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# Management Board Composition of Banking Institutions and Bank Risk-Taking: The Case of the Czech Republic

Diana Žigraiová *

## Abstract

The paper investigates how the management board composition of banking institutions affects their risk-taking behavior in the Czech Republic. More specifically, we examine the effect of average director age, the proportion of female directors, the proportion of non-national directors, and director education level on four different bank risk proxies. We build a unique data set comprising selected biographical information on the management board members of Czech financial institutions holding a banking license over the 2001–2012 period. Our most robust finding is that higher proportions of non-national directors increase bank risk as measured by profit volatility and reduce bank stability as captured by the Z-score for the Czech banking sector overall and for the segments of general commercial banks, small and mid-sized banks and adequately capitalized banks. Moreover, we also detect risk-increasing implications of board size for the segments of building societies and small and mid-sized banks. As for average board tenure, its effect on risk-taking varies depending on bank characteristics. We find mixed evidence on the effect of female directors and do not find any strong effect of directors' age on risk in the Czech banking sector. All in all, the results of our analysis are subject to the proxy of bank risk used. The reader should keep in mind that higher absolute level of bank risk is not necessarily unfavorable as it does not capture if risk-taking behavior is excessive for a given return.

## Abstrakt

Tento článek analyzuje, jak složení představenstev českých bank ovlivňuje jejich rizikové chování. Konkrétněji se jedná o zkoumání vlivu průměrného věku členů představenstva, podílu žen mezi členy představenstva, podílu cizinců a dosaženého vzdělání členů představenstva na čtyři ukazatele rizikovosti bank. Za tímto účelem byl sestaven jedinečný soubor vybraných biografických údajů o členech představenstev českých finančních institucí, které jsou držiteli bankovní licence, za období 2001–2012. Naše nejvíce robustní zjištění je, že vyšší podíl cizinců ve složení představenstev zvyšuje rizikovost bank měřenou volatilitou zisku a snižuje jejich stabilitu zachycenou Z-indexem za český bankovní sektor a za segmenty komerčních bank, malých a středních bank a přiměřeně kapitalizovaných bank. Početnější představenstva také zvyšují rizikovost v segmentech stavebních spořitelen a malých a středních bank. Co se týče průměrné délky funkčního období členů představenstva, její vliv na rizikovost bank závisí na vlastnostech jednotlivých bank. Vliv žen v představenstvech není jednoznačný a nebyl zjištěn ani žádný silný vliv věku členů představenstva na rizikovost. Výsledky naší analýzy jsou ale ovlivněny typem míry rizikovosti, kterou používáme. Čtenář by tak měl vzít v úvahu, že vyšší absolutní rizikovost bank není nutně nežádoucí, jelikož nezachycuje zda rizikové chování je nadměrné pro požadovanou úroveň ziskovosti.

**JEL Codes:** C33, G21, G34, J16.
**Keywords:** Banks, management board composition, panel data, risk-taking.

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## Nontechnical Summary

The aim of this paper is to investigate how management board composition affects the risk-taking behavior of Czech banking institutions. More specifically, the paper examines what effect the management boards of Czech banks have on bank risk-taking in terms of board size, the average age of directors, director tenure, the proportion of female directors, the proportion of non-national directors, and director education level over the 2001–2012 period. To the best of the author's knowledge this is the first study of the economic effects of bank management board composition conducted to this extent for a post-transition CEE country with almost exclusive foreign ownership of its banking sector after the conclusion of the privatization process.

To investigate the research question, we prepare a unique data set that comprises selected biographical information on the management board members of Czech banking institutions. We then combine this data set with individual bank financial data to serve as control variables in our analysis. We use four bank risk proxies that capture different aspects of bank risk: the Z-score, profit volatility, the NPL ratio, and the ratio of liquid assets to deposits and short-term funding.

For the Czech banking sector overall, we find that a larger proportion of non-national directors on the board reduces bank stability as captured by the Z-score and increases bank profit volatility. Moreover, foreign directors have a risk-increasing effect across several categories of banking institutions, while for building societies, large banks, and better capitalized banks the effect is not significant. This finding opposes evidence typically found in the literature that non-national directors have a positive effect on the firm's performance by bringing in new technology and modern managerial techniques. On the one hand, the risk-increasing effect of foreign directors in small banks could be attributed to bank policies implemented by the management board. Small banks might pursue riskier policies in order to gain larger market share. On the other hand, the risk-increasing effect of foreign directors could also be explained by a lack of familiarity with the Czech banking environment or by language and cultural barriers that foreign directors might face in the boardroom (Masulis et al., 2012; European Commission, 2010).

As for education level, larger proportions of directors holding an MBA on management boards in the Czech banking sector overall raise riskiness as captured by ROA volatility. However, we find no effect of directors with an MBA on risk-taking across individual bank categories. As for directors with a PhD, we find that higher proportions of such directors have a stability-enhancing effect in large banks. The risk-reducing effect of directors with a PhD aligns with the evidence presented by Berger et al. (2014) that better-educated directors curb risk-taking. These findings shed some light on the dissimilar risk implications of the different types of degrees that directors hold.

The evidence on the effect of female directors is ambiguous for Czech general commercial banks. On the other hand, for building societies a larger proportion of female directors on the board aggravates riskiness. All in all, these results contribute to the mixed evidence on the effect of female directors on corporate performance found in the literature (e.g. Barber and Odean, 2001; Adams and Ferreira, 2007).

Overall, we did not find strong evidence on the relationship between board size and Czech banks' risk. The exceptions are building societies, where larger board size increases risk as captured by the non-performing loans ratio, and small and mid-sized banks, whose stability decreases with increasing board size. These findings are in line with Eisenberg et al. (1998), who found a significant negative correlation between board size and profitability in a sample of small and mid-sized firms (the size category to which Czech building societies belong).

In regard to director tenure, its effect on riskiness varies for different categories of Czech banking institutions. In building societies and better capitalized banks, riskiness increases with increasing board tenure. On the other hand, stability increases with increasing board tenure in large banks. These findings are broadly in line with Huang (2013), who claims that board tenure can be positively or negatively related to firm value and this relation varies across firm characteristics. As for the average age of directors, there is no strong and systematic evidence that it affects riskiness in the Czech banking sector.

Our findings are, however, subject to the proxy of bank risk used. While certain management board composition might imply higher absolute level of bank risk it is not necessarily unfavorable. Higher absolute risk does not reflect if a bank's risk-taking behavior is excessive for a given return.

In addition to the impact of corporate governance variables on bank risk, bank size is a risk-contributing factor. This could be attributed to large banks' capacity to better absorb risk or to too-big-to-fail or too-systemic-to-fail policies put in place. On the other hand, capitalization, by increasing monitoring and reducing moral hazard incentives, lowers bank riskiness. Similarly, growth of bank assets has risk-reducing implications. In line with the almost exclusive foreign ownership of the Czech banking sector's assets, we found that the link between the risk appetite of foreign parent bank groups and their Czech affiliates' risk is positive and significant across different risk proxies.

# 1. Introduction

The recent global crisis put financial stability and financial supervision research in the spotlight. In 2009, the OECD Steering Group on Corporate Governance (Kirkpatrick, 2009) highlighted the need to pay special attention to commercial bank corporate governance issues. They concluded that "the financial crisis can be to an important extent attributed to failures and weaknesses in corporate governance arrangements. When they were put to a test, corporate governance routines did not serve their purpose to safeguard against excessive risk-taking in a number of financial services companies." This aspect of financial supervision has been supported by the Basel Committee on Banking Supervision (BCBS), which has drawn attention to the need to study, understand, and improve the corporate governance of financial entities. The BCBS especially advocates studies of a governance structure composed of a board of directors and senior management (Basel Committee on Banking Supervision, 2006).

In the Czech Republic, the Act on Banks 21/1992 governs the organizational structure of financial entities holding a banking license. This legislation requires banks to implement policies that ensure diversity in the members of governing bodies, for example, in their profiles and backgrounds, views, and sets of competencies. Such diversity can lead to a wider pool of resources and expertise, generating more discussion, more monitoring, and more challenges in the boardroom, as stated in the European Commission's 2011 Green Paper (European Commission, 2011). In particular, the European Commission seeks to improve existing corporate governance practices, i.e., the functioning, composition, and skills of commercial banks' boards of directors (European Commission, 2010).

Following these endeavors, this paper focuses on investigating how the management board composition of commercial banks affects bank risk-taking behavior in the Czech Republic over the 2001–2012 period. Specifically, the paper aims to examine what effect commercial bank management boards have on bank risk-taking in terms of board size, the average age of directors, director tenure, the proportion of female directors, director education level, and the proportion of non-national directors. To the best of the author's knowledge this is the first study of the economic effects of bank management board composition conducted to this extent for a post-transition CEE country with almost exclusive foreign ownership of its banking sector after the conclusion of the privatization process. Furthermore, the paper allows for investigating if managing directors holding different degrees affect bank risk in a dissimilar way. This differentiation between degree types diverges from similar studies that focus solely on the economic effects of directors with MBAs (e.g. Bertrand and Schoar, 2003) or directors with PhDs (e.g. Berger et al., 2014), and from studies that do not differentiate between the two (e.g. Dionne and Triki, 2005).

Overall, corporate governance research has produced numerous studies dedicated to the roles and composition of boards of directors. In these studies, interest is centered on board independence in terms of inside and outside directors (Hermalin and Weisbach, 1988; Raheja, 2005; Linck et al., 2008), how this composition affects CEO turnover (Weisbach, 1988), the determinants of board size (Boone et al., 2007), and the conditions under which boards are controlled by insiders as opposed to outsiders (Harris and Raviv, 2008). Furthermore, the link between ownership structure and board composition (Denis and Sarin, 1999) and the effects of outside directors on performance (Dahya and McConnell, 2007; Coles et al., 2008; Nguyen and Nielsen, 2010) have also been subject to investigation. Another block of studies relates board diversity in terms of gender to firm performance (Adams and Ferreira, 2009; Ahern et al., 2012; Adams and Funk, 2012).

The composition of commercial bank boards and its risk-taking implications are not sufficiently explored in the corporate governance literature. To the author's knowledge, the only other studies

to have addressed this issue are those by Berger et al. (2014) with a focus on Germany, by Pathan (2009), and by Erkens et al. (2012). However, two of these studies—Pathan (2009) and Erkens et al. (2012)—use market-based proxies for bank risk-taking which are not applicable to many transition countries of the CEE region, whose banks are not commonly listed on stock exchanges. Moreover, most studies focus on advanced countries, while relatively little is known about the corporate governance structure and its role in the banking sectors of emerging economies. So far, relatively few studies (Adams and Mehran, 2008; Caprio et al., 2007; Levine, 2004) have focused on corporate governance issues in banks, even though core aspects of corporate governance can be applied to them. Problems arising from different types of ownership and control as well as collective action issues that stakeholders face in search of efficient allocation of resources are also all present in financial firms. As banks are responsible for safeguarding depositors' rights, guaranteeing the stability of the payment system, and reducing systemic risk (Andres and Vallelado, 2008), they are subject to more intense regulation than other firms. Corporate governance research focused on banks in developing and transition countries is thus of high relevance. In addition, to the best of the author's knowledge the issue of bank management board composition and its impact on risk-taking has not yet been investigated to this extent for a post-transition country in the CEE region, and this paper aims to fill this gap in the literature.

Focusing on Czech banking institutions, the analysis is performed for bank management boards in a system of corporate governance with two-tier boards. In two-tier systems, the management board, chaired by the CEO, runs the corporation and reports to the supervisory board. The supervisory board, on the other hand, performs a monitoring role equivalent to that of non-managing directors in the one-tier system found in Anglo-Saxon countries. The supervisory board thus appoints and dismisses members of the management board on behalf of the shareholders. Members of the supervisory board cannot simultaneously hold positions on the board of directors, and vice versa. The two-tier system thus allows for clear separation between inside directors, who run the bank and hold positions on the board of directors, and outside directors, i.e., members of the supervisory board. According to the literature, this board design has risk-taking implications. Adams and Ferreira (2007) found that increasing board independence in a one-tier system makes a CEO less likely to disclose information to non-managing directors, thereby hindering their involvement in management decisions. This, in turn, results in less well informed top management decisions and has direct consequences for risk-taking. However, in two-tier systems the CEO does not face this trade-off in disclosing information and, because shareholders' interests are aligned with those of the supervisory board, the monitoring of managing directors is more intensive and leads to less risk-taking (Berger et al., 2014).

This paper aims to reveal a more efficient management board composition in terms of risk-taking in the Czech banking sector. This also translates into implications for the stability of the Czech financial sector. However, while certain management board composition might imply higher absolute level of bank risk it is not necessarily unfavorable. Higher absolute risk does not reflect if a bank's risk-taking behavior is excessive for a given return. In addition to investigating the impact of management board composition on risk-taking, the effect of some bank characteristics, i.e., bank size, capitalization, and profitability, on bank risk appetite is examined.

The paper is structured as follows. Section 2 describes the development and specific features of the Czech banking sector and formulates our research hypotheses. Section 3 builds the data set for investigating the research question and presents descriptive statistics for board composition variables and bank financial indicators. Section 4 describes the methodology applied, section 5 presents our findings, and section 6 concludes.

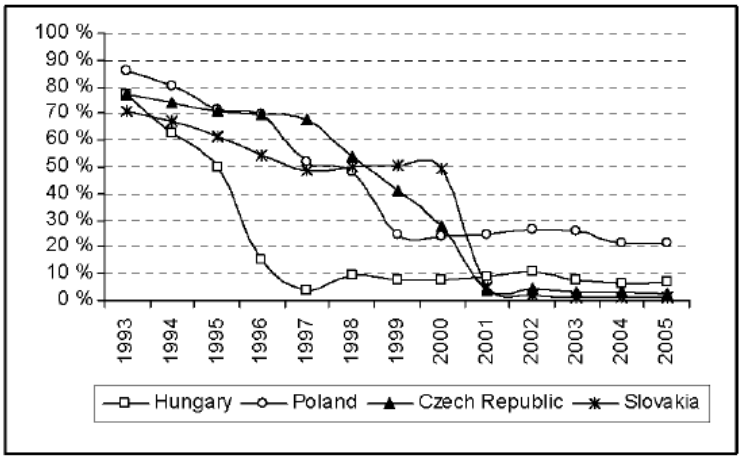
## 2. Czech Banking Sector and Research Hypotheses

The current commercial banking sectors in the Visegrad Four countries, i.e., Hungary, Poland, the Czech Republic, and Slovakia, emerged following the breakup of the state bank (monobank) system combined with the issuing of licenses to new banks. At the start of the transformation process, a two-tier banking system had to be created, with the central bank ensuring macroeconomic stability—and in the Czech case also supervision of commercial banks—and commercial banks contributing to efficient credit allocation. The Czech Republic, along with other post-communist countries, faced problems that made the transformation process difficult: (i) no managerial and supervisory know-how; (ii) no market history of potential lenders; (iii) great uncertainty regarding the outcome of entrepreneurial projects; (iv) inherited bad loans; and (v) no adequate legal framework and regulation (Tuma, 2002).

After the two-tier banking system was formed in 1990, the large Czech banks were transformed into joint-stock companies in 1992 and partially privatized. Nevertheless, the state kept controlling stakes in these banks until the late 1990s. Banking licenses were granted quite freely to newly created banks in the early 1990s and the market was opened to foreign bank branches. This led to a fast increase in the number of banks during this time period.

