# Does Espoused Risk Culture Pay? Evidence from European Banks

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**Abstract**

A poor risk culture was one of the causes of the financial crisis. Surprisingly, there is no evidence of the link between risk culture and bank stability. Using a large sample of European banks from 2004 to 2017, our paper shows that a sound risk culture leads to better performance. Our research design is based on three steps. First, we developed a new Sound Risk Culture Indicator based on the Financial Stability Board (2014) risk culture framework. Second, we estimated this new metric by applying Quantitative Text Analysis. Third, we used an IV 2SLS panel data approach to establish a causal link between bank risk culture and profitability.

**Keywords:** *Risk Culture, Performance, Banking, Text Analysis, Stability*
**JEL codes:** G21; M14

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*"The pressure on the risk department to keep up and approve transactions was immense. Psychology played a big part. The risk department had a separate reporting line to the board to preserve its independence. This had been reinforced by the regulators, who believed it was essential for objective risk analysis and assessment. However, this separation hurt our relationship with the bankers and traders we were supposed to monitor. In their eyes, we were not earning money for the bank."*

*Confession of a risk manager, The Economist 2017.*

## 1. Introduction

Popular press, practitioners, and financial regulators have argued that weak risk governance and culture were shortcomings of the financial system after 2008 (Parliamentary Commission on Banking Standards, 2013; House of Commons Treasury Committee, 2009; Institute of International Finance, 2009). The Financial Stability Board (2014) states that "*Weaknesses in risk culture are often considered a root cause of the global financial crisis, headline risk and compliance events*" (FSB, 2014, p. 1). Similarly, in a letter written to FSB on January 2014, HSBC notes that "*establishing and maintaining a strong link culture is of fundamental importance in ensuring the sustainable success of an organization and to the reestablishment of trust of financial institutions and the banking sector*" (HSBC, 2014, page 1).

There is anecdotal evidence that suggests a lack of risk culture in banking prior to the financial crisis. Jean-Claude Trichet, Chairman and CEO of the Group of Thirty and former president of the European Central Bank, noted that "*Too often, bank bosses' promises to change the 'corporate culture' and ensure their employees' good conduct have not been matched by fully effective implementation*" (Trichet, 2015, page 1). Since the crisis, the largest financial institutions have been levied over $100 billion in fines, suggesting that ethical lapses in banking are not just the outcome of a few bad apples, but a reflection of systematic weaknesses (Thakor, 2016). The lack of risk culture in banking is essential in the trade-off between risk-taking and profits, as explained by the statement of a US risk manager describing the conflict between the risk

management department and business lines before the financial crisis. Not surprisingly, financial regulators have proposed various initiatives to reinforce banks' risk cultures. William C. Dudley, President and Chief Executive Officer of the Federal Reserve of New York, noted that *"In the last year, we have seen emerging approaches to supervision that aim to address culture, conduct and governance. These methods are being developed in a number of jurisdictions*" (Dudley, 2015, page 1). New regulation is pushing banks to develop internal Risk Culture; the latter requires investments and imposes costs to institutions (Basel Committee for Banking Supervision, 2015a, 2015b).

Although there is a vast literature investigating the determinants of European bank performance (Molyneux and Wilson, 2017; Cocorese and Girardone, 2017; Doumpos, et al., 2017, among the others), there is no empirical evidence based on large samples demonstrating the extent to which a risk culture influences financial institutions' behaviors or supporting that a strong risk culture negatively influences bank performance (as is generally believed by practitioners) or positively influences it (as argued by regulators and supervisors). This leads us to address the following question: Do banks with a sound risk culture achieve better returns? To empirically answer this question, we developed an indicator, labeled as Sound Risk Culture Indicator (SRCI) at the bank level, estimated this metric for a large sample of banks (through Quantitative Text Analysis [QTA] of annual reports, corporate governance reports, and Pillar 3 reports), and estimated the causal link between the SRCI and various bank performance measures (Return on Assets [ROA], Return On Equity [ROE]) and risk-adjusted performance measures (Gross income on risk-weighted assets, and ROA On Implied Volatility). Our main result is that a strong risk culture is related to better performance, measured by various financial ratios. We also considered that banks may manipulate qualitative disclosure (the text in the official documents analyzed) and

show that a bank's performance decreases in case of an abnormal SRCI increase. To test the robustness of our findings, we repeated our main analysis excluding observations with signals of manipulation and obtained very consistent results.

We face two major issues in addressing our research questions. The first is building a metric that can capture risk culture at the bank level and can be estimated in an objective and replicable manner for many banks. Economists have traditionally been reluctant to discuss culture as a determinant of economic phenomena because the notion of culture is nebulous and raises numerous measurement issues in empirical research (Guiso et al., 2006). However, in what has been labeled the "culture revolution" by Zingales (2015), there has been a burgeoning interest in objectively measuring culture. Prior research has typically proxied for culture using socio-demographic measures at the country level (including religious identity, nationality, gender, blood donations, etc.) or social capital measures. In comparison, relatively few papers analyze corporate culture at the firm level (see, for example, Fiordelisi and Ricci, 2014, Guiso et al., 2015, and Cerqueti et al., 2017). The first step in solving this issue is to find a risk cultural framework that is largely accepted; we focused on the FSB (2014) framework, which sums up recognized risk culture's best practices (McConnell, 2013; Power et al., 2013). The FSB framework identifies four features of a sound risk culture: i) tone from the top (TFT)—board members and senior managers are responsible for promoting risk culture and including it in the bank's strategy; ii) accountability (ACC)—banks must develop a policy of ownership of risk in which employees are held accountable for their actions and are aware of the consequences for not adhering to the desired behaviors toward risk; iii) effective communication and challenge (COM)—top managers must encourage alternative views and pay attention to risk managers' suggestions to make informed risk decisions; iv) incentives (INC)—banks need a risk-linked rewarding system based on monetary

and non-monetary incentives. We define a selection of words to measure each of these four items extracted from the FSB framework. Then, we analyze each bank's official documents (annual reports, corporate governance reports, and Pillar 3 reports) in a QTA, an objective and replicable approach that can be applied to many firms.

The second issue is related to our identification strategy. Addressing both endogeneity and reverse causality issues in our empirical methodology is important. In our setting (in which risk culture is estimated by applying text analysis on disclosure), we may find that a bank's performance is positively related to greater risk culture. However, this may be driven by the fact that: 1) top managers use certain terms because they expect a certain outcome in terms of performance; and 2) a bank initiates projects with an aim of enhancing its risk culture (and discloses these initiatives in its official documents) only when they achieve greater performance. Previous research on this topic attempted to manage endogeneity and reverse causality issues using an instrumental variable approach and by lagging the independent variables by one year. We apply a Two Stage Least Square Instrumental Variable (2SLS IV) model using immigrated population (measured in millions) as an instrument. The entrance of foreigners in a country is an exogenous shock that modifies national preferences and belief systems (Fernandez and Fogli, 2009). Polavieja (2015) uses a similar approach by employing cultural traits of the migrant population as an instrument to study the effect of national traditionalism on female labor force participation. The central tenet of these epidemiological approaches is exploiting the portability of culture: *"Migrants take their culture with them, from one social context to another, and this provides a unique opportunity to isolate and quantify (i.e., to identify) the causal effect of culture on people's behavior"* (Polavieja, 2015, page 168).

The main contribution of our paper is that we focus on bank culture, not on bank risk-taking. We argue that bank risk-taking is the effect of the bank risk culture and that the latter drives banks to more efficient risk decisions. The idea is that a higher attention to risk culture could allow the bank to decrease the trade-off between risk-taking and stability, with a positive effect on profits. It is widely believed that corporate culture is a main determinant of most of the bank features considered in previous research (such as corporate governance mechanism, capital structure, and efficiency). We develop an objective measure of risk culture at the bank level and estimate this metric for a large sample of banks through automatic text data processing of official documents. Our approach is objective and replicable in future research. We also show that an enhanced risk culture does not negatively impact banks' performance; rather, it is related to greater profits and value. This result is very important for financial regulators and supervisors, suggesting that banks with a sound risk culture can accurately account for their risk-taking and achieve greater profits to create shareholder value. Various regulatory interventions to enhance bank risk culture are justified and appear to be an important tool for enhancing bank stability. Our findings also provide evidence of how cultural traits are likely to affect financial institutions' performances.

This is one of few studies assessing the role of corporate culture in banking based in Europe, as most papers focus on the US (as Cerqueti et al., 2017). The lack of studies in Europe is surprising because the crisis was very severe in the European Union and stability of the banking system has not yet been fully achieved, as shown by the large stock of non-performing loans (almost EUR 1 trillion at the end of 2016) and by the substantial number of bail-out and bail-in cases of large banks in the recent years. We select a large sample of banks in the Euro zone and U.K. from 2004 to 2017 with total assets greater than EUR 1 billion and with at least one annual report in English.

The remainder of the paper is structured as follows. Section 2 reviews literature, defines the concept of risk culture, and develops research hypotheses. Section 3 illustrates the sample and methodology applied to compute the SRCI. The results of the fixed effect regression models are presented in Section 4, and Section 5 contains 2SLS IV model estimations. Section 6 shows different robustness tests and Section 7 presents the conclusions.

## 2. Literature Review

In the aftermath of the recent financial crisis, the tendency of some banks to perform poorly compared to others that were more resilient was argued to be a matter of "culture" (Aebi et al., 2012; Fahlenbrach et al., 2012; Irresberger et al., 2015; Bonaccorsi and Kashyap, 2017). Although culture has become a popular topic in recent years, it is not a new issue.

Corporate culture has been traditionally considered (and measured) as a subset of the environmental or national culture. Culture is the "*collective programming of the mind that distinguishes the members of one human group from those of the others. Culture in this sense is a system of collectively held values*" (Hofstede 1991, page 5). By measuring culture through environment variables, various research shows that culture affects banks' performance and stability. Boubakri et al. (2017) show that banks in high uncertainty avoidance and power distance societies perform relatively better during the recent financial crisis. Chui et al. (2016) evidence that cultural dimensions of embeddedness and mastery negatively affect the cost of debt through bankruptcy risk and sensitivity to agency activity channels. Frijns et al. (2013) show that CEOs of firms in countries with lower levels of risk tolerance require higher premiums on takeovers and that uncertainty avoidance plays a greater role in relatively large takeovers. Carretta et al. (2015) provide empirical evidence that supervisory culture influences banks' stability.

Another part of the literature considers culture as a specific phenomenon of companies; corporate culture is "*a system of shared values that define what is important, and norms that define appropriate attitudes and behaviors for organizational members*" (O'Reilly and Chatman 1996, page 160). Research shows evidence that corporate culture influences firms' behavior and performance (Wilkins and Ouchi, 1983; Schein, 1990; Van den Steen, 2010). In the principal-agent framework, managerial "moral hazard" may be conduct consistent with the culture of the principals (Gorton, 2014). In the incomplete contract theory framework (Grossman and Hart, 1986), in which managers and employees face choices that cannot be properly regulated ex ante, corporate culture may be crucial to explain their decisions, contributions and, ultimately, corporate performance (Guiso, Sapienza and Zingales, 2015).

