Supervisory effectiveness and bank risk

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Abstract

This paper investigates the role of banking supervision in controlling bank risk. Banking supervision is measured in terms of enforcement outputs (i.e., on-site audits and sanctions). Our results show an inverted U-shaped relationship between on-site audits and bank risk, while the relationship between sanctions and risk appears to be linear and negative. We also consider the combined effect of effective supervision and banking regulation (in the form of capital and market discipline requirements) on bank risk. We find that effective supervision and market discipline requirements are important and complementary mechanisms in reducing bank fragility. This is in contrast to capital requirements, which prove to be rather futile in controlling bank risk, even when supplemented with a higher volume of on-site audits and sanctions.

JEL Classifications: G21; G32; G38

Keywords: Bank risk; Supervision; Sanctions; Audits

1. Introduction

The financial turmoil that commenced in 2007 has stimulated substantial research aimed at identifying the reasons behind the crisis and at proposing recovery measures. A handful of interrelated explanations have been offered, one of the most interesting of which involves supervisory inertia (e.g., Blanchard, 2008; Caprio et al., 2008). This paper examines empirically the relationship between supervisory effectiveness and bank risk.[1] The main novelty of our work is that we measure supervisory effectiveness in terms of enforcement actions (sanctions) and on-site audits, and how these affect the level of bank risk in bank portfolios.

Our research was inspired by the works of Jackson (2007), Jackson and Roe (2009), and Coffee (2007). More specifically, we endorse the observation made by these studies that employing information on sanctions and on-site examinations (enforcement outputs) offers the opportunity to capture supervisory effectiveness in containing bank risk more directly and accurately than does the use of data on enforcement inputs, i.e., regulatory budgets and staffing.

Indeed, according to the second pillar of Basel II, on-site inspections constitute an essential component of supervisory review, in concert with the application of appropriate sanctions where breaches of law are revealed (Basel Committee, 2006). On-site inspections, in particular, enable the timely detection of management deficiencies and provide independent verification of both the quality of the internal control systems and the reliability of information produced by banks (Basel Committee, 2002). Therefore, it comes

[1] Our work distinguishes between banking supervision and regulation. Regulation encompasses formal rules that are adopted by an official public authority (law-on-the-books). Banking supervision comprises the on-going monitoring of law-on-the-books and the imposition of remedial measures in case of violations (Basel Committee, 2002).

as no surprise that on-site examinations and sanctions are considered essential tools for ensuring the stability of the system (Quintyn and Taylor, 2002).[2]

In this context, we build a new panel dataset that contains information on on-site audits and sanctions for 17 countries over the period 1998-2008. This period begins after the Asian and Russian financial crises and ends with the recent financial crisis having already unfolded. Thus, it provides ample room to identify whether the effectiveness of banking supervision is related to the increased risk-taking by banks that has been observed in recent years. This paper examines first and foremost whether on-site audits and enforcement actions have a negative and direct impact on bank risk. Put differently, we ask whether supervisors who inspect banks more regularly and adopt a more forceful enforcement attitude are better positioned to restrain bank risk.

Deviating from most of the contemporary literature that examines separately the impact that each of the three Basel II components has on banking stability/performance, we also examine the relationship between supervisory effectiveness, on the one hand, and capital adequacy requirements and market discipline-transparency, on the other hand, in shaping bank risk. Our research tests the rather neglected principle set out by the Basel Committee (Basel Committee, 2006) that market discipline (Pillar 3) supplements both minimum capital adequacy requirements (Pillar 1) and the supervisory review process (Pillar 2). We are motivated by the concern that the proxies used by empirical research for supervisory quality so far rely heavily on law-on-the-books, as opposed to actual supervisory alertness (e.g., La Porta et al., 2006). Moreover, we suspect that differences in

[2] A potential drawback of our measure is that the use of data on audits and sanctions does not capture "supervisory efficiency" in an economic sense, because the decision to intervene is affected by a number of factors not considered in the paper, for example, supervisors' private interests (they may earn fees from exams) and cost considerations concerning inspections/sanctions.

the stringency of law enforcement may constitute an interesting explanatory factor for the diverse empirical outcomes concerning the impact of capital and transparency requirements on bank risk-taking (e.g., VanHoose, 2007; Alexandre et al., 2010).

Our estimation results indicate that the impact of on-site examinations on various measures of bank risk is non-linear. In contrast, enforcement actions exert a linear negative impact on risk. Therefore, it is quite clear that direct measures of supervisory effectiveness are negatively related to bank risk. Turning our attention to the interplay among banking regulation, supervision, and risk, we make two appealing inferences for regulatory and supervisory policy-making. First, it appears that transparency regulation exercises a significant disciplinary effect upon bank risk, both directly and when viewed in combination with effective banking supervision. Second, our results fail to establish a similar correlation for capital adequacy requirements in general. Capital regulation, either directly or through its effective supervision, does not curtail bank risk but only affects those banks that hold a level of capital very close to the minimum capital adequacy requirements (see also Berger et al., 2010).

The existing literature has so far attempted to gauge the quality of banking supervision in a rather indirect manner. Proxies for enforcement quality involve the official attributes of supervisory authorities, such as independence and scope of powers (e.g., La Porta et al., 2006), or the degree of corruption and political freedom reflecting the quality of government efficiency in general (e.g., Noy, 2004). However, because they place undue weight on law-on-the-books, these indices produce less precise estimations. Surveys and questionnaires that involve supervisory authorities as respondents have also been used to assess supervisory quality (e.g., Barth et al., 2001, 2004 and 2008). Though they provide an excellent proxy for the regulatory and supervisory environment (law-on-the-books), these measures may be prone to two limitations. First, they are affected by the subjective

judgment of the respondents (Demirgüç-Kunt et al., 2008, p. 515). Second, due to lack of a complete set of historical data, the work of Barth et al. is based upon information that is available for only three points in time and, hence, displays a relatively more static character.

To the same end, the IMF-World Bank Financial Sector Program (FSAP) has been examining the degree of compliance with the 25 Basel Committee Core Principles (BCPs) for effective banking supervision (Basel Committee, 2006b). Again, however, several limitations emerge: letter-of-law evaluations supplemented by the opinions of experts neglect the factor of actual implementation and introduce an aspect of subjectivity, while the inherently vague content of the BCPs undermines the reliability of the compliance testing. Finally, Neyapti and Dincer (2005) examine whether countries have adopted laws covering the areas of supervisory interest indicated by the BCPs and the related literature (e.g., capital, lending, ownership, management, reporting, corrective action, supervision, deposit insurance); contrary to our work, however, these studies do not attempt to assess whether and to what extent these laws are actually implemented.

The rest of this paper is organized as follows. Section 2 discusses the related literature and forms the research questions. Section 3 describes the sample and variables to be used in the empirical analysis. In Section 4, we analyze the direct impact of banking supervision on risk. Section 5 considers the combined effect of banking supervision and banking regulations on risk. Section 6 concludes the paper.

2. Related Literature and Theoretical Underpinnings

In this section we offer a brief review of the literature associated with our work and we set out the main research questions.

2.1 THE DISCIPLINARY EFFECT OF BANKING SUPERVISORY ENFORCEMENT

Wu (1969) was among the first to note that the criticism by bank examiners of business loans is reasonably accurate, thus offering a good ex ante measure of loan quality. Wu's statement has been corroborated ever since by several studies focusing on the predictive and corrective character of bank examinations regarding the quality of loans (e.g., Berger et al., 2000; DeYoung et al., 2001; Bhattacharya et al., 2002; Gunther and Moore, 2003). All these authors tend to reach the general conclusion that on-site audits exercise a disciplinary power upon banks in three ways. First, they force the production of more accurate financial reports. Second, they enhance market discipline through public disclosure of audit findings. And third, they improve supervisory discipline, as the auditors' discoveries may form the basis for the application of remedial actions by supervisory authorities.

The empirical research focusing directly on the impact of sanctions on banking discipline has been limited. From a theoretical standpoint, the materialization of legal standards (law-on-the-books) through the employment of enforcement actions is viewed as the means that gives the law "teeth to bite" and offers meaning to the otherwise "blank letter" of legal rules (e.g., Bhattacharya and Daouk, 2002). Swindle (1995) and DeYoung et al. (2001), among others, suggest that the positive relationship between the frequency of on-site audits and banking discipline is due to the fact that the information gained by supervisors following examinations enables them to apply appropriate remedial measures on imprudent banks. A variation of the above argument is that on-site audits may transmit "regulatory discipline information" to the market. In other words, an unanticipated change of rating accompanied by regulatory restrictions or reliefs may affect the bank value. In the event of a rating downgrade and concomitant introduction of regulatory restrictions, the

value of the bank is likely to decrease, thus exerting disciplining power (Berger and Davies, 1998).

All in all, the above research suggests that the frequency of on-site audits and the number of supervisory sanctions should be positively correlated with banking discipline. On this basis, the first question (Question 1) asked in this study is: Are the quality of supervisory enforcement, dictated as the number of on-site audits and sanctions, and bank risk indeed negatively associated?

2.2 THE RELATIONSHIP BETWEEN BANKING STABILITY, SUPERVISORY EFFECTIVENESS, AND BANKING REGULATION

Besides exploring the direct effect of enforcement on bank risk, our work attempts to offer a more integrated approach of the three Basel II ingredients, by studying whether it is the effective supervision (Pillar 2) of capital adequacy (Pillar 1) and transparency (Pillar 3) regulation that has an effect on bank risk. From this perspective, our work appears to be related to the literature that focuses on the relationship between banking regulation (in the form of capital adequacy and disclosure requirements) and banking fragility.

