NATIONAL RESEARCH UNIVERSITY
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AN OVERCONFIDENT CEO VS A RATIONAL BOARD: THE TALE ABOUT BANK RISK-TAKING

BASIC RESEARCH PROGRAM
WORKING PAPERS

SERIES: FINANCIAL ECONOMICS
WP BRP 78/FE/2019

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Bank risk-taking behavior is of significant interest for researches and policy makers because financial failures due to excessive risk in this sector can have severe consequences for the bank's numerous stakeholders and for the macroeconomic system overall. A growing literature investigates the main factors contributing to "well above average" risk. In particular, this study explains risk strategies in firms taking into account the bounded rationality of corporate governance agents. On a panel dataset of 110 listed US banks in the period of 2011-2016 empirical evidence is provided that excessive risk-taking in banks arises from the cognitive bias of the overconfidence of CEO decision-making. The study also presents how the impact of an overconfident CEO on risk-taking is affected considering the interaction of CEO overconfidence with the board of directors. It was revealed that the CEO's positive influence on risk is moderated if the board is an effective monitoring mechanism with the presence of independent directors who are experts in the financial sphere.

JEL Classification: G21, G39

Keywords: bank risk-taking, CEO overconfidence, board of directors, behavioral finance, behavioral biases

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Introduction

After excessive risk-taking was identified as one of the core reasons for bank distress during the latest financial crisis[4], much research, trying to identify the determinants of banks' risk-taking strategy, has been carried out. While most of it explained risk-taking incentives from the traditional finance point of view (moral hazard theory for example[5]), it would be also useful to extend the explanation of motives for risk in banks with the behavioral finance approach since the people involved in decision-making on the corporate level are inevitably subject to cognitive biases. One such bias, which can significantly affect the pattern of corporate decision-making in banks, is overconfidence. Being triggered by certain psychological traits, overconfidence is particularly attributed to CEOs and makes them overestimate the future potential cash flows from investments and projects while underestimating their potential risks. This can eventually lead to excessive risk-taking. One of the main research questions of this study is whether different levels of risk-taking in banks can be explained by such cognitive biases in CEO behavior as overconfidence.

In the corporate finance literature it is assumed that boards of directors are also involved in strategic decision-making as part of the governance structure. Boards, as well as CEOs, are prone to certain cognitive biases, which impede the implementation of the advising and monitoring functions prescribed to them. Without a board of directors as a high quality advising and monitor structure, corporate governance mechanisms cannot prevent the opportunistic behavior of CEOs. If the board of directors is not captured by cognitive biases as a group, it provides better advice and monitoring and is therefore able to restrain the CEO from making suboptimal and detrimental strategic decisions such as excess risk-taking. The second research question this study is whether the presence of an unbiased board of directors can moderate the relationship between CEO overconfidence and risk-taking, or whether a biased board would induce it.

To answer the research questions a sample of 110 US banks is used covering the period from 2011 to 2016. A regression panel model with fixed effects is applied. To measure overconfidence, a textual analysis of transcripts of annual earnings conference calls was carried out to identify the CEO's "overconfident tone". Market and accounting based indicators are used to measure risk in the model. The effectiveness of the board of directors as a mechanism for

[4] According to Congressional Research Service report (2010) excessive risk-taking was one of the core reasons of financial crisis 2007-2008

[5] Moral hazard theory was mentioned as the main reason for excessive risk-taking in the following empirical works: Keeley M.C. (1990); Kwan S., Eisenbeis R.A. (1997); Dam, L., Koetter M. (2012)

monitoring and advising is determined by the share of independent directors who are experts in the financial sphere. The regression analysis showed that CEO overconfidence has a positive effect on banks' risk-taking, but the strength of CEO's positive influence on risk decreases if there is a large proportion of independent director-experts on the board.

This study contributes to the existing literature, first, by providing a new insight into this relationship by applying multiple measures of risk-taking and a measure of CEO overconfidence that has not previously been used in research into banking sector. Second, the study explores how the relationship between an overconfident CEO and risk-taking behavior is affected, considering the interaction between CEO overconfidence and an unbiased or biased board of directors. Thus, results of the research will help to develop good corporate governance practices that are associated with optimal risk-taking strategies in banks.

Literature review

CEO overconfidence as a cognitive bias

Previous research has confirmed the positive relationship between CEO overconfidence and risk-taking in the banking sector. The existence of overconfidence as a cognitive bias, which leads to the overestimation of one's abilities, was established in psychological research in the 1960s. It was extended to other fields, including economic decision-making [Skala, 2008]. "Overconfidence" is divided into two main groups according to psychology: "miscalibration" and positive illusions. Ben-Davis et al. (2013) refer to "miscalibration" as an overestimation of the precision of knowledge. Forecasts made by "miscalibrated" individuals tend to have narrow confidence intervals [Alpert et al., 1982]. While "miscalibration" is the leading factor in psychological research, positive illusions, which consist of three behavioral biases (the "better-than-average" effect, the illusion of control and unrealistic optimism) are mainly studied in behavioral finance to explain the existence of overconfidence [Skala, 2008].

Heaton describes unrealistic optimism as the tendency to increase the probability of good outcomes while underestimating the probability of bad ones. Individuals tend to be optimistic about the outcome of events if they initially thought they had control over them [Heaton, 2002]. This leads to the next aspect of overconfidence – the illusion of control – which is defined as the belief that future events can be governed even though they are managed mainly by chance [Kruger, 1999]. CEOs tend not to take into account some share of risk and uncertainty in future projects

and mistakenly believe that all processes of the company are under their complete control [Heaton, 2002].

The “better-than-average” effect comes from an overestimation of one’s acumen relative to others [Alicke et al., 1985; Svenson, 1981] predominantly due to a lack of information about the abilities and skills of other people [Alicke, 1985]. The “better-than-average” effect is often identified by researches as the main determinant of CEO overconfidence. While working in an organization, CEOs do not have a comparison group with whom to objectively compare their abilities, and the results of their work are estimated only through the company’s performance, which creates an illusion that everything depends on their decisions and abilities [Malmendier, Tate, 2005; Shu, 2013].