During the period of economic boom of 1994–1996, triggered by inflows of foreign short-term capital and subsequent growth of the money supply, serious problems started to emerge in the sector of small banks due to bad loans and other balance sheet weaknesses. The economic recession in 1997–1998 worsened the excessive credit risk that Czech banks had taken on owing to their poor corporate governance (Tuma, 2002). At the end of 1999, non-performing loans constituted more than 40% of the loans granted by large banks, while the same indicator for small Czech-owned banks even exceeded 50%.

***Figure 1: Proportion of State Control in the Visegrad Four Countries***




***Notes:*** Figure 1 shows the evolution of the proportion of state control in banks in the Visegrad Four countries as measured by the asset share of banks owned by the state. Source: Kocenda et al. (2007)

During the later stages of the transformation process in the second half of the 1990s, the share of foreign owners in the equity capital of Czech banks grew sharply. The new shareholders of Czech banks are foreign banks based mostly in Belgium, France, and Austria. The state is currently

involved in only two banks specializing in government programs in the areas of export promotion and support for small businesses. The overall evolution of bank privatization in the Czech Republic and the other Visegrad Four countries is summarized in Figure 1. Figure 1 shows the proportion of state control in banks as measured by the asset share of banks owned by the state. The Czech Republic managed to achieve full banking privatization by 2001, as observed by Kocenda et al. (2007).

As a result of the banking sector transformation and consolidation process there are currently 23 institutions that are holders of a banking license granted by the Czech National Bank in the Czech Republic. Moreover, almost 97% of the Czech banking sector's balance sheet assets are controlled by foreigners according to Financial Stability Report 2011/2012 issued by the CNB Financial Stability Department (2012).

Next, for our analysis we rely on the precondition that the composition of a bank's top management team affects corporate decision-making and, in turn, corporate outcomes, as supported, for example, by Graham et al. (2013) and Adams and Ferreira (2009). This allows for empirical examination of the research question in this paper. Furthermore, the project focuses on the following aspects to assess the effect of management board composition on bank risk-taking behavior:

***1. Average Age of Directors***

Empirical evidence suggests a negative relationship between age and risk-taking, as given by Campbell (2006) for investment behavior, Bucciol and Miniaci (2011) for households' risk attitudes, and Sahm (2007) and Grable et al. (2009) based on survey evidence. Therefore, we expect the coefficient for the average board age to have a negative sign in our analysis.

***2. Proportion of Female Directors***

There are two contrasting outlooks on how women affect economic outcomes. First, women are more risk averse than men in financial decision-making. This finding is supported by Jianakoplos and Bernasek (1998), Sunden and Surette (1998), and Agnew et al. (2003). Furthermore, women being less overconfident than men makes them less prone to making poor investment decisions, as shown by Barber and Odean (2001), Niederle and Vesterlund (2007), and Goel and Thakor (2008).

Second, in the corporate governance literature, female directors are, however, more likely to take risks than men (Adams and Funk, 2012). A number of studies show that female directors execute excessive monitoring, which reduces shareholder value (Almazan and Suarez, 2003; Adams and Ferreira, 2007), and make poorer investment decisions, as they face greater obstacles than men in gathering information (Bharath et al., 2009). Owing to the dual effect of women on risk-taking in the literature, both effects of female director representation in management boards—increasing as well as reducing risk-taking—should be investigated.

The effect of female representation in boards on economic outcomes is currently of particular interest due to the adoption of legislative measures regulating female board representation in some European countries (e.g. Norway, France, the Netherlands, and Belgium).

***3. Education Level***

There is a dual effect of directors' educational background on corporate risk behavior. First, the survey by Graham and Harvey (2001) shows that directors holding an MBA employ sophisticated

valuation techniques more than directors without such a degree. These sophisticated valuation methods should reduce the risks to the firm.

Second, directors with an MBA are also shown to be more aggressive and employ riskier firm policies (Bertrand and Schoar, 2003). Following Berger et al. (2014), who found a risk-reducing effect of directors with a PhD, we also focus in our analysis on the effect of directors holding a PhD on bank risk. As there are no directors holding both a PhD and an MBA in our sample, this allows us to check if managing directors holding different degrees affect bank riskiness differently. Overall, both the risk-reducing and risk-increasing effect of education on corporate risk-taking should be examined.

***4. Proportion of Non-national Directors***

The literature typically finds a positive effect of foreign directors on firm performance, as foreign directors might bring new technology and modern managerial techniques into the firm (e.g. Oxelheim and Randoy, 2003). On the other hand, Masulis et al. (2012) find that foreign independent directors can provide valuable international expertise and advice to firms but could weaken the board's monitoring and disciplining role. The European Commission's 2010 Green Paper (European Commission, 2010) shares this outlook, as it finds that "some interviewed companies highlighted the importance of foreign board members for international companies while others underlined the difficulties deriving from different cultural backgrounds and languages." Therefore, we hypothesize that foreign directors can either reduce bank riskiness via the modern managerial techniques and better skills they bring into the bank, or increase bank risk due to their unfamiliarity with local market or banking sector specificities and due to the obstacles they face in overcoming cultural and language barriers in the boardroom.

***5. Board Size***

There is a dual outlook in the corporate governance literature on the number of directors on management boards, i.e., board size. On the one hand, larger boards potentially offer more experience and knowledge and better advice (Dalton et al., 1999) as well as assigning more people to supervision. On the other hand, boards with too many directors face considerable problems with coordination, communication, and decision-making (Lipton and Lorsch, 1992; Jensen, 1993). Greater difficulty in achieving compromises in large decision-making groups results in bigger boards adopting less extreme decisions (e.g. Nakano and Nguyen, 2012). This leads to the hypothesis that larger boards are associated with lower corporate risk-taking.

***6. Director Tenure***

There is again a dual outlook in the literature on the impact of director tenure on firm performance and, by extension, on firm risk as one of the attributes of firm performance. Huang (2013) finds that board tenure can be positively or negatively related to firm value depending on firm characteristics. In more complex firms with greater advisory needs, board members are more likely to require more time to gain sufficient knowledge to perform appropriate strategic decision-making. Consequently, the quality of board advice and expertise increases over time, with positive implications for firm performance. However, as the effect of board tenure is determined by the trade-off between the marginal benefits of learning and the marginal costs of entrenchment, Huang (2013) also finds that the marginal costs of entrenchment might quickly dominate over the benefits of learning in firms with greater monitoring needs. This implies decreasing firm value with increasing board

tenure. Therefore, we hypothesize that the effect of board tenure can be either risk-increasing or risk-reducing depending on bank characteristics.

# 3. Data Set and Descriptive Statistics

To investigate the effect of management board composition on risk-taking, we need to combine two types of data sets. The first data set is prepared by the author from the annual reports of 21 Czech institutions holding a banking license granted by the Czech National Bank.[1] This data set is unique and includes selected information on banks' management board members. In particular, we collect data on the average age of directors, the size of the management board, the average length of time directors hold their positions, the proportion of female directors, the proportion of directors holding a PhD or an MBA, and the proportion of non-national directors.[2]. The management board descriptive statistics and their evolution are presented in subsection 3.3.

The second data set contains financial data on individual banks extracted primarily from the Bankscope database. As described in section 2, the 1990s were a turbulent time for the Czech Republic, characterized by banking privatization and consolidation of the banking sector. Moreover, by 2001 full banking privatization had been achieved (Kocenda et al., 2007) and the Czech banking sector had gained its current defining characteristics, for example, in terms of being almost exclusively owned by foreign investors (Tuma, 2002; CNB Financial Stability Department, 2012). For the reasons given above, and to control for potential bank survivor bias, the combined data set covers the period of 2001–2012. The descriptive statistics of banks' financial variables are presented in subsection 3.3.

## 3.1 Bank Risk Measures

In this subsection we discuss various approaches to quantifying bank risk and classify them into three broad types of risk measures.

### *1. Market-based Indicators of Bank Risk*

Some studies investigate the impact of bank board composition on risk-taking using market-based measures of risk (Pathan, 2009; Erkens et al., 2012). Pathan (2009), for instance, derives measures of total risk, systematic risk, and idiosyncratic risk by using bank equity returns, among other indicators. The advantage of these measures is that they reflect the market's perceptions about the risks inherent in the bank's asset, liability, and off-balance sheet positions. However, these measures cannot be used to capture the riskiness of Czech banks owing to the fact that in the Czech Republic, similar to other post-transition countries of the CEE region, banks are not commonly listed on stock exchanges, so their shares are not publicly traded.

[1] The remaining two banks, which are also holders of banking licenses, are excluded from the analysis, as, unlike other commercial banks, they primarily serve government schemes in the areas of export support and assistance for small businesses. Moreover, they are state-controlled and, as such, management board decisions in these banks might be motivated by other factors than those in their privately-owned counterparts.

[2] Despite the evidence provided by Minton et al. (2014) on the importance of directors' financial expertise in bank risk-taking, our analysis does not consider this director characteristic due to data limitations.

### *2. Conventional Indicators of Bank Risk*

The Z-score has been frequently used to analyze the determinants of bank risk-taking in the pre-crisis period (e.g. Laeven and Levine, 2009; Foos et al., 2010; Altunbas et al., 2012; Demirguc-Kunt and Huizinga, 2010). Moreover, the measure has been widely used to capture bank stability in studies investigating the relationship between bank competition and financial stability—Agoraki et al. (2011), Anginer et al. (2014), Berger et al. (2009), Nicolo and Loukoianova (2007), and Cihak and Hesse (2010), to mention the most prominent ones. The Z-score indicates how many standard deviations in the return on assets a bank is away from insolvency and, by extension, the likelihood of failure:

$$Z\text{-}score_{i,t} = \frac{ROA_{i,t} + E_{i,t}/TA_{i,t}}{sROA_{i,t}}, \tag{1}$$

where $i$ takes values from bank 1 to bank 21 and $t$ indicates a year from 2001 to 2012. $ROA_{i,t}$ captures the return on assets of bank $i$ at time $t$, $E_{i,t}/TA_{i,t}$ measures the ratio of a bank's equity capital to its total assets, and $sROA_{i,t}$ measures the volatility of a bank's return on assets calculated as a three-year moving average.

Another popular risk proxy is the ratio of non-performing loans to total bank loans (the NPL ratio). This is a measure of credit quality with regard to banks' lending practices. Similarly to the Z-score, the NPL ratio is used abundantly as a fragility indicator in the bank competition-stability literature—see, for example, Cihak and Schaeck (2012), Agoraki et al. (2011), Yeyati and Micco (2007), and Berger et al. (2009). Nevertheless, the NPL ratio only covers credit risk and cannot be directly linked to the likelihood of bank failure (Beck, 2008).

Next, the volatility of the return on assets (sROA), calculated as a three-year moving average, is also used as a proxy for bank risk. This measure of individual bank distress focuses on bank profitability, in particular on the volatility of bank profits, and is frequently used in the literature along with other indicators of bank risk, i.e., the Z-score and the NPL ratio (Beck et al., 2013; Cihak and Schaeck, 2012; Uhde and Heimeshoff, 2009; Liu et al., 2012).

As the last proxy for bank risk we focus on bank liquidity risk. Several indicators can be used to capture bank liquidity, for example the ratio of quick assets to total assets, the ratio of time deposits to total deposits, the ratio of quick assets to client deposits, or the ratio of client deposits to total client loans. In addition to liquidity stress tests, these measures of liquidity are tracked for the purposes of analyzing the liquidity position of the Czech banking sector by the CNB Financial Stability Department (2015). In our analysis, we use the ratio of liquid assets to customers' deposits and short-term funding (LAsfund). This measure allows us to understand whether the buffer of liquid assets held by a bank will be sufficient to meet its short-term liabilities. Bonfim and Kim (2012) advocate the use of this indicator due to its closeness to the international regulatory framework on liquidity risk, which is a part of the Basel III regulatory package. In particular, the liquidity coverage ratio (LCR) proposed in Basel III captures the short-term resilience of the liquidity risk profile of a bank, i.e., the stock of liquid assets that can be easily and immediately converted into cash to meet a bank's liquidity needs.

Despite the ease of use of these bank risk proxies and their simplicity and popularity in the literature, they are derived from banks' financial reports and, as such, are inherently backward-looking.

***3. Efficiency-based Indicators of Bank Risk***

Podpiera and Weill (2009) derive a new measure of excessive bank risk-taking based on the application of the Markowitz portfolio approach to Czech banks. First, they compute the risk and return for each category of loans at the country level (i.e., aggregated across all banks). They then apply the portfolio approach to estimate the efficient frontier, i.e., the combinations of shares of loan categories that produce the least risk for a given return. To obtain a measure of excessive risk-taking for the Czech banking sector in each time period, they compare the actual outcome to the efficient frontier. Regarding the definition of risk, Podpiera and Weill (2009) assume that the interest rate charged on loans includes ex ante risk compensation, i.e., based on clients' overall creditworthiness. This, however, does not distinguish whether the riskiness stems from differences in maturity or differences in creditworthiness for different loan categories in a bank's portfolio. In contrast to some conventional measures of risk, such as the NPL ratio, which measure the ex post realized risk, the measure by Podpiera and Weill (2009) is oriented towards ex ante risk assessment.

Moreover, this measure reflects changes in the exposure structure rather than business cycle fluctuations. The authors therefore suggest that it could serve as a complementary indicator to the conventional NPL ratio, which reflects the business cycle only.

However, a significant reallocation might violate an assumption of the portfolio approach used to construct this measure, i.e., the assumption of an exogenous relationship between the shares of loans in each category and the return and risk characteristics of each category of loans. Furthermore, Podpiera and Weill (2009) are restricted in the construction of their measure to the period from January 2005 to February 2008 due to data availability issues. This hinders the applicability of this measure in earlier years in our analysis and would ultimately lead to a further shortening of our data set.

In another study, Podpiera and Weill (2007) attempt to identify whether the conventional NPL ratio or bank cost efficiency is the key determinant of bank failures. They provide clear support for the bad management hypothesis, according to which deteriorations in cost efficiency precede increases in non-performing loans, and reject the bad luck hypothesis, which predicts the reverse causality.

To conclude the discussion of potential risk indicators, market-based measures cannot be used to address our research question, as Czech banks' shares are not traded on the stock market. Efficiency-based indicators, despite their usefulness, are subject to data issues and would thus hinder our analysis in the years preceding 2005. Consequently, for analyzing how management board composition affects bank risk-taking we use the four conventional indicators of bank risk, i.e., the Z-score, the NPL ratio, profit volatility, and the ratio of liquid assets to customers' deposits and short-term funding. In addition, the use of these indicators will make our results consistent and comparable to most studies dealing with board composition issues, as performance indicators extracted from financial reports are used abundantly in the literature.

## 3.2 Bank Control Variables

To estimate the effect of management board composition on bank risk, we also need to control for individual bank characteristics in our analysis, by including the following variables:

First, ***bank size***, expressed as the ratio of a bank's total assets to the Czech banking sector's total assets, accounts for the fact that larger banks have a greater capacity to absorb risk and that some banks are too big to fail. Therefore, a positive relation is expected between bank size and risk-taking.

Second, the ***logarithm of total assets*** is added to account for asset growth in first differences. In times of fast asset growth, banks are characterized by a different amount of risk-taking.

