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Bank Safety and Soundness and the Structure of Bank Supervision: A Cross-Country Analysis*

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ABSTRACT

Two central questions about the structure of bank supervision are whether central banks should supervise banks and whether to have multiple supervisors. We use data for 70 countries across developed, emerging and transition economies to estimate statistical connections between banking performance, the structure of bank supervision, permissible banking activities, legal environments, banking market structure and macro-economic conditions. We find that where central banks supervise banks, banks tend to have more non-performing loans. Countries with multiple supervisors have lower capital ratios and higher liquidity risk. We also find that conclusions from non-transition economies may not necessarily apply to transition economies.

I. INTRODUCTION

Debate about the appropriate structure and purview of bank supervision has taken on more urgency in recent years.[1] In part, this is because banking crises have become much more frequent in the past two decades than previously and have often imposed on taxpayers huge, direct resolution costs and indirect costs through disruptions to macroeconomic performance.[2] In addition, many transition economies privatized their banks and needed to build bank supervision virtually from scratch. Analytical and technological advances in telecom-munications further blurred traditional distinctions between banking and other

 1 The term supervision is used to represent regulation as well except where otherwise noted.
 2 Caprio and Klingebiel (2002) provide a comprehensive cataloguing of 113 systemic banking crises in 93 countries since the late 1970s.

financial activities.[3] Furthermore, deregulation and consolidation of banking in many countries has produced larger, more complex banks that conduct wide-ranging activities. Globalization of commerce and finance generally enables foreign banks to play increasingly important roles in many countries.[4]

Much of the debate about the structure of an individual country's bank supervision has confined itself to the existing institutional arrangements in that country. Increasingly, however, discussions are focusing on the differences across countries in the structure of banking and of bank supervision.

Our study investigates the statistical connections between the structure of bank supervision and the safety and soundness of banking systems around the world. We use data for 70 countries, including variables describing the structure of bank supervision and banking markets, macroeconomic conditions and measures of each country's legal origin and level of corruption. We focus on two specific aspects of the structure of bank supervision: (a) whether a country has a single bank supervisor (rather than multiple supervisory authorities); and (b) whether, in addition to conducting monetary policy, the central bank is involved in bank supervision.

We find that countries with multiple supervisors tend to have lower bank capital ratios and higher liquidity risk. As might be expected if banks face rival bank supervisors, we find that having multiple bank supervisors (rather than one supervisor) is consistent empirically with 'competition in laxity'. We also find that when a country's central bank is involved in bank supervision banks tend to have more non-performing loans. At the same time, the structure of bank supervision appears to have little statistical connection to the profitability of banks.

There are important connections between corporate governance, the structure of bank supervision and the safety and soundness of banks. We focus on the disincentives that public policies impart to private sector governance of banks and the attempts by governments to supplement governance via bank supervision.

As with any private sector corporation, various stakeholders (shareholders, managers, insured and uninsured creditors) in banks often have conflicting interests. Frequently it is asserted that, especially in banks where deposits are insured, shareholders seek greater risks and expected returns than the bank's managers or (uninsured) creditors desire. One reason for this conflict is that although shareholders may be well diversified, managers are less likely to be; this is due to having the values of their professional reputations and their holdings of stocks and options tied much more closely to the fate of their employing bank. Various private sector mechanisms have been devised to address misalignments of incentives, such as independent directors, external auditors, share analysts, substantial leverage and bond rating companies. Public sector governance tends to stipulate more directly what banks can and cannot do.

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3 Furst et al. (2001) discuss technological change and the structure and performance of banking.
4 See Group of Ten (2001) for timely and comprehensive research on the nature, causes, and consequences of consolidation in the 11 G-10 countries plus Australia and Spain. For estimates of the determinants of foreign banking, see Dopico and Wilcox (2002).

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Public policies impinge more on banks than on most other private sector industries. One rationale for the involvement of the public sector is that banking has macroeconomic externalities that are large in expected value and variance. As a result, governments around the world have instituted safety nets by acting as (implicit or explicit) deposit insurers and as lenders of last resort. The (dis-) incentives to monitor and control banks that arise from the bank safety net, in turn, lead governments to supervise banks further. Thus, in most countries, the public sector has elected to become a major stakeholder in banks. Bank supervisors are then charged with undertaking much of the monitoring and control that public policies have encouraged the private sector to forsake. Thus, protecting their economies gives bank supervisors incentives that in some ways resemble those that holders of large blocks of bank stock would have.

Our finding that under multiple supervisors the banking industry has lower equity capital ratios and higher liquidity risk comports with the hypothesis that multiple supervisors weaken the corporate governance of banks. Our finding that non-performing loans are higher when the central bank is involved in bank supervision supports the hypothesis that a more narrowly focused bank supervisor might strengthen the monitoring and control of banks.

Section II reviews previous literature on the effects of the structure of supervision. Sections III and IV describe the data that we use and the econometric specifications that we estimate. Section V presents our estimates of the effects of the structure of bank supervision on various measures that comprise bank safety and soundness. Section VI summarizes and concludes.

II. PREVIOUS RESEARCH ON THE EFFECTS OF THE STRUCTURE OF BANK SUPERVISION[5]

Recently available data permit statistical studies of the effect of the structure of bank supervision on various aspects of banking.[6] Using these data, cross-country studies test for statistical connections between banking industry performance and various features of bank regulation, such as deposit insurance and permissible bank activities.[7] To date, however, research about the effects of the structure of bank supervision on bank performance and conditions remains rare. As Abrams and Taylor (2001) note, 'the subject of regulatory structure has ... been under-researched'.[8]

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5 This section draws heavily on a more detailed discussion in Barth et al. (2002).
6 See Barth et al. (2001b) for a detailed explanation of recently available data.
7 See Barth et al. (2001b) and Beck et al. (2001). For cross-country studies of deposit insurance, see Lindgren et al. (1996), Demirgüç-Kunt and Huizinga (2000), Demirgüç-Kunt and Sobaci (2000) and Kane (2000). For studies of bank powers, see Barth et al. (2000, 2001a, 2004).
8 Abrams and Taylor (2001) and Taylor and Fleming (1999) point out that, although the recent significant changes in the structure of supervision in northern Europe generated a great deal of discussion within governments and in the press, they did not 'lead to a significant academic debate'.