Since CEOs are highly influential in company decision-making, their biased behavior has an impact on the overall firm performance. One of the first studies in this area – the empirical work of Malmendier and Tate (2005) – proves that CEO overconfidence is related to the company's investment decisions. It was found that overconfident CEOs tend to engage in more M&A and use internal resources to finance projects. Research has also shown that managerial overconfidence is closely related to firms’ risk-taking behavior. According to Kahnemann and Lovallo (1993) and Heaton (2002) overconfident CEO’s undertake risky projects because they have overly optimistic beliefs about the returns they are going to generate. Malmeinder and Tate (2008) also show that overconfident CEOs often choose strategies with greater risk because they underestimate the probability of failure.

Table 1. Literature review

Author	*Sample*	*CEO overconfidence measure*	*Results*
CEO overconfidence as a cognitive bias			
Heaton (2002)	Theoretical study	-	Overconfident individuals increase the probability of good outcomes while underestimating the probability of bad ones
Malmendier and Tate (2005); Shu (2013)	US, S&P firms	Option-based method	"Better-than-average" effect is the main determinant of CEO overconfidence
CEO overconfidence as a determinant of risk-taking			
Malmeinder, Tate (2008);	S&P firms;	Option-based method	Overconfidence leads to overestimation of future cash flows, underestimation of risks and acceptance of risky projects
Niu J. (2010)	US, 108 banks, 1994-2002	Media portrait of CEO	Banks headed by overconfident CEOs take more risk
Ho et al. (2016)	US, 1634 observations, 1994-2009	Option-based method	Overconfident CEOs weaken lending standards which, in the end, leads to greater increase in non-performing loans during crisis
Sironi u Suntheim (2012)	23 countries, 113 banks, 2000-2008	Option-based method	CEO overconfidence has a positive effect on banks' credit risk and the likelihood of a bank failing.
Chen et al. (2013)	G20+Taiwan	Option-based method	Overconfident CEOs adopt strategies with greater risk only during periods of recession, while during boom periods they are more likely to reduce risk strategies

CEO overconfidence as a determinant of risk-taking in banks

Niu (2008), on a sample of 108 US banks (1994-2004), demonstrates that there is a positive relation between risk measured by the standard deviation of stock returns and CEO overconfidence determined via their media portrait. Ho et al. (2016) showed that overconfident CEOs weaken lending standards due to an overestimation of borrower's financial capabilities, which leads to a greater increase in non-performing loans during crises. Black and Gallemore (2012) use a sample of US banks in their study to show that overconfident CEOs are prone to incorporating less future

loan deteriorations in banks' loss provisions than unbiased CEOs. Sironi and Suntheim (2012), on a sample of 113 banks (1997-2008), find that managerial overconfidence (determined by whether a CEO postpones the exercise of an "in-the-money" option) positively affects bank risk-taking measured by Z-scores on a cross-country level. In Chen et al. (2013), the hypothesis that overconfident CEOs adopt strategies with greater risk only during periods of recession while during boom periods they are more likely to reduce risk strategies was empirically proved on a sample of G20 countries.

Since most of the currently available research (a review of the research is presented in Table 1) establishes a positive relationship between CEO overconfidence and the degree of riskiness of bank policies, the following hypothesis is put forward for its further empirical testing:

H1: CEO overconfidence has a positive effect on the riskiness of bank policy.

[ADD TABLE 1 HERE]

Board of directors as a CEO-restraining corporate governance mechanism

Separating control from ownership in modern companies creates an "agent problem" between shareholders and CEOs [Berle, Means, 1932]. As a result of the separation, the latter receive full power over strategic decision-making in the organization but at the same time may not act in the best interests of the owners. Since it has been established previously that CEOs in companies are prone to certain bias affecting their decision-making, one should expect that corporate governance mechanisms exist to prevent the CEO from taking excessive risks. In companies, such a mechanism is the board of directors. The board of directors helps the CEO to avoid strategic mistakes by carefully monitoring his actions [Jensen, Meckling, 1976; Weisbach, 1988]. Prior research assessed the ability of boards to perform their monitoring function based on their structure (size, number of independent directors) as the main determinants of quality. For example, it is believed that independent directors better monitor the activities of the CEO. However, according to the modern paradigm in corporate finance, the functions of the board of directors are not limited to monitoring [Leblank, Gillies, 2005]. In fact, boards are active participants in the decision-making process in a company, and thus also perform an "advisory function" [Coleset. al., 2012]. According to the new paradigm, when assessing the effectiveness of the board of directors, the focus should be on the processes inside the board, and specifically on the decision-making processes. The quality of the board depends primarily on the quality of these making processes [Leblanc, Schwartz, 2007; Marnet 2007, 2008].

From the perspective of behavioral finance, decision-making processes in boards are subject to certain group biases that can seriously undermine their effectiveness. One of the most common is “loyalty towards the CEO” [Morck, 2008; Conger, Kanungo, 1998]. Board members may show loyalty towards the CEO whenever there are any social ties between them (for example, when the CEO influenced the appointment of a particular director [Coles, Daniel, Naveen, 2008]). Directors can also experience a loyalty bias when they are captured by a powerful CEO’s personality [Morck, 2008; Conger, Kanungo, 1998]. The loyalty bias can have a significant negative impact on quality of monitoring and advising, since it makes boards unable to criticize the CEO’s decisions and give unbiased advice. The presence of independent director-experts on the board helps to reduce the likelihood of the loyalty bias. These directors are generally able to avoid falling under the influence of the CEO. According to Zhu and Chen (2015), the presence of expert directors on boards helps to mitigate the impact of overconfident CEOs on M&A. In the banking sector, the presence of knowledgeable and experienced independent directors helps to identify and prevent CEO’s risk-taking behavior [Grove et al., 2011]. In this study, it is assumed that in banks the presence of independent directors who are experts in finance will reduce the likelihood of misplaced loyalty towards the CEO, increase the effectiveness of board monitoring and advice, and limit the negative consequences of CEO overconfidence on risk:

H2a: The influence of an overconfident CEO on the riskiness of bank policy will be less if there is a large proportion of experts in finance among the independent directors on the board.

In some works, however, it is said that the presence of expert directors can increase the riskiness of a bank's strategy. Almandoz and Tilcsik (2016) argue that expert directors had a significant impact on the financial collapse of banks during the last crisis. Experience in banking and financial areas also makes such directors overconfident and they accept greater risk. In this paper, an alternative hypothesis is put forward:

H2b: The influence of an overconfident CEO on the riskiness of bank policy will be greater if there is a large proportion of experts in finance among the independent directors on the board.

