

Yiwei Fang – Iftekhar Hasan – Katherin Marton

**Market reforms, legal changes and
bank risk-taking – evidence from
transition economies**



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The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Bank of Finland.

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Abstract

The policy changes and structural reforms in transition economies over the past two decades have created exogenous variations in institutional development, which offers us an ideal natural experiment to analyse the causal effects of institutions on bank risk-taking behaviour. This paper examines a wide array of institutional reforms in respect of law and legal institutions, banking liberalization, and enterprise restructuring in privatization and corporate governance. Using a difference-in-difference approach, we find that banks' financial stability has increased substantially subsequent to the institutional reforms. Further analysis suggests that the enhancement of financial stability mostly comes from the reduction of asset risk. Moreover, the effects of institutional reforms on bank risk are more pronounced for domestic banks than foreign banks. From the policy consideration, our study sheds light on the risk implications of different institutional reforms that have been characterizing transition countries.

Keywords: institutional development, bank risk, transition banking, foreign ownership

JEL classification numbers: G21, P30, P34, P52

Markkinoiden institutionaalisten rakenneuudistusten ja lainsäädäntömuutosten vaikutukset pankkien riskinottoon siirtymätalouksissa

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Yiwei Fang – Iftekhar Hasan – Katherin Marton
Rahapolitiikka- ja tutkimusosasto

Tiivistelmä

Siirtymätalouksissa viimeisten parin vuosikymmenen aikana toteutettujen rakenneuudistusten ja harjoitetun politiikan linjamuutosten ansiosta näiden maiden institutionaalinen kehitys tarjoaa ihanteelliset luonnonmukaiset testiolosuhteet, joiden avulla voidaan tutkia instituutioiden kausaalisia vaikutuksia pankkien riskinottoon. Tässä työssä institutionaalisia uudistuksia tarkastellaan usean indikaattorin avulla. Nämä indikaattorit liittyvät lainsäädännön ja oikeusjärjestelmän muutoksiin, pankkitoiminnan vapauttamiseen, yritystoiminnan rakennejärjestelyihin ja yritysten hallinta- ja valvontajärjestelmien muutoksiin. Tutkimuksessa käytetty estimointimenetelmä soveltuu hyvin erojen tunnistamiseen. Tulosten mukaan pankkien taloudellinen vakaumus on lisääntynyt merkittävästi tehtyjen institutionaalisten uudistusten jälkeen. Lisätarkastelut viittaavat siihen, että pankkien vakaampi talous on ennen kaikkea seurausta pankkien varoihin kohdistuvien riskien pienentymisestä. Institutionaaliset uudistukset vaikuttavat lisäksi voimakkaammin kotimaisten kuin ulkomaisten pankkien riskinottoon. Pankkien sääntelyn ja valvonnan kannalta tutkimus korostaa erilaisten kehittyvissä talouksissa toteutettujen institutionaalisten uudistusten vaikutuksia pankkien riskinottoon.

Avainsanat: institutionaalinen kehitys, pankkien riskit, siirtymäajan pankkitoiminta, ulkomaalaisomistus

JEL-luokittelu: G21, P30, P34, P52

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1 Introduction

A growing literature pioneered by La Porta, Lopez-de-Silanes, and Vishny (1998, 1999) has demonstrated the important connections between legal institutions and finance. In particular, this line of research suggests that efficient legal systems and stronger investor protections can empower investors to enforce their contracts, and therefore better institutions are positively correlated with external financing and economic development (Levine, 1998, 1999; Djankov, McLiesh, and Shleifer, 2007; Haselmann, Pistor, and Vig, 2010). A number of more recent papers bring these important insights into the examination of firm risk. For example, John, Litov, and Yeung (2008) show that strong shareholder protections could encourage managers to undertake riskier but value-enhancing projects. Acharya, Amihud, and Litov (2009) find that strong creditor rights could lead to risk reduction through value-decreasing acquisition. Focusing on banking institutions, Laeven and Levine (2009) emphasize the important role of governance structure in shaping bank risk. They find that strong shareholder power and cash flow rights are associated with greater risk-taking behavior. Importantly, the effects of national regulation on bank risk may also depend on the governance structure of the banks. Houston, Lin, Lin and Ma (2010) investigate the links between creditor rights and bank risk. Their findings further suggest that a stronger credit right environment also induces banks taking more risk.

Noticeably, these studies are mainly focused on market economies, where institutional development began long time ago and the quality of the institutions has hardly changed over the recent years. Little attention by far has been paid to institutional reforms, especially how substantial changes in institutional environment could get transmitted to the banking sectors and influence bank risk-taking behavior. The limited research is somewhat surprising given that many developing countries have undertaken considerable institutional reforms over the last two decades. Moreover, since banking soundness is vital to economic stability and long-term growth (Allen and Gale, 2004; Levine, 2005), it is essential to examine the risk implications of institution reforms from a policy perspective. We therefore attempt to fill this gap.

In this paper, we propose a natural experiment to empirically analyze the causal effects of institutional reforms on banks' risk-taking behavior. The experiment exploits the considerable variations in the timing and depth of institutional reforms in the Eastern European transition economies caused by their transition processes from socialist central planning to market-oriented systems. We believe this to be an ideal natural experiment for the following reasons. First, their social and economic background offers us the unique opportunity to observe institutional development from the initial situation when market-oriented institutions were totally absent. We therefore can have a clean natural experiment

to test how substantial changes of institutional set-up affect bank risk. Second, policy changes and institutional reforms are exogenous shocks to the institutional development. This allows us to overcome the endogenous nature of institutional variables and explore the causal relationships between institutions and bank risk. Third, as suggested by Haselmann, Pistor, and Vig (2010), transition countries are a fairly homogeneous group in terms of economic conditions and social background; there is considerable inter-temporal variation in the timing and depth of institutional reforms; and they are all bank-based economies. These features make them an excellent sample to study how institutional changes affect bank risk.

We assemble a dataset comprising various individual bank characteristics and time series information of institutional reforms for 15 Eastern European transition countries during 1997 to 2008. To explore in detail the channels through which institutional changes impact bank risk, we examine different types of reforms in law and legal institutions, banking sectors, as well as enterprise sectors. Using a difference-in-difference methodology (DID hereafter), we find strong evidence that individual banks' financial stability increase dramatically subsequent to the institutional reforms. Notably, 1% improvement of legal reforms could lead to 1.3% increase in bank stability (measured by Z-score). This finding suggests that the establishment a well-functioning legal system is greatly needed in transition economies to produce a stable banking sector. Our examination on banking liberalization also obtains striking result. In particular, an improvement of banking reforms by 1% could lead to an increase in bank stability by 2.2%. Notice that the major projects of banking reforms include decentralizing central banks' commercial banking activities, privatizing state banks, liberalizing credit allocation, and establishing prudential regulation and supervision. Hence, our finding supports the bright side of banking deregulation, which argues that banks could better explore economies of scope and scale and thereby create more stable revenue (Claessens and Klingebiel, 2000). Restrictive regulations, on the other hand, may undermine bank stability (Barth, Caprio, and Levine, 2001; 2004; Gonzalez, 2005). The third type of institutional reform is enterprise restructuring, which primarily consists of the privatization of state-owned firms and the implementation of modern corporate governance. Our finding shows that enterprise reform has the largest impact on bank risk, that is, 1% improvement of enterprise reform is associated with 5.5% increases of bank stability. This result highlights the key role of privatization and corporate governance in reducing risk of financial sector. Lastly, to explore fully the role of institutional reforms on different types of banks, we investigate the impact of institutional reforms on foreign banks versus domestic banks. Our findings suggest that the improvement of institutional environment seems benefit domestic banks more than foreign banks. We consider various bank characteristics, country characteristics, and a variety of measures of bank risk. These conclusions are extremely robust.