Third, according to Keeley (1990) incentives to take risks are reduced if a bank has a large charter value. ***Charter value*** can be defined as the future economic rents a bank can obtain from its access to markets that are to a large extent protected from competition. Hutchison and Pennacchi (1996) show that the ratio of demand deposits to total deposits is a good proxy for a bank's charter value. A negative relation is expected between risk-taking and charter value.

Fourth, the ***share of Tier 1 capital in total capital***, calculated as the ratio of Tier I capital to Tier I and Tier II capital, is also included, as capital increases monitoring and reduces moral hazard incentives (Morrison and White, 2004; Allen et al., 2011). Thus, a negative relation is expected between Tier I capital share and risk-taking.

Fifth, a ***merger dummy*** that takes a value of one if the bank engaged in a merger and zero otherwise should be included, as mergers often coincide with board composition changes.

Sixth, to incorporate macroeconomic conditions, ***year dummies*** are included. They account for common shocks in the market and regulatory environment.

Last, the ***parent bank's risk appetite*** needs to be accounted for in the analysis, as almost 97% of the Czech banking sector's balance sheet assets are controlled by foreigners (CNB Financial Stability Department, 2012). This control assumes that there is a link between the riskiness of the foreign parent bank and its Czech affiliate. It is measured in the same way as domestic bank risk-taking to keep the analysis consistent.

The final data set is of annual frequency. Table 1 provides an overview of the data and lists the sources for each variable.

***Table 1: Overview of Variables in the Data Set***

| Variable | Expected sign | Description | Source |
|---|---|---|---|
| **Risk measures** | | | |
| NPLL | | Share of non-performing loans in total loans | Bankscope |
| LAsfund | | Ratio of liquid assets to deposits and short-term funding | Bankscope |
| Z | | Z-score (profitability and capitalization over volatility of profits, calculated over 3-year period) | Bankscope |
| sROA | | 3-year ROA volatility | Bankscope |
| **Board variables** | | | |
| Boardsize | +/- | Number of directors on management board | Annual reports |
| Avrage | - | Average age of directors | Annual reports |
| Avrboardten | +/- | Average number of years over which directors hold their positions on board | Annual reports |
| Sharefem | +/- | Proportion of female directors on board | Annual reports |
| SharePhD | - | Proportion of directors with PhD on board | Annual reports |
| ShareMBA | +/- | Proportion of directors with MBA on board | Annual reports |
| Shareforeign | +/- | Proportion of foreign directors on board | Annual reports |
| **Control variables** | | | |

Continued on next page

***Table 1: Overview of Variables in the Data Set (continued)***

| Variable | Expected sign | Description | Source |
|---|---|---|---|
| TAg | + | Growth rate of total bank assets | Bankscope |
| Banksize | + | Share of bank's total assets in banking sector's total assets | Bankscope |
| Charterval | - | Bank's demand deposits over total deposits, used as proxy for charter value | Bankscope |
| Tier1 | - | Share of Tier I capital in bank's capital | ICD |
| MergerDummy | | equals 1 if bank engaged in merger in given year | Annual reports |
| Dbank | | equals 1 if institution is general commercial bank | |
| DS | | equals 1 if institution is building society | |
| Dlar | | equals 1 if Banksize exceeds 75th percentile | |
| Dbetter | | equals 1 if Tier 1 is above median value | |
| Dadeq | | equals 1 if Tier 1 is below median value | |
| **Parent bank risk measures** | | | |
| mNPLL | | Parent bank's share of non-performing loans in total loans | Bankscope |
| mLAsfund | | Parent bank's ratio of liquid assets to deposits and short-term funding | Bankscope |
| mZ | | Parent bank's Z-score (profitability and capitalization over volatility of profits, calculated over 3-year period) | Bankscope |
| msROA | | Parent bank's 3-year ROA volatility | Bankscope |

***Notes:*** The expected signs should be reversed for the Z-score and the ratio of liquid assets to deposits and short-term funding, as these are proxies for bank stability as opposed to bank riskiness. Equation 1 provides the definition of the Z-score. ICD = the Czech National Bank's internal regulatory information database.

### 3.3 Descriptive Analysis of the Czech Banking Sector

We now turn to a descriptive analysis of the data set that was introduced in the first part of section 3. We divide all Czech banks in the sample into categories by their business model, size, and capitalization and provide their descriptive statistics.

By **business model**, Czech banks can be divided into general commercial banks and building societies, a specialized type of banks that concentrate on gathering savings for home construction purposes and providing loans for new home construction and renovation and whose product receives state support. In the Czech Republic there are currently five building societies and 16 general commercial banks that we include in the sample. The state is involved in the remaining two banks, which serve specific government schemes and are thus excluded from our analysis.

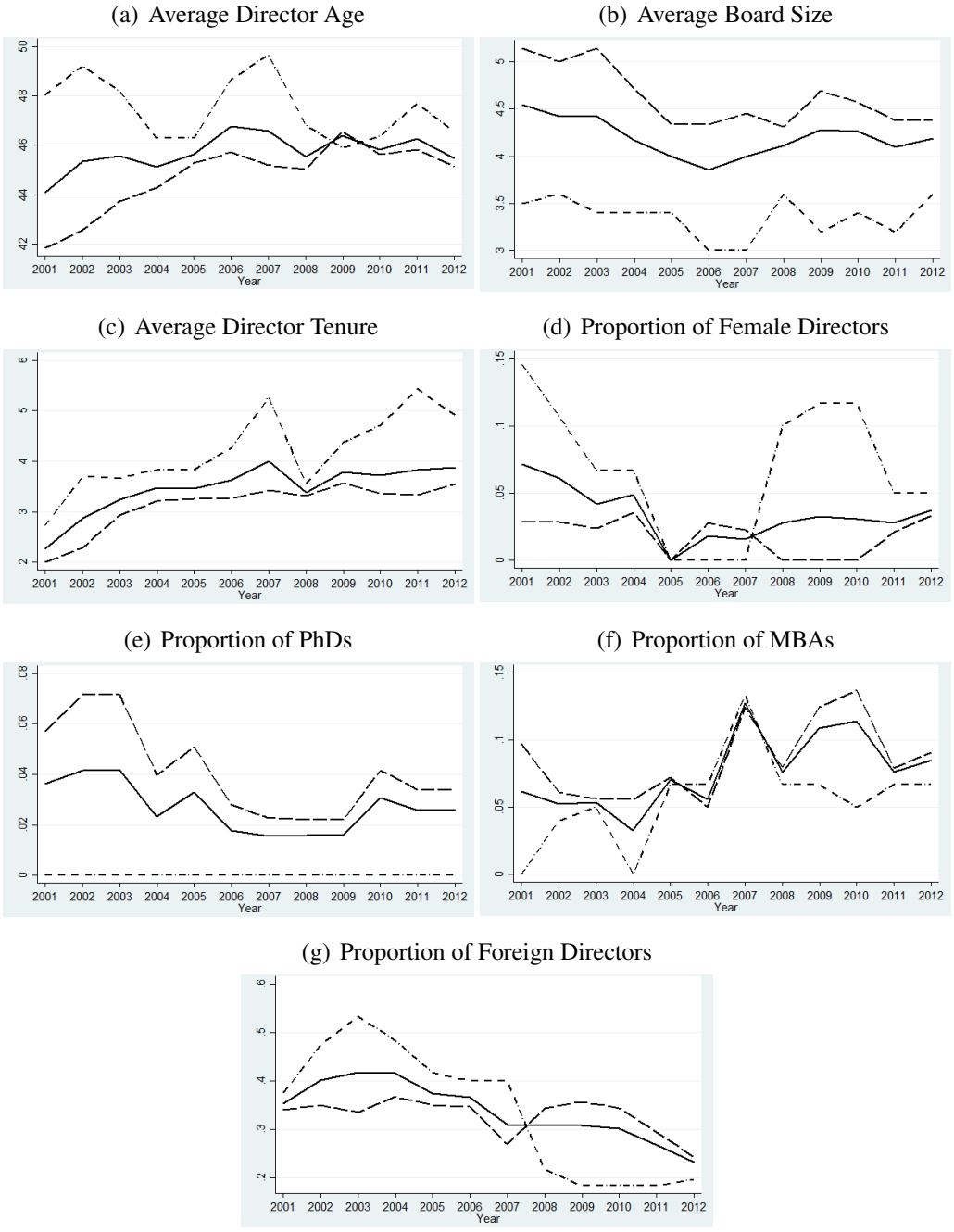
As to the **size** of Czech banks, we categorize them as large banks when the share of their total assets in the Czech banking sector's total assets exceeds the 75th percentile of the distribution. Otherwise, we classify them as small or mid-sized banks. This condition essentially divides banks into the top five largest banks in the Czech Republic and the remaining 16 banking institutions.

As for **capitalization**, we put banking institutions whose Tier I ratio exceeds the mean of the distribution into the category of banks that are better-than-sufficiently capitalized. On the other hand, banks with a Tier I ratio below the mean belong in the category of sufficiently capitalized banks. According to CNB Financial Stability Department (2012) the Czech banking sector maintains quite

high overall and Tier 1 capital adequacy ratios, with only a small proportion of banks (representing 5.1% of the sector's total assets) not exceeding the prescribed capitalization levels.

Figure 2 shows the evolution of the management board characteristics over 2001–2012 for all Czech banks in the sample as well as for general commercial banks and building societies.

***Figure 2: Evolution of Management Board Characteristics***




***Notes:*** The solid line represents the evolution of management board characteristics for all Czech banking institutions in the sample. The dashed line represents general commercial banks, while the dash-dot line represents Czech building societies.
***Source:*** Author's calculations.

From Figure 2 we observe that average director age and tenure increased over 2001–2012, while average board size decreased over the same period. However, for Czech building societies board size did not change much on average. Overall, the proportion of women on management boards fell, with the exception of general commercial banks, for which this proportion fluctuates over time. As for the education level of directors, the proportion of directors holding a PhD on the management boards of all banking institutions and general commercial banks decreased , whereas there were no directors with a PhD on the boards of building societies at any time over the sample period. On the other hand, the proportion of directors with an MBA rose over time for the entire sector and for building societies. In general commercial banks, the proportion of directors holding an MBA appears to be similar at the sample end to that in 2001. The proportion of non-national directors decreased over time in general commercial banks while falling more dramatically in building societies over 2001–2012. Table 2 presents an overview of management board characteristics for the individual categories of banking institutions.

***Table 2: Management Board Characteristics by Bank Category***

| **Variable** | *No. of obs* | *Mean* | *Std. Dev.* | *Min* | *Max* | *No. of obs* | *Mean* | *Std. Dev.* | *Min* | *Max* |
|---|---|---|---|---|---|---|---|---|---|---|
| | **General commercial banks** | | | | | **Building societies** | | | | |
| Avrage | 129 | 45.03 | 5.32 | 35.75 | 62.67 | 59 | 47.47 | 4.59 | 37.00 | 57.67 |
| Avrboardten | 129 | 3.23 | 2.28 | 0.00 | 9.60 | 59 | 4.21 | 2.07 | 0.33 | 8.33 |
| Boardsize | 129 | 4.56 | 1.60 | 2.00 | 9.00 | 59 | 3.36 | 0.55 | 3.00 | 5.00 |
| Sharefem | 129 | 0.02 | 0.06 | 0.00 | 0.33 | 59 | 0.07 | 0.12 | 0.00 | 0.33 |
| SharePhD | 129 | 0.04 | 0.10 | 0.00 | 0.40 | 59 | 0.00 | 0.00 | 0.00 | 0.00 |
| ShareMBA | 129 | 0.09 | 0.13 | 0.00 | 0.67 | 59 | 0.06 | 0.12 | 0.00 | 0.33 |
| Shareforeign | 129 | 0.32 | 0.28 | 0.00 | 1.00 | 59 | 0.34 | 0.22 | 0.00 | 0.67 |
| | **Large banks** | | | | | **Small and mid-sized banks** | | | | |
| Avrage | 47 | 48.71 | 3.48 | 40.29 | 54.25 | 141 | 44.82 | 5.34 | 35.75 | 62.67 |
| Avrboardten | 47 | 4.59 | 2.75 | 0.00 | 9.60 | 141 | 3.18 | 1.96 | 0.00 | 8.33 |
| Boardsize | 47 | 6.13 | 1.24 | 4.00 | 9.00 | 141 | 3.53 | 0.82 | 2.00 | 7.00 |
| Sharefem | 47 | 0.00 | 0.00 | 0.00 | 0.00 | 141 | 0.04 | 0.10 | 0.00 | 0.33 |
| SharePhD | 47 | 0.08 | 0.12 | 0.00 | 0.40 | 141 | 0.01 | 0.05 | 0.00 | 0.33 |
| ShareMBA | 47 | 0.11 | 0.11 | 0.00 | 0.33 | 141 | 0.07 | 0.13 | 0.00 | 0.67 |
| Shareforeign | 47 | 0.35 | 0.18 | 0.00 | 0.67 | 141 | 0.32 | 0.28 | 0.00 | 1.00 |
| | **Better capitalized banks** | | | | | **Sufficiently capitalized banks** | | | | |
| Avrage | 68 | 45.54 | 4.43 | 35.75 | 54.25 | 120 | 45.94 | 5.62 | 36.00 | 62.67 |
| Avrboardten | 68 | 3.69 | 2.31 | 0.00 | 9.60 | 120 | 3.45 | 2.23 | 0.00 | 9.60 |
| Boardsize | 68 | 4.04 | 1.24 | 3.00 | 9.00 | 120 | 4.26 | 1.59 | 2.00 | 9.00 |
| Sharefem | 68 | 0.03 | 0.09 | 0.00 | 0.33 | 120 | 0.03 | 0.09 | 0.00 | 0.33 |
| SharePhD | 68 | 0.02 | 0.07 | 0.00 | 0.40 | 120 | 0.03 | 0.09 | 0.00 | 0.33 |
| ShareMBA | 68 | 0.09 | 0.13 | 0.00 | 0.33 | 120 | 0.07 | 0.13 | 0.00 | 0.67 |
| Shareforeign | 68 | 0.27 | 0.28 | 0.00 | 1.00 | 120 | 0.36 | 0.25 | 0.00 | 1.00 |

***Notes:*** The table presents descriptive statistics for board variables by bank category. Banking institutions with a Tier I ratio greater than the median constitute better-than-sufficiently capitalized banks, while those with a Tier I ratio smaller than the median form the sufficiently capitalized bank group. Banks whose share in the Czech banking sector's assets exceeds the 75th percentile constitute large banks. Banks with a lower asset share are defined as small and mid-sized banks. The definitions of the variables can be found in Table 1.
***Source:*** Author's calculations.

By dividing banking institutions into general commercial banks and building societies, we can observe that directors on management boards in general commercial banks are two years younger on

average and hold their positions on the board for one year less on average. Moreover, the boards of general commercial banks are more than one board member larger on average and have a greater share of directors with an MBA. In comparison, building societies' boards have a larger proportion of female and non-national directors, while there were no directors with a PhD in building societies over the sample period.

Table 2 shows that large banks have directors who are almost four years older on average and hold their positions on the board more than one year longer on average than managing directors in small and medium-sized banks. Large banks also have boards that are almost three board members larger on average and have more directors holding a PhD or an MBA. Similarly, slightly more foreign directors sit on management boards in large banks, while there were no female directors on management boards in large banks.