Methodology

CEO overconfidence measurement

One of the most common ways for measuring overconfidence in the literature is the option-based method [Malmeinder, Tate, 2005]. The method determines CEO as overconfident if he postpones the exercise of the "in-the-money" option for an irrational period, expecting a further increase in the price of the company's shares. Despite the popularity of the option-based approach among researchers, it has some drawbacks. A CEO can postpone option execution for alternative reasons, for example, because he has insider information about the growth opportunities for the company. Bayat et al. (2016) find a positive relation between postponing the exercising of options by CEOs and the characteristics of the company. The postponement of exercising options does not necessarily indicate that the CEO has an overconfidence bias.

Another method of measuring overconfidence is based on the portrait of the CEO in the media [Malmeinder, Tate, 2008]. A CEO is considered overconfident if the number of mentions in the press about him as an "overconfident individual" exceeds the number of mentions as "conservative and cautious". This method also has drawbacks in the form of the subjectivity of media evaluations.

A new method for measuring overconfidence involves studying the language of an individual in order to identify its tone. According to a recent paper by Garrard (2014), there is a strong link between linguistic features and cognitive biases. From a psychological point of view, an overly optimistic and confident tone indicates the presence of overconfidence [Merkl-Davies, Brennan, 2011]. Some papers in corporate finance support this hypothesis. For example, Craig and Amernic (2011) found signs of overconfidence in the language of the CEOs of Enron, Starbacks and GeneralMotors, studying corporate disclosure documents, such as letters to shareholders. Another study shows the relationship between the personal characteristics of CEOs (narcissism, overconfidence) and the tone of their speech during annual income conference calls [Davis et al., 2012]. It can be argued that the tone used by CEOs in documents disclosing corporate information is influenced by their inherent cognitive biases, and, on the basis of an analysis of their tone, we can reveal the presence of overconfidence.

However, a CEO's tone in corporate disclosure documents is also strongly influenced by "impression management" [Merkl-Davies, Brennan, 2011]. This means that CEOs use the tone of their speech to inform investors about the successes or failures in the company's current activities and to give signals about its future performance. That is, in addition to the personal characteristics of the CEO, the tone in corporate documents can also reflect the present and future characteristics of the company. Since this paper examines exclusively the influence of CEO overconfidence on

bank risk, it is necessary to separate the tone associated with "impression management" from the tone reflecting CEO's personality. One way is to build a regression model with CEO tone as the dependent variable and the present and future characteristics of the company and its performance as independent variables and use the estimated model residuals (the unexplained part) as a tone meter reflecting the "true overconfidence" of a CEO [Davis et al., 2012]:

$$OverConfidentTone_{i,t} = \alpha_0 + \alpha_1 * ROA_{i,t} + \alpha_2 * ROA_{i,t+1} + \alpha_3 * Book - to - market\ ratio_{i,t} + \alpha_4 * Bank\ Size_{i,t} + \alpha_5 * MA_{Dummy}{}_{i,t} + \varepsilon_{i,t}, \quad (1)$$

Model (1) has the following independent variables:

ROA (Return on assets): This indicator displays the current performance of the company. It is expected that the better the current performance, the more positive and confident the tone of the CEO during the conference call.

ROA (t+1): This indicator displays the company's future performance. It is included in the model since a confident and positive tone is also likely to be positively related to the future level of bank profitability [Davis et al., 2012].

Book-to-market ratio: The tone is likely to be positively related to the growth potential of the company, which would be reflected in a negative relation between the book-to-market indicator and an overconfident tone.

Bank Size: The proxy for the size of the bank is the logarithm of assets. It is included in the model, since it can affect the degree of overconfidence. When the size of the bank increases, attention to it from outside agents grows. CEO statements can become more cautious to avoid legal costs, however , they can be more confident and positive to influence the media.

MA_Dummy: Dummy variable takes the value of 1 if the bank expects a merger or acquisition in the next period. According to a study by Huang (2014), the tone is more positive if such a deal is expected.

OverConfident Tone is the dependent variable in model (1). To identify this, a semantic analysis of the texts of transcripts of annual income conference calls is used. While in most papers in this area, financial reports and letters to shareholders are selected for text analysis, conference call transcripts are a better tool for analysis for a number of reasons. First, in the analysis of letters to shareholders there is a high probability that the letter was not written by CEO him- or herself or, in any case, it was heavily edited. In the case of transcripts, the probability of this is extremely

small. Second, the speech of a CEO in transcripts will largely reflect that part of the tone that is associated with his personal characteristics. The largest section in conference calls is unscripted, with the answers to the questions of analysts, in which CEO has little control over the tone of his speech, unlike with the prepared text of letters to the shareholders.

For text analysis, annual transcripts of bank conference calls (2011-2015) were collected from the Thomson Reuters database. In the literature on psychology and finance it has been established that overconfident individuals tend to use more positive and confident words while avoiding words of negative and uncertain tone [Loughram, Mcdonald, 2011; Merkl-Davies, Brennan, 2011]. In this study, dictionaries of positive/strong modal words in contrast to negative/uncertain/weak modal words developed specially for the financial sector by Loughram and Mcdonald are used (examples of words are given in Table 2) to build a continuous variable that reflects the degree of overconfidence in CEO's tone:

$$OverconfidentTone = \\ = \frac{(Positive + Strong\ Modal) - (Negative + Uncertain + Weak\ Modal)}{Total\ number\ of\ words}$$

Table 2. Word examples from Loughram and Mcdonald dictionary[6]

Negative	*concern, postpone, challenges, cut, difficult, disadvantage, miss, unable, worry*
Uncertain	*approximately, might, doubt, uncertain, apparently*
Weak Modal	*maybe, perhaps, possible, could*
Positive	*able, assure, strong, enthusiasm, excellent*
Strong Modal	*always, definitely, strongly, will*

By its construction, the *OverconfidentTone* variable implies that the higher it is, the more overconfident tone the CEO has. Using the sum of words from different dictionaries to describe the degree of tone overconfidence is justified by "the similarity of these dictionaries in terms of explaining the same personal characteristics of individuals" [Loughram, Mcdonald, 2011].

[6] Full version of dictionaries can be found on https://sraf.nd.edu/ website

Model (1) is estimated for each year from 2011 to 2015 and the residuals of the estimated regressions are used to construct the *ResOverconfidentTone* variable. This variable measures the degree of CEO overconfidence in this study to assess its impact on risk-taking by banks.

