.0639		0.0594
		[0.023]**		[0.027]**
Official Supervisory Power		0.0125		0.0105
		[0.347]		[0.360]
Independence of Supervisory Authority × Official Supervisory Power		0.0073		0.0076
		[0.017]**		[0.028]**
Strength of external audit			0.0295	0.0253
			[0.041]**	[0.018]**
Certified Audit Required			0.0673	0.0792
			[0.014]**	[0.091]*
Bank accounting informative			0.0289	0.0292
			[0.021]**	[0.014]**
Deposit insurance coverage/ deposit per capita			-0.0422	-0.0295
			[0.021]**	[0.022]**
HHI	-0.0126	-0.0107	-0.0110	-0.0105
	[0.018]**	[0.021]**	[0.039]**	[0.032]**
Government owned banks	-0.0030	-0.0026	-0.0034	-0.0030
	[0.069]*	[0.075]*	[0.067]*	[0.023]**
Log total Assets	0.0510	0.0456	0.0485	0.0464
	[0.038]**	[0.062]*	[0.098]*	[0.042]**
Equity / Total Assets	0.0056	0.0054	0.0057	0.0056
	[0.035]**	[0.065]*	[0.052]*	[0.038]**
Inflation	-0.0036	-0.0027	-0.0033	-0.0025
	[0.014]**	[0.061]*	[0.094]*	[0.031]**
Log GDP per capita	0.0249	0.0242	0.0145	0.0102
	[0.044]**	[0.070]*	[0.083]*	[0.043]**
Log GDP	0.0059	0.0052	0.0053	0.0057
	[0.034]**	[0.091]*	[0.037]**	[0.088]*
Observations	8,115	8,069	8,143	8,069
Countries	71	70	72	70
1st-stage F-test (p-value)	0.000	0.000	0.000	0.000
P-value of Hansen's overidentification J test	0.358	0.364	0.217	0.288
Pseudo_R2	0.298	0.317	0.304	0.308

Note: See Table 1 for variable definitions. The dependent variable is the bank efficiency score. Instrumental variables for bank regulations include ethnic fractionalization, latitude, religions, legal origins, and the average regulatory level of other countries in the sample in the time period. The estimation is based on a consistent IV estimation of limited dependent variable regressions (Newey, 1987, Wooldridge, 2002). The sample is a 3-period panel based on the average values of 1999-2001, 2002-2004, and 2005-2007, respectively. A constant is included but not reported. The coefficient estimates are transformed to represent the marginal effects evaluated at the means of the independent variables from the interval regressions. The marginal effect of a dummy is calculated as the discrete change in the expected value of the dependent variable as the dummy variable changes from 0 to 1. P-values are computed by the heteroskedasticity-robust standard errors clustered for banks and are presented in brackets. *, **, *** represent statistical significance at the 10%, 5% and 1% level, respectively.

Table 7. Change Regression Results

	1	2	3	4
Δ Activities restrictions	-0.0308			-0.0302
	[0.031]**			[0.034]**
Δ Overall capital stringency	0.0048			0.0031
	[0.063]*			[0.152]
Δ Average tenure of supervisors		0.0045		0.0043
		[0.026]**		[0.032]**
Δ Independence of Supervisory Authority - Overall		0.0481		0.0415
		[0.033]**		[0.047]**
Δ Official Supervisory Power		0.0063		0.0067
		[0.431]		[0.218]
Δ (Independence of Supervisory Authority × Official Supervisory Power)		0.0041		0.0047
		[0.010]**		[0.024]**
Δ Strength of external audit			0.0138	0.0141
			[0.037]**	[0.004]***
Δ Certified Audit Required			0.0370	0.0307
			[0.032]**	[0.038]**
Δ Bank accounting informative			0.0126	0.0123
			[0.023]**	[0.027]**
Δ (Deposit insurance coverage/ deposit per capita)			-0.0283	-0.0274
			[0.017]**	[0.016]**
Δ HHI	-0.0162	-0.0149	-0.0158	-0.0141
	[0.017]**	[0.029]**	[0.023]**	[0.038]**
Δ Government owned banks	-0.0022	-0.0024	-0.0027	-0.0021
	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Δ Log total Assets	0.0183	0.0172	0.0193	0.0192
	[0.080]*	[0.019]**	[0.063]*	[0.037]**
Δ (Equity / Total Assets)	0.0035	0.0034	0.0034	0.0034
	[0.028]**	[0.086]*	[0.014]**	[0.033]**
Δ Inflation	-0.0019	-0.0023	-0.0022	-0.0026
	[0.015]**	[0.070]*	[0.052]*	[0.039]**
Δ Log GDP per capita	0.0334	0.0372	0.0349	0.0425
	[0.060]*	[0.036]**	[0.085]*	[0.040]**
Δ Log GDP	0.0022	0.0027	0.0025	0.0033
	[0.020]**	[0.067]*	[0.081]*	[0.026]**
Observations	4,076	4,053	4,090	4,053
Countries	71	70	72	70
Pseudo_R2	0.156	0.178	0.156	0.182