Risk culture is an expression of corporate culture that focuses on risk-taking and risk-control activities. A first risk culture definition was proposed by Sheedy and Griffin (2018, page 4) and Sheedy et al., (2017, page 101) as "*the shared perceptions among employees of the relative priority given to risk management, including perceptions of the risk-related practices and behaviors that are expected, valued, and supported*." However, risk culture is a concept not only related to risk management's ability, it rather influences the entire organization of a company as suggested by the Basel Committee for Banking Supervision (2015, page 2), which defines a bank's risk culture as *"A bank's norms, attitudes, and behaviors related to risk awareness, risk-taking, and risk management, and controls that shape decisions on risks. Risk culture influences the decisions of management and employees during the day-to-day activities and has an impact on the risks they assume.*"

Recalling the old adage that "one cannot manage what one does not measure," we have to define a risk culture measurement system. However, there are various problems that we need to

face. First, it is necessary to consider various items (such as ethics, incentive systems, regulatory constraints, and risk oversight) that are not routinely measured or reported. Second, a risk culture assessment focusing only on risk management practices could only be referred to the long term and should be able to identify managerial skills and/or luck (Sheedy and Griffin, 2018). Third, measurement methods based both on regular interviews and surveys are impractical on a large scale (i.e., a large number of companies), do not enable one to make objective comparisons over time and across businesses (e.g., a bank may show multiple risk culture measures in different departments, especially when it is a large company or it operates in multiple locations), and usually suffers of low response rates and measurement biases (Sheedy et al., 2017). To face these problems, we adopt a different "objective" approach focusing on the espoused risk culture and risk governance (i.e., policies, structures, and systems related to risk management) rather than culture per se[1]: specifically, we run a QTA of corporate documents (annual reports, corporate governance reports, and Pillar 3 reports)[2] to measure the risk culture espoused by banks. This technique is applied to observe, in a systematic and objective manner, the characteristics specific to a text (Stone et al., 1966).

As suggested by Kabanoff et al. (1995), corporate reports are a team product whose content is carefully reviewed by top management, thus reflecting the type of culture within which they are produced. The basic underlying idea is that the words and expressions used in corporate documents (i.e., the "vocabulary") represent the outcome of the corporate culture (Levinson, 2003). Moreover,

[1] We would like to thank the associate editor for his constructive comments and help to clarify that our measures are mainly picking up espoused risk culture and risk governance.

[2] One concern is that many financial institutions have great policies, structures, and systems related to risk management on paper that are not taken very seriously in practice. In other terms, the words used could reflect image more than substance. Despite this, the high visibility (internal and external) of these documents together with the supervisory screening of the information provided should limit their misleading content.

measures of risk culture obtained through QTA are less prone to the subjectivity of opinions of the researcher.

To implement a content analysis, we need to preliminarily identify a risk culture framework. As such, we focus on the one developed by the FSB (2015) that synthesizes various approaches (e.g., Cass Business School & New City Agenda, 2014; Institute of Risk Management, 2012; Senior Supervisors Group, 2009; McKinsey framework; KPMG framework; Charted Institute of Internal Auditors, 2014). This FSB (2015) framework refers to the following four main attributes that make a bank's risk culture "sound": i) TFT, ii) ACC, iii) COM, and iv) INC.

The first element of the FSB's scheme is TFT; the board and senior management are responsible for promoting risk culture and including it in their strategy. The top members of the organization oversee the development of an adequate risk culture, create mechanisms for implementation of risk appetite, and lead by example. The second required element is ACC. The organization must develop competences to communicate potential threats that allow for risk recognition and escalation processes (such as whistle blowing). The consequences of risk-taking that is not aligned with risk appetite (regardless of the financial result of the action) must be explained. COM refers to the possibility of making informed risk decisions; top management must encourage alternative views and pay attention to risk management's observations. Finally, the organization needs a system of rewards and penalties that is not only monetary (i.e., opportunities for training, job rotation, and successions), which is also based on both risk-taking and performance, and including all individuals in the organization (as the CEO and loan officers).

The FSB (2015) framework is not evidence based and there is no existing evidence supporting its validity. Thus, our paper is the first that uses it to measure bank risk culture using a large sample of firms. Our results provide novel empirical evidence regarding the link between a

sound (according to FSB framework) risk culture and bank performance. Our main research assumption is that a "sound" (according to FSB framework) risk culture, despite the costs for its development, improves banks' performance by enabling banks to be more efficient in risk-taking and risk management.

## 3. Data and Variables

The most challenging task of this paper is the development of the SRCI, i.e., a new measurable indicator of risk culture. We use QTA, which has been proven to be a reliable methodology in previous financial research (Hoberg and Phillips, 2010; Hoberg and Hanley, 2010).

Our approach to developing the SRCI involves the following three steps: first, we select different vectors of words that capture attributes of the SRC; second, we identify appropriate companies' publicly available documents that mirror the risk culture. Third, we define our equations to quantify the SRCI.

We follow the FSB framework that examines four attributes that constitute an SRC. The FSB specifies different qualities for each attribute (labeled as "indicators") that help identify what each attribute consists of. To measure the banks' attention to the four attributes, we select "vectors of words" from the FSB's indicator descriptions; we do not choose single words but consider combinations of two and three terms[3], labeled "Group Meaning Units" (GMUs). Our QTA algorithm enables us to examine if words belonging to the same GMU appear together in a sentence. This approach evaluates how often banks link two concepts (management and information, board and uncertainty, incentives and risk, etc.). For example, the words "board" and

[3] The vectors of words selected directly from the FSB framework are reported in Table 1 of the on-line Appendix. Each comma-separated term in the first group is searched with each term of the second group (in the "Extracted Sentences" column).

"lead" appearing alone in a sentence would not be sufficient to signal a leadership attitude of the board (ID 4.1.a in the Table 1 in the on-line Appendix), but these words together in a phrase underline a board's guidance role. To allow for a more effective analysis, our methodology includes new GMUs composed of synonyms taken from the Collins Dictionary and Thesaurus[4]. We remove all morphological affixes with a Porter's stemming algorithm implemented in Python's Snowball Stemmer package[5]. As a result, 8638 GMUs are included in the analysis[6].

In the second step, we analyze annual, corporate governance, and Pillar 3 reports. These documents contain information about performance, risk, and internal policies, respectively. The structure of these documents is partially regulated by the European Banking Authority, but banks are free to determine the documents' detail and length so we can use them to estimate bank risk culture.

In the third step, we compute the SRCI and TFTI, ACCI, COMI, and INCI indicators as:

$$(1) \qquad TFTI_{it} = ln\left(\frac{TFTD_{it}}{sd(TFTD)_{3,it}}\right), \text{with } TFTD_{it} = \frac{N_{it}^{TFT}}{tphr_{it}}$$

$$(2) \qquad ACCI_{it} = ln\left(\frac{ACCD_{it}}{sd(ACCD)_{3,it}}\right), \text{with } ACCD_{it} = \frac{N_{it}^{ACC}}{tphr_{it}}$$

$$(3) \qquad COMI_{it} = ln\left(\frac{COMD_{it}}{sd(COMD)_{3,it}}\right), \text{with } COMD_{it} = \frac{N_{it}^{COM}}{tphr_{it}}$$

$$(4) \qquad INCI_{Iit} = ln\left(\frac{INCD_{it}}{sd(INCD)_{3,it}}\right), \text{with } INCD_{it} = \frac{N_{it}^{INC}}{tphr_{it}}$$

$$(5) \qquad SRCI_{it} = ln\left(\frac{SRCD_{it}}{sd(SRCD)_{3,it}}\right), \text{with } SRCD_{it}$$

$$= TFTD_{it} + ACCD_{it} + COMD_{it} + INCD_{it}$$

[4] Table 2 in the on-line Appendix I provides details on the selected and discarded synonyms.
[5] To manage the duplicated GMUs we applied the following rule: when duplicates belonged to the same attribute, we retained only one of them; if they referred to different attributes, we deleted both.
[6] Listed in the Table 3 of the on-line Appendix.

$TFTD_{it}$, $ACCD_{it}$, $COMD_{it}$, and $INCD_{it}$ are TFT, Accountability, Communication, and Incentives attention's density, respectively. $N_{it}^{TFT}$, $N_{it}^{ACC}$, $N_{it}^{COM}$ and $N_{it}^{INC}$ are the total number of sentences[7] containing a GMU associated with the corresponding indicator (TFT, Accountability, Communication, and Incentives) for the bank-*i*'s disclosure at time *t*. $tphr_{it}$ is the total number of sentences in bank-*i*'s disclosure at time *t*. These ratios measure how much banks display a vocabulary linked with each of the four attributes of the SRC, divided by the total number of sentences correct indicator for the distortions due to a longer or shorter bank disclosure term. $SRCD_{it}$ is the sum of the four attributes' densities[8]. The cultural indicators (TFTI, ACCI, COMI, INCI)[9] are the ratios between the densities and their standard deviations, computed using a three-year rolling window[10]. The indicators measure the number of times the densities exceed their standard deviation; this allows to clean the series by jumps from one year to another.

The sample includes the main banks' holding companies in the Euro zone and U.K., active from 2004 to 2017, with total assets greater than EUR 1 billion, and with at least one annual report in English. The banks' names are obtained from *DataStream* and the register of Significant Supervised Entities published by BCE. The analysis focuses on large banks because they showed problems in ensuring a common risk culture throughout the organization. The balance sheet data are taken from *BankScope and BankFocus* databases. Data on foreign-born populations are obtained from the OECD database[11].

[7] A sentence is defined as consecutive words contained between a blank line and a dot or between two dots.
[8] The densities are hereafter referred to as TFTD, ACCD, COMD, INCD, and SRCD.
[9] Indicators, cultural indicators, culture's indicators, and sound risk culture's indicators are hereafter referred to as TFTI, COMI, and INC.
[10] Standard deviation of the SRCD in the last three years.
[11] Foreign-born populations in OECD countries (indicator). doi: 10.1787/b1fc67fa-en (Accessed on 15 March 2017).

We define a *word* as a term with more than two letters that is not an article or a conjunction. To clean the errors from the data, we retain observations with more than 5000 words and winsorize SRCIs at 1%. This allows for removal of reports with little information since they clearly show anomalous paths in an unreported graph. Table 2 provides some descriptive statistics of the main variables.

As shown in Figure 1, the average SRCD increases yearly and has a mean of 0.189, meaning that on average, 19% of the phrases in bank's disclosures contain SRC vocabulary. All indicators and densities show a high standard deviation of approximately 50% of the mean. The other variables are defined in Table 1.

**4. Preliminary investigation**

Before conducting our empirical analysis, we screen the economic meaning of our SCRI by comparing our new measure with various bank risk and performance measures.

First, we measure the correlation among performance indicators, sound risk culture, and the other dependent variables (tables 3.1 and 3.2). The strong correlation among SRC and SRCI attributes (TFTI, ACCI, COMI, and INCI) is worth mentioning. This suggests that the SRCI attributes influence each other. Figure 2 shows the mean annual SRCI and its standard deviation; there is a clear fluctuation of the indicator on all the periods. There is no high variation in the cultural indicator because culture may not change excessively from year to year. The standard deviation of the SRCI within the year is very high, meaning that banks have different levels of culture within the same year.