A. The structure of bank supervision: single versus multiple supervisors

Several reasons have been suggested for why a single bank supervisor would best promote bank safety and soundness. A single supervisor might be better able comprehensively to supervise banks that engage in a wide range of activities. A single supervisor might thereby avoid the gaps that could arise when different subsidiaries within complex financial companies are supervised by different supervisors. A single supervisor might also reduce supervisory arbitrage by avoiding the 'competition in laxity' that might arise when banks can choose among multiple supervisors. If the performance of a single supervisor is likely to be more transparent and accountable than that of multiple supervisors, a single supervisor might perform more diligently (Briault 1999; Llewellyn 1999; Abrams and Taylor 2001).

A single, and therefore larger, bank supervisor may also operate at lower cost if it can capitalize on more specialized labour or other economies of scale. In addition, a single supervisor might better attract, develop and maintain staff expertise, an advantage that may be particularly important for emerging market economies (Abrams and Taylor 2001). A single supervisor may avoid duplication in supervision and related costs to banks (Briault 1999; Llewellyn 1999; Abrams and Taylor 2001).

However, having more than one supervisor might also have advantages. When different supervisors take different approaches, they might acquire otherwise unavailable information (Llewellyn 1999). Having multiple supervisors may encourage innovative or efficiency-enhancing competition (Kane 1984; Romano 1985, 1997, 2001; Kupiec and White 1996).[9] Further, multiple supervisors might be less likely to become inefficient and inflexible or to accumulate excessive power and use it inappropriately (Taylor 1995; Kane 1996; Briault 1999; Llewellyn 1999; Abrams and Taylor 2001).

B. The structure of bank supervision: central banks as bank supervisors

Discussion of the role of central banks has been stimulated by the actual and potential removal of bank supervision from the central banks of several countries. This discussion has largely been conceptual, although a few empirical studies exist. Many of those arguing for a role for the central bank in bank supervision emphasize that because banks transmit monetary policy, having accurate and timely information about banks might enable a central bank to conduct generally better monetary policy. In addition, it is argued that to serve best as lender of last resort a central bank needs information about the solvency and liquidity of banks. Having timely information is also especially valuable in financial crises. Preventing and mitigating crises would then be best achieved by having the central bank supervise banks (Goodhart and Schoenmaker 1993; Goodhart 1995; Haubrich 1996; Briault 1999; Peek et al. 1999; Abrams and Taylor 2001).

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9 Choi and Guzman (1998) and Romano (2001) note that, when firms in a single industry differ substantially, they might benefit from different supervisory approaches and authorities.

Further, bank supervisors that are independent of political pressures may better enforce disciplinary actions on banks. Central banks have typically been granted more independence than bank supervisory agencies, which often depend upon the executive. Thus, central banks may have more leeway to enforce discipline on banks (Giddy 1994; Abrams and Taylor 2001). Abrams and Taylor (2001) argue that entrusting bank supervision to central banks may be particularly important in transition and emerging-market countries, where there are greater dangers of 'politicization of bank regulation'. Moreover, central banks may have advantages in recruiting and retaining professional staff, due to their usual ability to pay higher salaries, especially in countries where human capital is scarce (Abrams and Taylor 2001).

On the other hand, when the central bank supervises banks, it may pursue overly loose monetary policy to avoid adverse effects on bank earnings and credit quality (Goodhart and Schoenmaker 1993, 1995; Haubrich 1996; Briault 1999; Abrams and Taylor 2001). Further, if the central bank is responsible for bank supervision, when bank failures do occur, public perception of its credibility in conducting monetary policy could be adversely affected (Haubrich 1996; Briault 1999; Abrams and Taylor 2001). Briault (1999) argues that the very independence of a central bank may be jeopardized by its having a purview that includes bank supervision.

There has been little empirical examination of these arguments, but that which exists seems to support the benefits of a narrower focus for the central bank that does not include bank supervision. Using cross-country data, Goodhart and Schoenmaker (1995) and Di Noia and Di Giorgio (1999) find a positive correlation between the rate of inflation and the central bank having responsibility for both monetary policy and supervision. Goodhart and Schoenmaker (1995) point out that independent central banks, which have typically been found to be much better at fighting inflation, are also more likely not to have responsibility for banking supervision.[10] Ioannidou's (2002) analysis focuses on the USA, where the central bank is one of three federal-level bank supervisors. Using data on the formal actions federal bank supervisors take against banks, she presents evidence that the Fed's monetary policy responsibilities affect its supervisory behaviour. In particular, she finds that when the Fed increases the federal funds rate, its supervisory posture eases somewhat. This could be interpreted as the Fed's attempt to compensate banks for the extra pressure it puts on them when it increases the funds rate.

III. DATA

The World Bank and the US Office of the Comptroller of the Currency (OCC) obtained data on bank supervision by directly surveying the national bank

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10 Briault (1999) mentions the converse of this in observing that 'less independent central banks tend to combine monetary policy and regulatory functions'.

supervisors in over 100 countries. The World Bank survey gathered information for 1999 from 107 countries, as detailed in Barth et al. (2001b). The World Bank survey concentrated on bank regulation and supervision. It also collected data on the structure of banking markets. The OCC survey gathered annual information from 110 countries for the years 1996–9,[11] and focused on data for bank market structure and bank performance. When the same variable was collected by both surveys for overlapping but not identical groups of countries (such as the percentage of total bank assets held by foreign-owned banks), each survey data set could be used to validate and supplement the other data set.

By combining the data from both surveys, we are able to compile a wide range of banking data across 133 countries. However, because some of the data relevant to the present study were missing, our final data set includes 83 countries. Table 1 shows that of those 83 countries, 12 countries are transition countries (i.e. formerly centrally planned economies in the process of changing to market-oriented systems) and, following Erricco and Musalem (1999), 13 countries were classified as offshore financial centres. We exclude the 13 offshore centres from our regression analysis because the banking industry in offshore financial centres focuses heavily (and in some cases, almost exclusively) on the 'export' of an environment that lowers costs to foreign-owned banks, due to such factors as tax breaks and lower disclosure requirements. This contrasts with the nature of banking in most countries, which is to facilitate credit extension and provide payment system services domestically.