Note: See Table 1 for variable definitions. The dependent variable is the change in the bank efficiency score. The sample is a 3-period panel based on the average values of 1999-2001, 2002-2004, and 2005-2007, respectively. Δ indicates the first-difference of the variable between two consecutive periods. The estimation is based on truncated regression proposed by Simar and Wilson (2007). A constant is included but not reported. The coefficient estimates are transformed to represent the marginal effects evaluated at the means of the independent variables from the interval regressions. The marginal effect of a dummy is calculated as the discrete change in the expected value of the dependent variable as the dummy variable changes from 0 to 1. P-values are computed by the heteroskedasticity-robust standard errors clustered for banks and are presented in brackets. *, **, *** represent statistical significance at the 10%, 5% and 1% level, respectively.

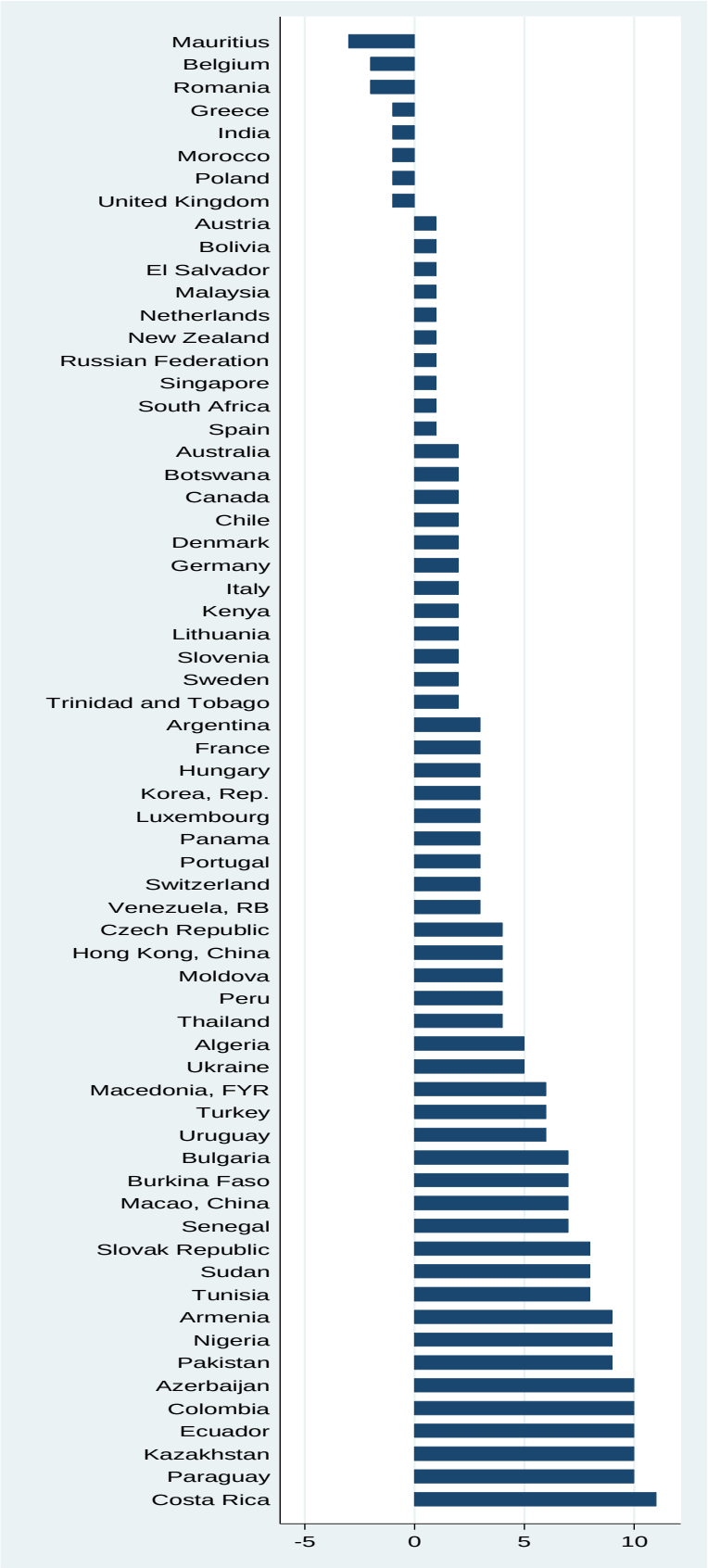
Table 8: Results with more institutional controls