The method of overconfidence measurement presented in this chapter seems to be the most suitable for the study. An analysis of the tone of annual reports allows the construction of a time-varying and continuous indicator of overconfidence, which is important since the level of overconfidence of individuals can change over time under the influence of various factors. In addition, isolating the component responsible for personal characteristics in a tone to assess its impact on the risks of banks in the next step is fully justified. Davis et al.'s (2012) study empirically proves that the specific component of the tone obtained by constructing a regression of type (1) is positively influenced by personal characteristics, revealing the overconfidence and optimism inherent in CEOs. Other works also show the existence of a connection between a specific component of tone and various characteristics of companies: tax planning [Bamber et al., 2010], the choice between financial reporting methods [Ge et al., 2011]. In particular, Huang et al. (2014) show a negative relationship between the specific tone component and the future performance of non-financial companies with a two-year lag.

An analysis of the impact of CEO overconfidence on banks' risk

The model used to study the impact of banks CEOs overconfidence on their risk acceptance is presented in equation (2):

$$Risk_{i,t} = \beta_1 + \beta_2 * ResOverconfident_{Tone_{i,t-1}} + \beta_3 * Expert_{Board_{i,t-1}} + \beta_4 * ResOverconfident_{Tone_{i,t-1}} * Expert_{Board_{i,t-1}} + \beta_4 * X_{i,t-1} + \sum_{i=2012}^{i=2017} \beta_m Year_i + \varepsilon_{i,t}, \quad (2)$$

Three variables were used to measure risk taking:

Risk: The literature shows a variety of different bank risk indicators. To consider the impact of overconfidence on risks, three market indicators are most often used: Total Risk, Systematic Risk and Idiosyncratic Risk.

Total risk is calculated as the standard deviation of the company's daily returns [Niu, 2010] and is able to capture market perceptions of the riskiness of bank assets, liabilities or any off-balance sheet activities.

Systematic and idiosyncratic risks are calculated based on the work of Niu (2011) using a market model:

$$R_{i,t} = \alpha_0 + \alpha_1 * R_{mt} + \varepsilon_{i,t} \ , \quad (3)$$

where $R_{i,t}$ is the return of shares of the bank *i* on day *t*, R_{mt} is the market return on day *t*, calculated on the basis of the S&P index, $\varepsilon_{i,t}$is error of the model. The coefficient α_1 is the systematic risk, and the standard deviation of the regression residuals is the idiosyncratic risk. Systematic risk is part of the total risk associated with changes in the financial and macroeconomic environment. Idiosyncratic risk reflects that part of the total risk which is associated with bank-specific factors. This usually refers to the properties of the portfolio of loans, investments, deposits and the capital structure of banks. The use of all three types of risk is justified by the fact that CEOs can have an impact on them individually or as a whole.

The following variables were used as independent variables in the model:

ResOverconfident_Tone (Overconfident tone): Represents the residuals of the regression model (1) (see "CEO overconfidence measurement"). It is expected that there is a positive relationship between overconfident tone and bank's risks.

*Expert_Board and ResOverconfident_Tone*Expert_Board: Expert_Board* is constructed following Malmeinder and Tate (2008): independent directors are classified as financial experts if they have experience in commercial banks or other financial institutions, have held a CFO position in non-financial companies, or have an academic degree in finance. Inclusion of the variable intersection with *ResOverconfident_Tone* is necessary to test hypothesis H2 (see "Board of directors as a CEO-restraining corporate governance mechanism"). According to hypothesis H2a, the sign before the variable of the intersection must be negative (a large proportion of directors, who are experts in finance among independent directors, should reduce the positive effect of CEO on risks). According to the hypothesis H2b, the sign should be positive (a large proportion of directors who are experts in finance among independent directors must maximize the positive effect of CEO on risk).

The following variables were used as control variables in the model:

Financial characteristics of banks:

Bank_Size: Previous studies have shown that the size of the bank can have a negative impact on risk taking [Demsetz, Strahan, 1997], as a larger bank allows for a better diversification of assets and easier access to capital in case of falling liquidity. The market may also regard such banks as the most stable because of the "too big to fail" effect. However, financial institutions that

recognize that they are perceived as "too big to fail" may also have incentives to take additional risk.

Book_to_market_ratio: Earlier studies have shown that banks with a high book-to-market value are more likely to experience financial difficulties [Fama, French, 1992]. It was subsequently found that a high market-to-book value has a disciplining effect on banks, forcing them to take fewer risks [Keeley, 1990; Carletti, Hartmann, 2003]. A high market-to-book value also indicates a large potential for growth and greater volatility of share returns. [Adam, Goyal, 2004].

Tier1: A large ratio of the bank's own funds to risk-weighted assets indicate greater stability and, therefore, lower volatility of share returns [Kim, Santomero, 1998].

Diversification: The bank's income diversification index is built following the procedure described in Stiroh and Rumble (2006):

$$Diversification = 1 - \left[\left(\frac{Net\ interest\ income}{Net\ operating\ income}\right)^2 + \left(\frac{Net\ non-interest\ income}{Net\ operating\ income}\right)^2\right]$$

A higher value of the index corresponds to greater diversification. Previous studies suggest that banks can diversify their risks through engaging in unconventional businesses (Stiroh, Rumble, 2006). However, there is also the possibility that a large share of unconventional income will lead to destabilization, as non-interest income is usually more volatile than interest income [DeYoung, Roland, 2001].

ROA: The ROA adjusted for taxes and reserves reflects the bank's profitability. It is generally assumed that there is a negative relationship between ROA and risk, as banks have less need to increase risk if they already have high returns.

Loans_to_Deposits: The ratio of loans to deposits is included in the model to show differences in the structure of banks financing. Banks receiving a large share of financing from non-deposit sources are less stable [Altunbas et al., 2011].

Features of CEO:

Following other studies, the model also includes CEO's characteristics that potentially affect risk.

CEO_ownership: A large share of stocks owned by the CEO can make him or her behave more cautiously. However, some studies also argue that this aligns their interests with the interests of shareholders and leads to an increase in risk-taking [McConnell, Servaes, 1990].

CEO_age: CEO age affects their incentives to take risks. According to Serfling (2012) the older the CEO, the lower their incentives to take risks.

CEO_turnover: For additional control, a dummy variable that equals one if the CEO was replaced during the year included in the model.