The two categories of banks in terms of capitalization have directors of comparable age on their management boards. However, directors in better-than-sufficiently capitalized banks stay on boards slightly longer, while sufficiently capitalized banks tend to have slightly larger boards. The two categories have the same proportion of women on the board on average, while sufficiently capitalized banks have more non-national directors. As for education level, there are more directors holding an MBA on the boards of better capitalized banks, whereas sufficiently capitalized banks tend to have more directors with a PhD.

***Table 3: Financial Variables by Bank Category***

| **Variable** | *Unit* | *No. of obs* | *Mean* | *Std. Dev.* | *Min* | *Max* | *No. of obs* | *Mean* | *Std. Dev.* | *Min* | *Max* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **General commercial banks** | | | | | **Building societies** | | | | |
| NPLL | ratio | 108 | 0.06 | 0.05 | 0.00 | 0.25 | 25 | 0.02 | 0.01 | 0.01 | 0.04 |
| LAsfund | % | 124 | 41.20 | 39.03 | 0.62 | 367.18 | 49 | 15.21 | 11.83 | 0.06 | 47.44 |
| logZ | log | 125 | 3.99 | 1.09 | 1.51 | 7.44 | 44 | 3.75 | 0.95 | 2.32 | 7.45 |
| sROA | std.dev. | 125 | 0.39 | 0.46 | 0.01 | 2.92 | 44 | 0.16 | 0.11 | 0.00 | 0.44 |
| TAg | change | 112 | 0.16 | 0.26 | -0.12 | 2.31 | 56 | 0.11 | 0.11 | -0.01 | 0.57 |
| Charterval | ratio | 104 | -0.01 | 0.14 | -0.56 | 0.41 | 43 | 0.00 | 0.01 | -0.01 | 0.03 |
| Tier1 | ratio | 130 | 0.90 | 0.11 | 0.60 | 1.33 | 28 | 0.96 | 0.10 | 0.72 | 1.10 |
| | | **Large banks** | | | | | **Small and mid-sized banks** | | | | |
| NPLL | ratio | 44 | 0.05 | 0.04 | 0.01 | 0.24 | 89 | 0.06 | 0.05 | 0.00 | 0.25 |
| LAsfund | % | 47 | 37.21 | 19.90 | 11.82 | 79.03 | 126 | 32.58 | 39.89 | 0.06 | 367.18 |
| logZ | log | 47 | 3.99 | 0.97 | 1.65 | 5.51 | 122 | 3.91 | 1.10 | 1.51 | 7.45 |
| sROA | std.dev. | 47 | 0.27 | 0.27 | 0.04 | 1.26 | 122 | 0.35 | 0.46 | 0.00 | 2.92 |
| TAg | change | 46 | 0.06 | 0.08 | -0.12 | 0.44 | 122 | 0.18 | 0.25 | -0.12 | 2.31 |
| Charterval | ratio | 46 | -0.02 | 0.14 | -0.56 | 0.19 | 101 | 0.00 | 0.11 | -0.44 | 0.41 |
| Tier1 | ratio | 45 | 0.89 | 0.10 | 0.70 | 1.01 | 113 | 0.92 | 0.12 | 0.60 | 1.33 |
| | | **Better capitalized banks** | | | | | **Sufficiently capitalized banks** | | | | |
| NPLL | ratio | 58 | 0.06 | 0.05 | 0.00 | 0.25 | 75 | 0.05 | 0.05 | 0.00 | 0.24 |
| LAsfund | % | 66 | 38.44 | 49.59 | 0.06 | 367.18 | 107 | 31.00 | 22.93 | 0.68 | 137.01 |
| logZ | log | 61 | 4.12 | 1.01 | 1.51 | 7.45 | 108 | 3.82 | 1.08 | 1.65 | 7.44 |
| sROA | std.dev. | 61 | 0.29 | 0.38 | 0.00 | 2.12 | 108 | 0.35 | 0.43 | 0.01 | 2.92 |
| TAg | change | 62 | 0.14 | 0.31 | -0.05 | 2.31 | 106 | 0.15 | 0.15 | -0.12 | 0.73 |
| Charterval | ratio | 59 | -0.01 | 0.13 | -0.56 | 0.36 | 88 | -0.01 | 0.11 | -0.44 | 0.41 |
| Tier1 | ratio | 72 | 1.00 | 0.05 | 0.96 | 1.33 | 86 | 0.83 | 0.09 | 0.60 | 0.96 |

***Notes:*** The table presents descriptive statistics for financial variables by bank category. Banking institutions with a Tier I ratio greater than the median constitute better-than-sufficiently capitalized banks, while those with a Tier I ratio smaller than the median form the sufficiently capitalized bank group. Banks whose share in the Czech banking sector's assets exceeds the 75th percentile constitute large banks. Banks with a lower asset share are defined as small and mid-sized banks. The descriptive statistics presented in this table are for stationary variables. The definitions of the variables can be found in Table 1.
***Source:*** Author's calculations.

We now turn to the breakdown of financial variables in the sample by bank category.

Table 3 shows that compared to building societies, general commercial banks are slightly more stable overall as measured by the Z-score and enjoy almost three times more liquidity at their disposal on average (CNB Financial Stability Department, 2012). However, the lower liquidity levels in Czech building societies can be justified by their business model and by the type of loans these institutions provide. On the other hand, general commercial banks have more than twice the profit volatility and a greater share of non-performing loans in their loan portfolios compared to building societies. In contrast, building societies are slightly better capitalized. In terms of asset growth, general commercial banks dominate the segment of building societies. This can be attributed to a drop in their share in house purchase loans, the growing segment of mortgage loans, and migration of clients to competing mortgage banks when refinancing their house purchase loans (CNB Financial Stability Department, 2012).

Large banks have higher share of liquid assets in customers' deposits and short-term funding on average, indicating more liquidity at their disposal. Moreover, large banks have a marginally higher Z-score compared to the segment of small and mid-sized banks. Small and mid-sized banks, on the other hand, have a comparable ratio of non-performing loans and slightly higher volatility in their return on assets (sROA), which points to greater profit volatility. The segment of small and mid-sized banks is slightly better capitalized, having a higher Tier I ratio on average. Over the sample period, the assets of small and mid-sized banks grew three times faster than those of large Czech banks.

As for better-than-sufficiently capitalized and sufficiently capitalized banks, most of the financial variables presented in Table 3 are comparable in magnitude for the two groups. However, better capitalized banks have more liquidity at their disposal as measured by the ratio of liquid assets to deposits and short-term funding.

# 4. Methodology

## 4.1 Discussion of Endogeneity and Estimation Approach

Endogeneity is a frequent problem in corporate governance analysis (Hermalin and Weisbach, 2003). In our case, not only does board composition affect risk-taking, but the reverse implication (risk-taking affecting management board composition) might also be an issue. Wooldridge (2001) advises to apply a transformation that eliminates unobserved effects and instruments that deal with endogeneity for models that violate the strict exogeneity condition. Therefore, we use the two-step system estimator (SE) with standard errors adjusted for potential heteroskedasticity (Arellano and Bond, 1988) to estimate the model specified as follows:

$$Bank\ risk\text{-}taking_{i,t} = \alpha + \sum_{j}[\beta_j * board\ variables^{j}_{i,t}] + y * control\ variables_{i,t} + \varepsilon_{i,t}. \qquad (2)$$

where $i$ takes values from bank 1 to bank 21, $j$ denotes board variables from 1 to 7 and $t$ indicates a year from 2001 to 2012. The parameter $\beta$ captures the impact of management board composition on risk-taking. The board variables in Equation 2 are the variables of interest whose effect on bank risk-taking we primarily study. The full list of board variables can be found in Table 1 in section 3. In order to quantify the effect of board variables on risk-taking, we also control for the variables that could potentially affect a bank's risk appetite. These variables are also listed in Table 1 under Control variables and Parent bank risk measures.

The method by Arellano and Bond (1988) requires us to transform the variables into first differences to account for the unobserved effect and then to use generalized method of moments (GMM) estimation to deal with endogeneity. Next, to perform the estimation we need to build instruments for variables that are potentially endogenous. The logic is that lagged board variables can be used as instruments owing to the fact that board variables in earlier years could not have resulted from bank risk-taking in subsequent years. Moreover, since the sample size for the Czech Republic is not large, we also apply the small sample size adjustment by Windmeijer (2005). This adjustment should improve the robustness of the results and prevent any downward bias in the estimated asymptotic standard errors. We report the GMM estimation results for all the dependent variables, in which we include all seven board variables from Table 1, in Table B1.

Despite the fact that we use only one lag of each board variable as instruments and collapse them, the GMM estimation of our model in Table B1 suffers from the problem of too many instruments. According to Roodman (2006) a finite sample may lack enough information to estimate such a large matrix well. Our sample is quite small in both the time and cross-sectional dimension, causing the instrument collection in the GMM to overfit the endogenous variables. In addition, the problem of too many instruments weakens the Sargan/Hansen instrument validity test to the point where it generates implausibly good p values of 1.000, as is the case in Table B1.

Due to the small size of the sample, we turn to instrumental variable regressions to test the validity and exogeneity of the instruments. We estimate the model in Equation 2 by means of two-stage least squares (2SLS) regressions, where the exogeneity of director characteristics, i.e., the proportion of female directors, the proportion of directors holding a PhD or an MBA, and the proportion of foreign directors, was tested in separate regressions. Up to three lags of each director variable were used as instruments. The 2SLS results are reported in Appendix B.

The J statistic of the Sargan-Hansen test of validity of the instruments used and their correct exclusion from the estimated equation, and the C statistic of the test of exogeneity of director characteristics are reported in Table B2, Table B3, and Table B4 for regressions with different dependent variables. The null hypotheses of instrument validity and exogeneity of director variables cannot be rejected at the 5% significance level in all but one of the regression specifications. In instrumenting the effect of the proportion of directors with a PhD on bank risk as measured by the NPL ratio, the null of instrument validity is not rejected. This might invalidate the effect of directors holding a PhD on bank risk as reported in Table B2.

Having confirmed the absence of endogeneity of director characteristics, we can now estimate the model in Equation 2 by taking into account specific features of each bank in the sample (e.g. management style, business strategy), i.e., unobservable and constant heterogeneity. For this purpose we use the data set in a panel structure to deal with the presence of unobservable fixed effects associated with each commercial bank and correlated with the rest of the explanatory variables (Andres and Vallelado, 2008). The approach follows Liang et al. (2013), who estimate the impact of bank board characteristics on bank performance in China.

## 5. Empirical Results

Based on the discussion and results of the endogeneity testing in section 4, we analyze the impact of board and bank characteristics on bank risk-taking by means of fixed effects panel regressions and estimate the model specified in Equation 2. In all regressions, we regress the risk-taking proxy on the set of board variables, i.e., board size, director age, and director tenure. Next, we add ad-

ditional director characteristics in separate regressions, i.e., the proportion of female directors, the proportion of directors with a PhD, the proportion of directors holding an MBA, and the proportion of non-national directors. As we run a large number of regressions in our analysis (four regressions with director characteristics added separately for each of the four risk-taking dependent variables in the baseline analysis and the same number for each segment of Czech banks), we report in subsection 5.1 and subsection 5.2 only those regressions in which either director or board characteristics emerged as significant.

### 5.1 Baseline Model

Table 4 presents calculations of the impact of board and bank financial variables on each of the bank risk proxies for all Czech banks in the sample.

For the Czech banking sector overall, *board size, director age, and director tenure* do not affect bank riskiness as measured by any of the four risk proxies. Table 4, however, shows that a larger *proportion of non-national* directors on the board reduces bank stability as captured by the Z-score and increases bank profit volatility as measured by ROA volatility. A higher proportion of directors holding an MBA also increases bank risk as measured by ROA volatility. This finding is in line, for example, with Bertrand and Schoar (2003), who show that directors with an MBA are more aggressive and employ riskier firm policies. As for the risk-increasing effect of foreign directors, this result is contrary to the effect commonly found in the literature that foreign directors improve firm performance (Oxelheim and Randoy, 2003). Our finding, however, supports the hypothesis that foreign directors might face obstacles in overcoming cultural and language barriers in the boardroom and suffer from unfamiliarity with local market specificities, which, in turn, translate into increased bank risk (Masulis et al., 2012; European Commission, 2010).

***Table 4: Impact of Board Characteristics on Bank Risk—Baseline Model***

| *VARIABLES* | **NPLL** | **logZ** | **sROA** | **sROA** | **LAsfund** |
|---|---|---|---|---|---|
| Avrage | -0.00142 | -0.00178 | 0.00182 | 0.00481 | -0.0538 |
| | (0.00134) | (0.0346) | (0.00823) | (0.00633) | (0.582) |
| Boardsize | -0.00199 | -0.136 | 0.0244 | 0.0373 | -0.388 |
| | (0.00280) | (0.0962) | (0.0148) | (0.0272) | (1.133) |
| AvrBoardten | 0.00246 | -0.000296 | -0.0186 | -0.0112 | 2.211 |
| | (0.00215) | (0.122) | (0.0231) | (0.0266) | (1.762) |
| TAg | -0.121*** | 0.640 | -0.363 | -0.335 | 1.297 |
| | (0.0272) | (0.664) | (0.284) | (0.208) | (12.57) |
| Banksize | 0.344 | -35.77** | 9.268** | 9.520*** | 113.1 |
| | (0.215) | (16.12) | (3.264) | (2.797) | (336.7) |
| Charterval | 0.0700*** | -0.822 | -0.0773 | -0.0513 | -1.957 |
| | (0.0195) | (0.757) | (0.131) | (0.115) | (12.50) |
| MergerDummy | 0.00398 | 0.0312 | -0.0196 | 0.000872 | 10.00 |
| | (0.00904) | (0.380) | (0.0680) | (0.0656) | (9.261) |
| Tier1 | -0.0586*** | 2.754 | -0.767** | -0.836** | 1.081 |
| | (0.0167) | (2.301) | (0.353) | (0.302) | (31.60) |
| Parent bank risk | 0.137*** | 0.180* | 0.0556 | 0.0538 | 0.437** |
| | (0.0189) | (0.0965) | (0.0349) | (0.0340) | (0.158) |
| ShareMBA | | | 0.186* | | |
| | | | (0.102) | | |
| Shareforeign | -0.0201 | -1.708** | | 0.623* | 13.59 |
| | (0.0322) | (0.667) | | (0.354) | (13.06) |

Continued on next page

***Table 4: Impact of Board Characteristics on Bank Risk—Baseline Model (continued)***

| *VARIABLES* | **NPLL** | **logZ** | **sROA** | **sROA** | **LAsfund** |
|---|---|---|---|---|---|
| Constant | 0.107*** | 0.134 | 1.025** | 0.768 | 48.27** |
| | (0.0145) | (2.385) | (0.361) | (0.453) | (21.78) |
| Year dummies | YES | YES | YES | YES | YES |
| Observations | 76 | 102 | 100 | 100 | 108 |
| R-squared | 0.746 | 0.340 | 0.379 | 0.432 | 0.430 |
| No. of institutions | 16 | 18 | 18 | 18 | 20 |

***Notes:*** Equation 2 is estimated by fixed effects with clustered standard errors at bank level (in parentheses). The first line of Table 4 shows the dependent variables in the individual regressions. For the definitions of the variables, see Table 1. Significance levels: *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

As for the bank financial variables from Table 4, in terms of their share in the Czech banking sector's total assets large banks tend to be more risky as captured by the Z-score and ROA volatility. On the other hand, better capitalization reduces bank riskiness in terms of the non-performing loans ratio and profit volatility. These findings are in line with the expected signs for bank financial variables in section 3.[3]

Next, in subsection 5.2, we focus on investigating the effect of management board composition on bank risk for different categories of Czech banks.