	1	2	3	4	5	6
Activities restrictions	-0.0113	-0.0113	-0.0123	-0.0122	-0.0117	-0.0119
	[0.033]**	[0.057]*	[0.084]*	[0.035]**	[0.039]**	[0.034]**
Overall capital stringency	0.0028	0.0030	0.0027	0.0029	0.0025	0.0028
	[0.132]	[0.154]	[0.146]	[0.083]*	[0.128]	[0.144]
Average tenure of supervisors	0.0046	0.0045	0.0049	0.0046	0.0042	0.0043
	[0.032]**	[0.031]**	[0.059]*	[0.030]**	[0.032]**	[0.069]*
Independence of Supervisory Authority - Overall	0.0315	0.0312	0.0304	0.0302	0.0323	0.0306
	[0.037]**	[0.064]*	[0.036]**	[0.038]**	[0.079]*	[0.032]**
Official Supervisory Power	0.0046	0.0043	0.0044	0.0046	0.0042	0.0041
	[0.391]	[0.370]	[0.390]	[0.370]	[0.393]	[0.369]
Independence of Supervisory Authority x Official Supervisory Power	0.0036	0.0039	0.0032	0.0037	0.0038	0.0031
	[0.024]**	[0.026]**	[0.063]*	[0.026]**	[0.024]**	[0.072]*
Strength of external audit	0.0107	0.0094	0.0106	0.0104	0.0093	0.0098
	[0.058]*	[0.037]**	[0.030]**	[0.032]**	[0.061]*	[0.030]**
Certified Audit Required	0.0425	0.0426	0.0409	0.0412	0.0426	0.0415
	[0.041]**	[0.055]*	[0.047]**	[0.064]*	[0.047]**	[0.039]**
Bank accounting informative	0.0131	0.0133	0.0125	0.0128	0.0136	0.0132
	[0.023]**	[0.062]*	[0.024]**	[0.032]**	[0.023]**	[0.057]*
Deposit insurance coverage / deposit per capita	-0.0120	-0.0119	-0.0128	-0.0121	-0.0120	-0.0124
	[0.052]*	[0.020]**	[0.017]**	[0.020]**	[0.063]*	[0.022]**
HHI	-0.0105	-0.0104	-0.0112	-0.0105	-0.0103	-0.0108
	[0.026]**	[0.038]**	[0.074]*	[0.063]*	[0.028]**	[0.026]**
Government owned banks	-0.0023	-0.0022	-0.0024	-0.0023	-0.0026	-0.0024
	[0.036]**	[0.060]*	[0.034]**	[0.038]**	[0.036]**	[0.054]*
Log total Assets	0.0457	0.0455	0.0485	0.0466	0.0454	0.0459
	[0.019]**	[0.034]**	[0.058]*	[0.019]**	[0.026]**	[0.018]**
Equity / Total Assets	0.0055	0.0057	0.0053	0.0054	0.0055	0.0054
	[0.061]*	[0.079]*	[0.073]*	[0.078]*	[0.075]*	[0.079]*
Inflation	-0.0026	-0.0022	-0.0028	-0.0026	-0.0027	-0.0023
	[0.032]**	[0.063]*	[0.030]**	[0.072]*	[0.032]**	[0.068]*
Log GDP per capita	0.0177	0.0176	0.0188	0.0176	0.0179	0.0178
	[0.053]*	[0.029]**	[0.031]**	[0.062]*	[0.031]**	[0.029]**
Log GDP	0.0081	0.0076	0.0082	0.0080	0.0077	0.0079
	[0.034]**	[0.053]*	[0.032]**	[0.034]**	[0.063]*	[0.038]**
Control of Corruption	0.0259					
	[0.172]					
Government Effectiveness		0.0357				
		[0.143]				
Political Stability			0.0671			
			[0.328]			
Quality and Regulation				0.0205		
				[0.017]**		
Rule of Law					0.0254	
					[0.023]**	