This paper contributes to the literature in the following ways. Firstly, we add to the law and finance literature by demonstrating the significant effects of institutional reforms on bank risk. Institutional reforms are critical steps that influence the entire course of institutional development. However, little attention has been paid to such extraordinary events and their impacts on the risk-taking behavior of firms. We believe that a thorough and good understanding of this issue could provide new insights on the dynamics of how institutions affect bank risk, eg how substantial changes in institutional settings could get transmitted to the banking sectors and affect banks' risk-taking behavior. In our paper, we show that, far from having a neutral effect, institutional reforms in respect of legal, banking, and enterprise sector all have a profound influence on the bank risk. Subsequent to the improvement of the institutional environment, bank financial stability increases substantially. Secondly, the institutional variables used in the prior studies have largely suffered from the fact that they hardly change over time, and because of that, many studies rely on a cross-country set-up to capture the differences in legal institutions. However, this approach may cause the omitted variable problem because many country characteristics are unobservable. Our research design exploits the exogenous variations of institutional development. Using a DID approach, we derive a direct and clean test on the causal nexus between institutions and bank risk-taking behavior. Thirdly, our research contributes to the transition banking literature. Although there have been extensive studies examining the performance of banks in transition economies (eg Weill, 2003; Bonin, Hasan, and Wachtel, 2005a, 2005b, 2009), knowledge is still scant with regards to their risk-taking behavior and how the institutional environment influences it. A notable exception is Haselmann and Wachtel (2007), who analyze the risk management activities of banks during transition process. However, their results indicate that there are no significant connections between risk taking and the quality of legal institution, though capital ratio is found to be higher in unsound legal environment. Our paper takes a more comprehensive approach to understand various channels through which institutional environment could influence the risky behavior of banks. Instead of examining law and legal institutions only, we also investigate institutional development in the banking sector as well as enterprise sector. In this respect, our findings complement previous work that tells us how law affects bank lending in transition economies (Pistor, 2000; Pistor, Raiser, and Gelfer, 2000; Haselmann and Wachtel, 2010; Haselmann, Pistor, and Vig, 2010; Pistor, Raiser, and Gelfer, 2010).

The rest of the paper is organized as follows. In Section 2, we introduce various institutional reforms, review the relevant literature, and then propose our hypotheses. Section 3 describes the sample selection and methodology. Section 4 presents the analysis of the empirical results, and Section 5 discusses policy implications and concludes.

2 Institutional reforms in transition economies and bank risk

2.1 Banking liberalization

The banking sectors of transition economies have progressed remarkably in the past twenty years. Under a centrally planned economy, commercial banks only served one industry and their lending activities were entirely decided by the central banks based on the government budget plans. Banks therefore faced no pressure of competition and had little incentive to monitor firms. This situation has changed dramatically since banking reforms started. To make the transformation from socialist to market-oriented banking sectors, governments implemented numerous policies to liberalize interest rates and decentralize central banks' commercial banking activities to state banks. To foster a competitive banking industry, many originally state-owned banks were privatized into private hands with a large involvement of foreign banks. In the recent years, greater efforts have been given to the establishment of prudential regulation and supervision guidelines. Significant progress towards the implementation of the core principles of Basle Committee has been made.

In the literature, the relation between bank regulation and risk taking is ambiguous. Under the traditional view, bank deregulation is likely to foster a competitive market and the increased competition would further encourage greater bank risk-taking and induce intensified moral hazard problem (Keeley, 1990; Grossman, 1992; Galloway, Lee, and Roden, 1997; Boyd, Chang, and Smith, 1998). Consistent with these findings, Dick finds higher loan loss provisions following the Riegle-Neal Act deregulation in the 1990s in US (Dick, 2006). An alternative argument by Claessens and Klingebiel (2000), however, says that if banks are given greater freedom, they could have more ability to pursue economies of scale and scope and diversify income flows. Recent studies by Barth, Capiro, and Levine (2001, 2004) and Laeven and Levine (2009) provide supporting evidence to this view that countries with restrictive regulations on securities underwriting, brokering, and mutual fund business tend to have more fragile financial systems. Similarly, Hellmann, Murdock, and Stiglitz (2000) and Gonzalez (2005) show that regulatory restrictions reduce banks' charter value and consequently increase their incentive to take on risky projects.

Prior studies on regulation and risk taking are primarily focused on market-oriented countries and many transition economies are left out of the sample. A recent paper by Brissimis, Delis, and Papanikolaou (2008) analyzes the effect of banking reforms on efficiency. They show that banking reforms, through increased competition and greater risk taking, lead to an increase in banking

efficiency. Bank risk in their paper is considered as a determinant of efficiency performance. In our paper, we directly test the impact of banking reforms on bank risk. Drawing on prior studies, if the competition effect resulted from banking liberalization dominates the banking market, we would expect to find that banks might take more risky projects in order to compete with others. Moreover, intensified moral hazard problem might further undermine the financial stability of the banking sector. These considerations would translate into an increased level of bank risk subsequent to banking reforms. On the other hand, if deregulation of bank activities actually gives banks more freedom to pursue economies of scope and scale, one would find bank risk to decrease. In addition, with the involvement of experienced foreign banks, risk management skills may also spill over to the other banks in the market. These arguments, then, would lead to a positive relationship between banking liberalization and bank stability.

2.2 Enterprise reforms

State ownership and weak corporate control have been main factors explaining the poor performance of enterprises in transition economies (Kornai, 1992; Stiglitz, 1999). The concept of financial discipline and accountability was absent from socialist firms. Enterprises did not have to worry about raising external finance as government provided what they needed based on the budget plans. At the early stage of the transition process, firms tended to follow the old socialist style and had little incentive to repay their debt (Perotti, 1993). And the problem of bad loans still persisted in many banks in transition economies (Kager, 2002). To promote corporate governance effectively, governments in transition economies have implemented numerous reforms in recent years. These reforms include the privatization of state-owned firms, tighter credit and subsidy policies vis-à-vis enterprises, the enforcement of bankruptcy legislation, actions that foster competition and market discipline, the strengthening of financial discipline, and the hardening of budget constraints. The ultimate goal of these reforms is to foster market-driven restructuring and improve corporate control via financial institutions and markets.