Table 1 displays information on the structure of bank supervision in the 83 countries.[12] For 31 of the 58 countries in our base group, the central bank was the sole supervisor of banks. For 19 countries in our base group, the single supervisor was an authority other than the central bank. That is the case, for

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11 Unless otherwise noted, the data used in our statistical analysis measured countrywide totals for 1999.

12 The issue of who is responsible for bank supervision is not as clear-cut as some would imagine. As Goodhart (2002) observes, 'What happens in practice is often quite different from what appears to be the case simply by observing the formality of institutional structure.' Barth et al. (2003) explore this issue in detail and investigate the consequences empirically of taking into account different (authoritative) characterizations of the structure of supervision. They extend a model explaining bank pre-tax profitability developed by Demirgüç-Kunt and Huizinga (2000) by adding explanatory variables covering whether a bank operated in a system with a single or multiple supervisory authorities, and whether the central bank is a bank supervisory authority (just as in the current study). The model uses bank-specific performance data for over 2300 banks in more than 50 countries, as well as country-specific supervisory and regulatory variables. When they use country-specific supervisory data from the survey of national supervisory authorities collected by the World Bank and the OCC – just as the current study does – they find no statistically significant coefficients for the two above-mentioned supervisory explanatory variables. However, when they take account of discrepancies between the survey data and information found in Courtis (1999) for eight countries, they find a statistically significant (negative) impact for having a single (versus multiple) bank supervisory authorities. In general, the discrepancies centre on the exact role for the central bank in bank supervision. For this study, we chose to adhere as closely as possible to the responses national supervisory authorities gave to the World Bank and OCC surveys.

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Table 1 The Structure of Bank Supervision: Number of Bank Supervisors and Central Banks as Bank Supervisors

Bank supervisors	Central bank involved in bank supervision	
	Yes	No
Base countries (58)		
Single	Botswana, Brazil, Burundi, Gambia, Ghana, Greece, Guatemala, Guyana, India, Indonesia, Israel, Italy, Jamaica, Jordan, Kenya, Kuwait, Malaysia, Maldives, Morocco, Nepal, Netherlands, New Zealand, Nigeria, Philippines, Portugal, Saudi Arabia, Singapore, South Africa, Spain, Tonga, Trinidad and Tobago	Belgium, Bolivia, Canada, Chile, Denmark, Finland, France, Honduras, Iceland, Japan, Luxembourg, Mexico, Panama, Peru, El Salvador, Sweden, Switzerland, UK, Venezuela
Multiple	Argentina, Germany, Rwanda, Thailand, Turkey, USA	Australia, Korea
Transition countries (12)		
Single	Croatia, Estonia, Lithuania, Moldova, Romania, Russia, Slovenia, Tajikistan	
Multiple	Belarus, Czech Republic, Latvia, Poland	
Offshore financial centres (13)		
Single	Aruba, Bahrain, Cyprus, Macau, Malta, Mauritius, Oman, Saint Kitts and Nevis, Seychelles	British Virgin Islands, Turks and Caicos
Multiple	Vanuatu	Gibraltar

example, in the UK, where the Financial Services Authority (FSA) was deemed the single supervisor of banks. In six of the 58 countries in our base group, the central bank shared supervisory duties with another supervisor. An example is the USA, where, in addition to the central bank, the OCC, the Federal Deposit Insurance Corporation (FDIC) and state bank supervisory authorities also supervise banks.[13]

We also complement the World Bank and OCC surveys with measures of macroeconomic performance and of the legal environment obtained from other sources. Gross domestic product per capita and average economic growth rates are calculated, respectively, using data from the World Bank and the

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13 Barth et al. (2002) present information on supervisory structure for 107 countries, stratified by income level. In general, central banks in the higher income countries were less likely to supervise banks.

International Monetary Fund (IMF). We use Transparency International's Corruption Perceptions Index (2003) to proxy the corruption of the environment in which the banking industry of each country operated. We base our classification of countries according to the origin of their legal system on that included in Levine (1998).

IV. STATISTICAL MODELS OF BANK SAFETY AND SOUNDNESS

Bank supervisors in the USA base their evaluations of individual banks on a 'CAMELS' system. Each letter of CAMELS represents a different component of bank safety and soundness: C, capital adequacy; A, asset quality; M, management quality; E, earnings; L, liquidity; and S, sensitivity to market risk. US bank supervisors' measures of the safety and soundness of banks or of banking systems are not publicly available. Furthermore, other countries do not explicitly use the CAMELS system.

Nevertheless, because the components of CAMELS measure the safety and soundness of banks quite generally, our choices for dependent variables seek to approximate the components of CAMELS, and thereby to serve as indicators of a country's banking system safety and soundness. These choices are as follows:[14]

- *Capital adequacy (C)*. EQUITY, the ratio[15] of equity capital to assets.
- *Asset quality (A)*. NPL, the ratio of non-performing loans to total loans.
- *Management quality (M)*. We use two variables to proxy for management quality: (a) OVERHEAD, the ratio of overhead (non-interest) costs to assets, measures cost control; (b) NONINTREV, the ratio of non-interest revenues to total revenues, signals business strategy. We interpret a higher ratio of non-interest revenue to total revenue as a signal of more prowess in non-traditional activities.
- *Earnings (E)*. We use two variables to proxy for earnings: (a) ROA is the ratio of net income to assets; (b) ROE is the ratio of net income to equity.
- *Liquidity (L)*. LIQRISK, the ratio of loans to assets plus the ratio of deposits to assets. Having more illiquid loans or more liquid deposits exposes banks more to liquidity risk (i.e. to the possibility that they will not be able to efficiently handle withdrawals).

Next, we introduce the independent variables that we use to estimate the effects of the structure of bank supervision on bank safety and soundness. To proxy our key factors of interest in bank supervisory structure, we construct SINGLE and CENBAN for each country in Table 1. SINGLE takes a value of 1 when there is a single bank supervisor, and 0 otherwise. CENBAN takes a value of 1

14 We did not have a suitable proxy for the recently added S in CAMELS,
15 In this analysis, variables representing ratios were entered in percentage form except for GDPCAP and BANKSIZE.

when the central bank supervises banks, and 0 otherwise. We relied on previous estimates in the literature, introspection and preliminary statistical findings to guide our selection of additional control variables in our models.[16] These additional variables seek to control for the potential effects of macroeconomic conditions, other aspects of bank supervision, the overall legal environment and banking market structure.