A considerable part of this research shares the view that increased transparency and the associated enhanced market discipline contribute significantly to banking stability by (i) limiting informational asymmetries, (ii) boosting private monitoring, (iii) facilitating supervisory oversight, and (iv) forcing banks to adopt more prudent risk-taking behavior (e.g., Beck et al., 2006; Demirgüç-Kunt et al., 2008). Other views, however, seem rather unconvinced, offering at least two reasons for which information disclosure may undermine banking system stability. First, and considering that the returns of banks are positively correlated, increased disclosure of information may cause depositors to overreact to adverse information about other banks and initiate a run on their bank (e.g., Chen and

Hasan, 2006). Second, compliance with information disclosure regulation entails not only direct (e.g., establishing and operating efficient information production and verification systems) and indirect (e.g., appropriation of disclosed information by rivals) costs, but it may also lead to pervasive free-riding of monitoring information and, by implication, to reduced profit margins (Hyytinen and Takalo, 2002).

Turning to the relationship between capital regulation and bank risk, the conventional view holds that capital requirements serve as a risk-mitigating mechanism that forces banks to put more of their own funds at risk and internalize possible losses. This view has been challenged, however, by a substantial portion of the theoretical literature. Research outcomes diverge as they appear to depend on whether: (a) banks are examined as value- or utility-maximizing firms operating in complete or incomplete markets and within a purely static or a more dynamic framework; (b) the limited liability of bank shareholders and the behavior-distorting effects of deposit insurance are fully considered; and (c) information asymmetries and monitoring incentives on the asset side as well as banks' ownership and market structure are appropriately accounted for.[3]

A central and common assumption underlying this theoretical literature is the ability of supervisors to enforce capital regulation. We assert that this conjecture deserves more attention as a potentially decisive factor in explaining the diverse empirical results. In particular, effective enforcement of capital requirements may constitute the key incentive mechanism for banks to curtail their portfolio and leverage risk, as well as reduce the value of their deposit insurance put option (see e.g., Flannery, 1989; Milne, 2002). Moreover, supervisory forbearance may be viewed as a form of government subsidy, inducing banks to increase their risky assets (Allen and Rai, 1996; Galloway et al., 1997).

[3] For a literature review see VanHoose (2007), Behr et al. (2010) and references therein.

In this context, we find it interesting and novel to examine the combined effect of supervisory enforcement (i.e., on-site audits and sanctions) and banking regulation (i.e., capital and transparency requirements) on bank risk. Thus, our second research question (Question 2) is: Is the combined effect of effective supervisory enforcement and banking regulation, in the form of capital and transparency requirements, important in shaping bank risk?

3. Empirical Model and Data

3.1 ESTIMATED EQUATIONS AND DATA COVERAGE

The following equation illustrates the direct relationship between banking supervision and bank risk:

$$r_{it} = \alpha + \delta r_{it-1} + \beta_1 audits_t + \beta_2 sanctions_t + \beta_3 reg_{t-1} + \beta_4 b_{it} + \beta_5 c_t + u_{it} \quad (1)$$

Here the risk variable *r* of bank *i* at time *t* is written as a function of the lagged dependent variable; the time-dependent variables *audits* and *sanctions* that correspond to the number of on-site examinations and sanctions per bank in each year (in logarithmic terms), respectively; the indices that reflect the regulatory conditions in the banking systems examined, *reg*; a vector of bank-level control variables, *b*; variables that capture the institutional and macroeconomic conditions common to all banks, *c*; and the error term, *u*.

In addition, to answer the second question set out in Section 2 concerning the combined effect of supervisory effectiveness and banking regulations on bank risk, we consider the following specification:

$$r_{it} = \alpha + \delta r_{it-1} + \beta_1 audits_t + \beta_2 sanctions_t + \beta_3 reg_{t-1} + \beta_4 audits_t * reg_{t-1} + \beta_5 sanctions_t * reg_{t-1} + \beta_6 b_{it} + \beta_7 c_t + u_{it} \quad (2)$$

We build a dataset that encompasses information on sanctions and on-site bank examinations for 17 countries over the period 1998-2008. The countries are Australia,

Bulgaria, the Czech Republic, Germany, Greece, Hong Kong, Korea, Latvia, Luxembourg, Portugal, Romania, Russia, Serbia, Spain, Turkey, Ukraine, and the United States. We chose these countries based on the availability of data on examinations and sanctions, as well as on the fact that they are representative of banking systems with different legal, regulatory, and institutional origins. Bank risk is captured at the bank level, which yields disaggregated information on individual bank strategies.

Table I shows information by country on the average number of supervised banks during the sample period and the actual number of banks for which the risk indicators are constructed. We use the legal definition of the term "bank" in each of the sample countries and conclude the deposit function constitutes a common denominator of all descriptions. Our data on the number of supervised banks cover (a) domestically established banks (home country depository institutions) and (b) domestic operations of foreign banks (e.g., branches, representative offices, subsidiaries of foreign banks). In contrast, branches of domestic banks are not counted as separate banks. All data for the bank-level variables are collected from Bankscope. We limit the empirical analysis to the unconsolidated statements of banks to reduce the possibility of introducing aggregation bias in the results. We included in the sample only the banks supervised by the national supervisory authorities (listed in Table I) so that our sample includes those banks upon which audits and sanctions were imposed. The percentage of banks in the sample to the total number of banks supervised is approximately 74%. A number of mergers and acquisitions took place during the sample period; these are taken into account in our dataset so as to avoid duplication. The data were also reviewed for reporting errors or other inconsistencies (zero or negative values for the variables used), and some observations are excluded accordingly (for more details, see Appendix and the supplement to the paper).

3.2 ON-SITE EXAMINATIONS AND SANCTIONS

Data on on-site audits and supervisory enforcement actions were obtained from the annual reports produced by the national supervisory authorities responsible for the conduct of banking supervision (Table I lists the supervisory authorities for each country). The actual variables employed are constructed as the number of on-site audits and sanctions per bank in the supervisory jurisdiction in each country per year. The panel is unbalanced and consists of a maximum of 159 observations for audits and 155 for sanctions (Table I provides details for the time span for each country and the supplement to the paper provides the full sample).

This is the first study that employs a panel of cross-country data for these variables, and in doing so it portrays actual banking supervisory effectiveness. Our dataset thus reflects the intensity of supervision applied to the banking sector *as a whole* and is intended to serve as a novel "banking supervision index" representing an *aggregate* measure of supervisory effectiveness. To address potential concerns over the comparability of data across countries we need to make two fundamental clarifications in advance concerning the collection and elaboration of information on sanctions, on-site audits, and number of supervised banks per country.

First, we consider that a basic, common understanding has been developed among sample countries concerning the meaning and objectives of "on-site audits" and "sanctions". All sample countries have been reported to adopt the BCPs and thus share a uniform perception over the fundamental principles elaborated therein, including Principles 20 and 23 concerning on-site audits and enforcement actions (Basel Committee, 2006c, pp. 32-33, 37-38). In this context, we are not concerned with the criteria (lenient or more stringent) that national supervisors employ in deciding to apply a sanction or conduct an audit, but with the actual outcome of banking supervision (number of audits and sanctions).

Put differently, what we explore is how the implementation of/compliance with two of the BCPs, that is, Principles 20 and 23, affects bank risk and interplays with capital and transparency requirements in shaping banking behavior.

Second, our analysis employs data on supervisory sanctions that are both directly related (e.g., violation of capital/liquidity requirements, breaches of large exposure limitations and internal organization standards) and not directly related (e.g., breaches of consumer protection law) to the banks' safety and soundness. Thus, with the exception of Australia where, as explained further below, the competent prudential supervisor is solely responsible for monitoring compliance with safety and soundness regulation, we collect data on the overall supervisory alertness for all sample countries. We did so because, as already underlined, we are interested in capturing the general disciplinary effect that supervisory sanctions exert upon banks' behavior. Moreover, from a purely technical-practical perspective, specific data on the violations of safety and soundness regulation are unavailable, with the exception of three countries (i.e., United States, Australia, Luxembourg). Thus, to verify and further support our inference on the correlation between enforcement actions and bank risk, we conduct additional analyses for the United States, Australia, and Luxembourg, where more information is offered on the legal basis behind supervisory sanctions.[4]

3.3 BANK RISK

We proxy bank risk by a number of measures that have been extensively used in the literature. First, we use as our primary measure the Z-index, which represents a universal measure of bank risk or insolvency risk (see e.g., Boyd et al., 2006 and Laeven and Levine,

[4] The ratio of sanctions related to safety and soundness to total sanctions is 32% in Australia, 30% in Luxembourg and 19% in the USA.

2009). It is defined as $Z = (ROA + EA)/\sigma(ROA)$, where *ROA* is the rate of return on assets (ratio of pre-tax profit to total assets), *EA* is the ratio of equity to assets, and $\sigma(ROA)$ is an estimate of the standard deviation of the rate of return on assets. To calculate $\sigma(ROA)$ at time *t*, we use data from the two previous years (i.e., *t*-1, *t*-2) and verify that using three or four lags gives very similar results. A higher *Z* indicates that a bank is farther from insolvency. Since *Z* is highly skewed, we use its natural logarithm, which is normally distributed. In our sample *Z* obtains a mean value equal to 3.45. The highest average *Z*-scores are reported in 2006 due to the high profitability of banks in that year.

Second, we use the ratio of non-performing loans to total loans, denoted as *NPL* (see Fernández and González, 2005, and the references therein). *NPL* reflects the quality of bank assets, i.e., the potential adverse exposure to earnings and asset market values due to deteriorating asset quality. Because a portion of non-performing loans will result in losses for the bank, a high value for this ratio is unwanted. A potential criticism on the value of this measure is that it may better capture risk taken in the past and not changes in the riskiness of the bank.[5] Therefore, we carry out sensitivity analysis by also using changes in *NPL* as the dependent variable. We obtain the data for this variable from Bankscope. Table II presents the descriptive statistics. The mean value equals 0.029, with countries such as Bulgaria, Romania, Hong Kong, and Korea obtaining high values at the beginning of the sample period[6] and countries such as Australia and Germany having low *NPL* ratios. The

[5] This is a criticism that does not concern the Z-index as much, because changes in bank riskiness are captured through the variance component of this index. Furthermore, the Z-index, as a measure of insolvency risk, concerns primarily the longer-term probability of bank failure and, in our context, how this probability relates to supervisory effectiveness.