### 5.2 Results for Different Bank Categories

For each of the categories of Czech banks presented in section 3 we investigate the effect of management board characteristics on bank risk-taking by adding dummy interactions for each bank category (i.e., a building society dummy, a large bank dummy, and a sufficiently capitalized dummy) with the individual board variables to the baseline regressions presented in Table 4. Again, to save space, we only report those regressions in which either board or director characteristics are significant.

Table 5 shows which board composition characteristics influence riskiness in general commercial banks and building societies. First, longer director tenure increases bank risk as measured by ROA volatility and impairs stability as captured by the Z-score in building societies. This finding could be explained by the fact that boards with long tenure are likely to be too set in their ways and to suffer from entrenchment (e.g. Huang, 2013).

Second, in building societies female directors appear to exacerbate riskiness as measured by the non-performing loans ratio, while in general commercial banks their impact on risk-taking is mixed and depends on the type of risk captured by the risk proxies. This highlights the ambiguous or dual effect women on boards might have on risk-taking (e.g. Barber and Odean, 2001; Adams and Ferreira, 2007).

Third, the higher proportion of foreign directors on the management boards of general commercial banks impairs stability and increases ROA volatility. The result is contrary to the effect commonly

[3] The author initially included additional financial variables as controls in the model specified in Equation 2, i.e., the share of customer loans in total bank assets, the ratio of bank off-balance sheet items to total bank assets, and the interest rate spread defined as the difference between the bank lending rate and the bank borrowing rate. These variables, however, are not jointly significant and were thus excluded from the analysis.

found in the literature that foreign directors improve firm performance (e.g. Oxelheim and Randoy, 2003). Despite the fact that general commercial banks have larger boards than building societies on average (Table 2), with the advantage of ensuring more dialogue and more compromises on the way to reaching consensus (Nakano and Nguyen, 2012), they still seem unable to mitigate the unfavorable effects of foreign directors (due to foreign directors' lack of familiarity with the local market, language barriers, etc.) on risk.

Next, there is also evidence that larger board size increases the riskiness of building societies when measured by the non-performing loans ratio. This risk-increasing effect of board size in Czech building societies is in line with Eisenberg et al. (1998), who found a significant negative correlation between board size and profitability in a sample of small and mid-sized firms (the size category to which Czech building societies belong).

***Table 5: Impact of Board Characteristics on Bank Risk—By Business Model***

| *VARIABLES* | **NPLL** | **logZ** | **logZ** | **sROA** | **sROA** | **LAsfund** |
|---|---|---|---|---|---|---|
| Avrage | -0.00151 | -0.0112 | -0.0359 | 0.00510 | 0.0117 | -0.0462 |
| | (0.00146) | (0.0474) | (0.0394) | (0.0108) | (0.00867) | (0.707) |
| DS_Avrage | 0.00117 | 0.109 | 0.155 | -0.0148 | -0.0194 | 1.136 |
| | (0.00176) | (0.118) | (0.127) | (0.0212) | (0.0260) | (1.624) |
| Boardsize | -0.00276 | -0.163 | -0.191 | 0.0376** | 0.0440 | -0.494 |
| | (0.00290) | (0.0938) | (0.121) | (0.0148) | (0.0311) | (1.396) |
| DS_Boardsize | 0.0174** | 0.495 | 0.389 | 0.0457 | 0.00126 | 11.80* |
| | (0.00627) | (0.693) | (0.582) | (0.137) | (0.109) | (6.291) |
| AvrBoardten | 0.00194 | 0.133 | 0.174 | -0.0384 | -0.0496 | 4.212* |
| | (0.00260) | (0.117) | (0.107) | (0.0303) | (0.0295) | (2.371) |
| DS_AvrBoardten | 0.00445 | -0.268* | -0.282* | 0.0738** | 0.0892** | -2.611 |
| | (0.00444) | (0.136) | (0.152) | (0.0346) | (0.0368) | (2.214) |
| TAg | -0.123*** | 0.653 | 0.630 | -0.383 | -0.333 | 0.0239 |
| | (0.0281) | (0.962) | (0.824) | (0.317) | (0.238) | (13.87) |
| Banksize | 0.366* | -38.26** | -38.94** | 10.38*** | 9.821*** | 126.1 |
| | (0.202) | (16.17) | (15.02) | (3.554) | (3.110) | (297.2) |
| Charterval | 0.0676*** | -0.988 | -1.008 | -0.0265 | 0.0217 | 0.770 |
| | (0.0213) | (0.887) | (0.877) | (0.151) | (0.131) | (13.10) |
| MergerDummy | 0.00458 | 0.199 | 0.0838 | -0.0360 | -0.000136 | 10.50 |
| | (0.00937) | (0.427) | (0.445) | (0.0668) | (0.0747) | (10.87) |
| Tier1 | -0.0398 | 3.177 | 3.524 | -1.052*** | -1.222*** | -35.21 |
| | (0.0516) | (3.092) | (3.100) | (0.354) | (0.339) | (59.99) |
| Parent bank risk | 0.116*** | 0.239** | 0.222** | 0.0721* | 0.0546 | 0.439*** |
| | (0.0337) | (0.113) | (0.103) | (0.0398) | (0.0332) | (0.152) |
| Dlar | -0.00327 | 0.0498 | -0.118 | -0.00240 | 0.0458 | -11.87*** |
| | (0.00528) | (0.493) | (0.345) | (0.109) | (0.0555) | (2.936) |
| Dbetter | -0.00654 | -0.293 | -0.362 | 0.0796 | 0.102 | 6.003 |
| | (0.0133) | (0.357) | (0.355) | (0.0508) | (0.0609) | (8.218) |
| Sharefem | -0.0476* | -2.728* | | 1.005* | | |
| | (0.0268) | (1.538) | | (0.547) | | |
| DS_Sharefem | 0.0726** | 3.391 | | -0.926* | | |
| | (0.0327) | (2.238) | | (0.520) | | |
| Shareforeign | | | -1.825*** | | 0.634* | 10.79 |
| | | | (0.609) | | (0.361) | (13.20) |
| DS_Shareforeign | | | 14.74 | | 1.363 | 66.80 |
| | | | (17.43) | | (3.251) | (168.9) |
| Constant | 0.0829* | -1.350 | -1.129 | 1.187*** | 1.010** | 71.20* |

Continued on next page

***Table 5: Impact of Board Characteristics on Bank Risk—By Business Model (continued)***

| *VARIABLES* | **NPLL** | **logZ** | **logZ** | **sROA** | **sROA** | **LAsfund** |
|---|---|---|---|---|---|---|
| | (0.0469) | (2.577) | (2.396) | (0.354) | (0.411) | (38.15) |
| Year dummies | YES | YES | YES | YES | YES | YES |
| Observations | 76 | 102 | 102 | 100 | 100 | 108 |
| R-squared | 0.756 | 0.366 | 0.385 | 0.426 | 0.471 | 0.475 |
| No. of institutions | 16 | 18 | 18 | 18 | 18 | 20 |

***Notes:*** Estimation by fixed effects with clustered standard errors at bank level (in parentheses). The first line of Table 5 shows the dependent variables in the individual regressions. "DS*board variable" denotes the interaction of the building society dummy with the corresponding board variable. For the definitions of the variables, see Table 1. Significance levels: *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

Next, we focus on dividing Czech banking institutions by size. Table 6 shows that *the greater the amount of time directors spend on the board*, the lower the riskiness of large banks as measured by the NPL ratio, the Z-score, and ROA volatility. This result could be explained by the evidence presented by Coles et al. (2008) and Huang (2013) that board members in larger or more complex firms with greater advisory requirements need more time to familiarize themselves with the corporate environment and to acquire enough knowledge to perform strategic decision-making, a fact which justifies longer average board tenure and also postpones potential entrenchment.

Furthermore, the higher *proportion of directors with a PhD* on the boards of large banks increases their overall stability. This is in line with the risk-mitigating effect of directors holding a PhD found by Berger et al. (2014) for German banks. Contrary to our research hypothesis and to the evidence presented, for example, by Campbell (2006), Bucciol and Miniaci (2011), and Grable et al. (2009), it also appears that with increasing *age* directors harm stability in large banks. However, the risk-increasing effect of director age might be due to potential collinearity with director tenure in these regressions.

As for the effect of *foreign directors* on bank risk, the overall effect is not significant in large banks, but in small and mid-sized banks foreigners on the board harm stability as captured by the Z-score and increase profit volatility. The negative effect of foreign directors in small and mid-sized banks could be explained by a combination of two factors; one, their relative unfamiliarity with the local market and potential language barriers they might face, and two, the relatively small size of management boards in Czech building societies as reported in Table 2. Taken together, the potential propensity of foreign directors to increase risk might not be sufficiently mitigated in smaller boards, as it is easier for directors on such boards to reach consensus, which, in turn, might lead to more extreme decisions (Nakano and Nguyen, 2012).

Finally, there is some evidence of a risk-increasing effect of board size in small and mid-sized banks when the Z-score is used as the dependent variable. This finding corresponds with Eisenberg et al. (1998), who found a significant negative correlation between board size and profitability in a sample of small and mid-sized firms. However, the risk-increasing implication of board size in small and mid-sized banks is contrary to the board size hypothesis in section 2. This could be justified by the fact that for small and mid-sized banks large boards might not be efficient, as they often face problems with communication, coordination, and decision-making, while the need for a wide range of expertise and skills might not be so great. Altogether, the problems linked to board size may outweigh the risk-mitigating effect of large boards (Coles et al., 2008; Nakano and Nguyen, 2012).

***Table 6: Impact of Board Characteristics on Bank Risk—By Size***

| *VARIABLES* | **NPLL** | **logZ** | **logZ** | **sROA** | **LAsfund** |
|---|---|---|---|---|---|
| Avrage | -0.00103 | 0.0370 | 0.0237 | 0.00339 | 0.333 |
| | (0.00163) | (0.0497) | (0.0414) | (0.00837) | (0.463) |
| Dlar_Avrage | -0.000387 | -0.180* | -0.160* | 0.0213** | -0.729 |
| | (0.00166) | (0.0931) | (0.0867) | (0.0100) | (1.548) |
| Boardsize | 0.000260 | -0.282* | -0.332* | 0.0892 | 1.335 |
| | (0.00394) | (0.159) | (0.181) | (0.0575) | (1.735) |
| Dlar_Boardsize | -0.00552 | 0.253 | 0.331 | -0.0869 | -1.695 |
| | (0.00400) | (0.194) | (0.196) | (0.0525) | (2.663) |
| AvrBoardten | 0.00528 | -0.134 | -0.167 | 0.0247 | 1.651 |
| | (0.00321) | (0.110) | (0.110) | (0.0201) | (1.440) |
| Dlar_AvrBoardten | -0.00688** | 0.911*** | 0.686*** | -0.146*** | 2.007 |
| | (0.00323) | (0.249) | (0.151) | (0.0231) | (3.137) |
| TAg | -0.116*** | 0.0517 | -0.193 | -0.121 | 2.365 |
| | (0.0292) | (0.664) | (0.680) | (0.155) | (14.37) |
| Banksize | 0.359** | -43.70*** | -33.35** | 7.365*** | 173.9 |
| | (0.152) | (13.42) | (12.96) | (2.137) | (364.6) |
| Charterval | 0.0733*** | -0.730 | -0.758 | -0.0124 | -2.852 |
| | (0.0213) | (0.831) | (0.777) | (0.103) | (11.70) |
| MergerDummy | 0.00541 | 0.331 | 0.190 | -0.0320 | 7.908 |
| | (0.0113) | (0.331) | (0.335) | (0.0430) | (9.136) |
| Tier1 | -0.0555 | 1.450 | 2.583 | -0.972*** | -38.51 |
| | (0.0481) | (2.774) | (2.848) | (0.321) | (58.62) |
| Parent bank risk | 0.139*** | 0.274** | 0.205* | 0.0395 | 0.468*** |
| | (0.0233) | (0.129) | (0.107) | (0.0272) | (0.154) |
| Dlar | 0.0251 | -1.716 | -2.106* | 0.600** | -4.417 |
| | (0.0185) | (1.373) | (1.134) | (0.279) | (16.01) |
| Dbetter | -0.00717 | 0.123 | 0.0559 | 0.0236 | 8.695 |
| | (0.0132) | (0.385) | (0.378) | (0.0496) | (9.273) |
| Dlar_SharePhD | | 5.845** | | | |
| | | (2.738) | | | |
| Shareforeign | -0.0194 | | -2.917*** | 1.126*** | -8.189 |
| | (0.0465) | | (0.433) | (0.246) | (10.66) |
| Dlar_Shareforeign | 0.0125 | | 2.094* | -1.280** | 73.15 |
| | (0.0481) | | (1.062) | (0.557) | (45.35) |
| Constant | 0.0998*** | 0.988 | 1.099 | 0.451 | 68.40 |
| | (0.0319) | (2.926) | (2.879) | (0.439) | (41.99) |
| Year dummies | YES | YES | YES | YES | YES |
| Observations | 76 | 102 | 102 | 100 | 108 |
| R-squared | 0.773 | 0.424 | 0.453 | 0.599 | 0.474 |
| No. of institutions | 16 | 18 | 18 | 18 | 20 |

***Notes:*** Estimation by fixed effects with clustered standard errors at bank level (in parentheses). The first line of Table 6 shows the dependent variables in the individual regressions. "Dlar*board variable" denotes the interaction of the large bank dummy with the corresponding board variable. For the definitions of the variables, see Table 1. Significance levels: *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

It appears that the presence of *foreign directors* on the management boards of sufficiently capitalized banks impairs bank stability as captured by the Z-score, while there is no such pronounced effect for better-than-sufficiently capitalized banks. Given that capital increases monitoring and reduces moral hazard incentives in firms (Morrison and White, 2004; Allen et al., 2011), it could curb the potential risk implications of foreign directors arising from their possible unfamiliarity with the local banking

environment or the language barriers they might face in the boardrooms of better-than-sufficiently capitalized banks. The same, however, might not be true for sufficiently capitalized Czech banks, hence the negative effect of non-national directors on bank risk reported in Table 7.

As for *director tenure*, the longer directors hold their positions on the management boards of better-than-sufficiently capitalized banks, the greater the risk measured by the NPL ratio. However, no director tenure effect is found in sufficiently capitalized banks. There is at least partial overlap of the better-than-sufficiently capitalized bank category and the segments of Czech building societies and small and mid-sized banks, as they are also better capitalized than the other category in each division, i.e., general commercial banks and large banks, respectively Table 3. Therefore, the same explanation as for building societies is relevant here: boards with long tenure are likely to be too set in their ways and to suffer from entrenchment (e.g. Huang, 2013). The results are presented in detail in Table 7.