Following Demirgüç-Kunt and Huizinga (2000) and Barth et al. (2000), we include gross domestic product per capita (GDPCAP, entered in thousand US$) and the average rate of real GDP growth during 1995–9 (DY9599) to control for the possibility of macroeconomic effects on bank safety and soundness. The level of economic development across countries may affect several of our measures for bank safety and soundness. For instance, the ability of loan officers to ascertain credit risk may vary across countries with different levels of use of credit-scoring models and with more or less mobile populations. Economic growth rates could also affect bank safety and soundness. For instance, low or negative economic growth rates are likely to be associated with higher levels of non-performing loans or lower profitability.

Aside from our two measures of bank supervisory structure, other aspects of bank supervision and regulation might be expected to affect bank safety and soundness. We control for three measures of bank supervision (supervisory independence, supervisory power and private monitoring) and two measures of bank regulation (restrictions on securities activities and restrictions on insurance activities). All three measures of bank supervision could be expected to affect some aspect of bank safety and soundness. For instance, most analysts would expect supervisory independence to have a positive long-term effect on banking safety and soundness and financial stability since independent supervisors would be more immune to short-term political pressures (Claessens et al. 2002; Quintyn and Taylor 2002). Most analysts also recognize the complementary roles played by government supervision and private monitoring of banking systems (Benink and Wihlborg 2002; Llewellyn 2002). However, for all three measures, the effects (and the expected sign) could be ambiguous. For instance, supervisory independence could lead either to lower levels of non-performing loans by ensuring that fewer bad loans are made during economic booms, or to higher measured levels of non-performing loans by ensuring that bad loans are actually recognized during downturns.

We control for the independence of the supervisory authority within government through an index (INDEP) that is based upon the approach taken by Barth et al. (2001b). In this index, the values of 1, 2 and 3 represent (respectively) low, medium and high independence. We control for supervisory power through an index (SUPPOWER) constructed by Barth et al. (2001b). This index is based on the ability of supervisory authorities to take specific actions to prevent and correct banking problems. For each of 16 separate powers, a value of

16 In particular, Barth et al. (2000, 2001a), Demirgüç-Kunt and Huizinga (2000) and Demirgüç-Kunt and Detragiache (1999) served as starting points for our specifications.

1 is assigned if supervisors can exercise authority (for example, forcing a bank to change its internal organizational structure), and a 0 is assigned if supervisors do not have such authority. Hence, the variable ranges in value between 0 and 16, with a higher value indicating greater supervisory power.

We also control for the possibility that private monitoring may complement (or replace) government supervision of individual banks. For this purpose, we use an index (PRIVMON) constructed by Barth et al. (2001b). This index is built across 11 attributes, with a value of 1 being assigned to a 'yes' answer as to whether private sector participants can effectively gain access to bank performance-related and bank operations-related information. Higher values indicate greater ability of private sector participants to monitor banks.

We control for two measures of bank regulation. The index RESTRICT_SEC represents the extent to which banks were restricted from engaging in underwriting, brokering and dealing in securities and mutual funds. The index RESTRICT_INS represents the extent to which banks were restricted from engaging in insurance underwriting and selling. Following Barth et al. (2001b), in each of these indices, a value of 1 implies that the activity is unrestricted. A value of 2 implies that the activity is permitted (for instance, through a separate subsidiary). A value of 3 implies that the activity is restricted (for instance, up to a maximum percentage of assets or capital). A value of 4 implies that the activity is prohibited. Controlling for these restrictions is necessary since the structure of banking varies widely across countries. For instance, banks that engage actively in securities activities or insurance activities are likely to have characteristics (such as capital levels, overhead and rates of return on assets) that approach those of investment banks or insurance companies. Short of detailed breakdowns on the percentages that each type of activity represent in different countries, these indices help to control for how banking systems differ throughout the world.

La Porta et al. (1998) and Levine (1998) among others have highlighted the effects of differing legal environments on the financial system. Thus, we control for the origin of a country's legal system and for the overall respect for the rule of law. The dummy variable CIVIL takes a value of 1 if a country's legal system is based on civil law (i.e. Roman–Napoleonic). Countries whose legal systems are based on common law (i.e. English) or that are formerly centrally planned economies are assigned a value of 0. We also experimented with more detailed breakdowns of legal origin such as English, French, German, Scandinavian and formerly centrally planned. The variable CIVIL assigns values of 1 to countries in the more specific French, German and Scandinavian legal traditions. However, since results were not sensitive to breaking down CIVIL into its components, we settled on the most parsimonious option. The dummy variable TRANSITION takes a value of 1 for formerly centrally planned economies, and 0 otherwise. As another measure of the legal environment, we also include the Corruption Perceptions Index released annually by Transparency International (here referred to as CLEAN). In this index, values range between 1 and 10, with higher values implying less corruption and, accordingly, an increased emphasis on the rule of law.

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We also control for different features of the market structure of the banking industry in each country. Following Claessens et al. (2001), we include the percentage of bank assets in foreign-owned banks (FOREIGN).[17] The share of assets in foreign banks controls for the openness of each market to foreign market forces and know-how. Foreign banks could affect asset quality, overhead and profitability. In particular, Claessens et al. (2001) find a larger foreign banking sector to be associated with higher profitability.

Econometric studies continue to find economies of scale in the banking industries of different countries (de Pinho 2001; Edirisuriya and O'Brien 2001; Wheelock and Wilson 2001; Mehdian and Rezvanian 2002). If increasing-scale effects are indeed empirically relevant, the average size of banks may significantly affect OVERHEAD. Thus, we use the ratio of total bank assets (in billion US$) to the number of banks in each country (BANKSIZE). Similarly, the more concentrated a country's banking market is, the more profitable we would expect its banks to be. Thus, following Demirgüç-Kunt and Huizinga (2000), we use the percentage of total bank assets held in the three largest banks (CONCENTRATION).