[6] The transition economies of our sample inherited a high volume of non-performing loans from the old centralized regime. For Korea and Hong Kong the 1997 financial crisis is responsible for the high values of non-performing loans observed at the beginning of the period.

correlation of the Z-score with *NPL* is negative and takes a value of -0.671, while low Z-scores are reported in countries with high credit risk (e.g., the Asian countries in the first years of our sample and some transition countries).

In sensitivity analysis, we confirm our baseline results by using additional measures of risk, such as the ratio of risky assets to total assets (*RA*) and its change from the previous period or the simple volatility of the return on assets $\sigma(ROA)$. $\sigma(ROA)$ is useful in separating the volatility of assets from the volatility of leverage in the Z-index (Laeven and Levine, 2009). *RA* reflects the riskiness of bank portfolios at any point in time and the extent to which banks hold illiquid assets. Banks' risky assets include all bank assets except cash, government securities (at market value), and balances due from other banks. In other words, all bank assets subject to change in value due to changes in market conditions or changes in credit quality at various re-pricing opportunities are included as risky assets. Naturally, an increase in *RA* demonstrates a more risky position of banks.

3.4 CAPITAL REQUIREMENTS AND MARKET DISCIPLINE

To quantify capital and transparency requirements, we use the approach followed by Barth et al. (2001) and more recent studies of the same authors.[7] We briefly discuss these indices below. Additional information can be found in the Appendix.

The first index, *capital stringency*, shows the extent of both initial and overall capital stringency. Initial capital stringency refers to whether the sources of funds counted as regulatory capital can include assets other than cash or government securities and

[7] This approach has been also followed by Fernández and González (2005) and Pasiouras et al. (2006), among others. An alternative would be to use principal component analysis as in Beck et al. (2006). Barth et al. (2004) have followed both approaches, mentioning (p. 218) that "*we have confirmed all this paper's conclusions using both methods*".

borrowed funds, and whether the regulatory or supervisory authorities verify these sources. Overall capital stringency indicates whether risk elements and value losses are considered when calculating the regulatory capital. Higher values of *capital stringency* indicate more stringent capital requirements.

The second index, *market discipline*, reflects the degree to which banks are forced to disclose accurate information to the public (e.g., disclosure of off-balance sheet items, risk management procedures, etc.) and whether there are incentives to increase market discipline, for example, via the issuance of subordinated debt and the abolition of deposit insurance schemes. Table II reports the descriptive statistics for these variables.

3.5 OTHER BANK- AND COUNTRY-LEVEL CONTROL VARIABLES

We control for a number of bank- and country-level variables (see Table II for descriptive statistics and the Appendix for formal definitions of the variables and data sources). At the bank level, we control for liquidity using the ratio of liquid assets to total assets. Liquid assets are cash, government securities (at market value), and balances due from other banks.[8] Banks with higher liquid assets have a less risky portfolio and thus a lower value of non-performing loans. However, these banks may also be less profitable, as risk-free assets do not offer yield, and, therefore, high liquidity may be associated with lower Z-scores. An additional bank-specific control variable is bank size, proxied by the natural logarithm of real total assets. Larger banks are usually more profitable due to economies of scale and/or possible market power in loans or deposits. As a result, we expect a positive relationship between bank size and the Z-score. Nonetheless, larger banks may also have incentive to increase their credit risk if they consider themselves to be in the

[8] Therefore, this variable is essentially the inverse of the risk variable *RA* and, thus, it is not included in the *RA* regressions. However, it can be used as a control variable in solvency and credit-risk regressions.

"too-big-to-fail" group of banks. Consequently, the impact of size on credit risk is ambiguous. Finally, we also control for bank capitalization (using the ratio of equity capital to total assets), loan loss provisions (using the ratio of loan loss provisions to total loans), and bank growth (a bank's revenue growth of the last year). These variables capture elements of the product market conditions, the health of bank portfolios, and the strategic management of banking institutions (see Laeven and Levine, 2009).

In connection with the variables pertaining to the institutional, regulatory, and macroeconomic environment, we employ an index of economic freedom (obtained from the Heritage Foundation). We also control for the level of economic development using the real gross domestic product (GDP) per capita, for price stability and monetary conditions using the inflation rate[9] (both these variables are taken from the World Development Indicators), and for banking market structure using the 3-bank concentration ratio.

Finally, we control for restrictions on bank activities through an index we constructed using the dataset of Barth et al. (2001, 2004 and 2008). We determined this index, named *activity restrictions*, by considering whether securities, insurance, real estate activities, and ownership of non-financial firms are unrestricted, permitted, restricted, or prohibited (for more information, please refer to the Appendix). The theoretical literature has identified both the advantages and the disadvantages of allowing banks to offer a wide range of financial services, with emphasis placed on the provision of investment services (e.g., Gande, 2008). First, conflicts of interest may arise as banks misstate a borrower's quality and underwrite securities at inflated prices to service outstanding loans, as well as misguide their depositors to acquire such securities (e.g., Kang and Liu, 2007). Second, banking stability may be undermined as entry into new business lines also gives rise to new

[9] We additionally employed as a proxy for the monetary conditions the central bank rate. This variable is highly collinear with the inflation rate and the results were quite similar.

types of risks for banks (e.g., John et al., 1994; Boyd et al., 1998). On the other hand, the preponderance of empirical research not only appears to negate the contention regarding the emergence of conflicts of interests (e.g., Ang and Richardson, 1994; Kroszner and Rajan, 1994), but also suggests that, in the course of monitoring their loans, banks obtain valuable information that places them in a unique position to certify the issuance of securities by their clients (e.g., Puri, 1996). Moreover, integrated banks may enjoy economies of scale and scope in the combined provision of banking and investment services (e.g., Ramírez, 2002) and also become more stable as a result of wider asset diversification (e.g., Barth et al., 2004; Angkinand, 2009). We examine which impact prevails in the empirical analysis that follows.

4. The Direct Impact of Banking Supervision on Bank Risk

4.1 IDENTIFICATION STRATEGY

Correlations between the variables used in Eq. (1) are not high enough to incur multicollinearity problems (see Table III). This is interesting when the *audits* and *sanctions* variables are considered because it implies that these variables, though positively correlated, do not capture the same aspect of enforcement. Moreover, we should note that potentially new regulatory initiatives are unlikely to affect the risk-taking behavior of banks in the immediate term. If regulations do affect risk-taking incentives, then lags are to be expected between the adoption of new banking laws or the implementation of new policy initiatives (that will be reflected in the corresponding indices) and the time that these laws or initiatives materialize into more sound banking practices. Therefore, the regulatory practices of the previous period can be expected to impact the contemporaneous level of bank risk. In fact, in the estimations below, we will be using both the first and the second lags of the regulation variables to ensure robustness of the results.

The potential endogeneity of some of the right-hand-side variables serves as a traditional econometric concern in a simple regression of bank risk. In the context of the present analysis, these concerns are well justified if one considers that a history of high bank risk may force supervisors to improve the quality of enforcement at some point in time. The opposite may also be true: in the presence of a prolonged period of prudent risk-taking bank behavior and a stable financial and economic environment, supervisory authorities may become more lax in enforcing banking regulations, thereby raising the incentive of banks to increase their risk-taking activities. In these cases, endogenous effects prevail, and ordinary least squares (OLS) estimation of Eq. (1) will produce biased estimates.

The fact that risk tends to persist and thus will deviate from equilibrium in the short run constitutes another element of potential bias in estimating risk equations (for a discussion, see Agoraki et al., 2009). Thus, a static model is biased, the choice of a dynamic empirical model (i.e., one that includes a lagged dependent variable) is well justified, and the coefficient on the lagged risk variable δ in Eq. (1) may be viewed as the speed of convergence to equilibrium. A value of δ statistically equal to 0 implies that bank risk is characterized by a high speed of adjustment, while a value statistically equal to 1 means that the adjustment is very slow. Values between 0 and 1 suggest that risk persists, but will eventually return to its normal (average) level. Finally, δ takes implausible (negative) values if convergence to equilibrium cannot be achieved, which probably indicates a problem with the dataset (e.g., a very small time dimension of the panel). Nerlove (2002) offers a more thorough analysis on these issues.

Given the above, we start with an OLS estimation of Eq. (1), but we resort to the system GMM estimator proposed by Blundell and Bond (1998) for inference. Besides accounting for the specified dynamics, the latter estimator has two additional virtues. First,

it does not break down in the presence of unit roots (for a proof see Binder et al., 2005). Second, and most important, it accommodates the possible endogeneity between risk and the endogenous right-hand-side variables by means of appropriate instruments.

The suitability of instruments is a concern in many economic problems and this case is no exception. We choose instruments taking two issues into consideration. First, one set of instruments has to comply with the identification of the GMM estimation method, and second, the other set must be correlated with enforcement but not with bank risk. Compliance with the first issue is achieved by using the second lags of the dependent, enforcement (audits and sanctions), regulatory, and bank-level variables as instruments (in line with Blundell and Bond, 1998 and Bond, 2002).[10] Treating these independent variables as symmetric instruments (i.e., using the equivalent lags) implies that they are all assumed to be endogenous (i.e., reverse causality may prevail), which is in line with the theoretical priors discussed above. Blundell and Bond (1998) and Bond (2002), among others, elaborate more on these issues. Finally, we use the first and second lags of the GDP per capita and inflation variables as instruments. This treatment of the macroeconomic variables (i.e., additionally using their first lag) corresponds to the assumption that banks

[10] The regulatory variables may be predetermined or endogenous depending on the sequence of events of the game played between banks and regulators. In particular, if banks observe the level and type of regulation and then choose their level of risk optimally, regulations should be treated as a predetermined variable. If regulations are indeed predetermined, then the first and longer lags of these variables are valid instruments. However, it may also be the case that in an effort to prevent financial turbulence, regulators enact new laws at the time they observe excess risk-taking. To the extent that the risk-taking of banks explains bank regulatory initiatives, this will be reflected in our regulation indices of that particular year. Hence, as the treatment of the regulatory variables as endogenous encompasses their treatment as predetermined, we assume that *capital stringency*, *market discipline*, and *activity restrictions* are endogenous variables. For further discussion on these issues, see Bond (2002).

and regulators choose their strategy when they observe the state of the economic environment at the beginning of the period (i.e., the macroeconomic variables are treated as predetermined). Longer lags of the variables are not included because, in that case, the estimated equations are over-identified.