The timelines of the SRCD for four European banks, Banque Populaire and Caisse d'Epargne Group (BPCE), Deutsche Bank AG, Banca Monte dei Paschi di Siena SpA, and Royal

Bank of Scotland Group PLC, are shown in Figure 3. As expected, the RBS and MPS show low levels of SRCD. In this regard, the Financial Services Authority Board Report (2011) on RBS crisis states that "*the poor decisions made by RBS management and Board which made RBS highly vulnerable to failure, and the underlying aspects of RBS' management style, governance, and culture which may have contributed to those poor decisions*." Also the *Testimony of the Governor of the Bank of Italy Ignazio Visco* (2016), with reference to referring to MPS scandal, points on problems relating to organizational safeguards and controls: *"management had failed to transmit to supervisors the information that was vital for a full recognition of the scale and nature of several operations that had been carried out in violation of the law."*

Although Deutsche shows higher levels of the SRCD indicator, at least at the beginning of the considered period. Following, there is an evident decline of the SRCD indicator, especially in the years of the LIBOR scandal. Finally, BPCE shows a growing trend for the SRCD indicator.

Third, we conduct a Multi-Dimensional-Scaling (Borg and Groenen, 2005) analysis on vectors representing the Risk Dictionary (RD) of the Banks. The matrix of the distances between banks (D) was computed considering the cosine of the angle the between bank-specific vectors $v^b \in R^N$, where N is the length of the RD. A typical pattern in human languages is that phrases that are used to describe the same topic share certain common words (Mu et al., 2016). Therefore, in line with Bodnaruk et al. (2015) and Loughran and McDonald (2011), the words that included the RD are those that appear in at least 5% of the risk sentences.

A risk sentence is a sentence containing the word "risk" at least once. The distance $d_{i,j}$ between vector $v^i$and vector $v^j$is computed as $d_{i,j} = \cos(\theta_{i,j}) = \frac{v^{i,2} \cdot v^{j,2}}{\|v^{i,2}\| \cdot \|v^{j,2}\|}$, where $d_{i,j}$ is the *i-th*, *j-th* element of the distance matrix $D \in R^{B \times B}$. The vectors $v^1, \dots, v^b, \dots, v^B \in R^N$, where $B$ is the total number of banks such that the element $v_w^b$ of the vector $v^b$ is $v_w^{b,2} = \frac{n_{w,b}}{Nr_b}$, $n_{w,b}$ is the number

of significant sentences in the documents of bank $b$ in which the word $w$ appears, $Nr_b$ is the number of the bank's significant sentences, and $v_w^b$ corrects for the amount of information disclosed by the bank. Figure 4 shows the MDS scatter plot for a graphic representation of the differences in banks' RD from 2004 to 2017; the greater the distance between two points, the greater the dissimilarity of vocabulary used to talk about risk. In figure 4, some of the main banks are underlined with a label[12].

We do not find similarities in the data points of banks with common characteristics (i.e., same country, dimension, or sector), even for labeled banks, which are similar in terms of business models and dimensions. This has important implications; each bank's disclosure vocabulary is unique and firm-specific; otherwise, some points would be closer together. Therefore, we conclude that a bank's annual report vocabulary is not determined by regulation, national culture, or business model.

## 4. Analysis and Results

Our main research assumption is that a sound risk culture produces positive effects on banks' performances. To test this assumption, we use the following panel data model:

$$(6) \quad Performance_{it} = \alpha_t + \alpha_i + \beta_1 SRCI_{i(t-1)} + \sum \beta_i m_{i(t-1)} + \delta_1 GDP_{j(t-2,t-1)} + \delta_2 crisis_i + \epsilon_{it}$$

where a bank's performance is measured using various indicators such as the GI\RWA indicator (which allows for evaluation of the bank's performance, net of the taxation effect, and standardized

[12] Santander, Commerzbank, Deutsche, Raiffeisen Banking Group, KBC group, BNParibas, Mediobanca, Intesa Sanpaolo, Unicredit, Monte Paschi di Siena, Societe Generale, BBVA

by the risk-weighted assets[13]), ROA, ROE, and, similarly to Eckles, Hoyt and Miller (2014), ROA On Implied Volatility (ROA/VOL). The primary coefficient of interest is $\beta_1$, which measures the link between a bank's $SRCI_{it}$ (as defined in Equation 5) and performance. We also controlled for various bank characteristics ($m_{it}$) that have been found to be important (Molyneux and Thornton, 1992; Athanasogloua, et al., 2008; Berger and Bouwman, 2009; Goddard, et al., 2013; Tran et al., 2016) in the link between risk culture and performance. First, we use bank size, measured by the natural logarithm of the total assets (lnTA). Larger banks benefit from economies advantages and could be more profitable than smaller ones. Nevertheless, larger banks could penalize the performance due to the associated higher complexity and bureaucracy to be managed (Athanasogloua, et al., 2008). Second, we refer to the business model of the banks, proxied by the total loans on total assets (TL\TA) ratio. Loans are typically less liquid and riskier than other assets and therefore, due to the higher credit risk exposure, we may expect a lower performance. However, a higher specialization in lending may reduce intermediation costs and improve performance (Goddard, 2013). Third, capitalization is measured as equity on the total asset (E\TA). High-capitalized banks could have better access to financing sources with lower cost and risk, and better access to higher quality asset markets (Tran et al., 2016). Nonetheless, Goddard et al. (2013) find that well-capitalized banks appear to have lower profitability in eight European Union member countries from 1992 to 2007. Forth, also the bank's propensity to liquidity, approximated by the ratio of detained liquid assets (LIQA\TA), could have a mixed effect on performance. We could have a positive effect due to higher net surpluses that can be shared among stakeholders (Berger and Bouwman, 2009). However, Molyneux and Thornton (1992) and Goddard et al.

[13] As explained in Table 1, the gross income is the bank's income before taxation and the RWA is the weight of each asset based on the risk of loss of its value, according to regulation. Higher bank income due to higher risk-taking would increase the ROA but not change the GI\RWA.

(2013) find a negative effect across European countries for the periods of 1986–1989 and the mid-1990s, respectively. Fifth, loan loss provision on the gross loans (LP\L) could be considered both i) a measure of the prudency in accounting policies and, therefore, it could have a positive effect on performance; and ii) a proxy of the exposure to credit risk that could be associated with a lower performance (Athanasogloua, et al., 2008). Finally, the bank's efficiency, measured using the cost-to-income-ratio (CO\INC), is expected to have a positive effect on performance (Goddard, 2013).

We also controlled for the annual GDP growth rate ($GDP_{j,(t-2,t-1)}$), whose effect on performance is expected to be positive. To manage the omitted variable problem, such as risk management ability discussed by Ellul and Yerramilli, 2013, and control for the role of financial crisis, we included both the year-fixed effect (α_t) and the bank-fixed effect (α_i). The idea is that a strong risk culture shows its effects not only during crises but also in periods characterized by higher bank stability. On the one hand, a risk culture could emphasize excessive risk-taking for short-term profits at the expense of longer-term firm performance and sustainable shareholder value during non-crisis periods. On the other hand, influencing the decisions of management during day-to-day activities, risk culture could be an important factor for maintaining and the recovery of adequate levels of bank performance also during crisis periods. To handle the reverse causality problem, all independent variables were lagged by one period. All the variables are described in Table 1.

Table 4 reports our results for equation (6) using SRCI (columns 1 and 2) and each of the four FSB attributes (columns 3 to 6). The effect of the SRCI is positive and highly statistically significant, with a substantial economic magnitude; an increase of one SRCI standard deviation (1.050) increased the GI\RWA by 119% of the mean (0.005). The results are strongly consistent when the model is applied both with and without control variables. We obtained very similar

results when the analysis was repeated with each of the four attributes (TFTI, ACCI, COMI, and INCI), confirming previous results.

We repeated the analysis using the other performance measures, ROA, ROE, and ROA/VOL (Table 5). Consistent with previous results, we found that the coefficient estimates for the SRCI are positive and highly statistically significant, with high economic meaning; an increase of 10% in the SRCI results in an increase of 0.2 percentage points in the following year for the ROA, 0.24 percentage points for the ROE, and of 1.32 percentage points for the ROA/VOL.

These results are novel and suggest the validity of the framework elaborated by the Financial Stability Board. We showed that a sound risk culture (that bolsters effective risk management, promotes sound risk-taking, and ensures that emerging risks or risk-taking activities beyond the institution's risk appetite are recognized, assessed, escalated, and addressed in a timely manner) is a positive element in a bank's performance rather than merely a cost. Considering the dimensions of a sound risk culture, there is evidence that it has a positive effect on performance on an individual basis. This means that a bank that desires to enhance performance should pay attention to its risk culture at an overall level and at the levels of its attributes.

## 5. Managing Endogeneity

In the previous section, we included both the year-fixed effect ($\alpha_t$) and the bank-fixed effect ($\alpha_i$) to manage the omitted variable problem and lagged all independent variables by one period to manage the reverse causality problem.

To allow for a more robust analysis, we applied a 2SLS IV model (Wooldridge, 2010). IV models allow for estimating the exogenous impact of SRCI on the dependent variables, solving the problem of endogenous preferences. Our instrument is the immigration rate, measured by

annual variation in the foreign-born population's in the country (IMMIGR). New foreign-born population influences tradition and beliefs at the national level (Ditlmann et al., 2011), changing perceptions of risk and uncertainty. This effect is strengthened by people's tendency to overestimate the immigration phenomenon in terms of its dimension and impact (Alba et al., 2005; Sides and Citrin, 2007). Furthermore, immigration changes the size and skills of the labor force (Pandey and Chaudhuri, 2017). These elements modify culture at the country level and indirectly affect bank employees and management, who face the challenge of re-assessing common culture inside the firm after each cultural shock.

The only variable that could influence a bank's performance and risk and the foreign-born population at the same time is economic growth in the country (higher growth in a country could positively influence banks' performances and attract more immigrants). Thus, in the analysis, we added firm-fixed effects to the regressions, which control for underlying trends and the GDP growth rate. The literature associates immigration with increases in rents and house prices (Mussa et al., 2017) and with a decrease in direct investment in the short term (Tomohara, 2017). The performance of banks specialized in sectors affected by these variables could be directly influenced by the immigration rate. Therefore, we controlled for bank-specific characteristics such as efficiency and dimension.