We use ordinary least squares (OLS) to estimate the effects of the two measures of bank supervisory structure (SINGLE and CENBAN) on the seven CAMELS dependent variables, while controlling for macroeconomic conditions, other supervisory and regulatory issues, the legal environment and bank market structure. However, it is possible that the structure of bank supervision across countries may, in turn, be affected by their experiences with bank safety and soundness. If bank supervisory structure and bank safety and soundness simultaneously determine each other, estimates from OLS would be biased, and other estimating techniques would be required. Thus, we tested for the possibility of simultaneity between our dependent variables and our key explanatory variables (SINGLE and CENBAN) by performing the omitted variables version of the Hausman test (Kennedy 1992). The results from these tests imply that simultaneity was present in only one (NPL) out of seven of our dependent variables. For the regressions where simultaneity was present, we use (and report) results from two-stage least squares (2SLS) regressions instead of OLS. Results were corrected for heteroscedasticity where appropriate.

Over the past decade, formerly centrally planned economies have undergone deep transformations in nearly every aspect of their economies. In many cases, banks have been largely privatized and sold to foreign banks. Bank managers are having to learn overnight how to lend to private companies and to assess credit risk. At the same time, bank supervisors are having to learn anew how to assess and discipline banks. These deep and fast transformations raise the question of whether transition economies can be meaningfully included in regressions with

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17 We also tested (but do not report) several additional independent variables including the share of bank assets held by government-owned banks (Tschoegl 1981), and an index of restrictions on the mixing of banking and commerce. In each case, the additional variables did not have significant coefficients and did not alter the size and significance of the reported coefficients.

countries with far longer experiences as market economies. Thus, throughout our analysis, we performed Chow tests to determine whether our base countries and transition economies could be pooled (i.e. whether they could be regressed without using additional independent variables to identify separately the two subsets of data). The results from these tests implied that the data could not be pooled in only one (EQUITY) out of seven of our dependent variables.

When two subsets of data may not be pooled, the differences across the subsets are explored through regressions that combine the data, but use a dummy variable to identify the observations of one of the subsets and an interaction term for each original independent variable. However, for this technique to be practicable, each subset must be sufficiently large and contain a reasonably large degree of variation within its observations. Unfortunately, the number of transition economies in our data set is small and there is insufficient variation across relevant variables. For instance, among the transition economies, there are no countries where the central bank is not involved in bank supervision, and there are only four countries that have multiple supervisors. Thus, we include Tables 2 and 3 to explore possible differences between base countries and transition economies. Table 2 presents results using samples that include only the base countries. Table 3 presents results using samples including base countries plus transition economies. Regressions for this expanded data set cannot use interaction terms, but use a dummy variable identifying transition economies.

Within each of our two samples, we find the results regarding SINGLE and CENBAN to be robust across different model specifications. Tables 2 and 4 illustrate the overall robustness of results by comparing the results for regressions including 'short' and 'long' lists of independent variables for the sample of base countries. The 'short' regressions in Table 2 include a set of core variables (measures of supervisory structure and of macroeconomic conditions) and a small number of additional independent variables that vary across dependent variables. In contrast, all the regressions presented in Table 4 include SINGLE, CENBAN, GDPCAP, DY9599, INDEP, SUPPOWER, PRIVMON, RESTRICT_SEC, RESTRICT_INS, CIVIL, CLEAN and FOREIGN. In addition, the regression for OVERHEAD includes BANKSIZE and the regressions for ROA and ROE include CONCENTRATION. As may be expected, model specifications that held constant for longer lists of independent variables had worse goodness of fit (lower adjusted R^2, lower regression F statistics) and were more open to specification error (higher values for specification error tests such as the Ramsey Reset test).

V. REGRESSION ESTIMATES

The following sections describe the results for our seven proxies of components of the CAMELS ratings. Since results are largely robust across specifications, the discussion concentrates on the regressions presented in Table 2. Results from Tables 3 and 4 are discussed only when they are noticeably different.

A. Capital adequacy

Our proxy for the capital adequacy component of CAMELS is EQUITY. Whether there is a single bank supervisor does not generally affect most of our measures of bank safety and soundness significantly, but SINGLE is statistically significant and positive in the EQUITY equation for the sample of base countries (Table 2, column 1). This estimate suggests that having multiple supervisors lowers a country's ratio of equity capital to bank assets by more than 2 percentage points. This is an economically large reduction, amounting to more than one-third of the mean capital ratio, and implies considerably increased insolvency risk under a multiple, as compared to a single, supervisor system. Thus, the results for the EQUITY equation are consistent with the hypothesis of a 'competition in laxity' between multiple supervisors. However, at this point the implications from this result may not be applicable beyond the base countries, since SINGLE is not statistically significant in the expanded sample containing transition economies (Table 3, column 8). In contrast, whether the central bank supervises banks has no detectable effect on our measure of capital adequacy.

The coefficients for GDPCAP in Tables 2 and 3 imply that banks in higher income countries operate (all else held constant) with significantly lower capital ratios. A $10 000 larger per capita GDP (which is less than one standard deviation) is associated with a decline in EQUITY of 0.8 percentage points (of assets), which would reduce the mean capital ratio by about 11%. However, this result does not hold after controlling for additional measures of supervision, corruption and banking market structure (Table 4, column 15).

Other variables with economically large and significant coefficients include the indices for restrictions of bank activities in securities (RESTRICT_SEC) and in insurance (RESTRICT_INS) and our dummy variable for legal origin (CIVIL). A one-unit increase in RESTRICT_SEC (a little more than its standard deviation) is associated with an equity ratio that was 1.75 percentage points higher. This may reflect a tendency for banks that focus on investment banking to hold less capital. Conversely, banks that are precluded from securities activities appear to hold more capital. By comparison, a one-unit increase in RESTRICT_INS (slightly more than one standard deviation) is associated with an equity capital ratio that is lower by more than 1 percentage point (albeit only among the base countries). In general, we find the measures of legal origin (CIVIL and TRANSITION) to have largely insignificant coefficients across most regressions. However, all else held constant, our results imply that countries in the civil legal tradition have substantially lower equity ratios (by 2.31%).