***Table 7: Impact of Board Characteristics on Bank Risk—By Capitalization***

| *VARIABLES* | **NPLL** | **logZ** | **sROA** | **LAsfund** |
|---|---|---|---|---|
| Avrage | -0.00132 | 0.00972 | 0.00613 | 0.537 |
| | (0.00388) | (0.0850) | (0.0221) | (1.537) |
| Dadeq_Avrage | 0.000668 | 0.0279 | -0.00922 | -0.756 |
| | (0.00386) | (0.102) | (0.0264) | (1.458) |
| Boardsize | 0.00365 | -0.0154 | 0.00698 | -2.584 |
| | (0.00559) | (0.201) | (0.0564) | (2.803) |
| Dadeq_Boardsize | -0.00747 | -0.208 | 0.0478 | 3.039 |
| | (0.00507) | (0.179) | (0.0428) | (2.467) |
| AvrBoardten | 0.00696** | -0.0532 | -0.0133 | -0.929 |
| | (0.00264) | (0.142) | (0.0267) | (1.638) |
| Dadeq_AvrBoardten | -0.00764*** | 0.0865 | 0.00108 | 6.196 |
| | (0.00217) | (0.174) | (0.0561) | (4.380) |
| TAg | -0.121*** | 0.204 | -0.276 | -4.861 |
| | (0.0269) | (0.595) | (0.186) | (16.71) |
| Banksize | 0.448** | -27.50* | 7.804** | 148.1 |
| | (0.159) | (14.83) | (2.732) | (289.4) |
| Charterval | 0.0661*** | -0.595 | -0.0690 | 1.831 |
| | (0.0205) | (0.810) | (0.149) | (11.24) |
| MergerDummy | 0.00404 | -0.0710 | 0.0182 | 8.740 |
| | (0.0129) | (0.402) | (0.0712) | (7.569) |
| Tier1 | -0.0326 | 3.886 | -1.178*** | -39.44 |
| | (0.0603) | (2.424) | (0.241) | (55.09) |
| Parent bank risk | 0.131*** | 0.134 | 0.0418 | 0.586*** |
| | (0.0227) | (0.0956) | (0.0296) | (0.157) |
| Dlar | -0.00277 | -0.0530 | 0.0206 | -13.10*** |
| | (0.00459) | (0.418) | (0.0816) | (3.394) |
| Dbetter | -0.0408 | -1.711 | 0.370* | 17.84 |
| | (0.0378) | (1.000) | (0.175) | (13.68) |
| Shareforeign | -0.0271 | -0.214 | 0.450 | 27.07 |
| | (0.0446) | (1.202) | (0.326) | (32.57) |
| Dadeq_Shareforeign | 0.00910 | -1.990* | 0.253 | -15.95 |
| | (0.0324) | (1.128) | (0.225) | (29.55) |
| Constant | 0.0972** | -0.0256 | 0.726* | 72.51* |
| | (0.0419) | (2.434) | (0.416) | (40.90) |
| Year dummies | YES | YES | YES | YES |
| Observations | 76 | 102 | 100 | 108 |

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***Table 7: Impact of Board Characteristics on Bank Risk—By Capitalization (continued)***

| *VARIABLES* | **NPLL** | **logZ** | **sROA** | **LAsfund** |
|---|---|---|---|---|
| R-squared | 0.794 | 0.399 | 0.471 | 0.491 |
| No. of institutions | 16 | 18 | 18 | 20 |

***Notes:*** Estimation by fixed effects with clustered standard errors at bank level (in parentheses). The first line of Table 7 shows the dependent variables in the individual regressions. "Dadeq*board variable" denotes the interaction of the dummy for banks meeting the capital requirement with the corresponding board variable. For the definitions of the variables, see Table 1. Significance levels: *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

As for the impact of banks' financial characteristics on the measures of bank risk, in the regressions for all bank categories we found evidence that bank size is a risk-contributing factor when the Z-score, profit volatility, or the ratio of liquid assets to deposits and short-term funding are used as bank risk proxies. This could be attributed to large banks' capacity to better absorb risk or to too-big-to-fail or too-systemic-to-fail policies put in place. In addition, capitalization lowers bank riskiness as measured by profit volatility. This can be attributed to the fact that capital increases monitoring and reduces moral hazard incentives (Allen et al., 2011; Morrison and White, 2004). Similarly, growth of bank assets lowers risk as captured by the NPL ratio. In line with the almost exclusive foreign ownership of the Czech banking sector's assets, we found that the link between the risk appetite of foreign parent bank groups and their Czech affiliates' risk is positive and significant across different dependent variables.

In subsection 5.3 we also test for the presence of a nonlinear relationship between board size and bank risk-taking in the Czech banking sector, as detected in the literature by, for example, Coles et al. (2008) and Andres and Vallelado (2008). Furthermore, board tenure was shown to be either positively or negatively related to bank risk, with the variations in this relation depending on firm characteristics. In line with Huang (2013) we test for the presence of a potential U-shaped relationship between board tenure and riskiness in subsection 5.3.

### 5.3 Testing for Nonlinearities

Apart from observing linear relations between different board characteristics and performance, the corporate governance literature has also identified a nonlinear relation between board size and firm performance (Andres and Vallelado, 2008; Coles et al., 2008) and lately also between director tenure and performance (Huang, 2013). In light of the results presented in subsection 5.2, the different impact in particular of average board tenure on riskiness in Czech building societies, large banks, and better-than-sufficiently capitalized banks could be explained by the presence of nonlinearities in the data. Therefore, we now turn to testing for nonlinear relations between board tenure and risk-taking and between board size and risk-taking in the Czech banking sector.

First, we add quadratic terms for board size and director tenure to the baseline regressions in Table 4. Table C1 in Appendix C presents the results. For the Czech banking sector overall, no relationship—either linear or nonlinear—is found between board size and the risk proxies. While the quadratic term for director tenure emerged as significant in the regressions with the NPL ratio and Z-score as dependent variables, the relationship between director tenure and bank stability is not U-shaped. Moreover, the evidence is ambiguous, as longer director tenure is shown to raise the NPL ratio and Z-score as well. Therefore, we can conclude that no clear evidence of the effect of director tenure

was found for the sector as a whole. Similar to the results in Table 4, foreign directors raise riskiness as measured by the Z-score and ROA volatility.

Since the regressions for different bank categories in subsection 5.2 reported contrasting impacts of director tenure on risk-taking in building societies, large banks, and better-than-sufficiently capitalized banks, we also check for the presence of nonlinearities for these categories. The calculations are reported in Appendix C.

For general commercial banks and building societies, no nonlinearities emerged between either board size or director tenure versus risk-taking after we added quadratic terms and interactions of quadratic terms with the building society dummy. Furthermore, not even a linear effect between the two observed variables and risk was detected in these specifications. The effects of other board variables remained qualitatively the same as in Table 5, apart from the effect of the proportion of female directors on risk, which is now significant only for risk as captured by the NPL ratio.

In terms of the size of banking institutions, again no evidence for nonlinearities in either board size or director tenure was found for either size group. The impact of the remaining board variables on risk is qualitatively the same as in the regressions without quadratic terms for board size and director tenure reported in Table 6. The only difference from the results of the original regressions by size in subsection 5.2 is the emergence of a positive effect of foreign directors on bank liquidity in large banks, while we previously found no effect of foreigners on risk in large banks.

As for the groups of Czech banks by capitalization, no strong evidence of nonlinear effects between board size and director tenure was found, either (Table C4). For better-than-sufficiently capitalized banks, risk as measured by the NPL ratio remains increasing in director tenure, similar to Table 7. As for the other board variables, a larger proportion of non-national directors on the board increases risk as captured by profit volatility in better-than-sufficiently capitalized banks, an effect that is not reported in Table 7. However, given the small differences between the two bank segments by capitalization as evidenced by the descriptive statistics in Table 2 and Table 3, the result is consistent with our original findings.

All in all, despite failing to find nonlinear effects of board size and director tenure versus measures of risk in Czech banks, we have validated our original results about the existence of a linear relationship between director tenure and riskiness in the segments of large banks and better-than-sufficiently capitalized banks. However, the linear risk-increasing effect of board size as reported in Table 5 and Table 6 turns out not to be robust to the inclusion of additional variables in the regressions in Table C2 and Table C3.

## 6. Conclusions

In this paper, we investigate how the management board composition of banking institutions affects risk-taking behavior in the Czech Republic. More specifically, we examine what effect the management boards of Czech banks have on bank risk-taking in terms of the average age of directors, the proportion of female directors, the proportion of non-national directors, and director education level. In addition, we observe whether the number of directors on the management board and their average tenure affect bank risk as captured by four different risk proxies in any way.

To perform the analysis, we prepare a unique data set that comprises selected biographical information on the management board members of Czech banking institutions. We then combine this data

set with individual bank financial data to serve as control variables in our analysis. We use four bank risk proxies that capture different aspects of bank risk: the Z-score, profit volatility, the NPL ratio, and the ratio of liquid assets to deposits and short-term funding. Therefore, our findings are subject to the proxy of bank risk used.

For the Czech banking sector overall, we find that a larger proportion of non-national directors on the board reduces bank stability as captured by the Z-score and increases bank profit volatility as measured by ROA volatility. Moreover, foreign directors have a risk-increasing effect across several categories of banking institutions, while for building societies, large banks, and better capitalized banks the effect of foreign directors is not significant. This finding opposes evidence typically found in the literature (Oxelheim and Randoy, 2003) that non-national directors have a positive effect on the firm's performance by bringing in new technology and modern managerial techniques. On the one hand, the risk-increasing effect of foreign directors in small banks could be attributed to bank policies implemented by the management board. Small banks might pursue riskier policies in order to gain larger market share. On the other hand, the risk-increasing effect of foreign directors could also be explained by a lack of familiarity with the Czech banking environment or by language and cultural barriers that foreign directors might face in the boardroom (Masulis et al., 2012; European Commission, 2010).

As for education level, larger proportions of directors holding an MBA on management boards in the Czech banking sector overall raise riskiness as captured by ROA volatility. However, we find no effect of directors with an MBA on risk-taking across individual bank categories. The findings are in line with (Bertrand and Schoar, 2003), who show that directors holding an MBA tend to be more aggressive and pursue riskier firm policies. As for directors with a PhD, we find that they have a stability-enhancing effect in large banks. The risk-reducing effect of directors with a PhD aligns with the evidence presented by Berger et al. (2014) that better-educated directors curb risk-taking. However, no effect on bank risk, either positive or negative, has been found for the other categories of Czech banking institutions in our sample. These findings shed some light on the potentially different risk implications of differences in directors' degrees.

The evidence on the effect of female directors is ambiguous for Czech general commercial banks. Female directors reduce commercial banks' riskiness if the NPL ratio is used as the measure of risk. However, the effect is the opposite when the Z-score and ROA volatility are used as dependent variables. On the other hand, for building societies a larger proportion of female directors on the board aggravates riskiness. All in all, these results contribute to the mixed evidence on the effect of female directors on corporate performance found in the literature (e.g. Barber and Odean, 2001; Adams and Ferreira, 2007).

Despite abundant evidence found in the literature that board size affects firms' performance (e.g. Dalton et al., 1999; Lipton and Lorsch, 1992; Jensen, 1993), we did not find strong evidence on bank risk for Czech banks overall. The exceptions are building societies, where larger board size increases risk as captured by the non-performing loans ratio, and small and mid-sized banks, whose stability as measured by Z-scores decreases with increasing board size. These findings are in line with Eisenberg et al. (1998), who found a significant negative correlation between board size and profitability in a sample of small and mid-sized firms (the size category to which Czech building societies belong).

In regard to director tenure, its effect on riskiness varies for different categories of Czech banking institutions. In building societies, riskiness as captured by the Z-score and ROA volatility increases with increasing board tenure, while in better capitalized banks higher board tenure increases risk as

measured by the non-performing loans ratio. On the other hand, stability increases with increasing board tenure in large banks. These findings are broadly in line with Huang (2013), who claims that board tenure can be positively or negatively related to firm value and this relation varies across firm characteristics. As for the average age of directors, we found no strong and systematic evidence that it affects riskiness in the Czech banking sector.

All in all, while certain management board composition might imply higher absolute level of bank risk it is not necessarily unfavorable. Higher absolute risk does not reflect if a bank's risk-taking behavior is excessive for a given return. Efficiency-based indicators of bank risk account for excessive risk-taking behavior but their application in our paper is hindered by data restrictions.

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# Appendix A: Summary Statistics

***Table A1: Descriptive Statistics of Variables in the Data Set***

| Variable | Unit | N | Mean | SD | Min | Max |
|---|---|---|---|---|---|---|
| **Risk measures** | | | | | | |
| NPLL | ratio | 133 | 0.05 | 0.05 | 0.00 | 0.25 |
| LAsfund | % | 173 | 33.84 | 35.59 | 0.06 | 367.18 |
| logZ | log | 169 | 3.93 | 1.06 | 1.51 | 7.45 |
| sROA | SD | 169 | 0.33 | 0.41 | 0.00 | 2.92 |
| **Board variables** | | | | | | |
| Boardsize | | 188 | 4.18 | 1.47 | 2.00 | 9.00 |
| Avrage | | 177 | 0.09 | 2.95 | -12.67 | 10.31 |
| Avrboardten | | 177 | 0.23 | 1.20 | -6.60 | 1.88 |
| Sharefem | ratio | 177 | 0.00 | 0.07 | -0.33 | 0.33 |
| SharePhD | ratio | 177 | 0.00 | 0.05 | -0.33 | 0.25 |
| ShareMBA | ratio | 177 | 0.00 | 0.10 | -0.33 | 0.33 |
| Shareforeign | ratio | 188 | 0.33 | 0.26 | 0.00 | 1.00 |
| **Control variables** | | | | | | |
| TAg | change | 168 | 0.15 | 0.22 | -0.12 | 2.31 |
| Banksize | ratio | 168 | 0.00 | 0.01 | -0.12 | 0.02 |
| Charterval | ratio | 147 | -0.01 | 0.12 | -0.56 | 0.41 |
| MergerDummy | | 188 | 0.10 | 0.30 | 0.00 | 1.00 |
| Tier1 | ratio | 158 | 0.91 | 0.11 | 0.60 | 1.33 |
| DS | | 252 | 0.24 | 0.43 | 0.00 | 1.00 |
| Dlar | | 252 | 0.19 | 0.39 | 0.00 | 1.00 |
| Dadeq | | 252 | 0.71 | 0.45 | 0.00 | 1.00 |
| **Parent bank risk measures** | | | | | | |
| mNPLL | ratio | 139 | 0.07 | 0.09 | 0.00 | 0.76 |
| mLAsfund | % | 173 | 41.03 | 32.00 | 4.40 | 367.18 |
| logmZ | log | 194 | 3.62 | 1.07 | 1.03 | 5.61 |
| msROA | SD | 175 | -0.03 | 0.98 | -3.01 | 3.28 |

***Notes:*** N = number of observations, SD = standard deviation, Min = minimum value, and Max = maximum value. For the definitions of the variables, see Table 1.