Compliance with the second principle is achieved by using alternatively as instruments (i) the changes in the annual financial freedom index (obtained from the Heritage Foundation),[11] (ii) the legal origin dummy variables (obtained from La Porta et al., 1998, and employed, for example, by Demirguc-Kunt et al., 2008), or (iii) changes in the three regulatory indices described above. Correlations and simple regressions show that all these instruments are statistically valid and estimation results do not vary considerably among these three choices. However, we verified that changes in the annual financial freedom index is the instrumental variable most strongly correlated with audits and sanctions, while it is not correlated with bank risk; hence, it is the one favored. All in all, by providing a series of tests, we show that (i) the estimates are robust, (ii) the equations are not over- or under-identified, and (iii) the series are not autocorrelated. Finally, besides GMM and as a sensitivity analysis, we also employ a panel data instrumental variables (IV) regression with fixed effects, where (in line with the issues raised above) we exploit the change in the annual financial freedom index as instrument.

4.2 ESTIMATION RESULTS

Tables IV and V provide the results from estimating Eq. (1). Table IV reports the results of the Z-score regressions. Specification (1) is estimated using OLS, specifications (2) to (6) using GMM, and specification (7) using the IV method. The OLS regression displays low fit (most of the control variables appear statistically insignificant), thus

[11] For a similar set of instruments, see Laeven and Levine (2009).

contradicting most of our theoretical priors. The results based on the GMM method display better fit, while the specification tests imply that the equations are well specified. In particular, the coefficient on the lagged dependent variable seems to persist to a moderate extent, implying that risk will eventually return to its normal (average) level (see discussion in Section 4.1) The Sargan test for over-identifying restrictions rejects the relevant hypothesis, thus suggesting that the instruments are valid. Even though some of the equations indicate the presence of first-order autocorrelation (AR1), i.e., p-values should be below 0.05 for AR to be rejected at the 5% level, this does not indicate that the estimates are inconsistent. Inconsistency becomes an issue if second-order autocorrelation is present (Blundell and Bond, 1998). However, this case is rejected as indicated by the p-values of the relevant test for AR2 errors.

In column 2 of Table IV the coefficient on *audits* shows that on-site examinations do not have a significant impact on the Z-index. In the rest of the estimated equations we opt for a deeper investigation of this relationship by considering the existence of non-linearity. Indeed, the results show the relationship between *audits* and Z-index to be non-linear (U-shaped). To guarantee robustness of this result, we (i) include a cubic term of audits and (ii) drop 10% of the outliers (in terms of standard error) of the relevant variable. The results (included in the supplement to the paper) show the cubic term to be insignificant, while dropping the outliers has no impact on virtually any of the explanatory variables. These findings indicate that non-linearity is not sensitive to the particular non-linear relationship imposed on the data or to outliers. Higher sanctions, on the other hand, have a negative and highly significant effect on bank risk, a finding that remains constant among all alternative GMM regressions. We examine whether the pattern in the sanctions-risk relationship is also non-linear, but find no such evidence as the squared term of sanctions is insignificant (see supplement to the paper). In a nutshell, our results offer an

unequivocal "yes" to Question 1 as far as the impact of enforcement actions on bank risk is concerned and a qualified defense in the form of an inverted U-shaped relationship concerning the effect of on-site audits on risk.

Our results lead to interesting conclusions for policy-makers and supervisors alike. In particular, it appears that enforcement actions do have a statistically significant disciplinary effect on banks. By imposing direct or reputation costs on banks, supervisory sanctions contribute considerably to constraining bank risk. In light of the recent financial turbulence, this finding suggests that the benefits of safeguarding the safety and soundness of the banking system may outweigh the costs of adopting a more vigorous supervisory approach. Moreover, our inference on the inverted U-shaped relationship between on-site audits and banking fragility confirms the perception that the frequency of examinations holds the key. It seems that on-site audits have a negative effect on risk-taking when the number of audits exceeds a certain threshold. This happens either because banks may feel they have been placed in the spotlight by supervisors, which essentially increases the probability of being subject to enforcement actions (e.g., Berger and Davies, 1998; DeYoung et al., 2001), or because the market may become suspicious as a result of the intense supervisory scrutiny (e.g., Berger et al., 2000).

Other factors may account for the initial positive relation between on-site audits and risk. First, the market may become suspicious of a bank's excessive risk after the number of audits exceeds a certain threshold. Hence, until that point is reached, the latter may feel sheltered from market discipline. Second, on-site audits within a certain frequency threshold may be interpreted by banks as a sign of supervisory laxity or/and as an official approval of their risk strategy ("certification effect" of supervision). This may encourage their risk-taking incentives in search of yield, and may outweigh both stability considerations and the deterrent effects of enforcement.

Where the rest of the control variables are considered, our findings are close to expectations. A higher volume of liquid assets in bank portfolios reduces Z-scores, a result probably explained by the two mechanisms that have already been discussed above. First, banks that hold a high volume of liquid, low-yield assets are less profitable. Second, a moral hazard mechanism may prevail if liquidity requirements are in place. Furthermore, bank size is positively related to the Z-index. This shows that larger banks are more profitable, presumably due to economies of scale and/or market power.[12] In addition, revenue growth decreases solvency risk, while the impact of provisioning on this type of risk is found to be insignificant. As far as the macroeconomic variables are concerned, banks in countries with a high level of development (i.e., with high GDP per capita) are assigned a higher Z-index, while high inflation is associated with lower Z-scores. These results are intuitive considering that in developed and financially stable countries bank insolvency problems are less frequent and fewer resources are employed by banks to forecast the future levels of inflation.

The basic specifications are augmented in column (4) of Table IV by the regulatory variables. Our results seem to confirm the research discussed in Section 2, which implies a negative correlation between disclosure requirements (*market discipline*) and bank risk, while casting doubt on the effectiveness of capital regulation (*capital stringency*) as a disciplinary mechanism. This is not to say that capital adequacy requirements are redundant, but rather that transparency regulation should come at the forefront of regulators' and supervisors' agendas, as it constitutes the prerequisite layer of and supplement for effective banking supervision (of capital requirements) and market discipline (Barth et al., 2005; Flannery and Thakor, 2006; VanHoose, 2007).

[12] Of course this holds to the extent that bank size is positively correlated with bank market power.

Our finding that regulatory restrictions on banking activities tend to reduce risk-taking appears, on the one hand, to challenge the somewhat prevalent empirical view favoring the universal banking model (see the discussion in Section 3.5), but, on the other hand, seems to be in harmony with those worried opinions suspecting that the Glass-Steagall repeal should also be partially blamed for the current financial turmoil (Kuttner, 2007; Kaufman, 2009). In a recent study, Berger et al. (2010) find that placing restrictions on bank activities curtails bank risk. It is worth noting that the economic freedom variable in column (4) is positively linked to the Z-index. This implies that, when controlling for *activity restrictions*, increased economic freedom lowers insolvency risk, possibly due to increased flows from abroad and better diversification of bank risk.[13]

In the last three columns of Table IV we use three different measures of risk instead of the Z-index, namely *NPL*, $\sigma(ROA)$, and *RA*. Our main findings on the inverted U-shaped relationship between bank risk and audits and on the negative relationship between bank risk and sanctions remain practically unchanged. Concerning the impact of the control variables, three notable differences in the findings arise when *RA* is used as the dependent variable. First, provisions bear a positive and statistically significant coefficient, implying that higher levels of risky assets (lower levels of liquid assets) are associated with heavier

[13] Despite the fact that this is probably beyond the scope of the present analysis, we proceed a step further on this issue and examine whether the negative relationship between *activity restrictions* and bank risk holds regardless of the level of economic freedom of the countries in our sample. Therefore, we additionally estimate an equation that includes an interaction term between the variables *activity restrictions* and *economic freedom*. The results (with the Z-index as dependent variable) are included in the supplement to the paper and suggest that the higher the economic freedom in a country is, the less significant the impact of *activity restrictions* on bank risk. However, we leave it for future research to identify separately the two effects of *activity restrictions*, as set out in Section 3.5, and which one prevails in countries characterized by higher or lower economic freedom.

provisioning by banks. Second, higher concentration seems to lower the level of risky assets in bank portfolios, which may signify some form of strategic interaction between large banks in banking sectors that are highly concentrated. Put differently, it is possible that in banking sectors with a few large players, banks lower the level of risky assets and compensate their expected losses by increases in lending rates or in interest rate margins. Third, capital stringency appears for the first time to contain bank risk. In other words, higher capital stringency may not have a direct effect on solvency or credit risk, but it seems to affect the way banks manage the liquid vs. non-liquid assets in their portfolios. This is a finding similar to that of Berger et al. (2010).