B. Asset quality

Our estimates suggest that, in countries where central banks supervised banks, non-performing loans (NPL) are significantly higher. Our estimates from the NPL equation (Table 2, column 2) imply that, on average, non-performing loans are 4

Table 2 Estimated Effects of the Structure of Bank Supervision: Base countries, 'short' regressions

Independent variables	Capital adequacy (C)	Asset quality (A)	Management quality (M)		Earnings (E)		Liquidity (L)
	EQUITY (1)	NPL (2)	OVERHEAD (3)	NONINTREV (4)	ROA (5)	ROE (6)	LIQRISK (7)
1 Constant	8.01*** (3.40)	18.36 (0.92)	4.54** (2.21)	37.09** (2.12)	−0.44 (−0.65)	−8.56 (−1.17)	136.98*** (8.74)
2 SINGLE	2.43** (2.07)	7.28 (0.78)	−1.00 (−1.41)	4.88 (0.62)	0.58 (1.63)	5.32 (1.08)	−22.39** (−2.14)
3 CENBAN	−0.32 (−0.345)	4.27** (2.08)	−1.84* (−1.94)	−0.42 (−0.07)	0.24 (0.95)	2.06 (0.56)	−12.07 (−1.52)
4 GDPCAP	−0.08** (−2.10)	0.18 (1.26)	−0.08*** (−2.81)	0.64** (2.56)	−0.005 (−0.49)	0.12 (0.78)	−1.20** (−2.07)
5 DY9599	−0.15 (−0.88)	0.81 (0.97)	−0.16 (−0.85)	1.94 (1.65)	−0.01 (−0.29)	0.91 (1.29)	0.08 (0.05)
6 INDEP		−1.48 (−1.42)					
7 SUPPOWER		0.77** (2.03)					
8 PRIVMON		−1.57** (−2.06)		−3.19* (−1.88)			

9 RESTRICT_SEC	1.75***	−2.56	0.95***		0.32*		
	(2.96)	(−1.55)	(2.97)		(1.86)		
10 RESTRICT_INS	−1.22**	0.75	0.38		−0.16		
	(−2.59)	(0.64)	(0.97)		(−1.18)		
11 CIVIL	−2.31***	−3.86					
	(−2.80)	(−1.56)					
12 CLEAN		−2.03***					3.92
		(−2.90)					(1.52)
13 FOREIGN		−0.10***			0.008**	0.17***	
		(−3.00)			(2.03)	(2.89)	
14 BANKSIZE			−0.11**				
			(−2.16)				
15 CONCENTRATION					0.01**	0.18**	
					(2.44)	(2.55)	
Sample size (countries)	58	54	56	55	58	58	58
Adjusted R^2	0.33	0.48	0.29	0.16	0.21	0.23	0.07
F statistic	5.00***	3.10***	4.25***	3.01**	2.96***	3.80***	1.83
Ramsey Reset	0.12		0.73	0.10	3.65*	5.33**	0.10

Note: t statistics are in parentheses. ***, ** and * denote 1, 5 and 10% significance levels.

Table 3 Estimated Effects of the Structure of Bank Supervision: Base Countries plus Transition Economies, 'Short' Regressions

Independent variables	Dependent variables						
	Capital adequacy (C)	Asset quality (A)	Management quality (M)		Earnings (E)		Liquidity (L)
	EQUITY (8)	NPL (9)	OVERHEAD (10)	NONINTREV (11)	ROA (12)	ROE (13)	LIQRISK (14)
1 Constant	7.57** (2.54)	20.90 (1.35)	4.39** (2.44)	39.14*** (2.67)	−0.22 (−0.36)	17.20 (1.32)	131.28*** 9.88)
2 SINGLE	1.69 (0.94)	4.78 (0.60)	−0.78 (−1.31)	7.79 (1.10)	0.33 (1.09)	4.13 (0.79)	−8.65 (−0.99)
3 CENBAN	−0.64 (−0.74)	3.56* (1.89)	−1.88** (−2.08)	−1.91 (−0.30)	0.19 (0.74)	−0.86 (−0.29)	−10.06 (−1.28)
4 GDPCAP	−0.07* (−1.85)	0.13 (1.06)	−0.08*** (3.10)	0.43 (1.60)	−0.006 (−0.60)	0.14 (1.20)	−0.39 (−1.19)
5 DY9599	−0.37 (−1.25)	0.37 (0.58)	−0.22 (−1.26)	1.13 (1.08)	−0.04 (−1.00)	0.56 (0.83)	1.28 (0.97)
6 INDEP		−1.95* (−1.74)					
7 SUPPOWER		0.67* (1.71)		−1.90** (−2.12)			
8 PRIVMON		−1.62*** (−2.66)				−2.20** (−2.07)	

9 RESTRICT_SEC	2.10** (2.51)	−3.27*** (−2.57)	1.00*** (3.14)		0.29* (1.84)		
10 RESTRICT_INS	−0.68 (−0.82)	2.13* (1.69)	0.42 (1.32)		−0.11 (−0.87)		
11 CIVIL	−2.36** (−2.58)	−3.41 (−1.50)				−6.56* (−1.73)	
12 CLEAN		−1.78*** (−2.66)					
13 FOREIGN		−0.07** (−2.34)			0.008** (2.07)	0.12** (2.44)	
14 BANKSIZE			−0.11** (−2.43)				
15 CONCENTRATION					0.01*** (2.78)	0.15** (2.61)	
16 TRANSITION	4.04 (1.52)	1.33 (0.31)	0.97 (1.26)	6.31 (0.88)	−0.49 (−1.57)	−13.21** (−2.50)	−19.33** (−2.12)
Sample size (countries)	69	65	67	65	69	69	70
Adjusted R^2	0.27	0.35	0.33	0.06	0.20	0.27	0.08
F statistic	4.27***	3.67***	5.06***	1.73	2.86***	3.74***	2.15*
Ramsey Reset	2.54		1.13	0.18	2.69	10.04***	0.54

Note: t statistics are in parentheses. ***, ** and * denote 1, 5 and 10% significance levels.