Voice and Accountability						0.0169 [0.062]*
Observations	8069	8069	8069	8069	8069	8069
Countries	70	70	70	70	70	70
Pseudo R2	0.306	0.307	0.304	0.305	0.307	0.305

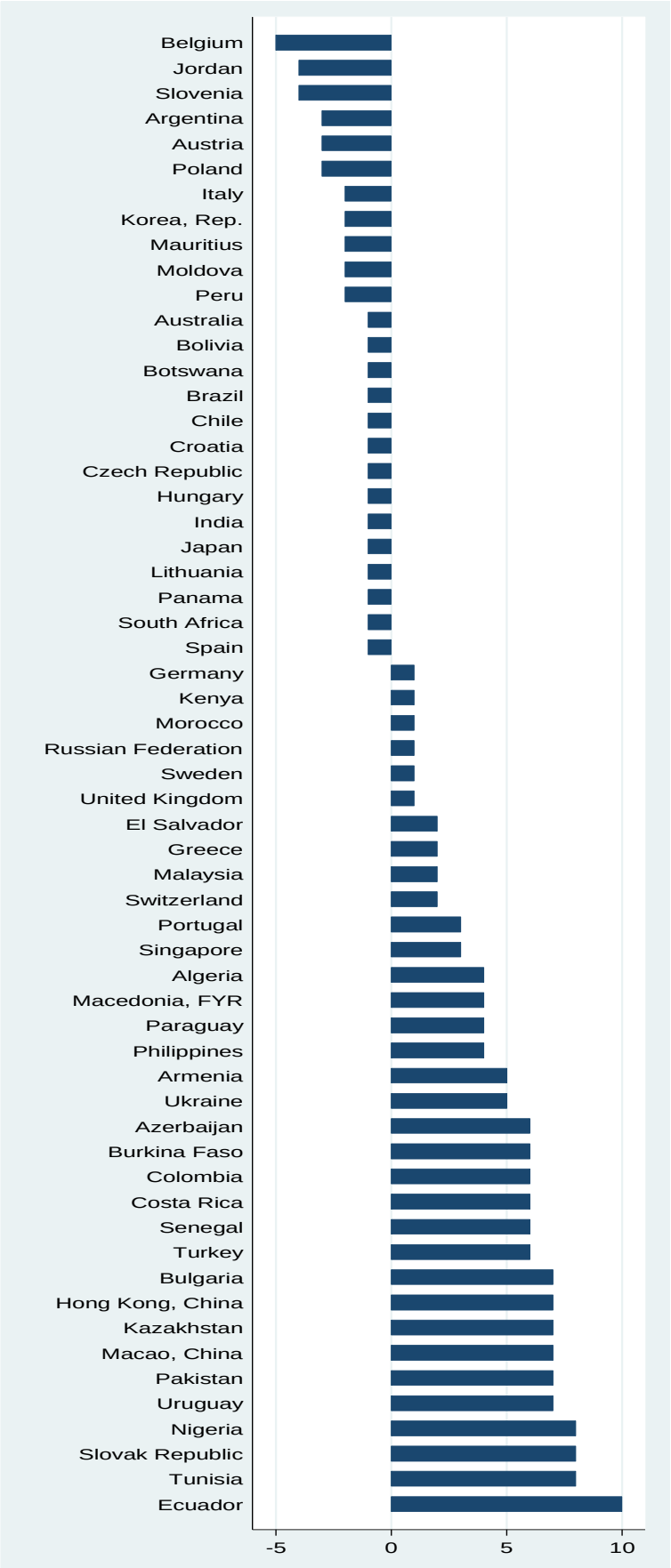
Note: See Table 1 for variable definitions. The dependent variable is the bank efficiency score. The estimation is based on truncated regression proposed by Simar and Wilson (2007). The sample is a 3-period panel based on the average values of 1999-2001, 2002-2004, and 2005-2007, respectively. A constant is included but not reported. The coefficient estimates are transformed to represent the marginal effects evaluated at the means of the independent variables. The marginal effect of a dummy is calculated as the discrete change in the expected value of the dependent variable as the dummy variable changes from 0 to 1. P-values are computed by the heteroskedasticity-robust standard errors clustered for banks and are presented in brackets. *, **, *** represent statistical significance at the 10%, 5% and 1% level, respectively.