Taking into account the panel data structure, the regression model (2) also includes fixed time effects. The independent variables of the model are assumed to have lags: financial characteristics can influence risks with a delay. In addition, the lags help to deal with possible endogeneity. In the case of the main independent variable, *Overconfident_Tone*, lag is also assumed since it is investigated how the signs of overconfidence found in CEO's tone in the conference call at the end of the year would affect the bank's risks the following year.

Table 3 shows all main variables used in the regression model (2).

Table 3. Description of variables in model (2)

Variable	*Description*	*Expected impact on risk*
	Dependent variable	
Total_Risk	Total risk. Standard deviation of the company's daily returns	
Systematic_Risk	Systematic risk. Coefficient in front of market risk in regression model (3)	
Idiosyncratic_Risk	Idiosyncratic risk. Standard deviation of residuals in regression model (3)	
	Independent variables	
ResOverconfident_Tone	Overconfident tone. Residuals of regression model (1). Introduced to test H1	Positive impact on risk (+)
Expert_Board	Share of directors – experts in finance among independent directors on the board[7] Alternatively: dummy variable that equals 1 if the share of directors – experts exceeds the average among all banks that year	Positive or negative impact is possible (+/-)
ResOverconfident_Tone*Expert_Board	Intersection variable. Included to test H2.	+/-
	Control variables. Financial characteristics	
Bank_Size	Logarithm of assets	+/-
Book_to_market_ratio	Ratio of book value of assets to market value	+/-
Tier1	Ratio of the bank's own funds to risk-weighted assets	Negative impact on risks (-)
Diversification	The degree of bank's income diversification. The proportion between income from interest and non-interest sources, calculated using a special formula	+/-
ROA	ROA adjusted for taxes and reserves on possible loan losses	+
Loans_to_Deposits	Ratio of bank's loans to deposits	+
	Control variables. CEO characteristics	
CEO_ownership	Share of bank's stocks in the manager's hands	+/-
CEO_age	Logarithm of CEO age	-
CEO_turnover	Dummy variable that equals one if there was a replacement of CEO in the bank that year	+/-

[7] Investment banking is excluded

Description of the sample and data sources

A sample of US commercial banks are used for the study[8]. Given the specifics of the variables, the sample included only banks whose shares are traded on the stock exchange. At the initial stage, the sample consisted of 115 banks for the regression model (1). The small number of banks in the sample is due to the manual data collection needed to measure CEO's overconfidence. The small sample size is also justified by the fact that 115 American banks cover almost 75% of the US banking sector. The study period (2011-2016) is dictated by the availability of transcripts of conference calls in the database. The sample was reduced to 110 banks for the model (2) evaluation due to the lack of detailed information on some corporate characteristics of 5 organizations. The sample includes 150 CEOs (20 banks replaced CEOs during the period).

The transcripts of conference calls were downloaded from the Thomson Reuters database. Text analysis was carried out using Python programming language (version 3.6.0). Financial characteristics were collected using the Thomson Reuters and Bloomberg databases. The characteristics of corporate governance, including information about the members of board necessary to build the variable *Expert_Board*, the age of CEO, and the proportion of shares they owned were found in Capital IQ database.

Results

CEO Overconfidence Measurement

Descriptive statistics for the variables used in model (1) are presented in Table 4. The positive average of the *Overconfident_Tone* value indicates that the average CEO's speech transcript during conference calls contains more positive and confident words than negative and uncertain ones. The value, however, is lower than in other studies where it exceeds 1% [Davis et al., 2014; Ataullah et al., 2013 and others]. This may be due to the fact that CEOs in US banks try to be more careful and conservative in their statements. Almost all variables in the sample, except for *Overconfident_Tone* and *MA_Dummy*, are not highly volatile, which is represented in relatively low standard deviations.

[8] SIC code 6021, 6022

Table 4. Descriptive statistics

VARIABLES	OVERCONFIDENT_TONE
ROA	0.178**
	(0.0745)
Book_to_Market_ratio	-0.00335***
	(0.0008)
MA_Dummy	0.0009**
	(0.0004)
ROA_(t+1)	0.158**
	(0.0793)
Bank_Size	0.000207***
	(0.00006)
Constant	Yes
Year FE	Yes
Observations	575
Number of id	115
R-squared	0.289

Regression model (1) was estimated for each year (2011-2016) with preliminary checks for multicollinearity[9]. The residuals of the regressions were used to build the *Overconfident_Tone* variable. In addition to cross-sectional regressions, a single regression with year fixed effects[10] was also constructed and estimated. The results are presented in Table 5[11].

Table 5. Results of model (1) estimation

Variable	*Number of observations*	*Mean value*	*Std. Dev.*	*Min. Value*	*Max. Value*
OVERCONFIDENT_TONE (%)	575	0.371	0.824	-1.421	2.630
ROA(%)	690	1.193	0.585	-2.561	2.693
Bank_Size	690	9.686	1.530	6.204	13.76
MA_Dummy	690	0.081	0.339	0	1
Book_to_market ratio	690	0.767	0.252	0.279	1.893

*** p<0.01, ** p<0.05

The coefficients for *ROA* and *ROA (t+1)* are positive and statistically significant at the level of 5% which indicates that a more confident and positive tone during conference calls is observed in banks with the best profitability indicators in the current and future years. The coefficient for *book-to-market ratio* is negative and statistically significant at the level of 1%, implying that CEOs in banks with high potential growth use a more confident and positive tone. The positive value of the coefficient for *Bank_Size* indicates that the tone of CEOs of larger banks is more positive and confident. In addition, the bank's strategic initiatives, such as M&A, also

[9] VIF values did not exceed 4 for all regressions
[10] Results of the model are robust to including clustering at the bank level
[11] Dummy variables for each year are not reflected in the table

increase confidence in the tone. In general, the characteristics of banks presented in the model explain 29% of the tone of the CEO during conference calls.

The impact of CEO's Overconfidence on Banks' Risks

The descriptive statistics for model (2) are provided in Appendix 1. The average values of full, systematic and idiosyncratic risks are 1.5%, 0.77% and 1.3% respectively, which is slightly less than the average market risk values for US banks in other studies [Niu, 2011; Pathan, 2009]. This lower volatility may be explained by the selected period of time for the study, which did not contain any particular crisis or shocks in the US banking sector. *ResOverconfident_Tone*, being the residuals of regression (1), predictably shows an average value of approximately zero. On average, about 28% of independent directors on the boards of directors are financial experts. Since 2011, when the share of expert directors was only 22%, the figure has increased to 33% in 2016. The average age of CEO in American banks is 58, the average percentage of their ownership of the company is 0.7%, but this figure is volatile in the sample.