Table 4 Estimated Effects of the Structure of Bank Supervision: Base Countries, 'Long' Regressions

Independent variables	Capital adequacy (C)	Asset quality (A)	Management quality (M)		Earnings (E)		Liquidity (L)
	EQUITY (15)	NPL (16)	OVERHEAD (17)	NONINTREV (18)	ROA (19)	ROE (20)	LIQRISK (21)
1 CONSTANT	8.90**	18.36	6.17*	48.48*	0.37	12.02	149.87***
	(2.14)	(0.92)	(1.78)	(1.69)	(0.30)	(0.67)	(3.88)
2 SINGLE	2.57**	7.28	−0.80	6.55	0.59	6.68	−27.16**
	(2.04)	(0.78)	(−0.83)	(0.73)	(1.57)	(1.23)	(−2.33)
3 CENBAN	−0.28	4.27**	−1.88**	0.46	0.11	−0.60	−17.36*
	(−0.29)	(2.08)	(−2.14)	(0.07)	(0.38)	(−0.15)	(−1.91)
4 GDPCAP	−0.04	0.18	−0.06	0.81*	0.01	0.28	−1.14*
	(−0.55)	(1.26)	(−1.55)	(1.72)	(0.71)	(0.93)	(−1.80)
5 DY9599	−0.07	0.81	−0.20	2.42*	0.004	0.86	−0.94
	(−0.36)	(0.97)	(−1.12)	(1.78)	(0.07)	(1.07)	(−0.54)
6 INDEP	−0.52	−1.48	−0.34	3.18	−0.09	−0.13	−6.04
	(−0.97)	(−1.42)	(−1.31)	(0.88)	(−0.59)	(−0.06)	(−1.20)
7 SUPPOWER	0.05	0.77**	0.26	−1.89	−0.005	−0.33	0.75
	(0.27)	(2.03)	(1.39)	(−1.44)	(−0.10)	(−0.46)	(0.46)
8 PRIVMON	0.19	−1.57**	−0.37	−2.43	0.03	−1.64	−1.98
	(0.68)	(−2.06)	(−1.31)	(−1.14)	(0.39)	(−1.36)	(−0.75)

9 RESTRICT_SEC	1.55**	−2.56	0.60	1.49	0.29	1.70	−0.40
	(2.39)	(−1.55)	(1.38)	(0.33)	(1.48)	(0.61)	(−0.07)
10 RESTRICT_INS	−1.43***	0.75	0.24	−1.78	−0.22	−0.76	4.58
	(−2.74)	(0.64)	(0.62)	(−0.51)	(−1.49)	(−0.35)	(0.97)
11 CIVIL	−2.82***	−3.86	−0.59	4.02	−0.37	−5.71	−9.21
	(−3.04)	(−1.56)	(−0.94)	(0.64)	(−1.33)	(−1.43)	(−1.07)
12 CLEAN	−0.21	−2.03***	−0.01	−1.63	−0.11	−0.58	5.43
	(−0.60)	(−2.90)	(−0.06)	(−0.66)	(−1.01)	(−0.37)	(1.64)
13 FOREIGN	−0.02	−0.10***	−0.005	0.04	0.007	0.16**	0.05
	(−1.23)	(−3.00)	(−0.43)	(0.39)	(1.48)	(2.37)	(0.31)
14 BANKSIZE			−0.09**				
			(−2.10)				
15 CONCENTRATION					0.01**		0.17**
					(2.21)		(2.06)
Sample size (countries)	57	54	55	54	57	57	57
Adjusted R^2	0.30	0.48	0.29	0.08	0.18	0.20	0.02
F statistic	3.03***	3.10***	2.71***	1.42	1.95**	2.07**	1.11
Ramsey Reset	0.18		14.88***	0.82	3.63*	7.19***	0.14

Note: t statistics are in parentheses. ***, ** and * denote 1, 5 and 10% significance levels.

percentage points higher when the central bank supervises banks.[18] This effect is economically rather large, amounting to more than 40% of the cross-country mean and standard deviation of non-performing loans. In contrast, whether there are multiple bank supervisors has no detectable effect on our measure of asset quality.

Our equations show several other variables to be significantly associated with NPL. Higher supervisory independence (INDEP) is associated with lower levels of non-performing loans (albeit at the 10% level and only in the expanded sample (column 9)). More power for government supervisors (SUPPOWER) was associated with higher (not lower) levels of NPL, and more powerful private monitoring (PRIVMON) was associated with lower levels of NPL. However, as stated above, it is difficult to interpret the effects of public supervision and private monitoring on the declared level of non-performing loans in a cross-sectional study. At different stages of a credit cycle, effective (whether aggressive or independent) public supervision or private monitoring could have different effects. Effective supervision and monitoring at an early stage may reduce actual NPL levels over the long term. However, once a crisis is ongoing, effective supervision and/or monitoring could be associated with higher declared NPL levels.

In the expanded sample, we also find restrictions on bank securities and insurance activities to have significant coefficients. A one-unit increase in RESTRICT_SEC is associated with NPL levels that are 3% higher, and a one-unit increase in RESTRICT_INS is associated with NPL levels that are 2% lower (albeit only significant at the 10% level). These results are consistent with the hypotheses that mixing lending and securities dealing may increase risk across countries, but that bank insurance activities do not increase risk.

We experimented with different measures of corruption from different sources. We found the different measures to be highly correlated both with one another and with GDPCAP. In general, we find measures of corruption (in particular CLEAN) to have largely insignificant coefficients across most dependent variables.[19] However, our results imply that countries that are perceived to have less corruption do have significantly lower NPL levels. In particular, a decrease in corruption of one standard deviation is associated with NPL levels that are 5% lower, which is more than 50% of the mean and standard deviation for NPL.

The share of assets in foreign banks (FOREIGN) also has a negative and significant effect on non-performing loans. A 28% increase in the foreign banks' share (one standard deviation) is associated with a level of non-performing loans that is more than 2 percentage points lower. This supports the hypothesis that

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18 We do not include separate 'short' and 'long' regressions for NPL. Thus, column 16 in Table 4 simply reproduces column 2 in Table 2.
19 Including either GDPCAP or CLEAN, or both, did not substantially alter the results in Tables 2 to 4.

foreign banks raise a country's average loan quality and thereby perhaps enhance banking system stability. Presumably, foreign banks themselves do a relatively good job of evaluating creditworthiness, which may in turn lead domestic banks to do so as well.

C. Management quality

Two variables proxy management quality: OVERHEAD and NONINTREV. The structure of bank supervision appears to have affected banks' overhead costs. Having the central bank supervise banks tends to reduce overhead costs significantly. The estimated 1.84 percentage point reduction amounts to about half the cross-country mean for the overhead cost variable. One possibility is that central banks, for which monetary policy is the primary objective, may be less focused on banking supervision. Less focused, and therefore perhaps less vigorous, supervision may impose lower costs on banks.