4.3 SENSITIVITY ANALYSIS

In this section, we look into the robustness of the results. First, we consider whether on-site audits and sanctions have a heterogeneous impact on large banks *vis à vis* small banks. If audits and sanctions are primarily targeted at small or systemically unimportant banks, supervisory effectiveness may not be high, even if the number of sanctions and/or audits is elevated. To account for this possibility, we split the sample into small and large banks and we re-estimate Eq. (1). Large banks are those falling into the top 25% in terms of total bank assets in each banking system considered, and small banks are those in the lower 25% of the distribution. In this way, we are able to model the relatively important players within a single banking industry. We use this as a general rule of thumb because it is probably better to consider a uniform rule for all banking systems examined irrespective of the general size of banks within a banking industry. Column (1) of Table V shows the results for large banks, column (2) the results for small banks. Even though there are some changes in the influence of the control variables, the impact of audits and sanctions remains the same. This implies that banks, regardless of their size, perceive and internalize

supervisory enforcement actions and monitoring efforts in a uniform way. To go a step further, we consider whether the impact of audits and sanctions on bank risk differs for banks with a high market share (the results are included in the supplement to the paper). Again, no such heterogeneity seems to be present.

Second, instead of the GMM method, we use the panel data IV method with fixed effects in column (3) of Table V. This method does not account for the dynamics of risk, but is favored by the majority of the relevant literature (see e.g., Laeven and Levine, 2009). As discussed above, we exploit the change in the annual financial freedom index of the Heritage Foundation as instrument. The results and policy recommendations are very similar to those of the GMM estimates. The Sargan test is somewhat inferior due to the use of a better set of instruments (at least for the present panel) in the differenced equations under the Blundell and Bond (1998) method.

Third, for reasons highlighted in the data section, we employ measures of bank risk that focus on the changes in the riskiness of the bank. In particular, in columns (4) and (5) of Table V, we use the change of *NPL* and *RA* from the previous period as dependent variables and our main results are not affected. Therefore, we conclude that bank risk-taking behavior is short term, as changes in supervisory severity do alter changes in bank risk in the same way they alter the level of bank risk.

Fourth, in columns (6) and (7) of Table V, we explore the possibility that supervisory effectiveness has a different impact on bank risk in developed economies *versus* emerging and transition economies. In the latter group we include Bulgaria, the Czech Republic, Latvia, Romania, Russia, Serbia, Turkey, and Ukraine, which according to the World Bank are not high-income countries. The rest of the countries are considered developed (high-income countries). The estimated coefficients are somewhat less statistically significant, a result attributed to the lower number of available observations.

However, our main results carry through in both subsamples, and only *audits* seems not to have a statistically significant impact at the 5% level (statistically significant at the 10% level). Moreover, in column (8) we use information on enforcement actions that aim directly at enhancing the safety and soundness of banks, instead of the total number of sanctions used in the rest of the empirical analysis. This type of separation is available only for Australia, Luxembourg, and the United States, thus leaving us with 35 observations on *audits* and *sanctions*. Still, most of the main findings of the paper concerning supervisory effectiveness carry through. In this case, however, the findings on the regulatory variables are inferior, possibly because we are left with very few observations on these variables (these variables do not change drastically over time).

We conclude this section by using the second lags of the regulation variables instead of the first lags employed in the estimations so far (the results are reported in the supplement to this paper). We find that changes in the coefficients with respect to the specifications included in Table IV are negligible, while the same holds for the credit risk equation. This is probably due to the fact that there are only minor and gradual changes in the regulatory indices over time and that the length of the dynamics is not a crucial element in shaping bank risk.

5. The Combined Effect of Banking Supervision and Banking Regulations on Bank Risk

The products of *reg* with *audits* and *sanctions* in Eq. (2) are highly multicollinear with the levels of these variables and cannot be included simultaneously in the regressions. This is a common problem in studies that employ interaction terms and can be partially solved by "centering" the variables. Centering means computing the mean of each independent variable and then replacing each value with the difference between it and the

mean. After centering the variables, the correlation between the products and their levels falls below 0.50. Note that *activity restrictions* is not interacted with the enforcement variables, because we are investigating whether and to what extent the effectiveness of banking supervision (Pillar 2 of Basel II) in connection with two specific types of regulation constituting the other two pillars of Basel II (capital and disclosure regulation) has a bearing on banking stability.

5.1 MAIN RESULTS

Table VI reports the results obtained from the estimation of Eq. (2). Given the analysis of the previous section, we resort only to equations that include both the squared term of audits and the regulatory variables, and we only report the results obtained from the GMM method. Moreover, we only report estimates of Z-index and *NPL* regressions, as we did not find any changes in the results when using other measures of risk or changes in risk measures. Again, the Sargan test shows no over-identifying restrictions and the AR2 test no second-order autocorrelation.

The results in column (1) show that the relationship between effective supervision of disclosure requirements (i.e., the product of *market discipline* and either *audits* or *sanctions*) and bank risk is negative and statistically significant. The same holds for the results of the *NPL* regression, reported in column (3). This is in contrast to the combined effect of banking supervision and capital regulation (i.e., the product of *capital stringency* and either *audits* or *sanctions*), which appears insignificant. In addition, the direct impact of *market discipline* on bank risk is negative and significant, *capital stringency* remains insignificant (much like in Table IV), and the variables *audits* and *sanctions* have the same effect as that reported in Table IV. Thus, in addition to the individual, direct effect of

enforcement and *market discipline* on bank risk, there is also an amplifying combined effect of these variables.

The findings imply an exaggerated regulatory and supervisory interest with capital requirements *vis à vis* transparency regulation. By extension, our work appears to contradict the "conventional wisdom" – also reflected in Basel II – concerning the effectiveness of capital regulation as a risk-control device and seems to be in line with the latest voices that emerged subsequent to the sub-prime crisis placing increasing weight on the transparency requirements (e.g., Financial Stability Forum, 2008; IOSCO, 2008; Basel Committee, 2009; IMF, 2009). From this perspective, our research validates the criticism that Caprio et al. (2008, p. 36) leveled against Basel II for devoting just "16 pages to issues of market discipline and 225 pages to spelling out formulas and strategies impeded in pillar one and options for national discretion authorized in pillar two".

An interesting extension that may save the day for capital regulation would be to consider a measure of capital buffers as well as its triple interaction with *capital stringency* and the supervisory effectiveness variables. We measure capital buffers by the distance of the capital ratio from the minimum capital requirement of 8%, and we multiply this by -1 to check precisely whether *capital stringency* has a positive impact on those banks closer to the minimum requirement. Column (2) reports the results, showing that both capital buffers (simply named *capital* in this regression) and the triple interaction are positive and statistically significant. This finding is not counterintuitive, nor does it cancel out our main inference. On the contrary, it may well be interpreted as supportive of our arguments. Banks that are close to the minimum threshold of capital requirements are more likely to attract supervisory scrutiny and become subject to disciplinary measures; hence, they are under increased pressure to adopt a more prudent behavior. Once more, effective supervision seems to constitute a convincing counterbalance against banks' excessive risk-

taking. This theoretical explanation seems to be consistent with the point made by Berger et al. (2008) and Berger et al. (2010) who suggest that banks receiving comparably the worst supervisory safety and soundness ratings adjust towards their target capital ratios in a relatively slower fashion, probably because supervisory pressure impedes their access to capital markets and prevents them from raising new capital effectively. Essentially, therefore, as banks approximate the minimum regulatory capital standards they have increasingly stronger incentives to curtail their risk to avoid supervisory intervention.

The impact of the rest of the control variables is not altered compared with the results reported in Tables IV and V. Much like before, the impact of economic freedom is positive and statistically significant in the Z-index regressions and negative in the *NPL* one, while higher GDP per capita and lower inflation implies a less risky environment for banks. Finally, regarding the bank-level variables, high levels of liquid assets tend to lower profits and increase risk, whereas size enters with a positive and significant coefficient in the Z-index regressions (negative and significant coefficient in the *NPL* regression).

5.2 SENSITIVITY ANALYSIS

As in Section 4.3, we check the robustness of our main results by (i) estimating our model for large and small banks, (ii) using subsamples of developed and emerging countries, and (iii) using data on sanctions pertaining only to safety and soundness remedial measures. Similar to the results presented in Table V above, it seems that the sign and statistical significance of our main results remains unchanged. In particular, the coefficients on *audits* and *sanctions* are statistically significant when we only use large or small banks (see columns 4 and 5), while the impact of the interaction terms remains in line with the findings above. Moreover, using subsamples of developed and transition countries produces qualitatively similar results, even though the statistical significance slightly falls

owing to the reduced number of observations (see columns 6 and 7). The same holds for the regression of column (8), where we use data from Australia, Luxembourg, and the United States to examine the impact of only those sanctions that are directly related to safety and soundness on bank risk: once again the results remain practically unchanged. Overall, the results of the sensitivity analysis indicate that the impact of *audits* and *sanctions* and their combined effect with regulatory indicators are robust to various methodological changes.

6. Conclusions

In this paper, we distinguish between banking regulation (i.e., law-on-the-books) and supervision (i.e., actual implementation of law-on-the-books) and move on to assess their individual, stand-alone, and combined effects on bank risk. Furthermore, by emphasizing capital and transparency requirements, our work offers an empirical assessment of the effect that the interplay among the three Basel II pillars (i.e., Pillar 1: capital requirements, Pillar 2: effective supervision, Pillar 3: transparency/market discipline) has upon banking fragility. We measure supervisory effectiveness using a panel of cross-country data on enforcement outputs (i.e., on-site audits and enforcement actions), which allows us to analyze the relationship between regulation, supervision, and risk in a more direct manner.

We contend that our findings have specific implications for regulators and supervisors alike, especially in the aftermath of the current financial turmoil. First, it appears that enforcement actions do exert a disciplinary power upon banks, while the inverted U-shaped relationship between on-site audits and banking fragility indicates that intensifying the frequency of examinations beyond a certain threshold may also constrain bank risk. Second, we obtain evidence of a negative relationship between disclosure

requirements and bank risk, whereas no such finding is observed for the relationship between capital stringency and risk. We do find, however, that increased capital stringency lowers the risk for those banks operating close to the minimum acceptable level of capital adequacy. Again, the development of a credible threat of supervisory intervention appears to be the underlying, driving force behind the disciplinary effect of capital requirements.