We modified the model in equation (6) as follows:

$$(7) \quad GI/RWA_{it} = \alpha_t + \alpha_i + \gamma_1 \widetilde{SRCI}_{i(t-1)} + \sum \gamma_i m_{i(t-1)} + \delta_1 GDPgr_{j(i)(t-1)} + \epsilon_{it}$$

$$(8) \quad \widetilde{SRCI}_{i(t-1)} = \omega_t + \omega_i + \partial_1 IMMIGR_{j(i)(t-1)} + \sum \partial_i m_{i(t-1)} + \varphi_1 GDPgr_{j(i)(t-1)} + \epsilon_{it}$$

where $IMMIGR_{j(i)t}$ is the immigration rate of bank-*i*'s home country in year *t.* Equations (7) and (8) are the first and second stages, respectively. The $\widetilde{SRCI}_{it}$ in Equation (8) is the predicted value of the SRCI in Equation (7). Column (2) of Table 6 shows the first stage. The immigration rate has a small, highly significant negative effect on sound risk culture. Column (1) reports the second stage; the results confirm the positive effect of the SRCI on banking performance. The F-stat refers to Kleibergen–Paap statistics for weak instruments test (Kleibergen and Paap, 2006). According to the thresholds of Hausman et al. (2005), all test values are above the 10% critical value. The total number of observations decreased to 371 because IMMIGR was not available for all countries in the sample[14].

## 6. Abnormal Risk Culture Changes

One challenge in the disclosure analysis is that firms could stress the importance of values that are not followed in practice (Guiso et al., 2015; Beyer and Guttman, 2012). We detected such behavior by exploiting the characteristic of culture to vary gradually over time. We expected that attention to SRC did not vary yearly; high variation could be a signal of disclosure manipulation.

Thus, we define:

$$SRCDvar_{it} = \frac{SRCD_{it}}{SRCD_{it-1}} \quad (9)$$

$$SRCIvar_{it}^{Q4} = \begin{cases} 1 & if\ SRCDvar_{it} \in Q_4 \\ 0 & Otherwise \end{cases} \quad (10)$$

where $SRCDvar$ is the ratio of bank-*i*'s $SRCD_{it}$ to its value in the previous year. $SRCIvar_{it}^{Q4}$ is the sound risk culture variation dummy that has a value of 1 if bank-*i*'s *SRCDvar* at time *t* is in the

[14] IMMGR data were lacking for Cyprus, Lichtenstein, Luxemburg and Malta.

4th-quartile ($Q_4$) of the overall *SRCDvar* distribution. Then, we evaluated equation (6) substituting SRCI with $SRCIvar_{it}^{Q4}$ to evaluate the effect of a high SRC attention increase[15] on the GI\RWA.

The estimation results are shown in Column (1) of Table 7. The effect is slightly negative and significant at 10%, indicating that increases in the SRCD do not have an effect or even negatively affect a bank's performance, corrected for risk-taking. There were 526 observations because we used observations from 2004 to build the variation index.

Column (2) of Table 7 reports the results of the model estimation in equation (6) on the sub-sample of observations with *SRCIvar* in Q4 at *t-1* (firms with an $SRCIvar_{i(t-1)}^{Q4}$ equal to 1). The SRCI was not significant and almost zero, confirming that in cases of abnormal SRC attention increase, a higher SRCI is associated with no change in bank performance.

Finally, we also run model equation (6) by excluding all observations with high SRCD variation (we included only banks with a $SRCIvar_{i(t-1)}^{Q4}$ of 0). The results are shown in column (3). The SRCI is still significant at 1% even if the absolute value is lower. Column (4) reports the results of the IV model, excluding high SRCD variations. As in the previous analysis reported in in Table 6, SRCI is significant at 1%. Since the analysis in Column (1) of Table 7 underlines a slightly significant negative effect of $SRCDvar^{Q4}_{t-1}$, analyses in Columns (3) and (4) check if this result is driven by abnormal variation of the indicator; in both cases SRCI is still significant.

## 7. Robustness Checks

Table 8 provides the results of different robustness tests we conducted. Column (1) reports the regression coefficients of the model in equation (6) estimated on the entire sample using *SRCI2*.

[15] Even if the statistics are not reported, the SRCDvar in $Q_4$ are all greater than one. Therefore, high variations coincide with increases in the SRCD.

Because we used a two-year rolling window, we considered two years as pre-crisis (2006 and 2007). Results show a positive effect of risk culture on performance during this non-crisis period. In column (2) of Table 8, we used a modified version of the SRCI that is focused on banks' risk approaches (SRCIR). The latter was obtained by repeating the text analysis using only vectors of words in the SRC framework (reported in the on-line Appendix) that include the word "risk." The original SRCI includes various bank items that are not-related to the risk attitude (as items related to the treatment of employees), and the SRCIR allows for focusing on banks' attention to issues linked to risk. The positive effect of risk culture on performance is still confirmed. Column (3) shows the same estimation of the second column in Table 4 on years after the crisis (2009 to 2017). The latter analysis tested if the results are consistent when excluding the effect of the crisis or when considering a longer period. In all the three estimations above, the coefficients were significant and confirmed our results. In other words, the positive effect of risk culture on performance is showed not only during the non-crisis period but also during the crisis period. We also check whether our risk culture measures also capture the quality of disclosure of each institution[16]; specifically, we include the Smog (Simple Measure of Gobbledygook Grade) in the model in column (4) as a control variable. Smog is a commonly used readability measure introduced by Mc Laughlin (1969); this is calculated for each bank through the content analysis of banks' annual and Pillar 3 reports in English, made possible by the use of the Python's Textstat package, as follows:

$$(12) \quad Smog = 1.0430 * \sqrt{number\ of\ polysyllables * \frac{30}{number\ of\ sentences}} + 3.1291$$

[16] We would like to thank one of the referees for suggesting us to control whether our risk culture measures may also capture the quality of disclosure of each institution.

The results do not seem to corroborate the possibility that our measure of risk culture is affected by the quality of disclosure.

Finally, Column (5) adds the interaction term year country among regressors, which allows to control for different aspects linked to country characteristics such as legal origin and institutional differences. Our results show that the role of risk culture is confirmed also controlling for these different aspects.

## 7. Conclusion

Regulators, supervisors, and practitioners identified weak risk governance and culture as a reason for financial crisis; a debate among regulators and practitioners (Parliamentary Commission on Banking Standards, 2013; Institute of International Finance, 2009) began in 2008 concerning how to enhance sound risk culture in banking. The benefits of a sound risk culture are related to more efficient risk management and conscious risk-taking, but the development of a such culture implies high costs. There is no empirical evidence based on a large sample that establishes the relationship between bank risk culture and performance.

The main challenge for scholars investigating risk culture is the development of a reliable measure capturing risk, a "soft" variable. The FSB (2014) provides a framework to identify attributes that are best practices in the sector, which are at the basis of a sound risk culture. Following FSB's framework, we developed the SRCI to apply QTA to banks' disclosures. We selected different vectors of words that captured the SRC attributes, identified each company's publicly available documents in which we believe the risk culture was mirrored, and defined our formula to quantify the SRCI.

Our results show that bank performance improves as bank risk culture increases. As the SRCI increases, banks record an increase in their performance indicators, specifically GI/RWA, ROA, ROE, and ROA/VOL, in the following year. These results suggest that developing an SRC is convenient from an organizational perspective as well as an economic one. The benefits of more effective risk-taking and risk management are greater than the expenses in enhancing the risk culture.

Examining banks with abnormal SRCs, we observe that an abnormal increase in the SRCI decreases a bank's performance. This could be explained by the fact that banks manipulate disclosure in an attempt to promote SRC with external claims that are not associated with actual changes in the firm's shared beliefs. Robustness tests confirmed the results even when we used an IV model with IMMIGR as an instrument, when we performed the regression on the post-crisis period only or used different indicators of SRC, and when we included in the regression an indicator of quality of disclosure of each institution.

Thus, the FSB's framework captures important dimensions of a sound risk culture; RC development allows for banks to increase their profits. Our hypothesis is that as the literature suggests, this effect is driven by more efficient risk-taking by banks. However, SRC attention can become merely an exercise; banks may claim cultural improvements that are not supported by actual internal efforts. Risk culture evaluation must consider this issue using proper tools.

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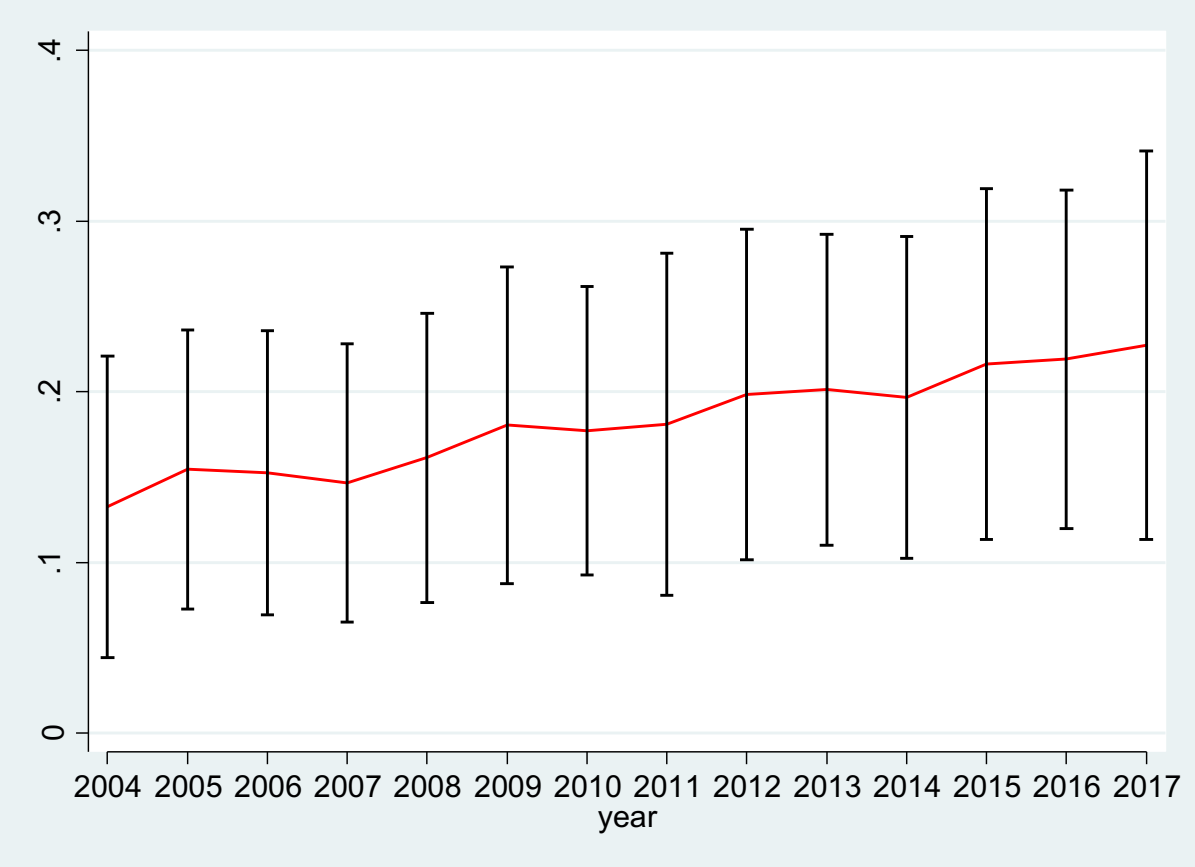
## Figure 1: Average Risk Culture Tone Density per Year

The average sound risk culture density (SRCD) per year (red line) and its standard deviation (black lines). The SRCD is the sum of four attributes of densities: Tone from the top attention density (TFTD), Accountability attention density (ACCD), Communication attention density (COMD), and Incentive attention density (INCD). The densities are the ratios between the number of the attribute's phrases in the bank's disclosure to the total number of phrases. The SRCD generally increased each year, with exceptions in 2006, 2007, 2010, and 2014. Attention to SRC is growing in the sector. The standard deviation within each year is high, meaning that the level of attention varies across banks.