A correlation matrix was constructed to provide an initial understanding of data interdependence and to identify potential multicollinearity (Appendix 2). *ResOverconfident_Tone* is weakly positively and significantly correlated with two market risk indicators: total risk and idiosyncratic risk (0.08 and 0.11 respectively). *Expert_Board* is significantly and negatively correlated with *Total_Risk* (-0.13). The relatively high coefficient of the correlation between *ROA* and *book_to_market ratio* (0.47) and *CEO_ownership* and *CEO_age* (0.37) makes us think about the possible problem of multicollinearity between variables. However, the average VIF for the regression does not exceed 2, which gives evidence of the absence of multicollinearity in model (2).

The choice between the methods of the panel data model (2) estimation was made using special tests. The Wald test showed the advantage of the fixed effect model over the pooled model (p-value<0.01). Hausman's test also showed that the fixed-effect model fits better than the random one (p-value<0.01). The heteroscedasticity test (Wald's heteroscedasticity test in the panel data model) rejected the hypothesis of homoscedasticity in the model at the level of 1%. In addition, the Wooldridge test for autocorrelation rejects the hypothesis of the absence of first order autocorrelation at a significance level of 5%[12]. Therefore, equation (2) is evaluated as a regression with fixed effects by years and clustering at the bank level to control for heteroscedasticity and

[12] Cross-sectoral correlation is absent in models as shown by the Pesaran test

autocorrelation.[13] The results of model (2)'s evaluation for all three types of risks are presented in Appendix 3.

The coefficient for *ResOverconfident_Tone* in regressions with *Total_Risk* and *Idiosyncratic_Risk* is positive and statistically significant at the level of 5%, which provides evidence of the confirmation of hypothesis H1: the CEO's tone, reflecting his or her overconfidence as a personal characteristic, has a positive effect on bank's risk exposure. From the point of view of economic significance, an increase in the tone of overconfidence by one standard deviation leads to an increase in the total risk by 0.099%, which is about 6.4% of its average value. It can be assumed from other studies that excessively confident CEOs in banks overestimate future cash flows and underestimate risks, which leads to the adoption of risky strategies in relation to, for example, investment, assets, liabilities, capital, and off-balance sheet items. Ultimately, this is reflected in increased risk. The *ResOverconfident_Tone* coefficient in the model with systematic risk is positive and significant at the level of 10%, which means that the impact of the CEO on this component of market risk is not as strong but is still present. The *Expert_Board* variable presented in this specification of the model is a binary variable that equals 1 if the share of independent expert directors in the board exceeds the average share for this year[14]. The coefficient for *Expert_Board* is insignificant for the idiosyncratic risk and is significant for the systematic risk and total risk at the 10% level. The intersection of *Overconfident_Tone* and *Expert_Board* is negative and significant at the level of 5% for total risk and at the level of 10% for idiosyncratic risk, which confirms hypothesis H2a in a weak form: the impact of an overconfident CEO on the riskiness of bank policy will be less if the share of independent directors who are financial experts is above average. For example, if the share of independent directors who are experts in finance is higher than the average, this leads to a decrease in the impact of *Overconfident_Tone* on total risk from 0.099% to 0.068%. Independent directors who are experts in finance are able to deter an overconfident CEO from implementing sub-optimal strategies which lead to excessive risk.

The coefficient for *ROA* is negative and statistically significant in all three models. The strong negative impact of profitability on risk proves the hypothesis that banks do not need to increase risk if they already have high returns. The coefficient for *Bank_Size* is also negative and statistically significant for models with total and idiosyncratic risk as dependent variables. It is

[13] For additional robustness testing, equation (2) was also evaluated using standard errors of Driscoll-Kraay, Newey-West and evaluation methods of Prais-Winsten; the results are qualitatively the same

[14] Continuous variable was used in another specification but the results did not differ qualitatively

negative and significant at the level of 5% for systematic risk. A possible explanation for this lies in the fact that a larger bank size contributes to a better diversification of asset risks, but also gives greater exposure to external changes. The degree of diversification of the bank's income has a positive and significant impact on all three types of market risks (at the level of 1% for total risk, at the level of 5% for systematic and at the level of 10% for idiosyncratic risk). It can be assumed that income from non-traditional activities for banks is associated with high risk. *Tier 1* negatively and significantly affects total and systematic risks, confirming its role as a disciplinary mechanism. In addition, the coefficient for *Loans_to_deposits* is positive and significant for all three dependent market risk variables, implying less stability for banks with weak liquidity or with a higher proportion of funding from non-deposit sources. The coefficient for the book-to-market ratio is negative and significant at the level of 5%, indicating that banks with greater growth potential are more volatile. The coefficients preceding CEO characteristics, such as age and ownership share, show a weak impact on bank's risks. The coefficient of *CEO_ownership* is positive and significant at the level of 10% only for idiosyncratic risk, and the coefficient for *CEO_age* is negative and significant at the level of 10% for total and idiosyncratic risks, implying that with age the incentives for risk decrease.

Additional research

The impact of CEO overconfidence on credit risks

All three risk measures presented as dependent variables in model (2) are based on market information. CEO overconfidence affects accounting-based bank indicators by, for example, credit risk represented by the share of non-performing loans (*NPL_ratio*). The result of the evaluation of the model with a dependent variable of the share of non-performing loans to the total loan portfolio is presented in Appendix 4. However, the results do not show the significance of the coefficient for *ResOverconfident_Tone*.[15] It is possible that CEOs in banks do not affect the formation of credit portfolios since this is solely the CFO's responsibility. However, this version is not confirmed in other studies, which found a positive relationship between the share of non-performing loans and overconfidence of CEOs [Chen et al., 2015]. In addition, taking into account the specificity of *NPL_ratio* as an ex post variable, it may be necessary to include more lags in the model to identify the relationship. Unfortunately, it is not possible in this work due to the small number of periods considered. Nevertheless, it is possible to investigate how *ResOverconfident_Tone* affects one of the ex ante indicators of credit risk – the growth of

[15] The model was tested with fixed effects, and additionally, with random and GMM method with first and second order lags, but the significance could not be detected in any of them.

commercial and industrial loans (C&I loans). According to numerous studies, the abnormal growth of C&I loans, one of the riskiest types of loans in any bank's portfolio (Pathan, 2009), is positively associated with the manifestation of credit risks in the future (Kohler, 2015). Following the work of Kohler (2015), abnormal C&I loan growth (*Abnormal_Loan_Growth*) is defined as the difference between the growth of C&I loans in a particular bank and the average growth of C&I loans among all banks for that year. The results of the model estimation are presented in Appendix 4 in the second column and indicate the presence of a positive and significant (at the 5% level) connection between *ResOverconfident_Tone* and *Abnormal_Loan_Growth.* Thus, it can be concluded that greater overconfidence in a CEOs tone during a conference call at the end of one year leads to an excessive growth of C&I loans the following year.