All in all, it seems that effective supervision rather than the mere adoption of regulation holds the key in deterring excessive bank risk. Moreover, it appears that regulatory persistence with capital adequacy constraints is rather unwarranted and that the policy-making agenda should be re-oriented to place more weight on the effective implementation of disclosure requirements. Our proposal for more transparency regulation and market discipline coincides with the recent comment made by Caprio et al. (2008), who suggest that the fundamental goal of supervisors should be to ensure that risks are fully understood and fairly priced by investors. Finally, our finding that regulations placing restrictions on banking activities are negatively correlated with risk encourages the supporters of a Glass-Steagall-type regulation.

Our work may provide stimulus for further research in many respects. To begin with, obtaining more data on enforcement outputs would allow the classification of our results according to legal origins (i.e., common law, civil law, German-Scandinavian legal systems) and provide a more direct link and opportunity for interesting comparisons with the rest of the law and finance literature employing data from law-on-the-books or questionnaires. Moreover, it would be interesting to look into the data on enforcement outputs and discern the areas of regulations enjoying less compliance, as well as categorize the types of enforcement actions taken by supervisors (e.g., criminal versus administrative proceedings) and assess their effect on bank risk. Finally, it would be challenging to

combine data on on-site audits and sanctions to construct a new, overall indicator of supervisory effectiveness. We leave all these for future research.

Appendix: Variable definitions and data sources

Variable	Measurement	Source
Z-index	This is a proxy for overall bank risk (solvency risk) and it is measured as $Z=(ROA+EA)/\sigma(ROA)$, where *ROA* is the ratio of total profits before tax to total assets, *EA* is the ratio of equity capital to total assets and $\sigma(ROA)$ is the variance of *ROA*. To calculate σ(ROA) we use ROA_{t-1} and ROA_{t-2}.	Own calculations on the basis of Bankscope data.
NPL	This is a proxy for credit risk and it is measured by the ratio of problem loans to total loans.	Own calculations on the basis of Bankscope data.
σ(ROA)	This is a proxy for overall bank risk (solvency risk), where *ROA* is the ratio of total profits before tax to total assets. To calculate σ(ROA) we use ROA_{t-1} and ROA_{t-2}.	Own calculations on the basis of Bankscope data.
RA	This is a proxy for the riskiness of bank portfolios (in terms of credit and liquidity risk) and it is measured by the ratio of risky assets (all assets except cash, money in other bank accounts, money market mutual funds, and short-term securities) to total assets.	Own calculations on the basis of Bankscope data.
audits	This variable represents supervisory effectiveness and it is measured as the natural logarithm of the number of audits divided by the number of supervised banks.	Own calculations on the basis of supervisory authorities' annual reports.
sanctions	This variable represents supervisory effectiveness and it is measured as the natural logarithm of the number of sanctions imposed on banks divided by the number of supervised banks.	Own calculations on the basis of supervisory authorities' annual reports.
liquidity	This variable represents liquidity risk and it is measured as the ratio of liquid assets to total assets.	Own calculations on the basis of Bankscope data.
bank size	This variable is measured by the natural logarithm of real total assets.	Own calculations on the basis of Bankscope data.
capital	This variable represents capitalization and it is measured by the ratio of equity capital to total assets.	Own calculations on the basis of Bankscope data.
provisions	This variable represents the management of provisions and it is measured by the ratio of loan loss provisions to total loans.	Own calculations on the basis of Bankscope data.
revenue growth	This is a proxy for the growth of the bank and it is measured by the annual change in total bank revenue.	Own calculations on the basis of Bankscope data.
concentration	This variable is measured by the assets of three largest banks as a share of assets of all banks.	Own calculations on the basis of Bankscope data.
economic freedom	This is an index of overall economic freedom.	Heritage Foundation.
gdp per capita	This is a proxy for economic development and it is measured by real GDP per capita (in million $US).	World Development Indicators.
inflation	This is a proxy for the monetary conditions and it is measured by the annual inflation rate (in % terms of the consumer price index).	World Development Indicators.
capital stringency	This is an index of capital stringency. The variable is determined by adding 1 if the answer is yes to questions 1-6 and 0 otherwise, while the opposite occurs in the case of questions 7 and 8 (i.e., yes=0, no =1). (1) Is the minimum required capital asset ratio risk-weighted in line with Basle guidelines? (2) Does the ratio vary with market risk? (3-5) 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? (6) Are the sources of funds to be used as capital verified by the regulatory/supervisory authorities? (7) Can the initial or subsequent injections of capital be done with assets other than cash or government securities? (8) Can initial disbursement of capital be done with borrowed funds?	Barth et al. (2001, 2004, 2008) database.

Appendix (continued)

market discipline	This variable is determined by adding 1 if the answer is yes to questions 1-7 and 0 otherwise, while the opposite occurs in the case of questions 8 and 9 (i.e., yes=0, no =1). (1) Is subordinated debt allowable (or required) as part of capital? (2) Are financial institutions required to produce consolidated accounts covering all bank and any non-bank financial subsidiaries? (3) Are off-balance sheet items disclosed to public? (4) Must banks disclose their risk management procedures to public? (5) Are directors legally liable for erroneous/misleading information? (6) Do regulations require credit ratings for commercial banks? (7) Is an external audit by certified/licensed auditor a compulsory obligation for banks? (8) Does accrued, though unpaid interest/principal enter the income statement while loan is non-performing? (9) Is there an explicit deposit insurance protection system?	Barth et al. (2001, 2004, 2008) database.
activity restrictions	The score for this variable is determined on the basis of the level of regulatory restrictiveness for bank participation in: (1) securities activities (2) insurance activities (3) real estate activities (4) bank ownership of non-financial firms. These activities can be unrestricted, permitted, restricted or prohibited that are assigned the values of 1, 2, 3 or 4 respectively. We use an overall index by calculating the average value over the four categories.	Barth et al. (2001, 2004, 2008) database.

Notes on the database:

1. As far as EU countries are concerned, (i.e., Luxembourg, Germany, Czech Republic, Bulgaria, Romania, Portugal, Latvia, Spain, Greece), national definitions of the term "bank" comply with the description offered by the Directive 2006/48/EC, OJ L 177/1, Article 4: "Credit institution means: (a) an undertaking whose business is to receive deposits or other repayable funds from the public and to grant credits for its own account; or (b) an electronic money institution within the meaning of Directive 2000/46/EC".
2. "Unofficial" sanctions (e.g., in the form of Memorandum of Understandings, meetings with bank executives and recommendations) are not included in our dataset. Such actions are reported on a cumulative basis for US banks and in very few of the rest sample countries (e.g., Luxembourg and Bulgaria), but no further information is provided as to their content.
3. In column (8) of Table V we use information on enforcement actions concerning banks' safety and soundness. This type of separation is available only for Australia, Luxembourg and the United States. For Australia the relevant data is directly accessed from the annual reports of the competent authority (Australian Prudential Regulation Authority, APRA). APRA is specifically responsible for conducting the so-called prudential supervision, that is, monitoring the banking system to ensure its safety and soundness, hence the sanctions published in its annual reports correspond to breaches of safety and soundness regulation. For Luxembourg, banking supervision is assigned to the Commission de Surveillance du Secteur Financier (CSSF). The CSSF's annual reports encompasses quite detailed information on the types and reasons of supervisory intervention, thus allowing us to trace those sanctions that more directly aim at ensuring banks' safety and soundness. In the case of US, on the other hand, the compilation of data is based upon a one-to-one collection, elaboration and categorization of supervisory actions, as the latter are reported at the Fed and FDIC websites (see <http://www.federalreserve.gov/boarddocs/enforcement/search.cfm> for Fed, and <http://www.fdic.gov/bank/individual/enforcement/begsrch.html> for FDIC).
4. We clean Bankscope data in three ways. First, we use the 'rank' module in Bankscope (which ranks the banks within a country according to size) and then we drop non-ranked banks to avoid duplications. Second, we need to make sure that the duplication was not due to a merger event. If a bank was not ranked but had assets greater than the country average, its history of mergers and acquisitions was examined carefully. Next, the pre-merger banks were re-ranked to ensure that they were included in the dataset, and the post-merger banks were de-ranked to exclude them from the pre-merger period. Finally, as is standard in studies that use the Bankscope database (e.g., Claessens and Laeven, 2004), we employ an outlier rule to the main bank-level variables corresponding to the 1^{st} and 99^{th} percentiles of the distributions of the respective variables. This also deletes banks for which data on one of the main variables is not available.
5. All ratios used to construct the variables are left unchanged (i.e. they are not transformed in percentages). The levels of the variables are in million $US.

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Table I. Supervisory authorities and average on-site audits and sanctions per bank

The table lists the supervisory authorities of the countries included in our sample and reports the average number of audits and sanctions per bank during the sample period. The table also reports the average total number of supervised banks in each country per year during the sample period and the average actual number of banks per year used in this study.