It is very intuitive that the fragility of the banking sector is closely related to the performance of enterprise sector, as corporate loans constitute a large proportion of banks' income. In transition countries, this connection should be more pronounced given that non-performing loans have been at the root of the commercial banks' trouble since the central planning economy (Perotti, 1993). Pistor (2000) argues that a good corporate governance structure could give a firm easier access to capital, as investors are less hesitant to lend money or buy shares in a corporation that subscribes to good corporate governance principles. When

substantial corporate governance reforms have not been taken and the newly emerged private ownership structure does not match investor protection, firms would suffer from external financing. Banks, as major credit providers to enterprises, might either hesitate to lend or not be able to retrieve their money, suffering from large income volatility. Therefore, we expect that a higher level of progress in enterprise reforms is associated with enhanced bank stability.

2.3 Legal reforms

In the early stage of transition, legal systems of transition countries were all well below the world average (Pistor, 2000). In the absence of the sanction of financial discipline and creditor rights, banks hesitated to lend money to a firm (Pistor, Raiser, and Gelfer, 2000). In order to create an investor-friendly, transparent and predictable legal environment, governments in transition economies initiate projects modifying laws and improving the efficiency of judicial systems. The legal reforms were driven by the desire to attract foreign investment during the early stage of transition (EBRD 1995, 1996). In the later years, the main objective was to catch up with international standards and to create a functional legal regime for an insolvency legal regime in a given practical situation (EBRD, 2003; 2004).

The law and finance literature has long recognized the importance of legal system in promoting the overall level of financing (La Porta, Lopez-de-Silanes, and Vishny, 1998; 1999; Levine, 1998; 1999; Djankov, McLiesh, and Shleifer, 2007; Haselmann, Pistor, and Vig, 2010). The suggested mechanism through which stronger creditor rights enhance lending volume is by empowering lenders to secure their loans and enforce their rights in bankruptcy procedures and collateral recovery. According to this rationale, we might expect that, all else equal, banks should be more likely to grab collateral, force repayment, and control the insolvent debtors in a stronger legal environment. This would lead to higher financial stability. Moreover, if banks are granted higher power, they could put on more restrictions and play a better role in monitoring firms. Clearly, this would also help reduce borrowers' default risk and enhance bank financial stability. However, an alternative hypothesis could be that stronger legal protection could foster the confidence of banks to lend to risky enterprises with poorer credit ratings. Supporting this point of view, Houston, Lin, Lin and Ma (2010) find that stronger creditor rights are correlated with higher bank risk taking. Moreover, the likelihood of financial crisis also increases in a better creditor right environment.

3 Data and methodology

3.1 Bank variables and country-level macro controls

Our sample consists of 434 banks in fifteen Eastern European countries (Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Montenegro, Poland, Romania, Serbia, Slovakia, and Slovenia) over the period from 1997 to 2008. Bank level accounting information is obtained from the BankScope database of Bureau van Dijk. It is a widely used database in banking studies, but the preliminary data for transition countries require careful editing (Bonin, Hasan, and Wachtel, 2005a). We make a careful examination of multiple entries for the same bank because they are not completely duplicated observations. First of all, we choose the unconsolidated financial reports of commercial banks since this gives the financial data for the bank rather than the holding company. Then we check the accounting standards. International Accounting Standards (IAS) data are used wherever available; otherwise, inflation-adjusted local accounting standards data are used. All accounting variables are inflation adjusted and reported in thousand USD.

The data for bank ownership is also drawn from BankScope. Since banks of transition countries changed ownership several times over the past two decades, it is important to have yearly ownership data so that all the ownership changes in our sample period are identified (Haas and Van Lelyveld, 2006). A limitation of BankScope is, however, that it only provides shareholder information for the year when the database was last updated. Therefore, we take separate editions of the database (1999, 2001, 2003, 2005 and 2007) and fill in the years in between with the previous year if data are available. We also go back to 1997 using the same ownership as 1999. To achieve higher accuracy we search manually bank homepages and business publications as a double check. Through this process we identify shareholder information for 305 banks. We group shareholders into two categories: foreign and domestic based on the aggregated shares held by each group. If foreign shares are majority then the bank is defined as a foreign bank, otherwise it is a domestic bank.

As for country-level variables, we collect per capital GDP and inflation from the 2010 World Bank World Development Indicators (WDI). In addition, we gather information on deposit insurance coverage of individual countries from the database developed by Demirguc-Kunt, Kane, and Laeven (2007). Deposit insurance is defined as a dummy variable, indicating if a country has explicit deposit insurance at a given year. We also obtain banking crisis information for individual countries from a dataset compiled by Laeven and Valencia (2008). Banking crisis is a dummy variable that takes one the value one if the country is going through a systemic crisis in a given year, and zero if it is not.

3.2 Measuring institutional reforms

We examine three categories of institutional reforms, namely banking reforms, enterprise restructuring, and legal reforms. Indicators for the first two reforms are obtained from the transition reports produced by European Bank for Reconstruction and Development (EBRD hereafter). EBRD research group have tracked the transition progress in different sectors of the former socialist countries. For each sector, EBRD have constructed indicators to proxy the year-end status of various reforms. For example, the construction of the indicator for banking reforms considers the degree of liberalization of interest rates, the allocation of bank credit, whether there is significant lending to private enterprises, whether there is a significant presence of private banks, and whether bank supervision and regulation are prudential. The indicator goes from 1 to 4.3 with higher numbers indicating higher stages of development (EBRD, 2007). To evaluate the progress of enterprise reforms, EBRD provides three indicators, namely small-scale privatization, large-scale privatization, and enterprise restructuring in corporate governance. Small-scale privatization is focused on small companies, while large-scale privatization is focused on large enterprises' privatization process. The indicator of enterprise restructuring in corporate governance evaluates whether there are sufficient corporate laws to promote modern governance mechanism. The three indices all have a value ranging from 1 to 4.3, with a higher value meaning significant improvement. We add them up and calculate the average value of the three indices to proxy for the overall progress of institutional reforms in the enterprise sector. The higher the index is, the more significant improvement in privatization and more effective corporate control exercised through domestic financial institutions and markets, fostering market-driven restructuring.

Regarding legal reforms, we borrow the creditor right indicator provided by Pistor, Raiser, and Gelfer (2000) and Haselmann, Pistor, and Vig (2010). Their creditor right indicator evaluates the progress of legal reforms in two main regimes: individual enforcement regimes (collateral laws) and collective enforcement regimes (bankruptcy laws). The collateral laws specify the type and scope of security interests a lender may pledge from a borrower, eg whether mortgage land or personal assets can be used as collateral. Bankruptcy laws are provisions to ensure an orderly procedure for conflicting claims so that creditors can control the liquidation process and avoid a wasteful run on the assets of the firm. The detailed construction of the credit right indicator can be found in their paper.

Table 1 provides a summary statistics of three institutional reforms of individual countries over the period 1997–2008.