Robustness check

Taking into account heteroscedasticity and autocorrelation in regression (2), an additional Prais-Winsten estimation of the model was carried out (Appendix 5, for *Total_Risk*). The results of the estimation do not differ qualitatively from the model with fixed effects, but demonstrate greater economic significance, which, however, may be due to the lack of control over fixed effects at the bank level. In addition, alternative variables describing the financial characteristics of banks and CEO characteristics were introduced into the model (logarithm of the market value was used instead of logarithm of assets, net interest margin was used instead of ROA, Capital Adequacy Ratio was used instead of Tier 1 and tenure was used instead of CEO's age). The results, however, do not change qualitatively for all specifications. Control over the ownership structure was also introduced, assuming that it may also have an impact on risks: the *block_ownership* variable which equals to 1, if more than 10% of shares are concentrated in the hands of one investor. It was assumed that less diluted ownership leads to greater risk control, but the hypothesis was not confirmed and the variable was not significant.

The study has certain limitations. Firstly, it is possible that the *Overconfident_Tone* variable is endogenous if unobservable bank preferences regarding risk strategies determine both the level of risk and the appointment of an overconfident CEO. Secondly, during conference calls CEOs can consciously use more confident and optimistic tone than is justified by the company's real performance to mislead investors. However, this is unlikely, as inflated investor expectations are extremely risky in the banking sector and may lead to reputational and legal issues.

Conclusion

A sample of 110 US banks (2011-2016) is used to examine how overconfidence can influence the risks of banks. The method of measuring overconfidence is based on the examination of CEO's language during conference calls. The language is analyzed in order to identify the tone which is most likely explained by the presence of cognitive bias. Empirically, we prove the positive impact of CEO overconfidence on banks' full and idiosyncratic risks. Excessively confident CEOs in banks overestimate future cash flows and underestimate risks, which leads to the adoption of risky strategies in relation to investment, assets, liabilities, capital, and off-balance sheet items. We also demonstrate the ability of an unbiased and effective board of directors represented by a larger share of independent directors who are experts in the financial field to restrain overconfident CEOs and reduce their impact on risk. There was no evidence of any influence of CEO overconfidence on banks' credit risks measured by the share of non-performing loans. However, it was shown that CEO overconfidence leads to an abnormal growth of commercial and industrial loans, which are among the riskiest items in the bank's asset portfolio.

This study shows the importance of taking into account the limited rationality of corporate governance agents when explaining excessive risk-taking by banks. It also demonstrates the role of the board of directors as an effective control and management mechanism in banks. Further research in this area can focus on identifying the overconfidence of other agents in corporate governance, for example, CFOs and directors, and on the impact of other cognitive bias on the characteristics of bank performance.

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Appendix

Appendix 1. Descriptive Statistics

Variable	*Number of observations*	*Mean value*	*Std. Dev.*	*Min. Value*	*Max. Value*
Total_Risk(%)	660	1.542	0.384	0.826	5.186
Systematic_Risk	660	0.77	0.323	-0.313	2.3
Idiosyncratic_Risk(%)	660	1.377	0.271	0.752	3.30
CEO_age	660	58.01	6.653	37	79
CEO_ownership(%)	660	0.766	1.355	0	9.6
Expert_Board	660	0.278	0.180	0	0.8
ROA(%)	690	1.193	0.585	-2.56	2.69
Log_Bank_Size	690	9.686	1.530	6.204	13.76
Diversification	660	0.344	0.119	0.05	0.49
TIER1(%)	660	13.08	3.35	8.6	51.9
Book_to_market ratio	690	0.767	0.252	0.279	1.893
Loans_to_deposits	660	0.852	0.1704	0.1479	2.06
ResOverconfident_Tone	575	0.000	0.007	-0.02	0.01

Notes: Mean values of total, systematic, and idiosyncratic risks are 1.5%, 0.77%, and 1.3%, respectively. ResOverconfident_Tone, which is residuals from regression (1) has an average value of approximately zero. On average, about 28% of independent directors in the board of directors are financial experts. The average age of CEO in American banks is 58 years, the average percentage of their ownership of the company's shares is 0.7%, but it is rather volatile in the sample.

Appendix 2. Correlation matrix

	ResOverconfident_Tone	*Expert_Board*	*CEO_ownership*	*CEO_age*	*ROA*	*Diversification*	*book_to_market_ratio*	*Bank_Size*	*Tier 1*	*Loans to deposits*
ResOverconfident_Tone	1.00									
Expert_Board	-0.11	1.00								
CEO_ownership	0.18	-0.03	1.00							
CEO_age	0.05	-0.08	**0.36**	1.00						
ROA	-0.00	0.05	0.11	0.13	1.00					
Diversification	0.10	-0.07	-0.04	-0.19	-0.13	1.00				
book_to_market_ratio	0.00	0.11	0.24	0.21	**0.47**	-0.17	1.00			
Bank_Size	-0.00	-0.13	-0.13	-0.10	-0.07	0.25	-0.20	1.00		
Tier1	0.06	0.02	0.03	-0.15	-0.01	-0.02	-0.12	0.05	1.00	
Loans to deposits	0.05	-0.09	0.10	0.08	0.02	-0.18	0.13	-0.15	-0.17	1.00
Total_Risk	**0.08**	**-0.13**	0.16	-0.01	-0.17	0.01	0.03	-0.07	-0.05	0.05
Systematic Risk	0.03	**0.01**	0.06	0.15	-0.2	0.11	0.04	0.06	-0.15	0.07
Idiosyncratic_Risk	**0.11**	-**0.06**	0.02	-0.01	-0.09	-0.08	0.05	-0.12	-0.09	0.06