Country	Supervisory authorities responsible for the conduct of banking supervision	Audits per bank	Sanctions per bank	Average no. of supervised banks	Average no. of banks in the sample	Time span of dataset	No. of observations
Australia	Australian Prudential Regulation Authority	0.83	0.07	257.4	200.7	1999-2008[a]	10
Bulgaria	Bulgarian National Bank	0.71	1.55	33.4	28.6	1998-2008	11
Czech Republic	Czech National Bank	0.28	0.33	43.2	33.8	1998-2008[b]	10
Germany	(a) Bundesaufsichtsamt für das Kreditwesen (b) Bundesanstalt für Finanzdienstleistungsaufsicht	0.14	0.02	2,696.6	2,092.4	1998-2008	11
Greece	Bank of Greece	3.52	0.42	61.8	44.0	2004-2007	4
Hong Kong	Hong Kong Monetary Authority	0.75	0.02	332.9	207.5	1998-2008	11
Korea	Financial Supervisory Service	9.86	4.06	59.0	50.2	2001-2008[c]	8
Latvia	Financial and Capital Market Commission	0.60	0.11	54.8	21.6	2001-2008[d]	8
Luxembourg	Commission de Surveillance du Secteur Financier	0.29	2.75	176.1	156.8	1999-2008	10
Portugal	Banco de Portugal	0.28	0.14	64.3	55.2	1998-2008	11
Romania	National Bank of Romania	1.32	1.97	40.5	33.8	1998-2008[e]	10
Russia	Central Bank of the Russian Federation	1.48	1.92	1,814.2	1,640.0	1998-2008	11
Serbia	(a) National Bank of Yugoslavia (b) National Bank of Serbia	0.60	0.66	41.4	37.2	2002-2008	7
Spain	Banco de Espaňa	1.57	0.05	357.8	295.0	1999-2008	10
Turkey	(a) Bankacilik Düzenleme ve Denetleme Kurumu (b) Banking Regulation and Supervision Agency	4.00	1.22	77.1	64.5	2002-2008	7
Ukraine	National Bank of Ukraine	3.41	1.01	189.0	145.1	2001-2008	8
USA	(a) Federal Deposit Insurance Corporation (b) Federal Reserve Board	0.70	0.03	13,531.0	6,028.6	1995-2008	14

[a] Data on audits is not available for the period 2006-2008.
[b] Data on sanctions is not available for the year 1998.
[c] Data on sanctions is not available for the period 2005-2008.
[d] Data on sanctions is not available for the period 2001-2002.
[e] No data is available for the year 2002.

Table II. Descriptive statistics
The table reports basic descriptive statistics for the variables used in the empirical analysis. The variables are defined in the Appendix.

Variable	No. of observations	Mean	Std. Dev.	Min.	Max.
Z-index	16,137	3.450	1.318	-1.260	9.813
NPL	21,381	0.029	0.048	0.004	0.409
audits	159	1.540	2.531	0.086	20.254
sanctions	155	0.850	1.226	0.000	5.533
liquidity	24,562	0.041	0.050	0.003	0.482
bank size	25,114	13.01	3.025	10.15	20.17
capital	24,612	0.090	0.071	-0.220	0.246
provisions	21,042	0.012	0.020	0.003	0.291
revenue growth	18,024	0.017	0.255	-0.518	2.090
concentration	190	0.569	0.368	0.181	0.984
economic freedom	180	65.14	11.65	37.20	90.60
gdp per capita	238	13,265.1	13,157.1	589.9	56,358.1
inflation	238	19.434	76.008	-3.959	1,058.4
capital stringency	190	5.279	1.265	2.000	8.000
market discipline	190	6.084	0.967	4.000	8.000
activity restrictions	190	2.212	0.524	1.250	3.250

Table III. Correlations between the explanatory variables

The table reports correlation coefficients between the independent variables used in the empirical analysis. The variables are defined in the Appendix.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. audits	1.000													
2. sanctions	0.485	1.000												
3. liquidity	-0.040	0.062	1.000											
4. bank size	-0.022	0.181	-0.138	1.000										
5. capital	0.011	0.028	0.135	0.099	1.000									
6. provisions	-0.036	-0.029	-0.055	0.070	-0.070	1.000								
7. revenue growth	0.074	0.107	0.082	0.030	0.132	-0.054	1.000							
8. concentration	0.080	0.040	0.018	0.008	0.109	-0.010	0.070	1.000						
9. economic freedom	-0.146	-0.249	-0.504	-0.072	-0.010	-0.007	0.042	0.161	1.000					
10. gdp per capita	-0.183	-0.030	-0.580	0.090	0.122	-0.043	0.030	0.114	0.555	1.000				
11. inflation	0.050	0.222	0.258	0.230	-0.040	0.070	-0.015	-0.070	-0.511	-0.413	1.000			
12. capital stringency	-0.306	-0.036	0.145	0.121	0.185	-0.045	-0.016	-0.058	-0.036	-0.001	-0.094	1.000		
13. market discipline	0.297	-0.046	-0.306	-0.110	-0.003	-0.038	-0.003	0.315	0.418	0.204	-0.321	-0.011	1.000	
14. activity restrictions	0.110	0.177	0.140	0.204	-0.040	0.095	-0.009	-0.209	-0.166	-0.179	0.163	-0.140	-0.090	1.000

Table IV. The direct effect of on-site audits and sanctions on bank risk (baseline regressions)
The table presents estimation results (coefficients and t-statistics in parentheses) on the relationship between bank risk and on-site audits and sanctions. Estimation method is OLS (with bank fixed effects) for equation 1, and dynamic panel GMM for the rest of the equations. The table also reports the R-squared and Fixed effects (p-value) tests for equation 1, as well as p-values of the Wald test for the joint significance of the coefficients, the tests for first (AR1) and second (AR2) order autocorrelation and the Sargan test for overidentifying restrictions. *, ** and *** denote significance at the 10, 5 and 1 per cent, respectively. The variables are defined in the Appendix.

Equation	1	2	3	4	5	6	7
Dependent variable	Z-index	Z-index	Z-index	Z-index	NPL	σ(ROA)	RA
lagged dependent		0.361***	0.366***	0.348***	0.428***	0.312***	0.802***
		(7.12)	(7.25)	(6.94)	(7.67)	(5.21)	(13.80)
audits	-0.312*	-0.115	-0.382**	-0.370**	1.064***	0.612***	0.780**
	(-1.80)	(-0.72)	(-2.33)	(-2.24)	(4.13)	(3.10)	(2.41)
sanctions	1.755**	1.792**	1.861***	1.856***	-1.205**	-0.955***	-1.122**
	(2.18)	(2.55)	(3.03)	(2.96)	(-2.34)	(-2.74)	(-2.45)
audits squared			0.083**	0.087**	-0.217***	-0.169***	-0.123**
			(2.17)	(2.22)	(-2.70)	(-2.99)	(-2.09)
liquidity	-0.037	-0.069**	-0.070**	-0.075**	0.088***	0.043**	
	(-1.58)	(-2.35)	(-2.37)	(-2.42)	(2.88)	(2.15)	
bank size	0.092**	0.099***	0.116***	0.088***	-0.036*	-0.014	-0.020***
	(2.42)	(2.90)	(3.14)	(2.84)	(-1.76)	(-0.96)	(-4.05)
capital					0.049**	0.035***	-0.007
					(2.22)	(2.89)	(-0.64)
provisions	-0.052	-0.061	-0.060	-0.065	0.047	0.075	0.004**
	(-1.38)	(-1.50)	(-1.50)	(-1.57)	(0.67)	(1.19)	(2.61)
revenue growth	0.020*	0.034**	0.038**	0.040**	-0.080*	-0.111***	0.006
	(1.77)	(2.10)	(2.15)	(2.18)	(-1.81)	(-4.06)	(0.04)
concentration	-0.080	-0.470	-0.528	-0.540	0.009	-0.146	-0.303***
	(-0.14)	(-0.95)	(-1.16)	(-1.19)	(0.15)	(-1.02)	(-4.02)
economic freedom	0.018	0.029	0.033	0.056**	-0.190**	-0.174**	-0.220***
	(0.67)	(1.12)	(1.18)	(2.20)	(-2.37)	(-2.09)	(-2.71)
gdp per capita	2.618**	3.095***	3.150***	3.006***	-5.004***	-3.458***	-3.004***
	(2.47)	(3.22)	(3.36)	(3.11)	(-6.12)	(-3.30)	(-2.82)
inflation	-0.020	-0.051**	-0.048**	-0.048**	0.110***	0.086**	-0.008***
	(-1.62)	(-2.20)	(-2.16)	(-2.17)	(3.01)	(2.11)	(-6.94)
capital stringency				0.200	0.108	0.029	-0.674***
				(0.79)	(0.45)	(0.43)	(-4.93)
market discipline				0.512**	-0.644**	-0.916***	-0.834***
				(2.09)	(-2.22)	(-2.70)	(-3.97)
activity restrictions				0.915***	-2.600***	-0.940**	-4.267***
				(3.62)	(-3.15)	(-2.60)	(-5.30)
No. of observations	32,137	30,113	30,113	30,113	37,385	30,113	39,889
R-squared	0.321						
Fixed effects	0.000						
Wald-test		0.000	0.000	0.000	0.000	0.000	0.000
AR1		0.112	0.103	0.094	0.078	0.103	0.141
AR2		0.022	0.034	0.020	0.016	0.010	0.029
Sargan		0.424	0.406	0.400	0.328	0.581	0.140

Table V. The direct effect of on-site audits and sanctions on bank risk (sensitivity analysis)
The table presents estimation results (coefficients and t-statistics in parentheses) on the relationship between bank risk and on-site audits and sanctions. Estimation method is dynamic panel GMM, except from equation 3 for which it is panel data instrumental variables with bank fixed effects. The table also reports p-values of the Wald test for the joint significance of the coefficients, the tests for first (AR1) and second (AR2) order autocorrelation and the Sargan test for overidentifying restrictions. *, ** and *** denote significance at the 10, 5 and 1 per cent, respectively. The variables are defined in the Appendix. Δ in front of NPL and RA (dependent variables in regressions 4 and 5, respectively) reflects change over the previous period and all explanatory variables in these specifications are also taken as changes.