Figure 1: Change in overall activities restrictions in countries (2006 vs. 1999)



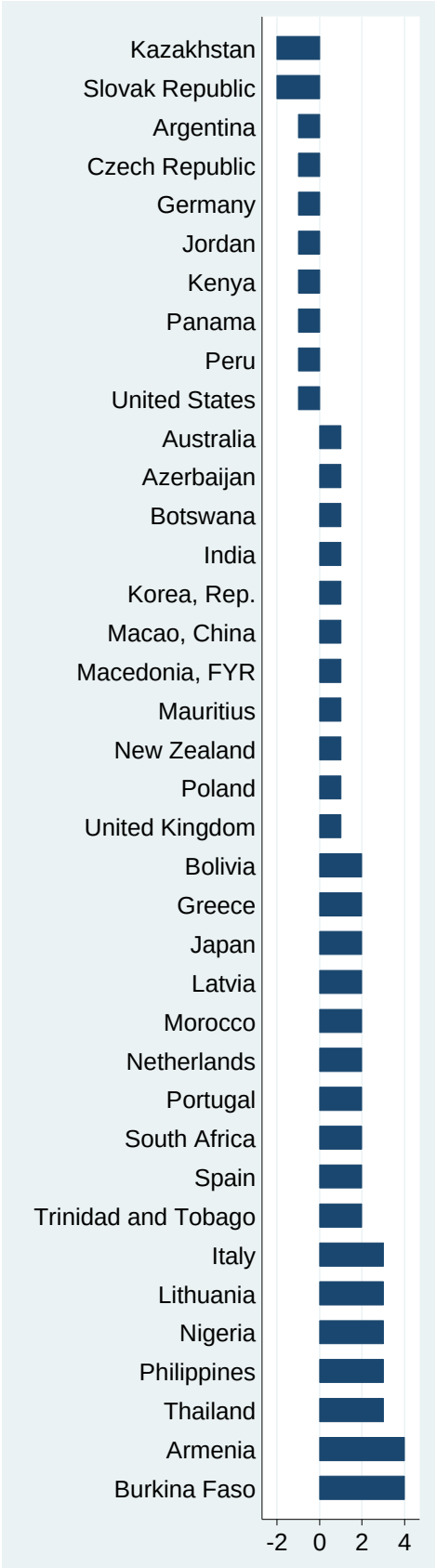
There has been no change in the following countries over 1999 to 2006: Brazil, Croatia, Japan, Jordan, Latvia, Philippines, and United States.

Figure 2: Changes in overall capital stringency in countries (2006 vs. 1999)



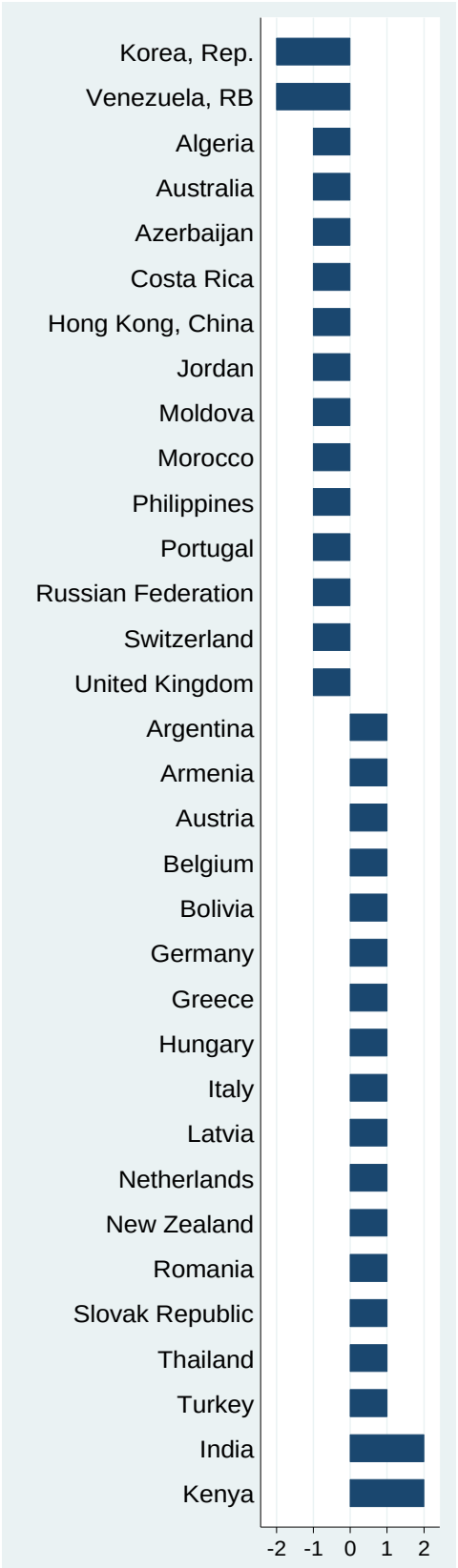
There has been no change in the following countries over 1999 to 2006: Canada, Denmark, France, Latvia, Luxembourg, Netherlands, New Zealand, Romania, Thailand, Trinidad and Tobago, United States, and Venezuela.