## Figure 2: Average Sound Risk Culture Indicator per Year

The mean and standard deviation of the sound risk culture indicator (SRCI) per year. The SRCI is the ratio between the sound risk culture density (SRCD) and its standard deviation, using a three-year rolling window. The indicator shows fluctuations on all the periods. The standard deviation is high, meaning that banks have different culture levels within the same year.

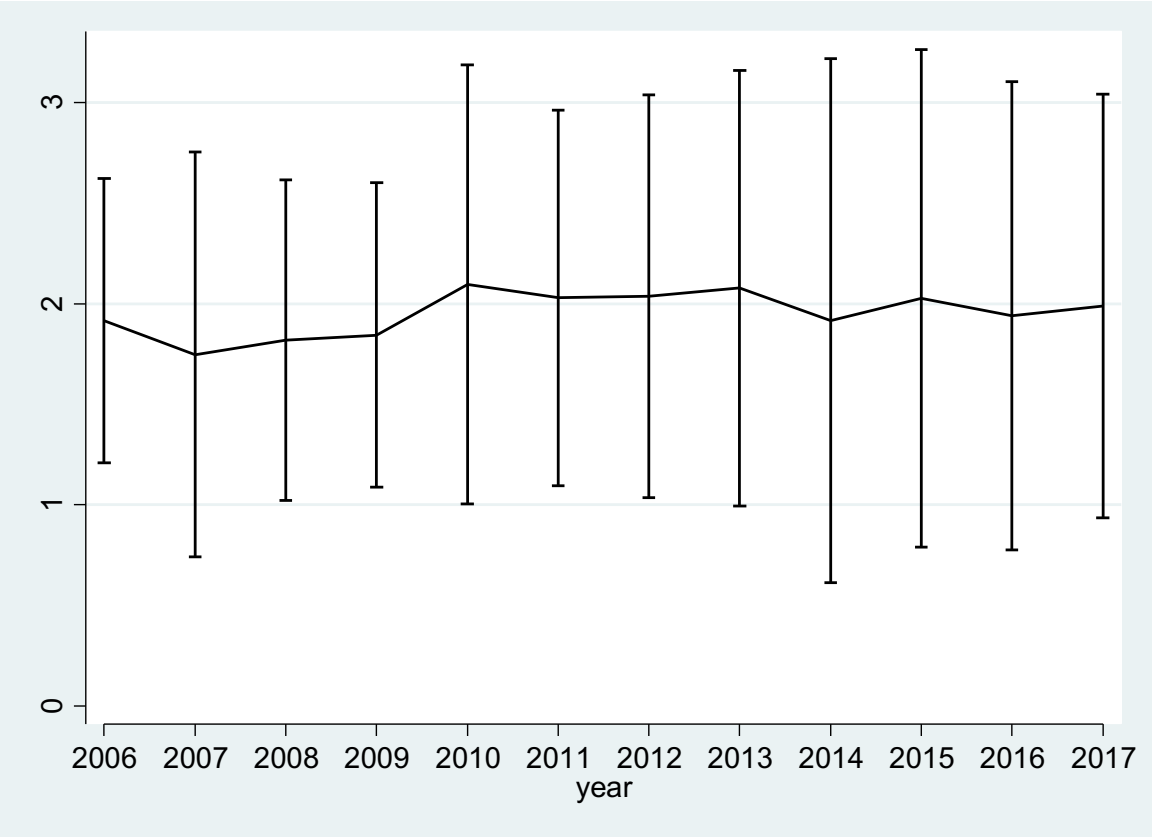
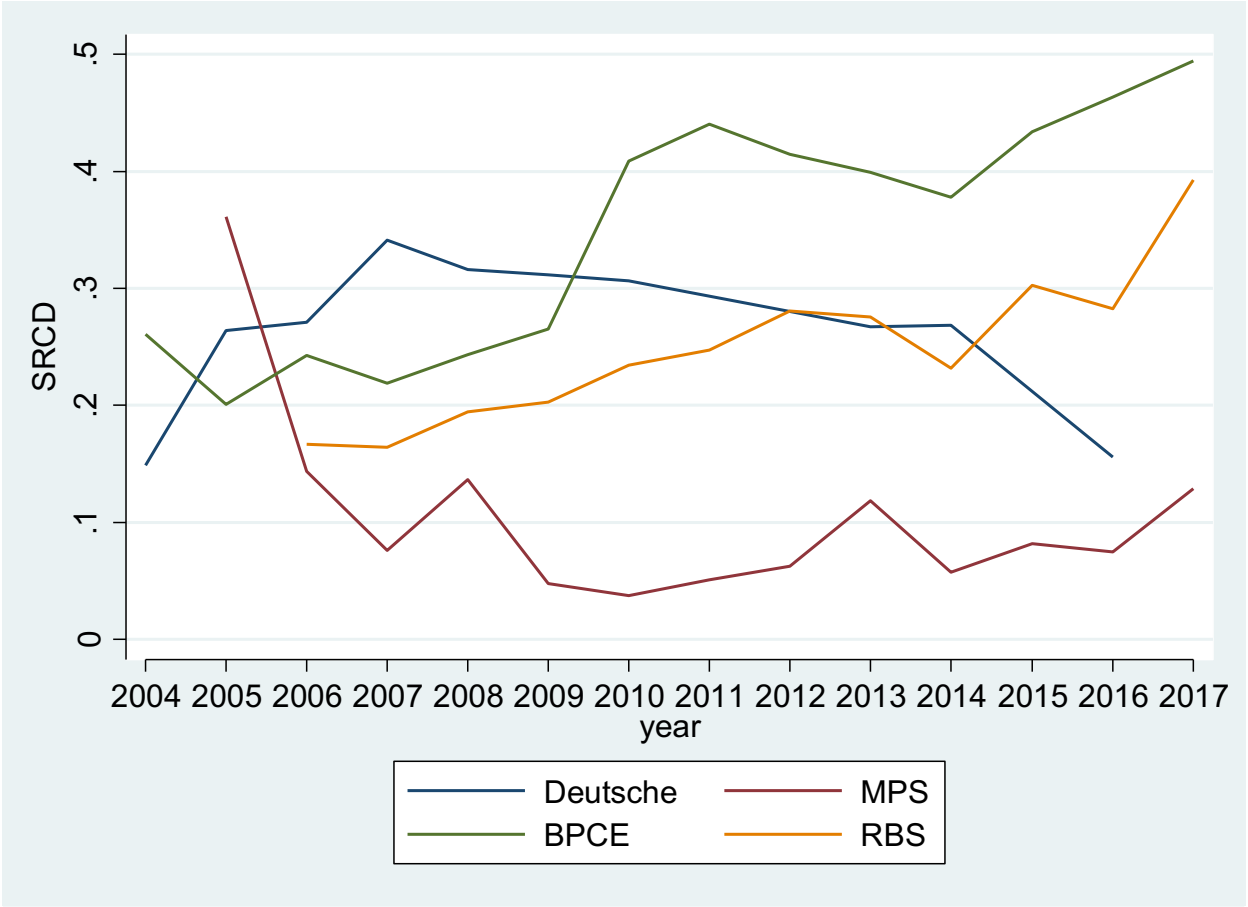


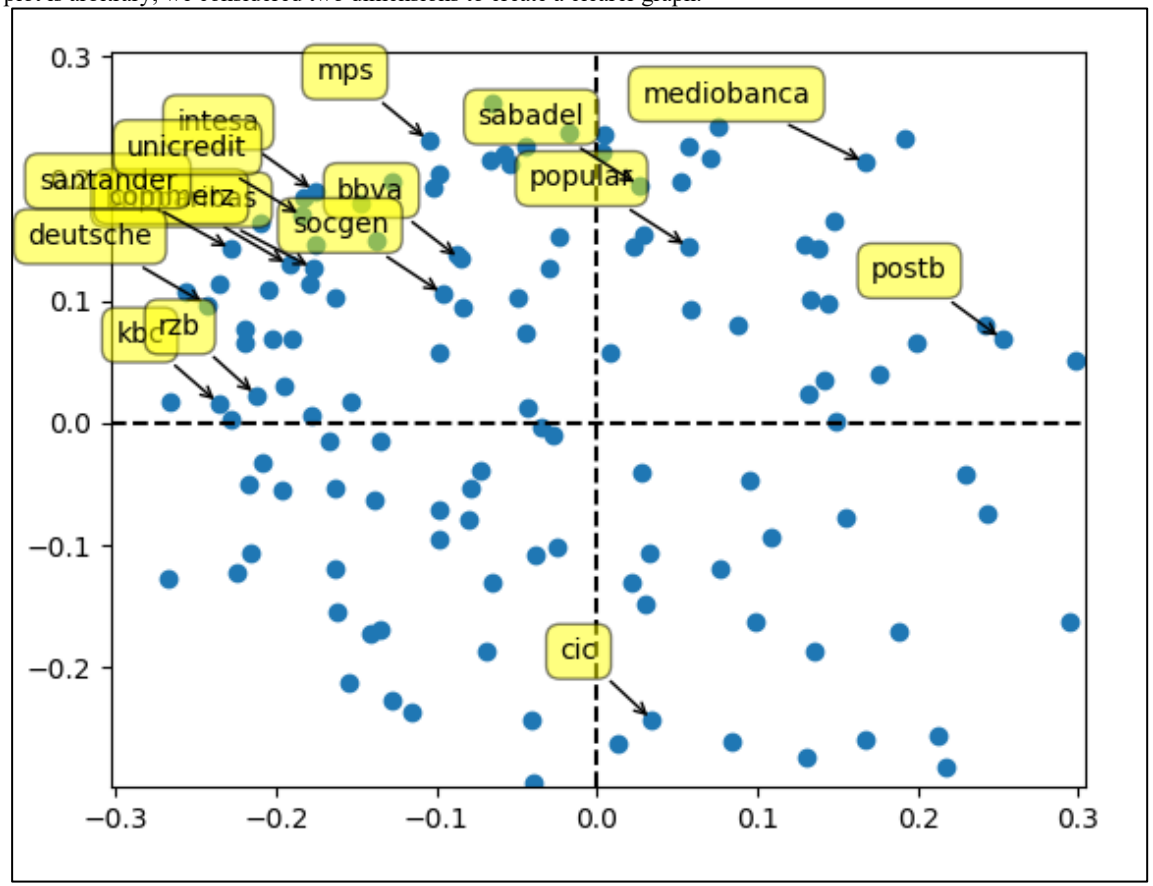
**Figure 3: Sound Risk Culture Density Indicators of Deutsche Bank, BPCE, Monte Paschi di Siena, and Royal Bank of Scotland**

Sound risk culture density indicator (SRCD) defined by equation (5) of four important European banks, Banque Populaire and Caisse d'Epargne (BPCE), Deutsche Bank AG, Banca Monte dei Paschi di Siena SpA, and Royal Bank of Scotland Group PLC. RBS and MPS show low levels of SRCD. Deutsche has higher values at the beginning of the period, but there is a decrease in the years of the LIBOR scandal.