Notes: ResOverconfident_Tone is weakly positively and significantly correlated with two market risk indicators: total risk and idiosyncratic risk (0.08 and 0.11 respectively). Expert_Board is significantly and negatively correlated with Total_Risk (-0.13). Relatively high coefficient of correlation between ROA and book_to_market ratio (0.47) and CEO_ownership and CEO_age (0.37) tells about the possible problem of multicollinearity between variables

Appendix 3. Model (2) estimation results

VARIABLES	(1) Total_Risk	(2) Idiosyncratic_Risk	(3) Systematic_Risk
ResOverconfident_Tone	0.00099**	0.000904**	0.00156*
	(0.0005)	(0.0004)	(0.0008)
Exp_Board	-0.001115*	-0.001254	-0.00151*
	(0.0005)	(0.0010)	(0.0007)
ResOverconf_Tone*Exp_Boa	-0.00031**	-0.000333*	0.000279
rd	(0.0001)	(0.0002)	(0.0004)
CEO_turnover	0.00024	0.000611	0.00107
	(0.0003)	(0.0004)	(0.00064)
CEO_ownership	-0.0000874	0.000058*	0.00017
	(0.0002)	(0.0000)	(0.0000)
Bank_Size	-0.00216***	-0.00162***	0.000466**
	(0.0004)	(0.0002)	(0.00022)
ROA	-0.11772**	-0.10578***	-0.211**
	(0.0523)	(0.0215)	(0.0254)
Loans_to_Deposits	0.014224***	0.01003**	0.09942***
	(0.0047)	(0.0050)	(0.0204)
Log_CEO_Age	-0.000509*	-0.000232*	0.00036
	(0.0002)	(0.0001)	(0.0012)
Diversification	0.000803***	0.00549*	0.00305**
	(0.0002)	(0.0033)	(0.00129)
Tier1	-0.0449***	-0.0758	-0.01468***
	(0.0116)	(0.0631)	(0.0056)
Book_to_market_ratio	-0.001947**	-0.001254**	-0.00093**
	(0.0009)	(0.0006)	(0.0004)
Constant	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Observations	550	550	550
Number of banks	110	110	110
R-squared	0.583	0.373	0.445

*Robust standard errors in parentheses *** p<0.01, **p<0.05, *p<0.1*

Notes: The coefficient in front of ResOverconfident_Tone in regressions with Total_Risk and Idiosyncratic_Risk is positive and statistically significant at the level of 5%, which provides the evidence of H1 hypothesis confirmation: CEO's tone, reflecting his or her overconfidence as a personal characteristic, has a positive effect on bank's risk exposure. . ResOverconfident_Tone coefficient in the model with systematic risk is positive and significant at the level of 10%. Expert_Board variable presented in this specification of the model is a binary variable that equals 1 if the share of independent expert directors in the board exceeds the average share for this year [16]. Coefficient in front of Expert_Board is insignificant for the idiosyncratic risk and is significant for the systematic risk and total risk at 10% level. At the same time, the coefficient preceding the

[16] Continuous variable was used in another specification but the results did not differ qualitatively

intersection of Overconfident_Tone and Expert_Board is negative and significant at the level of 5% for total risk and at the level of 10% for idiosyncratic one, which presents the confirmation of H2a hypothesis in a weak form: the impact of overconfident CEO on riskiness of bank's policy will be less if the share of independent directors who happen to be financial experts is above average on the board. For all three models ROA, Book_to_market ratio и Bank_Size have negative and significant impact on bank's risk. Loans_to_Deposits ratio has significant and positive influence on three dependent risk variables.

Appendix 4. Estimation results of the models with NPL_ratio и Abnormal_Loan_Growth as dependent variables

VARIABLES	(1) NPL_ratio	(2) Abnormal_Loan_Growth
ResOverconfident_Tone	-0.00306	0.02395**
	(0.0025)	(0.0114)
Expert_Board	-0.00815**	0.00665
	(0.0041)	(0.0055)
ResOverconfident_Tone*Expert_Board	-0.00061	0.00482
	(0.0006)	(0.0041)
CEO_turnover	0.00185	0.00126
	(0.00139)	(0.00115)
CEO_ownership	0.000947	0.000652
	(0.0007)	(0.0005)
Bank_Size	0.00407***	-0.04625***
	(0.0007)	(0.0073)
ROA	-0.575***	-1.9150***
	(0.103)	(0.5984)
Diversification	0.0185***	0.000568
	(0.0047)	(0.00175)
Tier1	-0.0903*	-0.88595**
	(0.0492)	(0.35007)
Book_to_market_ratio	0.0510***	-0.0491***
	(0.0021)	(0.0037)
Constant	Yes	Yes
Year FE	Yes	Yes
Bank FE	Yes	Yes
Observations	550	550
R-squared	0.372	0.298
Number of banks	110	110

*Robust standard errors in parentheses *** p<0.01, **p<0.05, *p<0.1*

Notes: Coefficient in front of ResOverconfident_Tone is not significant in the model with NPL_ratio (share of non-performing loans) as a dependent variable and is significant and positive in the model with Abnormal_Loan_Growth (growth of C&I loans beyond average among other banks). Thus, it can be concluded that greater overconfidence in CEOs tone during a conference call at the end of this year leads to an excessive growth of commercial and industrial loans next year.

Appendix 5. Results of Prais-Winsten estimation of model (2)

VARIABLES	Total_Risk
ResOverconfident_Tone	0.00134**
	(0.0007)
Exp_Board	-0.000576*
	(0.0003)
Overconfident_Tone*Expert_Board	-0.00109**
	(0.0005)
CEO_turnover	0.000199
	(0.0004)
CEO_ownership	0.000275*
	(0.0001)
Bank_Size	-0.00108**
	(0.0004)
ROA	-0.156**
	(0.0691)
Diversification	0.000909**
	(0.0004)
Loans_to_Deposits	0.00100**
	(0.0003)
Tier1	-0.00859**
	(0.0039)
Book_to_Market_ratio	-0.00378***
	(0.0009)
Constant	Yes
Year FE	Yes
Observations	550
Number of banks	110
R-squared	0.735

*Standard errors in parentheses *** p<0.01, **p<0.05, *p<0.1*

Notes: Results of estimation do not differ qualitatively from the model with fixed effects, but demonstrate greater economic significance, which, however, may be due to the lack of control over fixed effects at the bank level.

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