3.3 Measuring bank risk

Our primary measure is the Z-score, a widely used indicator of financial stability in the recent studies (eg Laeven and Levine, 2009; Houston, Lin, Lin, and Ma, 2010). Specifically, $Z\text{-score} = (ROA + E/A) / \sigma(ROA)$, where ROA and E/A are return on asset and capital to asset ratio calculated as the mean over three years (present year and the past two years), and $\sigma(ROA)$ is the standard deviation of return on asset, calculated over the same time window. Intuitively, Z-score can be considered as an inverse measure of insolvency risk, that is, the threat for a bank to be forced out of business because of a lack in capital to compensate for a decline in the value of its' assets ($E/A < -ROA$) (Roy, 1952). A higher Z-score implies a lower probability of insolvency and a greater financial stability. Since the Z-score is highly skewed, we follow Laeven and Levine (2009) and use the natural logarithm of the Z-score, which is normally distributed. In addition, given the asset booms that occurred in many of the transition countries, it is interesting to split Z-score into two parts: $\sigma(ROA)$ as a proxy for asset risk and capital ratio (E/A) as a proxy for leverage. The decomposition of Z-score could help us gain a thorough understanding whether the decrease in overall risk comes from a decrease in asset risk or an increase in capital ratio.

It is worth noting that Z-score, $\sigma(ROA)$, and capital ratio only represent achieved financial stability but reflect little about how individual banks perform in attaining their highest potential level. Put differently, two banks may have the same Z-score but one chooses a production plan that optimizes the risk-return tradeoff so that the bank can achieve the highest potential stability, while the other chooses to produce too many risky projects (eg securities) and get exposed to high risk. In the second case, the production plan does not maximize financial stability and the bank might have obtained a higher level of financial stability if it distributed its resources among risky and less risky assets more efficiently. This example shows that some measure that can gauge the deviation of individual banks' the actual stability from their highest potential might be useful to complement Z-score. In the banking literature, the concept of X-efficiency has been widely used to evaluate how banks perform compared with the 'best-practice' bank in terms of cost minimization or profit maximization (Leibenstein, 1966). If we think stability as a risk-adjusted performance measure, we can use the similar approach to estimate the X-efficiency of stability. We name it as 'stability efficiency' and take as our third measure of bank risk.

To empirically estimate stability efficiency, we employ a stochastic frontier approach (SFA) to fit an upper envelope of financial stability, proxied by Z-score. The difference between the envelope value and actual Z-score represents a bank's deviation from its potential highest stability, thereby providing information on banks' stability efficiency. One difficulty here is to find a functional form for Z-

score. We consider Z-score as a risk-adjusted profit, and use the nonstandard profit function to fit Z-score frontier. The model is specified as follows

$$\begin{aligned}
\ln(Z - \text{score} / w_3) = & \alpha_0 + \frac{1}{2} \sum_{i=1}^2 \beta_i \ln y_i + \frac{1}{2} \sum_{i=1}^2 \sum_{j=1}^2 \beta_{ij} \ln y_i \ln y_j \\
& + \sum_{m=1}^2 \delta_m \ln(w_m / w_3) + \frac{1}{2} \sum_{m=1}^2 \sum_{n=1}^2 \delta_{mn} \ln(w_m / w_3) \ln(w_n / w_3) \\
& + \frac{1}{2} \sum_{i=1}^2 \sum_{m=1}^2 \theta_{im} \ln y_i \ln(w_m / w_3) + \gamma_0 \ln z + \frac{1}{2} \gamma_1 (\ln z)^2 + \frac{1}{2} \sum_{i=1}^2 \eta_i \ln z \ln y_i \quad (3.1) \\
& + \frac{1}{2} \sum_{m=1}^2 \tau_m \ln z \ln(w_m / w_3) + \text{year dummies} + \text{GDP growth} + \text{inflation} \\
& + \ln \mu + \ln v
\end{aligned}$$

where y represents two output variable (y_1 : total loans and y_2 : other earning assets), x w represents three input prices (w_1 : price of borrowed funds, w_2 : fixed capital, and w_3 : price of labor), z is equity capital. The normalization by the last input price (w_3) ensures price homogeneity. In the estimation, we include year dummies to control for year fixed effect and country macroeconomic variables to reduce heterogeneity. The term $\ln v$ is a random noise and $\ln \mu$ represents the inefficiency of formulating a production plan to obtain the optimal financial stability. The advantage of SFA approach is that it can disentangle the inefficiency component ($\ln \mu$) from the random noise with certain distribution assumption (Aigner, Lovell, and Schmidt, 1977; Meeusen and van den Broeck, 1977). Here we assume the inefficiency component follows half-normal distribution because no banks operate beyond the optimal stability.

Our measure of stability efficiency overcomes the disadvantage of cost and profit efficiency, as they do not take into account risk factors (Hughes and Moon, 1995; Hughes, Lang, Mester, and Moon, 1996; Hughes, 1999; Hughes, Mester, and Moon, 2000, 2001). However, we acknowledge that using profit function to fit Z-score might not fully represent bank objective function of risk-return tradeoff, to the extent that it ignores some important determinants that may influence banks' risk-return trade off, eg managerial risk preference, market competition, and regulatory environment. These omitted variables, therefore, are likely to left in the inefficiency component estimated from Z-score frontier. Taking into account that the aim of this paper is to investigate the financial stability of banking sectors and relates it to the changes in the institutional environment, we control various potential factors in the regression analysis to mitigate the omitted variable problem.

3.4 Summary statistics

Table 2 reports the summary statistics of the key variables. The observations are at the bank-year level. As we can see, the average Z-score across all banks is about 46, indicating that on average, profits (ROA) have to fall by 46 times their standard deviation to deplete bank equity. Our estimates of stability efficiency show that the average level of the financial stability only reaches 47.5% of the best performers on the frontier. Examining bank-level financial characteristics, the mean (median) ROA is 0.01 (0.01) and the mean (median) $\sigma(\text{ROA})$ is 0.009 (0.004). Both numbers are lower than what have been reported in the developed countries and major emerging markets (Houston, Li, Li, and Ma, 2010). The mean bank size is 1800.781 million; equity to asset ratio (capital ratio) is 13.1%; loan ratio is 52%; and deposit ratio is 76.3%. All the financial variables in our sample are comparable with prior studies on transition banks (eg Bonin, Hasan, and Wachtel, 2005a, 2005b). Regarding country macro controls, we use per capita GDP (reported in \$000) to control for economic development, and inflation (reported in percentage) to control for economic stability. We also include deposit insurance coverage and banking crisis. In our sample, 96.2% country-year observations have explicit deposit insurance and 9.4% observations are going through banking crisis. Detailed variable definition can be found in Appendix A. The correlation matrix in Table 3 shows more their correlation matrix.

4 Empirical analysis

4.1 Difference-in-difference approach (DID)

We examine the effects of institutional reforms on bank risk by employing a differences-in-differences methodology. The approach basically compares the effects of policy changes on two kinds of groups (treatment- and control group) both pre-intervention and post-intervention periods. By subtracting the average gains in the control group from the average gains in the treatment group, it removes permanent differences between two groups, both observable and unobservable, which potentially impact the outcome variable in the post-intervention period, as well as biases from comparisons over time in the treatment group that could be the result of time trends (Imbens and Wooldridge, 2009). Thus a DID approach is desirable in order to properly control for ‘other’ changes that could affect the treated group, other than the policy of interest.