## Figure 4: Multi-Dimensional Scaling of a Bank's Risk Dictionary

Multi-Dimensional Scaling scatter plot of a Bank's Risk Dictionary. The words included in the RD are those that appear in at least 5% of the sample from 2004 to 2017. A risk sentence is a sentence containing the word "risk" at least once. The distance $d_{i,j}$ between vector $v^i$and vector $v^j$is computed as $d_{i,j} = \cos(\theta_{i,j}) = \frac{v^{i,2} \cdot v^{j,2}}{\|v^{i,2}\| \cdot \|v^{j,2}\|}$, where $d_{i,j}$ is the *i-th*, *j-th* element of the distance matrix $D \in R^{B \times B}$. The vectors $v^1, \dots, v^b, \dots, v^B \in R^N$, where $B$ is the total number of banks, are such that the element $v_w^b$ of the vector $v^b$ is $v_w^{b,2} = \frac{n_{w,b}}{Nr_b} n_{w,b}$ is the number of *SS* in the documents of bank $b$ in which the word $w$ appears, $Nr_b$ is the total number of bank's *SS* and $v_w^b$ corrects for the amount of information disclosed by the bank. This is a graphic representation of the differences in banks' vocabularies; the higher the distance between two points, the higher the dissimilarity of the RD. The figure is just a portion of the complete graph in which some banks are underlined (Santander, Commerzbank, Deutsche, Raiffeisen Banking Group, KBC group, BNParibas, Mediobanca, Intesa Sanpaolo, Unicredit, Monte Paschi di Siena, Societe Generale, BBVA); although they have similar business models and dimensions, the data points are not close. The graph shows that there is no cluster of culture, as points did not collect in groups. The number of dimensions in the plot is arbitrary; we considered two dimensions to create a clearer graph.



## Table 1: Variable Sources and Descriptions

Variables used in the empirical analysis. Data were obtained from the following sources: (+) content analysis on banks' annual and Pillar 3 reports in English using original script in python; (*) calculation on content analysis results; (0) BankScope/BankFocus Databases, author calculation; (1*) World Bank national accounts data and OECD National Accounts data files; (2*) OECD International Migration Statistics: International migration database; (3*) DataStream (Thomson Reuters).

| Acronym | Variable | Description |
|---|---|---|
| TFTD | Tone from the top attention density | Total number of sentences containing word vectors associated with tone from the top over the bank's total phrases in the disclosure[+] |
| ACCD | Accountability attention density | Total number of sentences containing word vectors associated with accountability over the bank's total phrases in the disclosure[+] |
| COMD | Communication attention density | Total number of sentences containing word vectors associated with communication over the bank's total phrases in the disclosure[+] |
| INCD | Incentive attention density | Total number of sentences containing word vectors associated with incentives over the bank's total phrases in the disclosure[+] |
| SRCD | Sound risk culture tone density | Sum of tone from the top, accountability, communication and incentive tone densities* |
| SRCI | Sound risk culture indicator | Logarithm of sound risk culture tone density over its standard deviation in the last three years* |
| SRCI2 | Sound risk culture indicator with two-year rolling window | Logarithm of sound risk culture tone density over its standard deviation in the last two years* |
| SRCIR | Sound risk culture indicator restricted to risk vocabulary | Same as the SRCI but we computed density without using all the vectors of words in the framework (reported in the on-line Appendix I), just vectors of words containing the word "risk". * |
| TFTI | Tone from the top indicator | Logarithm of tone from the top tone density over its standard deviation in the last three years* |
| ACCI | Accountability indicator | Logarithm of accountability tone density over its standard deviation in the last three years* |
| COMI | Communication indicator | Logarithm of communication tone density over its standard deviation in the last three years* |
| INCI | Incentives indicator | Logarithm of incentives tone density over its standard deviation in the last three years* |
| SRCDvar | Sound risk culture density variation | Sound risk culture tone density in a year over the previous year's value* |
| SRCDvar$^{Q4}$ | Sound risk culture density variation dummy | Dummy with value one if the sound risk culture phrases' density variation in the year is in the fourth quartile of the sound risk culture's density variation distribution in the overall period* |
| sdSRCD3 | Sound risk culture tone density standard deviation | Standard deviation of sound risk culture phrase density in the previous three years* |
| sdSRCD2 | Sound risk culture tone density standard deviation with two-year rolling window | Standard deviation of sound risk culture phrase density in the previous two years* |
| GI\RWA | Gross income on risk-weighted assets | Income before taxes on risk-weighted assets[0] |
| ROA | Return on Assets | Gross income on total assets[0] |
| ROE | Return on equity | Gross income on equity[0] |
| lnTA | Natural logarithm of total assets | |
| TL\TA | Total loans on total assets | Gross loans (net loans plus reserves for impaired & NPLs) on total assets[0] |
| E\TA | Equity in total assets | |
| LIQA\TA | Liquid assets to total assets | Trading assets plus loans and advances with maturity less than 3 months over total assets[0] |
| LP\L | Loan provision on loans | Loan loss provision over gross loans[0] |
| CO\INC | Cost-to-income ratio | Overheads on net interest income plus other operating incomes[0] |
| ROA\VOL | ROA On Implied Volatility | Natural logarithm of the ratio between ROA and the implied volatility of stock prices[3*]. |
| crisis | | Dummy variable with a value of one from 2008 to 2017[0] |
| gdpgr | GDP growth rate | Annual percentage growth rate of the GDP at market prices based on constant local currency[1*] |
| IMMIGR | Immigrated population | Stock of foreign-born population (in millions) in the country[2*] |

| | | |
|---|---|---|
| Smog | Smog grade | Simple Measure of Gobbledygook) grade, a commonly used readability measure introduced by Mc Laughlin (1969) [+] |

## Table 2: Descriptive Statistics

The number of observations, mean, standard deviation, median, maximum, and minimum of the main analysis variables. All variables were winsorized at 1% and are described in Table 1. The total assets are expressed in EUR trillions. The sample includes the main banks' holdings in the Euro zone and U.K., active from 2004 to 2017, with total assets greater than EUR 1 billion and with at least one annual report in English. The banks' names were obtained from DataStream and the register of Significant Supervised Entities published by the BCE. The analysis focuses on large banks because they showed problems in guaranteeing a common risk culture throughout the organization. Balance sheet data were taken from BankScope/BankFocus databases. Data on the foreign-born population were obtained from the OECD database. We performed text analysis on data from documents with more than 50,000 words. After all adjustments, the sample included 92 banks, including the main European banks. Banks accounted for about 35% of the total assets of the countries' banking systems in 2017.

| | n | mean | SD | med | max | min |
|---|---|---|---|---|---|---|
| SRCD | 542 | 0.189 | 0.099 | 0.176 | 0.494 | 0.015 |
| TFTD | 542 | 0.071 | 0.043 | 0.064 | 0.224 | 0.004 |
| ACCD | 542 | 0.069 | 0.037 | 0.065 | 0.271 | 0.006 |
| COMD | 542 | 0.030 | 0.021 | 0.025 | 0.169 | 0.001 |
| INCD | 542 | 0.019 | 0.011 | 0.017 | 0.065 | 0.001 |
| SRCI | 542 | 1.946 | 1.050 | 1.945 | 6.128 | −1.810 |
| TFTI | 542 | 1.844 | 1.046 | 1.883 | 5.982 | −3.209 |
| ACCI | 542 | 1.957 | 1.081 | 1.982 | 7.408 | −2.222 |
| COMI | 542 | 1.796 | 1.105 | 1.742 | 5.484 | −1.444 |
| INCI | 542 | 1.921 | 1.049 | 1.875 | 6.419 | −3.043 |
| ROE | 542 | 0.030 | 0.225 | 0.073 | 0.509 | −1.283 |
| ROA | 542 | 0.002 | 0.016 | 0.004 | 0.039 | −0.152 |
| GI\RWA | 542 | 0.005 | 0.029 | 0.009 | 0.127 | −0.229 |
| ROA\VOL | 270 | −9.571 | 2.365 | −9.290 | −1.199 | −16.056 |
| TA(tril) | 542 | 0.405 | 0.572 | 0.119 | 2.103 | 0.001 |
| TL\TA | 542 | 0.572 | 0.182 | 0.603 | 0.915 | 0.090 |
| E\TA | 542 | 0.063 | 0.026 | 0.063 | 0.158 | 0.009 |
| LIQA\TA | 542 | 0.184 | 0.118 | 0.163 | 0.759 | 0.029 |
| LP\L | 542 | 0.011 | 0.012 | 0.007 | 0.075 | 0.000 |
| CO\INC | 542 | 0.636 | 0.231 | 0.629 | 1.601 | −0.764 |
| gdpgr | 542 | 0.579 | 3.065 | 1.145 | 25.117 | −14.274 |
| Smog | 530 | 16.723 | 2.133 | 16.500 | 40.100 | 11.500 |

**Table 3: Correlation among SRCI and SRC attributes**

We report in this table the correlation matrices. In panel A, we focus on the sound risk culture indicator (SRCI) and its attributes: Tone from the top indicator (TFTI), Accountability indicator (ACCI), Communication indicator (COMI), and Incentives indicator (INCI). In panel B, we report the correlation matrix among performance, SRCI and dependent, independent, and control variables. All variables were winsorized at 1% and are described in Table 1.