Figure 3: Changes in the strength of external audits in countries (2006 vs. 1999)



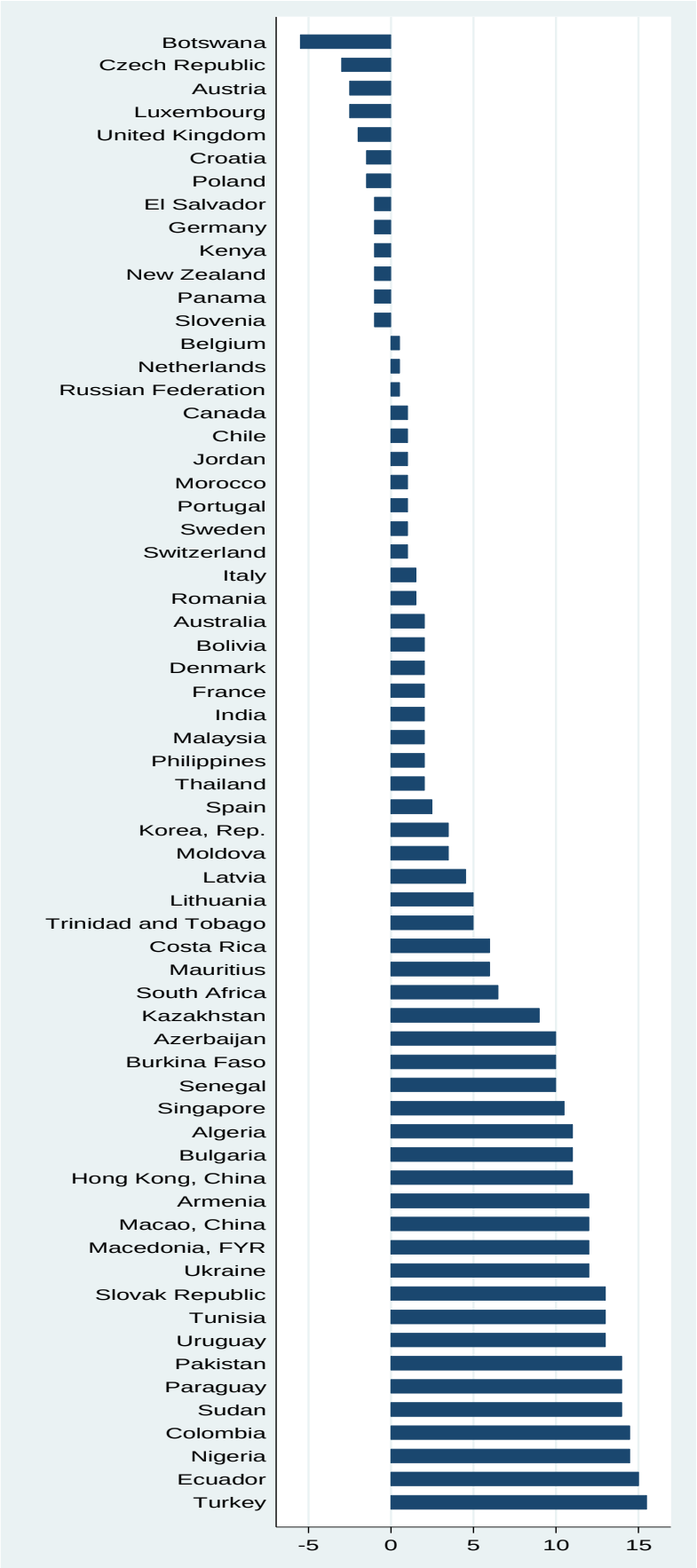
There has been no change in the following countries over 1999 to 2006:
Algeria, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, Colombia, Costa Rica, Croatia, Denmark, Ecuador, El Salvador, France, Hong Kong, Hungary, Luxembourg, Malaysia, Moldova, Pakistan, Paraguay, Romania, Russian Federation, Senegal, Singapore, Slovenia, Sudan, Sweden, Switzerland, Tunisia, Turkey, Ukraine, Uruguay, and Venezuela.