In our sample, we have 434 banks in 15 transition countries that experienced institutional reforms at different points of time. With multiple groups and time

periods, we apply a general framework of DID introduced by Bertrand, Duflo, and Mullainathan (2004). The equation at the individual bank level is as follows

$$\text{Bank risk}_{i,t} = \alpha_i + \alpha_t + \delta \cdot \text{Reform}_{j,t-1} + \gamma \cdot X_{j,t-1} + \varepsilon_i \quad (4.1)$$

where i indexes individual banks, j indexes countries, and t indexes years. The model has a full set of time effects (denoted by α_t), a full set of bank effects (denoted by α_i), group/time period covariates (denoted by $\text{Reforms}_{j,t-1}$), individual-specific controls (denoted by X_{it}), and individual-specific errors, ε_{it} . The dependent variable is individual bank's riskiness at year t . X_{it} includes various bank-specific and country macro controls. We are interested in estimating δ . Since our institutional reforms are continuous policy variables measuring the extent of progress in institutional reforms, δ captures the sensitivity of bank risk to the change of institutional reforms. It is also notable that following Haselmann, Pistor, and Vig (2010), we use one-year lag values of the reform variables considering that the reform indicators represent year-end status. Results are robust if we use the current year reform variables. As suggested by Bertrand, Duflo, and Mullainathan (2004), we use bootstrapped robust clustered standard errors to control for unobserved serial correlations.

4.2 Baseline results: institutional reforms and bank risk

We examine the impacts of institutional reforms on bank stability, measured by the logarithm of Z-score. The key testing variables are indicators of legal reforms, banking reforms and enterprise reforms. We take the logarithm of these indicators in order to see the percentage change in bank risk given a percentage change of institutional reforms. As specified in equation (4.1), our estimation model includes various bank-specific characteristics such as assets, capital ratio (equity to asset ratio), loan to asset ratio, deposit to asset ratio, and loan loss provision ratio of the previous year. Since it is a cross-country estimation, we also include some country-level macro variables including inflation, GDP per capital, indicator of deposit insurance, and indicator of banking crisis. Inflation is to control macroeconomic stability, and GDP per capita can capture income level and economic development of a country. Deposit insurance is used to proxy for market discipline, which has been argued to influence bank stability (Demirguc-Kunt and Detragiache, 2002; Barth, Capiro, and Levine, 2006). Similarly, banking crisis may also exert strong impact on the stability of banking sectors. We include the indicator of banking crisis to control for these events. The detailed definitions of these variables can be found in Appendix A. Our regression results are reported in Table 4.

As can be seen in Table 4, we consistently find that all reform indicators are positively and statistically significantly associated with Z-score. Since a higher Z-score implies more stability and less risk taking, our results in general suggest that better progress of institutional reforms lead to enhanced stability and reduced bank risk taking behavior. Elaborating in detail of each type of institutional reforms, the coefficient of legal reforms on Z-score is 1.3366, which means that 1% improvement of legal reforms translate into to 1.3% increase in Z-score. As explained in Section 2, stronger creditor rights may empower banks to secure their loans and enforce their rights in bankruptcy procedures and collateral recovery. Moreover, creditor rights also allow banks to put on more restrictions and play a better role in monitoring firms. Therefore, all else equal, banks operating in a better legal environment enjoy higher financial stability. Our finding is consistent with these arguments. From the policy perspective, it implies that the establishment a well-functioning legal system is greatly needed in transition economies to produce a stable banking sector. Our examination on banking liberalization also obtains striking result. The coefficient of banking reform indicator on Z-score is 2.1957, suggesting that an improvement of banking reforms by 1% could lead to an increase in bank stability by 2.1957%. This effect is statistically significant at one percent level and economically meaningful. This finding lends supportive evidence to a group of researchers who argue that less activity restrictions give banks more freedom to explore economies of scope and scale and thereby create more stable revenue (eg Claessens and Klingebiel, 2000; Barth, Capiro, and Levine, 2001; 2004; Laeven and Levine, 2009). Enterprise reform indicator measures the progress in two regimes, namely privatization of state-owned firms and implementation of modern corporate governance. As shown in Column (3), enterprise reform indicator is positively related with bank stability, measured by Z-score. Moreover, it has the largest economic significance among all institutional reforms. The coefficient of enterprise reform indicator on Z-score is 5.5268%, meaning that 1% improvement of enterprise reform is associated with 5.5% increases of bank stability. This result highlights the key role of privatization and corporate governance in reducing risk of financial sector.

Ideally, we want to enter three types of institutional reforms at the same time to see if their impacts on bank risk hold after controlling each other. However, one difficulty in including multiple institutional reforms in the same regression is that some of them are highly correlated. We therefore use the residuals from regressing each indicator on the other two as orthogonal measures of these institutional reforms. Column (4) in Table 4 reports the estimation results of regressing three residual measures of reform indicators on bank risk. As can be seen, all measures are positively related with Z-score and the coefficients are all at one percent statistical level.

Besides the main testing variables of institutional reforms, we generally find results consistent with existing literature. As might be expected, banks with larger

size and higher capital ratio enjoy higher stability. But loan loss provision of the previous year, which proxies for the credit risk ex ante, is negatively related to Z-score. We also include loan to asset ratio and deposit to asset ratio to control liquidity level, but do not find them to significantly affect Z-score. Examining the country-level macro controls, our results show that having an explicit deposit insurance policy significantly decreases bank stability. This is consistent with previous studies, which argue that deposit insurance diminishes market discipline and intensifies moral hazard problem in banking (eg Demirguc-Kunt and Detragiache, 2002; Barth, Capiro, and Levine, 2006).

4.3 Alternative measures of bank risk and disaggregation of the Z-score

In this subsection, we continue by running specification (4.1) using alternative measures of bank risk. First, we decompose Z-score into $\sigma(\text{ROA})$ and capital ratio as two separate measures of bank risk. Based on the calculation of Z-score, we know that all else equal, both lower $\sigma(\text{ROA})$ and higher capital ratio would translate into higher Z-score. Since in the previous estimation we have found Z-score increases subsequent to the institutional reforms, disaggregation of the Z-score could help us better understand whether the increase of overall bank stability is coming from the reduction of asset risk or increase of equity capital. Given the increasing lending activities in transition economies, it is interesting to see how institutional reforms affect asset risk and equity risk differently. Table 5 reports the estimation results.

We see that all three institutional reforms have a significant and negative coefficient associated with $\sigma(\text{ROA})$, which tells us that the improvement of institutional environment leads to a lower level of asset risk. When we enter three reforms in the same regression, results become even stronger. These findings suggest that the increase of overall bank stability is attributable to the reduction of asset risk. We then examine how capital ratio is influenced by the improvement of institutional reforms. Interestingly, we find capital ratio is not influenced by institutional reforms. The coefficients all have a positive sign, but are not statistically significant. We therefore conclude that the increase of overall bank stability is primarily driven by a reduction in $\sigma(\text{ROA})$.

In the last four columns, we use the stability efficiency as another measure of bank risk. This new measure evaluates the ability of individual banks in formulating a production plan and attaining their highest potential stability. As we explained in the methodology part, even though two banks have the same Z-score and ROA volatility, it is possible that one is operating close to its maximum stability while the other is not due to exogenous elements such as managerial

inefficiency and environment. Taking into account that the aim of this paper is to investigate bank stability and relates it to the changes in the institutional environment, we acknowledge that stability efficiency may also reflect some other factors such as managerial efficiency. However, we try to mitigate this problem by controlling various bank-specific variables. As shown in the results, the coefficients are positive and significant, which suggest that institutional reforms exert positive impacts on banks to achieve stability efficiency. These results are consistent with our findings for Z-score.