*Panel A − Sound Risk Culture Indicator and its components*

| | SRCI | TFTI | ACCI | COMI | INCI |
|---|---|---|---|---|---|
| SRCI | 1.00 | 0.92 | 0.89 | 0.78 | 0.75 |
| TFTI | 0.92 | 1.00 | 0.80 | 0.75 | 0.72 |
| ACCI | 0.89 | 0.80 | 1.00 | 0.67 | 0.71 |
| COMI | 0.78 | 0.75 | 0.67 | 1.00 | 0.59 |
| INCI | 0.75 | 0.72 | 0.71 | 0.59 | 1.00 |

*Panel B – All variables*

| | SRCI | ROE | ROA | GI\RWA | ROA\VOL | TA(tril) | TL\TA | E\TA | LIQA\TA | LP\L | CO\INC | gdpgr | Smog |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SRCI | 1.00 | 0.01 | −0.03 | 0.06 | −0.00 | 0.12 | −0.07 | −0.13 | 0.16 | −0.04 | 0.14 | 0.10 | −0.18 |
| ROE | 0.01 | 1.00 | 0.87 | 0.85 | 0.20 | −0.30 | −0.15 | 0.05 | −0.02 | −0.22 | −0.38 | 0.07 | −0.03 |
| ROA | −0.03 | 0.87 | 1.00 | 0.72 | 0.12 | −0.40 | −0.02 | 0.45 | −0.09 | −0.07 | −0.39 | 0.08 | −0.01 |
| GI\RWA | 0.06 | 0.85 | 0.72 | 1.00 | 0.25 | −0.20 | −0.26 | 0.02 | 0.02 | −0.28 | −0.35 | 0.13 | 0.03 |
| ROA\VOL | −0.00 | 0.20 | 0.12 | 0.25 | 1.00 | −0.24 | 0.21 | −0.02 | −0.28 | −0.22 | −0.10 | 0.20 | 0.04 |
| TA(tril) | 0.12 | −0.30 | −0.40 | −0.20 | −0.24 | 1.00 | −0.50 | −0.40 | 0.53 | 0.11 | −0.05 | 0.04 | −0.02 |
| TL\TA | −0.07 | −0.15 | −0.02 | −0.26 | 0.21 | −0.50 | 1.00 | 0.35 | −0.76 | 0.12 | −0.02 | −0.11 | 0.05 |
| E\TA | −0.13 | 0.05 | 0.45 | 0.02 | −0.02 | −0.40 | 0.35 | 1.00 | −0.28 | 0.27 | −0.20 | −0.01 | 0.00 |
| LIQA\TA | 0.16 | −0.02 | −0.09 | 0.02 | −0.28 | 0.53 | −0.76 | −0.28 | 1.00 | −0.01 | 0.05 | 0.14 | −0.12 |
| LP\L | −0.04 | −0.22 | −0.07 | −0.28 | −0.22 | 0.11 | 0.12 | 0.27 | −0.01 | 1.00 | −0.35 | −0.39 | 0.01 |
| CO\INC | 0.14 | −0.38 | −0.39 | −0.35 | −0.10 | −0.05 | −0.02 | −0.20 | 0.05 | −0.35 | 1.00 | 0.06 | 0.00 |
| gdpgr | 0.10 | 0.07 | 0.08 | 0.13 | 0.20 | 0.04 | −0.11 | −0.01 | 0.14 | −0.39 | 0.06 | 1.00 | 0.01 |
| Smog | −0.18 | −0.03 | −0.01 | 0.03 | 0.04 | −0.02 | 0.05 | 0.00 | −0.12 | 0.01 | 0.00 | 0.01 | 1.00 |

## Table 4: Sound Risk Culture Indicators' Effects on Risk-adjusted Performance Measures

The estimation results of equation (6) using the ratio between gross income and risk-weighted assets as the dependent variable ($y = GI\backslash RWA$). Columns (1) and (2) report our estimates using SRCI. Columns (3) to (6) report our estimates using each of the four attributes of the SRCI: Tone from the top indicator (TFTI), Accountability indicator (ACCI), Communication indicator (COMI), and Incentives indicator (INCI). We controlled for bank size (*lnTA*), business model ($TL\backslash TA$), capitalization ($E\backslash TA$), bank liquidity (LIQA\TA), loan loss provision on gross loans ($LP\backslash L$), and cost-to-income-ratio ($CO\backslash INC$). All independent variables are lagged by one year to manage a reverse causality problem. The number of observations decreased to 469 because we lost two years of data (2004 and 2005) due the rolling window applied to compute the SRCI. We considered only two years pre-crisis (2007 and 2006) and repeated the estimation in Section 6 using an SRCI built using a two-year rolling window to allow for inclusion of three years pre-crisis. We clustered the standard errors at the firm level. The standard deviations are shown in brackets, and stars correspond to the following p-value levels: * p < 0.1; ** p < 0.05; *** p < 0.01

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| $SRCI_{t-1}$ | 0.004*** | 0.004*** | | | | |
| | [0.001] | [0.001] | | | | |
| $TFTI_{t-1}$ | | | 0.004*** | | | |
| | | | [0.001] | | | |
| $ACCI_{t-1}$ | | | | 0.003*** | | |
| | | | | [0.001] | | |
| $COMI_{t-1}$ | | | | | 0.004*** | |
| | | | | | [0.002] | |
| $INCI_{t-1}$ | | | | | | 0.003** |
| | | | | | | [0.001] |
| $lnTA_{t-1}$ | | −0.015*** | −0.015*** | −0.013*** | −0.016*** | −0.014*** |
| | | [0.005] | [0.005] | [0.005] | [0.005] | [0.005] |
| $TL\backslash TA_{t-1}$ | | −0.058** | −0.061** | −0.056** | −0.055* | −0.051* |
| | | [0.028] | [0.028] | [0.028] | [0.028] | [0.028] |
| $E\backslash TA_{t-1}$ | | 0.274* | 0.285** | 0.263* | 0.269* | 0.256* |
| | | [0.140] | [0.137] | [0.140] | [0.141] | [0.140] |
| $LIQA\backslash TA_{t-1}$ | | −0.031 | −0.029 | −0.029 | −0.028 | −0.027 |
| | | [0.019] | [0.019] | [0.020] | [0.018] | [0.020] |
| $LP\backslash L_{t-1}$ | | −0.265 | −0.264 | −0.276 | −0.246 | −0.286 |
| | | [0.237] | [0.237] | [0.235] | [0.243] | [0.236] |
| $CO\backslash INC_{t-1}$ | | −0.004 | −0.004 | −0.004 | −0.003 | −0.004 |
| | | [0.007] | [0.008] | [0.007] | [0.007] | [0.007] |
| $gdpgr_{t-1}$ | | 0.002* | 0.002* | 0.002* | 0.002* | 0.002* |
| | | [0.001] | [0.001] | [0.001] | [0.001] | [0.001] |
| *N* | 469 | 469 | 469 | 469 | 469 | 469 |
| $R^2$ | 0.12 | 0.21 | 0.21 | 0.20 | 0.21 | 0.19 |
| $R^2adj$ | 0.10 | 0.17 | 0.18 | 0.17 | 0.18 | 0.16 |
| FE year | YES | YES | YES | YES | YES | YES |
| FE bank | YES | YES | YES | YES | YES | YES |

## Table 5: Sound Risk Culture's Effect on Performance Measures

Estimates of the SRCI's effect on different performance measures. Estimation results of equation (6) using the Return on Assets (*ROA*) and Return on Equity (*ROE*) as dependent variables (columns 1 and 2, respectively). In all models, we controlled for bank size (*lnTA*), business model (*TL\TA*), capitalization (*E\TA*), bank liquidity (LIQA\TA), loan loss provision on gross loans (*LP\L*), cost-to-income-ratio (*CO\INC*), and business cycle. All independent variables are lagged by one year to manage a reverse causality problem. The number of observations decreased to 469 because we lost two years (2004 and 2005) due to the rolling window applied to compute the SRCI. We consider only two years pre-crisis (2006 and 2007) and repeat the estimation in Section 6 using an SRCI built using a two-year rolling window to allow for inclusion of three years pre-crisis. The last column (3) uses the ratio between ROA and the implied volatility as dependent variables; in this last column, the number of observations drops to 256 because implied volatility was not available for all banks. We clustered the standard errors at the firm level. The standard deviations are shown in brackets, and stars correspond to the following p-value levels: * p < 0.1; ** p < 0.05; *** p < 0.01

| | $y=ROA_t$ | $y=ROE_t$ | y=ROA\VOL |
|---|---|---|---|
| | (1) | (2) | (3) |
| $SRCI_{t-1}$ | 0.002*** | 0.024*** | 0.132* |
| | [0.000] | [0.007] | [0.071] |
| $lnTA_{t-1}$ | −0.007*** | −0.207*** | −2.120*** |
| | [0.003] | [0.069] | [0.575] |
| $TL\backslash TA_{t-1}$ | −0.017 | −0.068 | 1.126 |
| | [0.021] | [0.352] | [1.525] |
| $E\backslash TA_{t-1}$ | 0.132 | 0.152 | 5.731 |
| | [0.082] | [1.444] | [12.799] |
| $LIQA\backslash TA_{t-1}$ | −0.018* | −0.072 | 0.225 |
| | [0.011] | [0.190] | [1.827] |
| $LP\backslash L_{t-1}$ | −0.177 | −2.830* | 29.583 |
| | [0.154] | [1.445] | [21.146] |
| $CO\backslash INC_{t-1}$ | −0.004 | 0.058 | 0.472 |
| | [0.004] | [0.082] | [0.608] |
| $gdpgr_{t-1}$ | 0.001* | 0.005 | −0.039 |
| | [0.001] | [0.008] | [0.105] |
| *N* | 469 | 469 | 256 |
| $R^2$ | 0.19 | 0.14 | 0.35 |
| $R^2adj$ | 0.16 | 0.11 | 0.31 |
| FE year | YES | YES | YES |
| FE bank | YES | YES | YES |

## Table 6: Sound Risk Culture Indicators' Effects on Risk-adjusted Performance Measures: 2SLS Instrumental Variable Approach

2SLS IV model estimation results. The model is described by equations (7) and (8). Column (1) reports the second stage results. We controlled for bank size (lnTA), business model (TL\TA), capitalization (E\TA), bank liquidity (LIQA\TA), loan loss provision on gross loans and bank efficiency (LP\L), and cost-to-income-ratio (CO\INC). Column (2) reports the first stage. IMMIGR is the immigration rate of a bank's home country in year *t*. The F-stat refers to the Kleibergen–Paap statistics for the weak instruments test (Kleibergen and Paap, 2006). Per the thresholds of Hausman et al. (2005), all test values were above the 10% critical value. The total number of observations decreased to 371 because IMMIGR data were not available for all countries in the sample. We clustered the standard errors at the firm level. The standard deviations are shown in brackets, and stars correspond to the following p-value levels: * p < 0.1; ** p < 0.05; *** p < 0.01

| | $GI\backslash RWA_t$ | $SRCI_{t-1}$ |
|---|---|---|
| | (1) | (2) |
| $SRCI_{t-1}$ | 0.007** | |
| | [0.003] | |
| $IMMIGR_{t-1}$ | | −0.870*** |
| | | [0.196] |
| $lnTA_{t-1}$ | −0.019*** | 0.310 |
| | [0.007] | [0.369] |
| $TL\backslash TA_{t-1}$ | −0.114*** | 2.847*** |
| | [0.036] | [1.022] |
| $E\backslash TA_{t-1}$ | 0.438* | −10.331* |
| | [0.240] | [5.815] |
| $LIQA\backslash TA_{t-1}$ | −0.032 | 1.373 |
| | [0.026] | [1.655] |
| $LP\backslash L_{t-1}$ | 0.055 | −21.533*** |
| | [0.174] | [8.155] |
| $CO\backslash INC_{t-1}$ | −0.002 | 0.201 |
| | [0.008] | [0.244] |
| $gdpgr_{t-1}$ | 0.002** | −0.052 |
| | [0.001] | [0.052] |
| *N* | 371 | 371 |
| $R^2$ | 0.23 | |
| rk F-stat | 19.6 | |
| FE year | YES | YES |
| FE bank | YES | YES |