Equation	1	2	3	4	5	6	7	8
Dependent variable	Z-index	Z-index	Z-index	ΔNPL	ΔRA	Z-index	Z-index	Z-index
Specification	Large banks	Small banks	Full sample	Full sample	Full sample	Developed countries	Emerging countries	Safety and soundness
lagged dependent	0.269***	0.351***		0.377***	0.649***	0.277***	0.338***	0.265***
	(4.13)	(6.57)		(4.08)	(8.82)	(4.16)	(5.12)	(3.90)
audits	-0.391**	-0.353**	-0.378**	0.295**	0.819**	-0.385**	-0.290*	-0.341**
	(-2.42)	(-2.10)	(-2.18)	(2.38)	(2.50)	(-2.40)	(-1.91)	(-2.04)
sanctions	1.901***	1.877***	1.762**	-0.933**	-0.993**	1.545**	1.717***	1.402**
	(3.40)	(3.10)	(2.26)	(-2.16)	(-2.08)	(2.55)	(2.70)	(2.12)
audits squared	0.090**	0.085**	0.077**	-0.139**	-0.208***	0.071**	0.084**	0.073**
	(2.27)	(2.20)	(2.09)	(-2.38)	(-2.82)	(1.98)	(2.19)	(2.04)
liquidity	-0.059**	-0.048*	-0.044*	0.073**		-0.061**	-0.045	-0.055**
	(-2.12)	(-1.71)	(-1.69)	(2.40)		(-2.16)	(-1.64)	(-2.03)
bank size			0.081**	-0.048**	-0.035***	0.080**	0.092**	0.071**
			(2.33)	(-1.99)	(-5.21)	(2.30)	(2.40)	(2.03)
capital				0.062**	0.155***			
				(2.55)	(5.33)			
provisions	-0.043	-0.030	-0.045	0.006	0.003*	-0.060	-0.084*	-0.055
	(-1.03)	(-0.89)	(-1.30)	(0.07)	(1.95)	(-1.48)	(-1.71)	(-1.43)
revenue growth	0.051**	0.030**	0.024*	-0.046	0.002	0.038**	0.068***	0.031**
	(2.33)	(1.97)	(1.84)	(-0.92)	(0.00)	(2.14)	(2.70)	(1.98)
concentration	0.027	-0.363	0.003	0.037	0.034	-0.039	0.628	0.006
	(0.03)	(-0.84)	(0.00)	(0.48)	(1.39)	(-0.18)	(1.25)	(0.02)
economic freedom	0.065**	0.013	0.016	-0.204*	-0.188**	0.044*	0.063**	0.031
	(2.39)	(0.50)	(0.60)	(-1.85)	(-2.30)	(1.81)	(2.35)	(1.56)
gdp per capita	2.748***	2.055**	2.610**	-4.002***	-2.975***	2.657**	2.422**	2.506**
	(2.63)	(2.16)	(2.30)	(-4.02)	(-2.88)	(2.55)	(2.30)	(2.44)
inflation	-0.023	-0.058**	-0.032*	0.231***	-0.006***	-0.021	-0.050**	-0.019
	(-1.65)	(-2.30)	(-1.79)	(4.85)	(-4.41)	(-1.62)	(-2.18)	(-1.57)
capital stringency	0.228	0.274	0.195	0.203	-0.622***	0.250	0.125	0.223
	(0.91)	(1.29)	(0.66)	(1.21)	(-3.83)	(1.02)	(0.40)	(0.88)
market discipline	0.598**	0.296	0.494**	-0.707**	-0.821***	0.507**	0.628**	0.463*
	(2.57)	(1.20)	(1.96)	(-2.18)	(-3.45)	(2.05)	(2.51)	(1.78)
activity restrictions	0.802***	0.650*	0.910***	-2.518***	-4.104***	0.846***	0.981***	0.678*
	(2.91)	(1.91)	(3.40)	(-2.99)	(-4.99)	(3.10)	(4.04)	(1.94)
No. of observations	7,528	7,528	32,137	33,042	35,610	24,692	5,421	17,164
R-squared			0.291					
Fixed effects			0.000					
Wald-test	0.000	0.000		0.000	0.000	0.000	0.000	0.002
AR1	0.196	0.069		0.120	0.092	0.102	0.095	0.081
AR2	0.025	0.041		0.036	0.025	0.027	0.040	0.040
Sargan	0.417	0.603	0.133	0.280	0.310	0.452	0.510	0.388

Table VI. The combined effect of regulation and enforcement on bank risk

The table presents estimation results (coefficients and t-statistics in parentheses) on the combined effect of regulation and enforcement on bank risk. Estimation method is dynamic panel GMM. The table also reports p-values of the Wald test for the joint significance of the coefficients, the tests for first (AR1) and second (AR2) order autocorrelation and the Sargan test for overidentifying restrictions. *, ** and *** denote significance at the 10, 5 and 1 per cent, respectively. The variables are defined in the Appendix. In equation 2 the variable capital is replaced by a measure of capital buffers (i.e., distance of the capital ratio from minimum capital requirement), and the interaction terms with audits and sanctions are replaced with the product of capital buffers with audits or sanctions and capital stringency.

Equation	1	2	3	4	5	6	7	8
Dependent variable	Z-index	Z-index	NPL	Z-index	Z-index	Z-index	Z-index	Z-index
Specification	Full sample	Capital buffers	Full sample	Large banks	Small banks	Developed countries	Emerging countries	Safety and soundness
lagged dependent	0.330***	0.344***	0.417***	0.281***	0.342***	0.303***	0.397***	0.267***
	(6.25)	(6.98)	(9.90)	(4.33)	(7.01)	(5.74)	(6.92)	(4.04)
audits	-0.392**	-0.345**	3.301***	-0.379**	-0.348**	-0.366**	-0.272*	-0.313**
	(-2.50)	(-2.05)	(2.86)	(-2.36)	(-2.04)	(-2.21)	(-1.83)	(-1.98)
sanctions	1.874***	1.846***	-0.817**	1.943***	1.855***	1.616***	1.803***	1.592***
	(3.01)	(2.93)	(-2.35)	(3.67)	(2.98)	(2.80)	(3.14)	(2.71)
audits squared	0.106**	0.079**	-0.044***	0.081**	0.079**	0.083**	0.086**	0.075**
	(2.65)	(1.99)	(-3.16)	(2.05)	(1.99)	(2.06)	(2.10)	(1.97)
liquidity	-0.067**	-0.061**	0.063**	-0.061**	-0.051*	-0.056**	-0.041	-0.051*
	(-2.44)	(-1.98)	(2.38)	(-2.18)	(-1.72)	(-2.04)	(-1.59)	(-1.88)
bank size	0.097***	0.096***	-0.031			0.077**	0.092**	0.070**
	(3.10)	(3.07)	(-1.62)			(2.20)	(2.36)	(1.99)
capital		0.083***	0.046**					
		(3.03)	(2.17)					
provisions	-0.04	-0.029	0.063	-0.046	-0.023	-0.058	-0.080*	-0.053
	(-1.12)	(-0.88)	(0.97)	(-1.35)	(-0.80)	(-1.44)	(-1.68)	(-1.40)
revenue growth	0.033**	0 .046**	-0.090**	0.041**	0.048**	0.032**	0.065**	0.030**
	(2.09)	(2.53)	(-1.94)	(2.36)	(2.55)	(2.03)	(2.61)	(1.97)
concentration	-0.38	-0.517	-0.006	0.148	-0.511	-0.012	0.701	0.002
	(-0.66)	(-1.27)	(-0.04)	(0.25)	(-1.24)	(-0.18)	(1.49)	(0.01)
economic freedom	0.071***	0.068**	-0.221**	0.070**	0.011	0.046*	0.060**	0.03
	(2.71)	(2.62)	(-2.65)	(2.45)	(0.64)	(1.82)	(2.32)	(1.55)
gdp per capita	3.014***	3.027***	-5.116***	3.040***	2.027**	2.650**	2.427**	2.518**
	(3.09)	(3.16)	(-6.45)	(3.46)	(2.06)	(2.50)	(2.28)	(2.38)

Table VI. (Continued)

inflation	-0.044**	-0.045**	0.173***	-0.025	-0.047**	-0.030*	-0.052**	-0.018
	(-2.03)	(-2.06)	(5.22)	(-1.52)	(-2.06)	(-1.69)	(-2.19)	(-1.41)
capital stringency	0.223	0.244	-0.11	0.199	0.241	0.214	0.129	0.231
	(0.81)	(1.22)	(-0.67)	(0.78)	(1.12)	(0.77)	(0.43)	(0.90)
market discipline	0.644**	0.650**	-0.797**	0.503**	0.349	0.522**	0.620**	0.451*
	(2.37)	(2.42)	(-2.44)	(2.05)	(1.65)	(2.10)	(2.47)	(1.83)
activity restrictions	0.918**	0.910**	-2.569***	0.932***	0.647*	0.851***	0.955***	0.691**
	(2.49)	(2.42)	(-3.18)	(3.73)	(1.90)	(3.14)	(3.82)	(1.99)
audits*capital stringency	0.039	0.649**	-0.156	-0.026	0.045	0.03	0.05	0.01
	(0.23)	(2.25)	(-1.33)	(-0.17)	(0.25)	(0.18)	(0.28)	(0.08)
audits*market discipline	0.820*	0.803*	-0.399***	0.943**	0.803*	0.982**	0.714	0.848**
	(1.90)	(1.86)	(-3.01)	(2.18)	(1.86)	(2.16)	(1.61)	(1.97)
sanctions*capital stringency	0.347	0.982***	-0.317	0.302	0.36	0.218	0.403	0.203
	(0.89)	(2.97)	(-0.92)	(0.69)	(0.97)	(0.66)	(1.11)	(0.61)
sanctions*market discipline	1.010***	0.947***	-1.888***	1.147***	0.947***	0.905***	1.148***	0.862**
	(3.11)	(2.95)	(-3.69)	(3.39)	(2.95)	(2.78)	(3.36)	(2.56)
No. of observations	30,113	30,113	37,385	7,528	7,528	24,692	5,421	17,164
Wald-test	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.001
AR1	0.087	0.069	0.106	0.049	0.069	0.082	0.086	0.049
AR2	0.025	0.045	0.035	0.009	0.145	0.023	0.040	0.020
Sargan	0.562	0.504	0.702	0.602	0.587	0.302	0.284	0.333