# Appendix B: Results of Endogeneity Testing

***Table B1: Testing for Endogeneity—GMM Approach***

| *VARIABLES* | **NPLL** | **logZ** | **sROA** | **LAsfund** |
|---|---|---|---|---|
| Avrage | -0.00209 | -0.225 | 0.0348 | -6.121 |
| | (0.00432) | (0.483) | (0.0562) | (4.975) |
| Boardsize | 0.0143 | 0.145 | -0.0331 | -28.66 |
| | (0.0150) | (0.209) | (0.163) | (16.75) |
| AvrBoardten | 0.0190* | 0.0556 | -0.290 | 1.288 |
| | (0.00998) | (1.692) | (0.167) | (7.109) |
| TAg | -0.00255 | 1.420 | 0 | -22.18 |
| | (0.0208) | (3.307) | (0) | (38.99) |
| Banksize | 0 | 0 | 0 | 0 |
| | (0) | (0) | (0) | (0) |
| Charterval | 0 | 0.120 | 0.660 | -193.5 |
| | (0) | (5.466) | (1.641) | (153.9) |
| MergerDummy | -0.151 | 1.543 | 0.161 | 24.27 |
| | (0.105) | (2.555) | (1.194) | (25.18) |
| Tier1 | -0.00537 | 0 | 0.387 | 274.0* |
| | (0.0714) | (0) | (0.815) | (145.6) |
| Parent bank risk | 0 | 0.0120 | 0.0661 | -0.578 |
| | (0) | (0.456) | (0.128) | (0.799) |
| Sharefem | 0 | 0 | 0 | 0 |
| | (0) | (0) | (0) | (0) |
| SharePhD | 0 | 0 | 0 | 0 |
| | (0) | (0) | (0) | (0) |
| ShareMBA | 0.223 | -8.126 | -1.534 | -372.3 |
| | (0.179) | (7.358) | (1.828) | (274.7) |
| Shareforeign | 0 | 0 | 0 | 38.74 |
| | (0) | (0) | (0) | (173.7) |
| Constant | 0 | 0 | 0 | 0 |
| | (0) | (0) | (0) | (0) |
| Year dummies | YES | YES | YES | YES |
| Observations | 76 | 102 | 100 | 108 |
| No. of institutions | 16 | 18 | 18 | 20 |
| Difference-in-Hansen test (p-value) | 1 | 1 | 1 | 1 |
| No. of instruments | 78 | 94 | 92 | 94 |

***Notes:*** Estimation of Equation 2 by the GMM with the Arellano-Bond two-step system estimator with heteroskedasticity-corrected standard errors and Windmeijer small sample size adjustment. The first line of Table B1 shows the dependent variables in the individual regressions. For the definitions of the variables, see Table 1. Significance levels: *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$. Standard errors in parentheses.

***Table B2: 2SLS Regressions—Dependent Variable: NPL Ratio***

| *VARIABLES* | **NPLL** | **NPLL** | **NPLL** | **NPLL** |
|---|---|---|---|---|
| Avrage | 0.00244* | 0.00304** | 0.00234* | 0.00117 |
| | (0.00132) | (0.00128) | (0.00124) | (0.00106) |
| Boardsize | 0.00248 | 0.00408 | 0.00231 | -0.00111 |
| | (0.00227) | (0.00257) | (0.00210) | (0.00174) |

Continued on next page

***Table B2: 2SLS Regressions—Dependent Variable: NPL Ratio (continued)***

| *VARIABLES* | **NPLL** | **NPLL** | **NPLL** | **NPLL** |
|---|---|---|---|---|
| AvrBoardten | -0.00376 | -0.00689* | -0.00326 | 0.000731 |
| | (0.00343) | (0.00361) | (0.00321) | (0.00254) |
| TAg | -0.0345 | -0.0440 | -0.0587* | -0.0319 |
| | (0.0386) | (0.0388) | (0.0329) | (0.0299) |
| Banksize | 0.554 | 0.909*** | 0.916** | 0.523 |
| | (0.396) | (0.352) | (0.417) | (0.324) |
| Charterval | 0.0420* | 0.0265 | 0.0269 | 0.0506*** |
| | (0.0218) | (0.0203) | (0.0214) | (0.0196) |
| MergerDummy | 0.0350* | 0.0322* | 0.0308 | 0.0325* |
| | (0.0212) | (0.0184) | (0.0192) | (0.0172) |
| Tier1 | -0.0767 | -0.0823* | -0.0587 | -0.147*** |
| | (0.0485) | (0.0483) | (0.0496) | (0.0412) |
| Parent bank risk | 0.0261 | 0.0472 | 0.0478 | 0.105*** |
| | (0.0448) | (0.0371) | (0.0350) | (0.0252) |
| Sharefem | -0.0539 | | | |
| | (0.0704) | | | |
| SharePhD | | -0.189*** | | |
| | | (0.0717) | | |
| ShareMBA | | | -0.114* | |
| | | | (0.0648) | |
| Shareforeign | | | | 0.0665*** |
| | | | | (0.0105) |
| Constant | 0.122** | 0.124** | 0.110** | 0.185*** |
| | (0.0541) | (0.0538) | (0.0541) | (0.0436) |
| Year dummies | YES | YES | YES | YES |
| Observations | 77 | 77 | 77 | 80 |
| R-squared | 0.313 | 0.310 | 0.338 | 0.529 |
| Hansen J statistic | 1.77 | 7.378 | 1.575 | 1.675 |
| Chi-sq(2) P-val | 0.4127 | 0.025 | 0.4549 | 0.4328 |
| C statistic | 0.444 | 0.021 | 0.006 | 3.689 |
| Chi-sq(1) P-val | 0.5051 | 0.8856 | 0.938 | 0.0548 |
| No. of instruments | 3 | 3 | 3 | 3 |

***Notes:*** Estimation by 2SLS with robust standard errors and 1–3 lags of the director variables used as instruments. The first line of Table B2 shows the dependent variable in each regression. For the definitions of the variables, see Table 1. Significance levels: *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$. Standard errors in parentheses.

***Table B3: 2SLS Regressions—Dependent Variable: Z-score***

| *VARIABLES* | **logZ** | **logZ** | **logZ** | **logZ** |
|---|---|---|---|---|
| Avrage | 0.0552* | 0.0395 | 0.0387 | 0.0587 |
| | (0.0308) | (0.0306) | (0.0327) | (0.0378) |
| Boardsize | -0.0604 | -0.0244 | -0.0351 | -0.0138 |
| | (0.0611) | (0.0671) | (0.0632) | (0.0539) |
| AvrBoardten | -0.0587 | -0.0396 | -0.0165 | -0.0502 |
| | (0.0850) | (0.0806) | (0.0962) | (0.0951) |
| TAg | 0.382 | -0.199 | -0.657 | 0.337 |
| | (1.091) | (1.097) | (1.075) | (1.092) |
| Banksize | 1.108 | 7.341 | 13.72 | -2.888 |

Continued on next page

***Table B3: 2SLS Regressions—Dependent Variable: Z-score (continued)***

| *VARIABLES* | **logZ** | **logZ** | **logZ** | **logZ** |
|---|---|---|---|---|
| | (23.54) | (23.72) | (21.96) | (24.05) |
| Charterval | -0.163 | 0.0389 | 0.0149 | -0.0738 |
| | (0.750) | (0.881) | (1.032) | (1.027) |
| MergerDummy | 0.558* | 0.432 | 0.445 | 0.511* |
| | (0.333) | (0.346) | (0.348) | (0.285) |
| Tier1 | -0.463 | 0.420 | 0.518 | 1.027 |
| | (1.224) | (1.387) | (1.522) | (1.303) |
| Parent bank risk | 0.0119 | -0.0728 | -0.0283 | -0.00228 |
| | (0.0838) | (0.0926) | (0.0935) | (0.0954) |
| Sharefem | -1.898 | | | |
| | (1.565) | | | |
| SharePhD | | -3.006 | | |
| | | (2.493) | | |
| ShareMBA | | | -1.803* | |
| | | | (1.045) | |
| Shareforeign | | | | -0.567* |
| | | | | (0.304) |
| Constant | 4.915*** | 4.275*** | 4.135** | 3.463** |
| | (1.440) | (1.508) | (1.664) | (1.426) |
| Year dummies | YES | YES | YES | YES |
| Observations | 82 | 82 | 82 | 86 |
| R-squared | 0.131 | 0.155 | 0.146 | 0.155 |
| Hansen J statistic | 0.373 | 1.35 | 2.168 | 0.208 |
| Chi-sq(2) P-val | 0.8299 | 0.509 | 0.3382 | 0.9012 |
| C statistic | 1.252 | 0.165 | 2.065 | 0.354 |
| Chi-sq(1) P-val | 0.2633 | 0.6849 | 0.1508 | 0.552 |
| No. of instruments | 3 | 3 | 3 | 3 |

***Notes:*** Estimation by 2SLS with robust standard errors and 1–3 lags of the director variables used as instruments. The first line of Table B3 shows the dependent variable in each regression. For the definitions of the variables, see Table 1. Significance levels: *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$. Standard errors in parentheses.

***Table B4: 2SLS Regressions—Dependent Variable: sROA***

| *VARIABLES* | **sROA** | **sROA** | **sROA** | **sROA** |
|---|---|---|---|---|
| Avrage | -0.00501 | 0.00114 | -0.00163 | 0.000115 |
| | (0.00589) | (0.00748) | (0.00618) | (0.00739) |
| Boardsize | 0.0283*** | 0.0237** | 0.0278*** | 0.0212** |
| | (0.0102) | (0.0106) | (0.0106) | (0.00885) |
| AvrBoardten | 0.00107 | -0.00311 | -0.00705 | -0.00931 |
| | (0.0178) | (0.0148) | (0.0193) | (0.0190) |
| TAg | 0.135 | 0.173 | 0.125 | 0.114 |
| | (0.188) | (0.206) | (0.158) | (0.178) |
| Banksize | -2.158 | -1.138 | -2.769 | -0.215 |
| | (5.111) | (4.987) | (4.158) | (5.446) |
| Charterval | 0.145 | 0.146 | 0.131 | 0.0472 |
| | (0.107) | (0.165) | (0.131) | (0.196) |
| MergerDummy | -0.0291 | -0.0297 | -0.00766 | -0.0718 |
| | (0.0741) | (0.0727) | (0.0676) | (0.0503) |

Continued on next page

***Table B4: 2SLS Regressions—Dependent Variable: sROA (continued)***

| *VARIABLES* | **sROA** | **sROA** | **sROA** | **sROA** |
|---|---|---|---|---|
| Tier1 | 0.0946 | 0.201 | 0.0724 | 0.0367 |
| | (0.219) | (0.227) | (0.188) | (0.215) |
| Parent bank risk | 0.00139 | -0.00456 | -0.00309 | 0.00435 |
| | (0.0152) | (0.0148) | (0.0127) | (0.0208) |
| Sharefem | 0.329** | | | |
| | (0.153) | | | |
| SharePhD | | 0.715 | | |
| | | (0.728) | | |
| ShareMBA | | | 0.221 | |
| | | | (0.177) | |
| Shareforeign | | | | 0.243*** |
| | | | | (0.0635) |
| Constant | -0.0650 | -0.151 | -0.0464 | -0.0265 |
| | (0.238) | (0.252) | (0.200) | (0.237) |
| Year dummies | YES | YES | YES | YES |
| Observations | 81 | 81 | 81 | 85 |
| R-squared | 0.173 | 0.211 | 0.188 | 0.225 |
| Hansen J statistic | 2.655 | 2.397 | 1.166 | 1.101 |
| Chi-sq(2) P-val | 0.2652 | 0.3016 | 0.5583 | 0.5765 |
| C statistic | 0.286 | 2.34 | 0.638 | 0.224 |
| Chi-sq(1) P-val | 0.593 | 0.1261 | 0.4245 | 0.6364 |
| No. of instruments | 3 | 3 | 3 | 3 |

***Notes:*** Estimation by 2SLS with robust standard errors and 1–3 lags of the director variables used as instruments. The first line of Table B4 shows the dependent variable in each regression. For the definitions of the variables, see Table 1. Significance levels: *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$. Standard errors in parentheses.

# Appendix C: Results of Nonlinearity Testing

***Table C1: Testing for the Effect of Nonlinearities—Baseline***

| textitVARIABLES | **NPLL** | **logZ** | **sROA** | **LAsfund** |
|---|---|---|---|---|
| Avrage | -0.000987 | -0.00394 | 0.00389 | 0.0250 |
| | (0.00125) | (0.0393) | (0.00765) | (0.611) |
| Boardsize | 0.0254 | -0.263 | 0.00244 | 0.276 |
| | (0.0194) | (0.440) | (0.107) | (7.293) |
| sq_Boardsize | -0.00242 | 0.00747 | 0.00324 | -0.109 |
| | (0.00157) | (0.0313) | (0.00708) | (0.588) |
| AvrBoardten | 0.00479* | 0.126 | -0.0184 | 3.558 |
| | (0.00225) | (0.113) | (0.0302) | (2.540) |
| sq_AvrBoardten | 0.00379** | 0.0520*** | -0.00298 | 0.598 |
| | (0.00165) | (0.0170) | (0.00394) | (0.504) |
| TAg | -0.126*** | 0.389 | -0.342 | -0.416 |
| | (0.0308) | (0.783) | (0.209) | (14.29) |
| Banksize | 0.272 | -37.56** | 9.586*** | 100.9 |
| | (0.201) | (14.96) | (2.828) | (308.0) |
| Charterval | 0.0740*** | -0.826 | -0.0374 | -0.667 |
| | (0.0196) | (0.820) | (0.123) | (13.10) |
| MergerDummy | 0.00221 | 0.161 | -0.00186 | 11.50 |
| | (0.0108) | (0.444) | (0.0747) | (11.05) |
| Tier1 | -0.0450*** | 2.494 | -0.814** | -2.566 |
| | (0.0112) | (2.182) | (0.287) | (28.51) |
| mNPLL | 0.141*** | 0.207** | 0.0544 | 0.412** |
| | (0.0193) | (0.0958) | (0.0347) | (0.161) |
| Sharefem | | | | |
| SharePhD | | | | |
| ShareMBA | | | | |
| Shareforeign | -0.0154 | -1.733** | 0.634* | 13.60 |
| | (0.0336) | (0.643) | (0.332) | (13.18) |
| Constant | 0.0761* | 0.521 | 0.833 | 50.20* |
| | (0.0426) | (2.868) | (0.599) | (28.03) |
| Year dummies | YES | YES | YES | YES |
| Observations | 76 | 102 | 100 | 108 |
| R-squared | 0.783 | 0.369 | 0.435 | 0.440 |
| No. of institutions | 16 | 18 | 18 | 20 |

***Notes:*** Estimation by fixed effects with clustered standard errors at bank level (in parentheses). The first line of Table C1 shows the dependent variables in the individual regressions. "sq_Boardsize" and "sq_AvrBoardten" denote the quadratic terms of the corresponding board variables. For the definitions of the variables, see Table 1. Significance levels: *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

***Table C2: Testing for the Effect of Nonlinearities—By Business Model***

| *VARIABLES* | **NPLL** | **logZ** | **logZ** | **sROA** | **LAsfund** |
|---|---|---|---|---|---|
| Avrage | -0.00106 | -0.0240 | -0.0430 | 0.0119 | -0.197 |
| | (0.00142) | (0.0547) | (0.0436) | (0.00974) | (0.750) |