4.4 Simultaneous estimation of bank risk and profitability

We are concerned that institutional reforms could influence bank risk-taking by affecting their profitability. If banks that are less risky are the ones that are losing money, then there might be no direct causal effect of institutional reforms on bank risk. Such a ‘spurious’ relationship may bias our results. To address this issue, we employ a simultaneous equation system to control for the potential linkage between institutional reforms and bank profitability. Following Acharya, Hasan, and Saunders (2006), we estimate using seemingly unrelated regression (SUR), a model developed by Arnold Zellner and first published in Zellner (1962). Specifically, in the simultaneous equations system, we use Z-score to measure bank risk and ROA to proxy for their profitability. Z-score is modeled exactly as in the equation (4.1). ROA is also modeled as the same function of institutional reforms and numerous bank- and country level control variables used in the risk equation. Bank fixed effect and year fixed effect are included. The results are reported in Table 6.

As shown in Table 7, three reform indicators all have positive and significant impact on Z-score, which indicates that the effects of institutional reforms on bank risk are robust after simultaneously controlling for ROA in the same equation system. Examining their coefficients on ROA, we further find that banking reforms and enterprise reforms only affect Z-score but not ROA, as the coefficients on ROA are not statistically significant. Only legal reform shows a significant association with ROA, implying that the improvement of legal institutions negatively affects profitability but positively affects bank stability. Overall, the simultaneous estimations do not change the results reported in the OLS models. Our findings are quite strong and consistent in all the robustness tests. Better progress in legal reforms, banking reforms, and enterprise reforms have a direct impact on bank stability.

4.5 Further test: foreign versus domestic banks

By this point, we have shown that banks on average enhance financial stability subsequent to the improvement of institutional development. In this subsection, we further examine whether domestic banks and foreign banks benefit in different ways. To test this, we divide our sample into domestic banks and foreign banks and re-estimate equation (4.1) for each sample separately. Table 8 reports our results.

As shown in Panel A, we find that domestic banks enhance financial stability significantly subsequent to all three institutional reforms. The influence of banking reforms and enterprise reforms is as strong as for the overall sample estimation, though the impact of legal reform has a much smaller magnitude. These results tell us that domestic banks do enjoy the benefit of risk reduction from the improvement of institutional development in transition economies. Specifically, better financial discipline on the enterprise sector and strengthened regulatory and legal environment may increase domestic banks' loan recovery rate and reduce their risk taking incentive. Examining Panel B, we do not find significant association between institutional reforms and bank risk for foreign banks, except for legal reforms, which decrease return volatility and increase capital ratio. This result is somewhat surprising. However, we believe that it is due to the neutralization of two effects. On one hand, foreign banks could enjoy lower risk because better institutional environment reduces information asymmetry and promotes an investor-friendly and efficient market (Khanna and Palepu, 2000; Buck, 2003). On the other hand, strengthened regulatory environment may also foster foreign banks' confidence to take on riskier projects, which then would cause lower loan recovery rate and higher insolvency risk. This conjecture is consistent with some research which has shown that foreign banks tend to lend more and charge lower interest rate to firms in countries with better legal environment (Qian and Strahan, 2007; Haselmann, Pistor and Vig, 2010).

5 Conclusion

The transition process from central economic planning toward market-oriented economies is one of the most extraordinary events in the global economy. Existing law and finance literature has been mainly focused on mature economies, where institutional development began long time ago and the quality of the institutions has hardly changed over the past decades. Largely absent from the literature is the examination of institutional reforms and how changes in institutional settings affect the risk-taking behavior of banks. This paper attempts

to further the scholarship in this area by examining different types of institutional reforms and their impacts on bank risk in transition economies.

Our findings have several broad implications. By exploiting exogenous variation in various institutional reforms, we demonstrate their causal effects on bank risk. Specifically, banking reforms such as liberalizing interest rates, decentralizing central banks' roles, and deregulating bank activities, have a positive impact on the financial stability of the banking sector. Enterprise restructuring of privatization and corporate governance also greatly enhances the financial stability of banks. With regard to legal reforms, in light with prior research that generally finds legal protection to facilitate the credit supplied in the economy, the results of our article show that it may also lead to greater financial stability. These results imply that legal environment strengthening and institutional development are crucial for a well-functioning and stable banking system. Our results also suggest that domestic banks benefit more from the improvement of institutional environment in terms of risk management. In complementing the economic argument that better legal institutional environment attracts more foreign capital, our finding implies that strengthening creditor rights is particularly helpful for domestic banks to gain a higher level of financial stability.

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Appendix A

Variable Name	Definition	Data Source	Year
<u>Bank variables/controls</u>			
Total assets	Total assets measured in USD 000'	Bankscope	1997–2008
ROA	Net profit divided by total assets	Bankscope	1997–2008
Loan to asset ratio	Net loans divided by total assets	Bankscope	1997–2008
Deposit to asset ratio	Total deposits divided by total assets	Bankscope	1997–2008
Equity to asset ratio	Total equity divided by total assets	Bankscope	1997–2008
Loanloss provision ratio	Total loan loss provision divided by total assets	Bankscope	1997–2008
Z-score	Calculated as the sum of ROA and equity-to-assets divided by the standard deviation of ROA of each bank over past three years.	Bankscope	1997–2008
ROA_std	Standard deviation of ROA of each bank computed over past three years	Bankscope	1997–2008
Stability efficiency	X-efficiency of Z-score. It measures how close a bank's actually financial stability is relative to the best performer estimated from stochastic frontier analysis	Bankscope	1997–2008
Foreign bank	=1 if more than 50% ownership is foreign	Bankscope	1997–2008
<u>Institutional variables</u>			
Legal_reform	An index that evaluates the progress of legal reforms in collateral laws and bankruptcy laws.	Bankscope Pistor(2000); Haselmann, Pistor, Vig (2010)	1997–2008
Banking reform	An index that measures the the degree of liberalization of interest rates, the allocation of bank credit, whether there is significant lending to private enterprises, whether there is a significant presence of private banks, and whether bank supervision and regulation are prudential. The indicator goes from 1 to 4.3 with higher numbers indicating higher stages of development	EBRD	1997–2008
Enterprise reform	An index that measures the extent of privatization and corporate governance restructuring in the enterprise sector. The values increase from 1.0 to 4.3, with higher value implying higher level of progress.	EBRD	1997–2008

Variable Name	Definition	Data Source	Year
<i><u>Country macro controls</u></i>			
GDP per capita (\$000)	GDP per capita in thousand dollars	WDI 2010	1997–2008
Inflation	Annual growth rate of consumer price index	WDI 2010	1997–2008
Deposit insurance	=1 both when the country has explicit deposit insurance and when depositors were fully compensated the last time a bank failed if the country did not have formal deposit insurance.	Demirgüç-Kunt, Asli, Edward J. Kane, and Luc Laeven, 2007	1997–2008
Bank crisis	=1 if this country is going through a situation when banking sector become insolvent and cannot continue to operate without special assistance from supervisory authorities.	Laeven, Luc and Fabian Valencia, 2010	1997–2008

Tables 1–7

Table 1. Description of institutional reforms in individual countries

This table shows the summary statistics of three institutional reform indices for individual countries over the sample period from 1997 to 2008.