Somewhat surprisingly, the coefficient for FOREIGN is statistically insignificant and economically very small (Table 4, column 17). Thus, this regression provides little support for the claims that foreign banking lowers a country's total bank costs. Having larger banks, higher per capita income or fewer restrictions on securities activities is associated with significantly lower overhead costs. Each of these effects may largely reflect various economies of scale and scope.

Our measure of non-interest revenue (NONINTREV) may measure how aggressive and innovative banks are. Non-interest revenues come from fees for traditional activities (e.g. account fees, ATM fees and financial advising services) and from less-traditional bank activities. We detect no effects of the structure of bank supervision on non-interest revenues.

Our results do suggest that banks in higher-income countries earned more fees. This result might reflect that the demand for financial services (such as insurance, asset management and retirement planning) increases with higher income levels. In addition, increased private monitoring appears to be associated with significantly smaller non-interest revenues. In environments where private monitoring is poor, the lack of transparency and enforceability of contracts might make market transactions subject to additional risks. Economies of scope may then emerge from synergies in information about providers. Conversely, increased private monitoring may then foster more specialized financial institutions.

The variables whose coefficients are significant in the NONINTREV 'short' equation (Table 2, column 4) do not match exactly the results from the regression including transition economies (Table 3, column 11) and those from the 'long' regression (Table 4, column 18). However, the values of the adjusted R^2 and regression F statistic imply that greater confidence should be placed in the results from the 'short' equation for base countries.

D. Earnings

According to our results, neither SINGLE nor CENBAN significantly predicts either ROA or ROE.[20] In the longer run, we would expect that, controlling for other factors, economic profits in banking would be determined more by market structure than by supervisory structure. Indeed, the share of total bank assets in the three largest banks (CONCENTRATION) and the share of assets in foreign banks (FOREIGN) both have positive and significant coefficients in the regressions for ROA and ROE. Our estimates suggest that a one standard deviation (23%) increase in market concentration is associated with ROE that is 4 percentage points higher. This effect is economically large, representing one-quarter of the mean of ROE. The coefficient of FOREIGN is consistent with the hypothesis that foreign banks may be more cost-efficient than domestic banks, spur greater efficiency at domestic banks and thus lead to increased profitability. In particular, a one standard deviation (28%) increase in foreign banking is associated with ROE that is almost 5 percentage points higher.

The coefficients for restrictions on securities activities are also significant (albeit only at the 10% level) for the ROA equation (columns 5 and 12), but not for the ROE equation (column 20). Industries with different ROA levels may produce similar ROE levels through the use of different levels of financial leverage. To the extent that banking industries differ across countries by providing non-commercial banking services, one may expect to see different ROA levels in different countries. Thus, the sign and significance for the coefficient of RESTRICT_SEC is consistent with banking industries that engage actively in (i.e. that are not restricted from) securities activities having lower ROAs (and higher levels of financial leverage).

For the ROA and ROE equations, the results contained in Tables 2 to 4 do not vary widely. Expanding the sample set to include transition economies, our estimates for ROE also find negative and significant coefficients for private monitoring and the dummy variables for both CIVIL and TRANSITION. Using a longer list of explanatory variables (Table 4, columns 19 and 20), some of the variables that were significant at the 5 and 10% levels, but not at the 1% level, in the 'short' regression would, predictably, only be significant at non-standard levels above 10%.

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20 Our data set includes several extreme values for earnings (e.g. ROEs of −110.8% in Indonesia and −88.6% in Thailand in 1999) associated with the 1998–9 East Asian financial crisis. We performed our regressions (a) including the extreme values, (b) excluding them and (c) restricting or trimming extreme ROA values to the range of [−1, 3] and ROE values to the range of [−20, 50]. The coefficients and significance for the measures of supervisory structure (SINGLE and CENBAN) were robust to the different options. We report the results based on the trimmed dependent variable. Including the extreme values risked their dominating the results. Excluding countries undergoing financial crises risked excluding the most relevant observations from the study.

E. Liquidity

According to our estimates, having multiple supervisors is associated with a statistically significant increase of about 20 percentage points in our measure of liquidity risk (LIQRISK) among the base countries. This is an economically large increase, amounting to about 20% of the cross-country mean of LIQRISK. Thus, as with the capital adequacy equation, the results for liquidity risk are consistent with the hypothesis of multiple bank supervisors pursuing a competition in supervisory laxity.

However, our results for liquidity risk should be interpreted with caution. The low values of the adjusted R^2 and the regression F statistics for our LIQRISK equations imply that, unlike with the other six dependent variables in Table 2, the overall regression results for the LIQRISK equation are not statistically significant at standard levels. Moreover, these results are not robust in the sample expanded to include transition economies or using a 'long' list of regressors. The results from a regression including transition economies (Table 2, column 14) do not yield a significant coefficient for SINGLE, and thus do not support extending the conclusions of the hypothesis of competition in supervisory laxity to transition economies. The results from a regression using a 'long' list of regressors (Table 4, column 21), while still having extremely low values for the regression F statistic, have negative and significant coefficients for both SINGLE and CENBAN.

VI. SUMMARY AND CONCLUSIONS

Our study estimates the effects on bank safety and soundness of two specific and important aspects of the structure of supervision: (a) whether there is a single or multiple bank supervisors; and (b) whether the central bank supervises banks. We use data for 70 developed, emerging and transition economies, and employ various measures of macroeconomic conditions, supervisory and regulatory structures, the legal environments and banking market structures.

As might be expected, when supervisors compete for 'clients', we find that countries with multiple authorities tend to have lower bank capital ratios and to have higher liquidity risk. Thus, the results indicate that having multiple bank supervisors (rather than one supervisor) is consistent with a 'competition in laxity'. This finding that multiple supervisors tend to reduce equity capital ratios and increase liquidity risk comports with the hypothesis that having multiple bank supervisors weakens corporate governance of banks. We also find that, when a country's central bank also supervises banks, its banks tend to have more non-performing loans. Our finding that non-performing loans are higher when the central bank supervises banks supports the hypothesis that a more focused bank supervisor might strengthen the monitoring and control of banks.

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