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***Table C2: Testing for the Effect of Nonlinearities—By Business Model (continued)***

| *VARIABLES* | **NPLL** | **logZ** | **logZ** | **sROA** | **LAsfund** |
|---|---|---|---|---|---|
| DS_Avrage | 0.00148 | 0.119 | 0.131 | -0.0234 | 1.468 |
| | (0.00232) | (0.157) | (0.144) | (0.0282) | (2.002) |
| Boardsize | 0.0254 | -0.479 | -0.463 | 0.0533 | -6.715 |
| | (0.0237) | (0.509) | (0.525) | (0.111) | (12.96) |
| sq_Boardsize | -0.00248 | 0.0247 | 0.0223 | -0.00121 | 0.599 |
| | (0.00193) | (0.0398) | (0.0404) | (0.00771) | (1.164) |
| DS_Boardsize | - | 4.866 | 11.05 | 1.413 | -91.89 |
| | | (15.84) | (13.82) | (3.515) | (289.5) |
| DS_sq_Boardsize | -0.000863 | -0.613 | -1.475 | -0.196 | 14.76 |
| | (0.00361) | (2.226) | (1.946) | (0.490) | (40.89) |
| AvrBoardten | 0.00540 | 0.210 | 0.215 | -0.0357 | 3.234 |
| | (0.00312) | (0.184) | (0.175) | (0.0379) | (1.952) |
| sq_AvrBoardten | 0.00451** | 0.0686 | 0.0357 | 0.0147 | -1.165 |
| | (0.00207) | (0.0728) | (0.0855) | (0.0158) | (1.674) |
| DS_AvrBoardten | -0.0104 | -0.266 | -0.165 | 0.0946 | -2.663 |
| | (0.0170) | (0.358) | (0.345) | (0.0627) | (5.174) |
| DS_sq_AvrBoardten | 0.00517 | -0.0225 | 0.0662 | -0.00273 | 0.520 |
| | (0.0222) | (0.158) | (0.160) | (0.0266) | (2.546) |
| TAg | -0.128*** | 0.420 | 0.437 | -0.349 | -1.809 |
| | (0.0309) | (0.961) | (0.784) | (0.235) | (15.97) |
| Banksize | 0.276 | -40.89** | -39.81*** | 9.639*** | 156.8 |
| | (0.206) | (14.58) | (13.48) | (3.278) | (336.3) |
| Charterval | 0.0702*** | -0.969 | -0.969 | -0.00818 | 0.259 |
| | (0.0208) | (1.034) | (1.020) | (0.137) | (13.04) |
| MergerDummy | 0.00360 | 0.288 | 0.144 | 0.00775 | 10.22 |
| | (0.0128) | (0.461) | (0.477) | (0.0836) | (10.62) |
| Tier1 | -0.0205 | 3.228 | 3.600 | -1.174*** | -42.15 |
| | (0.0522) | (3.289) | (3.232) | (0.361) | (70.70) |
| Parent bank risk | 0.117*** | 0.272* | 0.224* | 0.0554 | 0.483** |
| | (0.0317) | (0.147) | (0.128) | (0.0356) | (0.193) |
| Dbank | - | - | - | - | - |
| Dlar | -0.00708 | -0.00493 | -0.136 | 0.0335 | -10.80*** |
| | (0.00423) | (0.480) | (0.340) | (0.0620) | (2.900) |
| Dbetter | -0.00579 | -0.272 | -0.335 | 0.104 | 6.303 |
| | (0.0124) | (0.390) | (0.391) | (0.0630) | (8.588) |
| Sharefem | - | -2.908* | | | |
| | 0.0562*** | | | | |
| | (0.0174) | (1.453) | | | |
| DS_Sharefem | 0.0766** | 3.187 | | | |
| | (0.0305) | (2.039) | | | |
| SharePhD | | | | | |
| DS_SharePhD | | | | | |
| ShareMBA | | | | | |
| DS_ShareMBA | | | | | |
| Shareforeign | | | -1.757** | 0.645* | 10.63 |
| | | | (0.764) | (0.352) | (14.35) |
| DS_Shareforeign | | | - | - | - |

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***Table C2: Testing for the Effect of Nonlinearities—By Business Model (continued)***

| *VARIABLES* | **NPLL** | **logZ** | **logZ** | **sROA** | **LAsfund** |
|---|---|---|---|---|---|
| Constant | 0.0622 | -2.256 | -3.869 | 0.109 | 133.1 |
| | (0.0751) | (7.084) | (6.509) | (1.682) | (140.7) |
| Year dummies | YES | YES | YES | YES | YES |
| Observations | 76 | 102 | 102 | 100 | 108 |
| R-squared | 0.796 | 0.376 | 0.391 | 0.477 | 0.481 |
| No. of institutions | 16 | 18 | 18 | 18 | 20 |

***Notes:*** Estimation by fixed effects with clustered standard errors at bank level (in parentheses). The first line of Table C2 shows the dependent variables in the individual regressions. "sq_Boardsize" and "sq_AvrBoardten" denote the quadratic terms of the corresponding board variables, "DS_sq_Boardsize" and "DS_sq_AvrBoardten" denote the interactions of the building society dummy with the quadratic terms of the corresponding board variables. For the definitions of the variables, see Table 1. Significance levels: *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

***Table C3: Testing for the Effect of Nonlinearities—By Size***

| *VARIABLES* | **NPLL** | **logZ** | **logZ** | **sROA** | **sROA** | **LAsfund** |
|---|---|---|---|---|---|---|
| Avrage | -0.00233 | 0.0455 | 0.0314 | -0.00630 | 0.000916 | 0.176 |
| | (0.00183) | (0.0433) | (0.0402) | (0.0152) | (0.00903) | (0.484) |
| Dlar_Avrage | 0.000962 | -0.183** | -0.170** | 0.0327* | 0.0237** | -0.809 |
| | (0.00158) | (0.0846) | (0.0760) | (0.0179) | (0.0110) | (1.474) |
| Boardsize | -0.0345 | -0.134 | 0.164 | -0.0452 | -0.186* | 3.669 |
| | (0.0445) | (0.535) | (0.501) | (0.134) | (0.0931) | (11.16) |
| sq_Boardsize | 0.00430 | -0.00998 | -0.0507 | 0.0108 | 0.0308** | -0.522 |
| | (0.00490) | (0.0567) | (0.0522) | (0.0148) | (0.0140) | (1.247) |
| Dlar_Boardsize | 0.0805 | 2.257 | 1.660 | -0.280 | 0.0675 | -58.88** |
| | (0.0599) | (1.380) | (1.228) | (0.308) | (0.310) | (22.20) |
| Dlar_sq_Boardsize | -0.00853 | -0.167 | -0.102 | 0.0154 | -0.0209 | 4.965** |
| | (0.00608) | (0.121) | (0.111) | (0.0272) | (0.0299) | (2.106) |
| AvrBoardten | 0.00716 | -0.0516 | -0.0819 | 0.0174 | 0.0293 | 3.501 |
| | (0.00428) | (0.144) | (0.146) | (0.0336) | (0.0319) | (2.383) |
| sq_AvrBoardten | 0.00435 | 0.0266 | 0.0262 | 0.00145 | 0.00193 | 0.610 |
| | (0.00276) | (0.0273) | (0.0275) | (0.00604) | (0.00597) | (0.495) |
| Dlar_AvrBoardten | -0.00495 | 0.930** | 0.754*** | -0.163*** | -0.142*** | 1.144 |
| | (0.00514) | (0.376) | (0.252) | (0.0535) | (0.0444) | (2.929) |
| Dlar_sq_AvrBoardten | -0.000847 | 0.123 | 0.140 | 0.00254 | 0.000912 | -0.767 |
| | (0.00368) | (0.114) | (0.115) | (0.0214) | (0.0218) | (1.245) |
| TAg | -0.124*** | -0.118 | -0.327 | -0.267 | -0.154 | 2.592 |
| | (0.0315) | (0.718) | (0.742) | (0.304) | (0.123) | (13.91) |
| Banksize | 0.188 | -42.93*** | -35.41*** | 9.319** | 7.081*** | 118.5 |
| | (0.230) | (12.31) | (11.31) | (3.611) | (2.107) | (292.6) |
| Charterval | 0.0771*** | -1.337 | -1.290 | 0.0260 | 0.00546 | 2.737 |
| | (0.0230) | (0.908) | (0.986) | (0.140) | (0.148) | (14.64) |
| MergerDummy | -0.00162 | 0.365 | 0.253 | -0.0510 | -0.0386 | 10.44 |
| | (0.0101) | (0.380) | (0.394) | (0.0548) | (0.0479) | (10.56) |
| Tier1 | 0.0358 | 2.759 | 3.775 | -0.860* | -1.034** | -56.30 |
| | (0.0673) | (2.968) | (3.255) | (0.429) | (0.419) | (58.51) |
| Parent bank risk | 0.154*** | 0.283* | 0.245* | 0.0522 | 0.0373 | 0.532*** |
| | (0.0283) | (0.151) | (0.127) | (0.0354) | (0.0275) | (0.164) |

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***Table C3: Testing for the Effect of Nonlinearities—By Size (continued)***

| *VARIABLES* | **NPLL** | **logZ** | **logZ** | **sROA** | **sROA** | **LAsfund** |
|---|---|---|---|---|---|---|
| Dbank | - | - | - | - | - | - |
| Dlar | -0.183 | -7.599* | -6.380* | 1.096 | 0.391 | 150.8** |
| | (0.144) | (3.936) | (3.344) | (0.842) | (0.830) | (54.99) |
| Dbetter | -0.0150 | -0.0986 | -0.154 | 0.0367 | 0.0386 | 10.30 |
| | (0.0132) | (0.386) | (0.397) | (0.0604) | (0.0548) | (9.140) |
| Sharefem | | | | | | |
| Dlar_Sharefem | | | | | | |
| SharePhD | | - | | - | | |
| Dlar_SharePhD | | 5.638* | | -0.790* | | |
| | | (2.987) | | (0.449) | | |
| ShareMBA | -0.0301 | | | | | |
| | (0.0226) | | | | | |
| Dlar_ShareMBA | 0.0747* | | | | | |
| | (0.0415) | | | | | |
| Shareforeign | | | -2.800*** | | 1.188*** | -13.63 |
| | | | (0.349) | | (0.226) | (11.58) |
| Dlar_Shareforeign | | | 1.332 | | -1.259** | 96.83** |
| | | | (1.434) | | (0.564) | (42.94) |
| Constant | 0.0846 | -1.086 | -1.505 | 0.831* | 1.015* | 85.59 |
| | (0.0793) | (3.471) | (3.778) | (0.472) | (0.523) | (55.21) |
| Year dummies | YES | YES | YES | YES | YES | YES |
| Observations | 76 | 102 | 102 | 100 | 100 | 108 |
| R-squared | 0.824 | 0.460 | 0.489 | 0.475 | 0.616 | 0.501 |
| No. of institutions | 16 | 18 | 18 | 18 | 18 | 20 |

***Notes:*** Estimation by fixed effects with clustered standard errors at bank level (in parentheses). The first line of Table C3 shows the dependent variables in the individual regressions. "sq_Boardsize" and "sq_AvrBoardten" denote the quadratic terms of the corresponding board variables, "Dlar_sq_Boardsize" and "Dlar_sq_AvrBoardten" denote the interactions of the large bank dummy with the quadratic terms of the corresponding board variables. For the definitions of the variables, see Table 1. Significance levels: *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

***Table C4: Testing for the Effect of Nonlinearities—By Capitalization***

| textitVARIABLES | **NPLL** | **logZ** | **sROA** | **LAsfund** |
|---|---|---|---|---|
| Avrage | -0.00202 | 0.0734 | 0.00292 | 0.923 |
| | (0.00459) | (0.0824) | (0.0247) | (1.387) |
| Dadeq_Avrage | 0.000970 | -0.0616 | -0.00885 | -1.119 |
| | (0.00457) | (0.123) | (0.0320) | (1.489) |
| Boardsize | -0.0255 | 0.880 | -0.0408 | 20.96 |
| | (0.0323) | (0.945) | (0.208) | (13.38) |
| sq_Boardsize | 0.00346 | -0.0727 | 0.00390 | -2.725* |
| | (0.00311) | (0.0713) | (0.0136) | (1.515) |
| Dadeq_Boardsize | 0.0353 | -1.848** | 0.117 | -23.36 |
| | (0.0257) | (0.866) | (0.159) | (20.61) |
| Dadeq_sq_Boardsize | -0.00475 | 0.146* | -0.00648 | 3.028 |
| | (0.00285) | (0.0762) | (0.0128) | (2.228) |

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***Table C4: Testing for the Effect of Nonlinearities—By Capitalization (continued)***

| textitVARIABLES | **NPLL** | **logZ** | **sROA** | **LAsfund** |
|---|---|---|---|---|
| AvrBoardten | 0.00751** | 0.149 | -0.0352 | -0.767 |
| | (0.00335) | (0.213) | (0.0481) | (2.008) |
| sq_AvrBoardten | 0.00433 | 0.0562* | -0.00611 | 0.0891 |
| | (0.00423) | (0.0297) | (0.00763) | (0.366) |
| Dadeq_AvrBoardten | -0.00410 | 0.0856 | 0.0544 | 5.034 |
| | (0.00380) | (0.430) | (0.0948) | (4.290) |
| Dadeq_sq_AvrBoardten | -0.00130 | 0.0359 | 0.0259 | -0.789 |
| | (0.00448) | (0.128) | (0.0223) | (0.965) |
| TAg | -0.122*** | 0.252 | -0.219 | -3.320 |
| | (0.0239) | (0.984) | (0.179) | (18.19) |
| Banksize | 0.237 | -26.37 | 6.371** | 150.3 |
| | (0.229) | (17.61) | (2.425) | (311.2) |
| Charterval | 0.0752*** | -0.889 | -0.0666 | 7.279 |
| | (0.0230) | (0.917) | (0.133) | (12.50) |
| MergerDummy | -0.00195 | 0.0678 | 0.0205 | 8.674 |
| | (0.0143) | (0.511) | (0.0928) | (8.408) |
| Tier1 | 0.00164 | 3.972 | -1.043*** | -41.25 |
| | (0.0631) | (2.373) | (0.302) | (56.40) |
| Parent bank risk | 0.148*** | 0.193 | 0.0365 | 0.638*** |
| | (0.0271) | (0.122) | (0.0276) | (0.193) |
| Dbank | - | - | - | - |
| Dlar | -0.00467 | -0.222 | -0.00577 | -13.54*** |
| | (0.00795) | (0.575) | (0.121) | (2.668) |
| Dbetter | 0.0493 | -5.297* | 0.582 | -38.69 |
| | (0.0517) | (2.598) | (0.446) | (46.03) |
| Sharefem | | | | |
| Dadeq_Sharefem | | | | |
| SharePhD | | | | |
| Dadeq_SharePhD | | | | |
| ShareMBA | | -3.074* | | |
| | | (1.683) | | |
| Dadeq_ShareMBA | | 4.009** | | |
| | | (1.872) | | |
| Shareforeign | -0.0233 | | 0.507* | 25.64 |
| | (0.0412) | | (0.271) | (37.46) |
| Dadeq_Shareforeign | 0.0106 | | 0.248 | -17.12 |
| | (0.0351) | | (0.267) | (34.71) |
| Constant | 0.0890 | 0.774 | 0.572 | 81.21 |
| | (0.115) | (2.850) | (0.735) | (70.04) |
| Year dummies | YES | YES | YES | YES |
| Observations | 76 | 102 | 100 | 108 |
| R-squared | 0.820 | 0.450 | 0.486 | 0.499 |
| No. of institutions | 16 | 18 | 18 | 20 |

***Notes:*** Estimation by fixed effects with clustered standard errors at bank level (in parentheses). The first line of Table C4 shows the dependent variables in the individual regressions. "sq_Boardsize" and "sq_AvrBoardten" denote the quadratic terms of the corresponding board variables. "Dadeq_sq_Boardsize" and "Dadeq_sq_AvrBoardten" denote the interactions of the sufficiently capitalized bank dummy with the quadratic terms of the corresponding board variables. For the definitions of the variables, see Table 1. Significance levels: *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

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