Country	Banking reform index			Enterprise reform index			Legal reform index					
	mean	min	max	sd	mean	min	max	sd	mean	min	max	sd
Albania	2.44	2.00	2.67	0.24	3.00	2.89	3.11	0.08	/	/	/	/
Bosnia-Herzegovina	2.74	2.67	3.00	0.15	2.58	2.44	2.67	0.09	/	/	/	/
Bulgaria	3.57	3.33	3.67	0.17	3.45	3.22	3.56	0.13	5	5	5	0
Croatia	3.53	2.67	4.00	0.52	3.43	3.33	3.55	0.11	3.00	3.00	3.00	0.00
Czech Republic	3.61	3.00	4.00	0.37	3.86	3.78	3.89	0.05	3.00	3.00	3.00	0.00
Estonia	3.75	3.33	4.00	0.25	3.89	3.78	4.00	0.10	5.75	5.00	6.00	0.45
Hungary	4.00	4.00	4.00	0.00	3.92	3.78	4.00	0.07	5.00	5.00	5.00	0.00
Latvia	3.45	2.67	4.00	0.43	3.48	3.22	3.67	0.20	5.83	4.00	6.00	0.58
Lithuania	3.28	3.00	3.67	0.31	3.56	3.22	3.78	0.23	5.00	5.00	5.00	0.00
Macedonia (Fyrom)	2.70	2.67	3.00	0.10	3.16	3.00	3.33	0.13	/	/	/	/
Poland	3.42	3.00	3.67	0.21	3.66	3.55	3.78	0.10	3.83	2.00	4.00	0.58
Romania	2.83	2.33	3.33	0.30	3.03	2.67	3.34	0.25	5.17	3.00	6.00	1.19
Serbia	2.61	2.33	3.00	0.25	2.74	2.44	2.89	0.20	/	/	/	/
Slovakia	3.28	2.67	3.67	0.42	3.86	3.67	4.00	0.13	4.33	3.00	5.00	0.89
Slovenia	3.28	3.00	3.33	0.13	3.40	3.33	3.44	0.06	3.00	3.00	3.00	0.00

Table 2.

Summary statistics

This table reports summary statistics for the main analysis variables. Variable definitions are reported in Appendix A.

Variable name	mean	median	sd	min	max	N
<u>Bank variables/controls</u>						
Z_score	45.968	28.102	50.497	0.342	235.577	1453
Stability efficiency	0.475	0.487	0.146	0.041	0.841	1402
ROA	0.010	0.010	0.020	-0.113	0.070	1453
ROA_std	0.009	0.004	0.013	0.0002	0.070	1453
Total asset (\$000)	1800781	575660	3051181	10103	30400000	1453
Equity ratio	0.131	0.101	0.091	0.027	0.611	1453
Loan ratio	0.520	0.544	0.188	0.031	0.927	1453
Deposit ratio	0.763	0.809	0.147	0.035	0.964	1453
Loan loss provision ratio	0.013	0.006	0.024	0.000	0.463	1453
Foreign bank	0.569	1.000	0.495	0.000	1.000	1108
<u>Institutional reforms</u>						
Legal_reform	4.369	4.000	1.262	2.000	6.000	1261
Banking reform	3.354	3.330	0.463	2.330	4.000	1453
Enterprise reform	3.481	3.553	0.317	2.557	4.000	1453
<u>Country macro controls</u>						
GDP_percap (\$000)	7.226	5.600	4.646	1.300	26.800	1453
Inflation	5.997	4.598	5.599	0.102	45.804	1453
Deposit insurance	0.962	1.000	0.191	0.000	1.000	1453
Bank crisis	0.094	0.000	0.292	0.000	1.000	1453

Table 3.

Correlation table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	ln_Z	ROA	ROA_std	Total asset	Equity ratio	Loan ratio	Deposit ratio	Loanloss provision	Legal reform	Bank reform	Enterprise reform	GDP per capita	Inflation	Deposit insurance	Bank crisis
1	1														
2	0.3385	1													
3	-0.7644	-0.3618	1												
4	0.1305	0.0904	-0.211	1											
5	0.1377	0.1374	0.204	-0.2532	1										
6	0.231	0.0643	-0.1489	0.0971	0.0982	1									
7	-0.1166	-0.0925	-0.1304	0.1014	-0.6279	-0.1553	1								
8	-0.2822	-0.1277	0.3859	-0.1532	0.1989	0.0028	-0.2094	1							
9	-0.2116	-0.0485	0.2142	-0.0357	-0.0108	-0.1133	0.2512	-0.0297	1						
10	0.23	0.1065	-0.3151	0.2818	-0.2843	0.2167	0.0882	-0.2644	-0.0219	1					
11	0.099	0.0483	-0.2524	0.3005	-0.346	0.0573	0.1111	-0.2534	-0.0085	0.7399	1				
12	0.2344	0.0384	-0.2904	0.3039	-0.205	0.3337	0.0263	-0.2077	-0.2739	0.5714	0.4425	1			
13	-0.1482	-0.0114	0.1794	-0.0624	0.1162	-0.0742	0.0055	0.0979	0.23	-0.2281	-0.2636	-0.1476	1		
14	-0.0353	-0.0783	0.0294	0.0836	0.0453	0.0604	-0.0419	-0.0245	0.1396	0.0953	0.0822	-0.0028	-0.0762	1	
15	-0.0784	-0.0525	-0.0014	0.0163	-0.0389	-0.0326	-0.0419	0.0402	-0.1526	-0.0923	0.1759	0.0242	0.0695	0.064	1

Table 4.

DID regression results of Z-score and institutional reforms

The dependent variable is the logarithm of Z-score. Main interested independent variables are three institutional reforms. In the first three models institutional reform variables are entered separately. The last model includes all three reforms together. Due to the high correlations among institutional reform variables, we use residual measures and include three reforms together in the last model. Control variables include various bank characteristics and country macro factors. In all estimations year fixed effect and bank fixed effect are included but not reported. Bootstrapped robust clustered standard errors are used to control for unobserved serial correlations. T-statistics are presented in brackets. *, **, and *** represent significance level of 10%, 5%, and 1% respectively.