Figure 4: Changes in the informativeness of bank accounting information in countries (2006 vs. 1999)



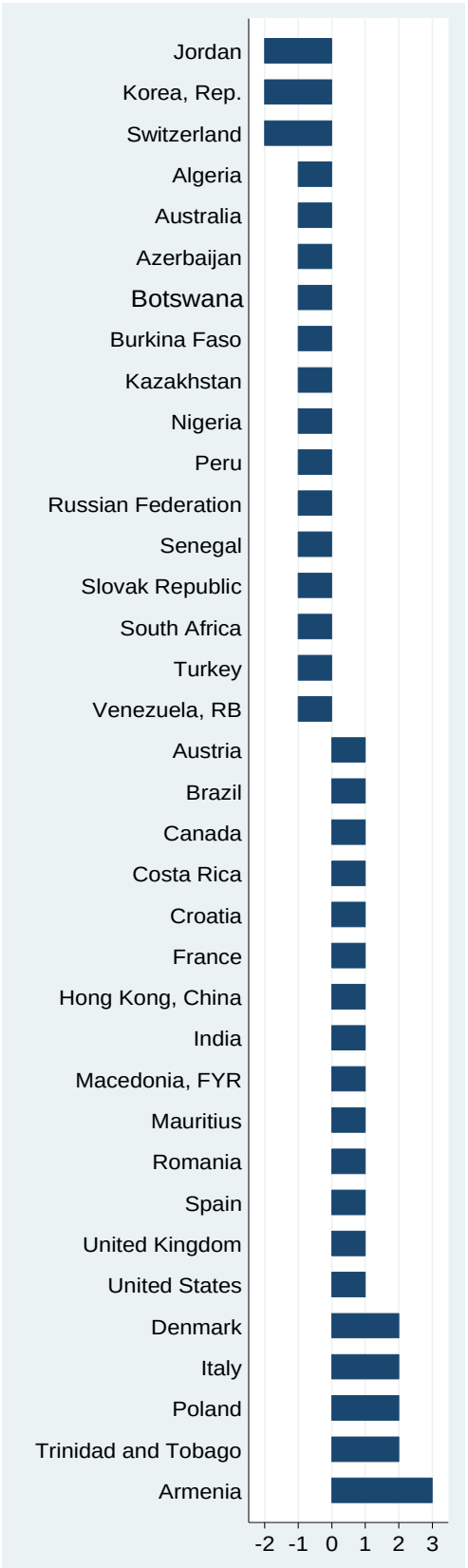
There has been no change in the following countries over 1999 to 2006:
Botswana, Brazil, Bulgaria, Burkina Faso, Canada, Chile, Colombia, Croatia, Czech Republic, Denmark, Ecuador, El Salvador, France, Japan, Kazakhstan, Lithuania, Luxembourg, Macao, Macedonia FYR, Malaysia, Mauritius, Nigeria, Pakistan, Panama, Paraguay, Peru, Poland, Senegal,

Figure 5: Changes in official supervisory power in countries (2006 vs. 1999)



There has been no change in the following countries over 1999 to 2006:
Argentina, Brazil, Greece, Honduras, Hungary, Japan, Peru, United States, and Venezuela.

Figure 6: Changes in supervisory independence in countries (2006 vs. 1999)



There has been no change in the following countries over 1999 to 2006:
Argentina, Belgium, Bolivia, Bulgaria, Chile, Colombia, Czech Republic, Ecuador, El Salvador, Germany, Greece, Hungary, Japan, Kenya, Latvia, Lithuania, Luxembourg, Macao, Malaysia, Moldova, Morocco, Netherlands, New Zealand, Pakistan, Panama, Philippines, Portugal, Singapore, Slovenia, Sweden, Thailand, Tunisia, Ukraine, and Uruguay.