	(1)	(2)	(3)	(4)
	ln_Z	ln_Z	ln_Z	ln_Z
<u>Reforms indicators</u>				
ln_Legal reform	1.3366** (2.4891)			
ln_Banking reform		2.1957*** (2.8204)		
ln_Enterprise reform			5.5268** (2.2841)	
<u>Reform indicators-residual measures</u>				
Legal_reform_residual				0.4888*** (3.3799)
Banking_reform_residual				2.8438*** (3.5473)
Enterprise_reform_residual				4.2205*** (3.1976)
<u>Bank characteristics</u>				
ln_asset	0.3921*** (2.7379)	0.4161*** (3.0137)	0.3451** (2.0075)	0.3097** (2.0672)
ln_Equity_Ratio	0.5476*** (2.7815)	0.6048*** (3.7215)	0.5815*** (2.8333)	0.5247*** (3.0360)
ln_Loanloss_prov	-0.1662*** (-3.8039)	-0.1352*** (-3.6351)	-0.1461*** (-4.7770)	-0.1579*** (-4.7854)
ln_Deposit_Ratio	0.1059 (0.4470)	0.0205 (0.0723)	0.1133 (0.4178)	0.1003 (0.3505)
ln_Loan_Ratio	0.1142 (0.7747)	0.1608 (1.1358)	0.1586 (0.9739)	0.0623 (0.3749)
<u>Country macro controls</u>				
GDP_per capita	0.0294 (0.6432)	0.0519 (1.2854)	0.0910** (2.2184)	0.1042** (2.2908)
Inflation	0.0116 (0.9721)	-0.0054 (-0.5204)	-0.0007 (-0.0682)	0.0050 (0.3579)
Deposit insurance	-1.1353*** (-4.2077)	-0.9088*** (-3.6720)	-0.9633*** (-3.9063)	-0.9342*** (-2.8336)
Bank crisis	-0.0774 (-0.4607)	0.0289 (0.1804)	-0.1684 (-0.8826)	-0.0502 (-0.3762)
Constant	-3.0602 (-1.5954)	-4.3236* (-1.7198)	-8.1510*** (-2.7844)	-1.9049 (-0.8551)
Firm fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Observations	1,261	1,453	1,453	1,261
Adjusted R-squared	0.0458	-0.0015	-0.0034	0.0742

Table 5. **Regression of alternative risk measures on institutional reforms**

The dependent variables are alternative risk measures including standard deviation of ROA, logarithm of capital ratio, and Z-score efficiency. Main interested independent variables are three institutional reforms. For each dependent variable, the first three models enter institutional reform variables separately. The last model includes all three reforms together. Due to the high correlation among institutional reforms, we use residual measures in the last model. Control variables include various bank characteristics and country macro factors. In all estimations year fixed effect and bank fixed effect are included but not reported. Bootstrapped robust clustered standard errors are used to control for unobserved serial correlations. T-statistics are presented in brackets. *, **, and *** represent significance level of 10%, 5%, and 1% respectively.

VARIABLES	$\sigma(\text{ROA})$	ln (Capital Ratio)	Z-score efficiency
<u>Reforms indicators</u>			
ln_Legal reform	-0.0110** (-2.1213)	0.0374 (0.2526)	0.1139** (2.1579)
ln_Banking reform	-0.0194* (-1.8925)	0.1969 (0.8157)	0.2757** (2.5702)
ln_Enterprise reform	-0.0679** (-2.3547)	0.8897 (1.6170)	0.7548** (2.1723)
<u>Reform index-residual measures</u>			
Legal_reform_residual	-0.0042*** (-2.8365)	0.0604 (1.5675)	0.0453*** (3.2704)
Banking_reform_residual	-0.0288*** (-3.4599)	0.0219 (0.0997)	0.3717*** (4.0437)
Enterprise_reform_residual	-0.0481*** (-3.2489)	0.0828 (0.2210)	0.5526*** (3.0225)
Constant	0.0966** * (3.4716)	1.4319* * (1.9844)	-0.2575 * (-0.9521)
Bank characteristics	Yes	Yes	Yes
Country macro controls	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Observations	1,456	1,737	1,409
Number of index	244	358	286
Adjusted R-squared	0.1459	0.1502	-0.1418
		0.1579	-0.1486
			-1.0669** (-2.3778)
			(-0.8785)

Table 6. **Simultaneous equations on bank risk and return**

The dependent variables for the simultaneous regressions are the logarithm of Z-score and profitability (logarithm of ROA). Main interested independent variables are three institutional reforms. Control variables include various bank characteristics and country macro factors. In all estimations year fixed effect and bank fixed effect are included but not reported. T-statistics are presented in brackets. *, **, and *** represent significance level of 10%, 5%, and 1% respectively.

VARIABLES	(1)	(2)	(3)	(4)
<i>Reform index</i>				
ln_Legal reform	0.9297*** (3.0978)	-0.8486*** (-3.3497)		
ln_Banking reform		2.6747*** (5.8189)	0.0522 (0.1345)	
ln_Enterprise reform			6.5304*** (5.0721)	-1.1189 (-1.0326)
<i>Reform index-residual measures</i>				
Legal_reform_residual				0.3722*** (4.4983)
Banking_reform_residual				-0.1849*** (-2.6027)
Enterprise_reform_residual				-0.0219 (-0.0541)
Constant	0.0000 (.)	-2.5512* (-1.9090)	-2.9758*** (-2.6366)	0.8336 (0.6075)
Bank characteristics	Yes	Yes	Yes	Yes
Country macro controls	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Observations	1,134	1,294	1,294	1,134
Adjusted R-squared	0.5637	0.5643	0.6175	0.5766

Table 7. **DID regression on domestic banks versus foreign banks**

The dependent variables are logarithm of Z-score and three alternative risk measures. Main interest independent variables are three institutional reforms. Table 8 reports the DID regression results separately for domestic banks and foreign banks. All model specifications use residual measures of institutional reforms. Control variables include various bank characteristics and country macro factors. Bank fixed effect and year fixed effect are included but not reported. Bootstrapped robust clustered standard errors are used to control for unobserved serial correlations. T-statistics are presented in brackets. *, **, and *** represent significance level of 10%, 5%, and 1% respectively.

VARIABLES	Domestic Banks				Foreign Banks			
	ln_Z	$\sigma(\text{ROA})$	ln(Capital ratio)	ZE	ln_Z	$\sigma(\text{ROA})$	ln(Capital ratio)	ZE
Legal_reform_r	0.7155*** (2.8462)	-0.0048 (-1.1654)	0.0301 (0.4479)	0.0341 (1.0747)	0.3371 (1.2333)	-0.0043** (-2.1004)	0.0847 (1.6048)	0.0171 (0.5155)
Banking_reform_r	4.2102*** (3.4565)	-0.0336** (-2.5133)	-0.2045 (-0.4664)	0.4861*** (2.7900)	0.0002 (0.0002)	-0.0022 (-0.2896)	-0.3455 (-1.2537)	0.0939 (0.5118)
Enterprise_reform_r	5.4361*** (2.8120)	-0.0491* (-1.8976)	-0.0252 (-0.0385)	0.6542* (1.8840)	-1.3933 (-0.6013)	0.0063 (0.4040)	-0.7761 (-1.5759)	-0.0695 (-0.2079)
Constant	3.1055 (0.5300)	0.0425 (0.7475)	1.1999 (0.5726)	0.5649 (0.9492)	-0.8818 (-0.2195)	0.0355 (1.5762)	1.3289 (1.1633)	0.1543 (0.2231)
Bank characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country macro controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	420	420	470	416	527	527	577	520
Number of index	91	91	102	90	126	126	139	126
Adjusted R-squared	-0.0999	-0.0529	0.1126	-0.0785	-0.0934	0.0187	0.0754	-0.2434

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