## Table 7: Sound Risk Culture High and Low Variations' Effects on Banks Performance

Results of different models estimated considering the effect of high variation of the SRCD. Column (1) estimates the effect of the $SRCDvar^{Q4}$ (a dummy with a value of 1 if bank-*i*'s SRCDvar at time *t* is in the 4th-quartile (Q4) of the overall SRCDvar distribution). There were 407 observations because we lost observations from 2004 to build the variation index. Column (2) estimates the effect of the SRCI on the sub-sample of observations with SRCIvar in Q4 at *t*-1. Column (3) shows the previous estimation represented in equation (6), excluding all observations with high SRCD variation (we included only banks with an $SRCDvar^{Q4}$ of 0). Column (4) reports the results of the IV model on the same sample as in column (3). The F-stat refers to the Kleibergen–Paap statistics, which are above the 15% critical value. In all models, we controlled for bank size (lnTA), business model (TL\TA), capitalization (E\TA), bank liquidity (LIQA\TA), loan loss provision on gross loans and bank efficiency (LP\L), cost-to-income-ratio (CO\INC), and business cycle. We clustered the standard errors at the firm level. The standard deviations are shown in brackets, and stars correspond to the following p-value levels: * p < 0.1; ** p < 0.05; *** p < 0.01

| | $GI\RWA_t$ | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $SRCDvar^{Q4}_{t-1}$ | −0.005 | | | |
| | [0.003] | | | |
| $SRCI_{t-1}$ | | 0.000 | 0.004*** | 0.007** |
| | | [0.006] | [0.001] | [0.003] |
| $lnTA_{t-1}$ | −0.005 | −0.017 | −0.020** | −0.018** |
| | [0.007] | [0.016] | [0.008] | [0.008] |
| $TL\TA_{t-1}$ | −0.034 | −0.136 | −0.074* | −0.118*** |
| | [0.031] | [0.111] | [0.044] | [0.041] |
| $E\TA_{t-1}$ | 0.197 | 0.901*** | 0.277 | 0.484 |
| | [0.129] | [0.321] | [0.212] | [0.359] |
| $LIQA\TA_{t-1}$ | 0.014 | −0.042 | −0.027 | −0.042 |
| | [0.030] | [0.144] | [0.026] | [0.032] |
| $LP\L_{t-1}$ | −0.313 | −0.079 | −0.344 | 0.308 |
| | [0.203] | [0.726] | [0.224] | [0.367] |
| $CO\INC_{t-1}$ | −0.004 | 0.013** | −0.004 | 0.004 |
| | [0.007] | [0.006] | [0.007] | [0.007] |
| $gdpgr_{t-1}$ | 0.002* | 0.011*** | 0.001 | 0.001 |
| | [0.001] | [0.004] | [0.001] | [0.001] |
| *N* | 526 | 118 | 351 | 276 |
| $R^2$ | 0.20 | 0.59 | 0.24 | 0.25 |
| $R^2adj$ | 0.17 | 0.52 | 0.20 | |
| FE year | YES | YES | YES | YES |
| FE bank | YES | YES | YES | YES |
| rk F-stat | | | | 13.12 |

## Table 8: Robustness Checks

Results of different robustness tests. Column (1) reports the regression coefficients of the model in equation (6), estimated on the entire sample using SRCI2 (SRCI computed using a two-year rolling window). We include three years pre-crisis (2005, 2006, and 2007). In column (2), we used a modified version of the SRCI that is focused on banks' risk approaches (SRCIR). Column (3) repeats the same estimation as in column (2) in Table 4 on the years after the crisis (from 2009 to 2017). Both previous analyses tested if the results are consistent when the effects of the crisis are excluded or when a longer period is considered. The latter was obtained by repeating text analysis using only vectors of words in the SRC framework (reported in the on-line Appendix) that included the word "risk." Column (4) includes among regressors the Smog-index. Column (5) add a country*year fixed effects. We controlled for bank size (lnTA), business model (TL\TA), capitalization (E\TA), bank liquidity (LIQA\TA), loan loss provision on gross loans and bank efficiency (LP\L), cost-to-income-ratio (CO\INC), and business cycle. We clustered the standard errors at the firm level. The standard deviations are shown in brackets, and stars correspond to the following p-value levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

| | $y=GI\backslash RWA_t$ | $y=GI\backslash RWA_t$ | $y=GI\backslash RWA_t$ | $y=GI\backslash RWA_t$ | $y=GI\backslash RWA_t$ |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| $SRCI2_{t-1}$ | 0.002** | | | | |
| | [0.001] | | | | |
| $SRCIR_{t-1}$ | | 0.003*** | | | |
| | | [0.001] | | | |
| $SRCI_{t-1}$ | | | 0.005*** | 0.004*** | 0.002* |
| | | | [0.002] | [0.001] | [0.001] |
| $lnTA_{t-1}$ | −0.007 | −0.014*** | −0.015** | −0.015*** | −0.003 |
| | [0.007] | [0.005] | [0.006] | [0.005] | [0.007] |
| $TL\backslash TA_{t-1}$ | −0.039 | −0.056* | −0.063** | −0.063** | −0.044** |
| | [0.032] | [0.029] | [0.031] | [0.030] | [0.021] |
| $E\backslash TA_{t-1}$ | 0.223 | 0.241* | 0.259 | 0.249* | 0.332** |
| | [0.142] | [0.142] | [0.168] | [0.141] | [0.163] |
| $LIQA\backslash TA_{t-1}$ | 0.023 | −0.037* | −0.053* | −0.034* | −0.054 |
| | [0.030] | [0.020] | [0.028] | [0.020] | [0.038] |
| $LP\backslash L_{t-1}$ | −0.324 | −0.339 | −0.123 | −0.280 | 0.290 |
| | [0.226] | [0.250] | [0.237] | [0.245] | [0.249] |
| $CO\backslash INC_{t-1}$ | −0.004 | −0.005 | −0.003 | −0.005 | 0.002 |
| | [0.008] | [0.008] | [0.008] | [0.008] | [0.004] |
| $gdpgr_{t-1}$ | 0.002 | 0.002* | 0.002* | 0.002* | −0.001 |
| | [0.001] | [0.001] | [0.001] | [0.001] | [0.011] |
| $Smog_{t-1}$ | | | | 0.001 | |
| | | | | [0.000] | |
| *N* | 499 | 459 | 411 | 457 | 469 |
| $R^2$ | 0.20 | 0.21 | 0.17 | 0.21 | 0.19 |
| $R^2adj$ | 0.17 | 0.18 | 0.13 | 0.18 | 0.16 |
| FE year | YES | YES | YES | YES | NO |
| FE bank | YES | YES | YES | YES | YES |
| FE year*country | NO | NO | NO | NO | YES |

# Does Espoused Risk Culture Pay? Evidence from European Banks

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**Abstract**

A poor risk culture was one of the causes of the financial crisis. Surprisingly, there is no evidence of the link between risk culture and bank stability. Using a large sample of European banks from 2004 to 2017, our paper shows that a sound risk culture leads to better performance. Our research design is based on three steps. First, we developed a new Sound Risk Culture Indicator based on the Financial Stability Board (2014) risk culture framework. Second, we estimated this new metric by applying Quantitative Text Analysis. Third, we used an IV 2SLS panel data approach to establish a causal link between bank risk culture and profitability.

**Keywords:** *Risk Culture, Performance, Banking, Text Analysis, Stability*
**JEL codes:** G21; M14

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*"The pressure on the risk department to keep up and approve transactions was immense. Psychology played a big part. The risk department had a separate reporting line to the board to preserve its independence. This had been reinforced by the regulators, who believed it was essential for objective risk analysis and assessment. However, this separation hurt our relationship with the bankers and traders we were supposed to monitor. In their eyes, we were not earning money for the bank."*

*Confession of a risk manager, The Economist 2017.*

## 1. Introduction

Popular press, practitioners, and financial regulators have argued that weak risk governance and culture were shortcomings of the financial system after 2008 (Parliamentary Commission on Banking Standards, 2013; House of Commons Treasury Committee, 2009; Institute of International Finance, 2009). The Financial Stability Board (2014) states that "*Weaknesses in risk culture are often considered a root cause of the global financial crisis, headline risk and compliance events*" (FSB, 2014, p. 1). Similarly, in a letter written to FSB on January 2014, HSBC notes that "*establishing and maintaining a strong link culture is of fundamental importance in ensuring the sustainable success of an organization and to the reestablishment of trust of financial institutions and the banking sector*" (HSBC, 2014, page 1).

There is anecdotal evidence that suggests a lack of risk culture in banking prior to the financial crisis. Jean-Claude Trichet, Chairman and CEO of the Group of Thirty and former president of the European Central Bank, noted that "*Too often, bank bosses' promises to change the 'corporate culture' and ensure their employees' good conduct have not been matched by fully effective implementation*" (Trichet, 2015, page 1). Since the crisis, the largest financial institutions have been levied over $100 billion in fines, suggesting that ethical lapses in banking are not just the outcome of a few bad apples, but a reflection of systematic weaknesses (Thakor, 2016). The lack of risk culture in banking is essential in the trade-off between risk-taking and profits, as explained by the statement of a US risk manager describing the conflict between the risk

management department and business lines before the financial crisis. Not surprisingly, financial regulators have proposed various initiatives to reinforce banks' risk cultures. William C. Dudley, President and Chief Executive Officer of the Federal Reserve of New York, noted that *"In the last year, we have seen emerging approaches to supervision that aim to address culture, conduct and governance. These methods are being developed in a number of jurisdictions*" (Dudley, 2015, page 1). New regulation is pushing banks to develop internal Risk Culture; the latter requires investments and imposes costs to institutions (Basel Committee for Banking Supervision, 2015a, 2015b).

Although there is a vast literature investigating the determinants of European bank performance (Molyneux and Wilson, 2017; Cocorese and Girardone, 2017; Doumpos, et al., 2017, among the others), there is no empirical evidence based on large samples demonstrating the extent to which a risk culture influences financial institutions' behaviors or supporting that a strong risk culture negatively influences bank performance (as is generally believed by practitioners) or positively influences it (as argued by regulators and supervisors). This leads us to address the following question: Do banks with a sound risk culture achieve better returns? To empirically answer this question, we developed an indicator, labeled as Sound Risk Culture Indicator (SRCI) at the bank level, estimated this metric for a large sample of banks (through Quantitative Text Analysis [QTA] of annual reports, corporate governance reports, and Pillar 3 reports), and estimated the causal link between the SRCI and various bank performance measures (Return on Assets [ROA], Return On Equity [ROE]) and risk-adjusted performance measures (Gross income on risk-weighted assets, and ROA On Implied Volatility). Our main result is that a strong risk culture is related to better performance, measured by various financial ratios. We also considered that banks may manipulate qualitative disclosure (the text in the official documents analyzed) and

show that a bank's performance decreases in case of an abnormal SRCI increase. To test the robustness of our findings, we repeated our main analysis excluding observations with signals of manipulation and obtained very consistent results.

We face two major issues in addressing our research questions. The first is building a metric that can capture risk culture at the bank level and can be estimated in an objective and replicable manner for many banks. Economists have traditionally been reluctant to discuss culture as a determinant of economic phenomena because the notion of culture is nebulous and raises numerous measurement issues in empirical research (Guiso et al., 2006). However, in what has been labeled the "culture revolution" by Zingales (2015), there has been a burgeoning interest in objectively measuring culture. Prior research has typically proxied for culture using socio-demographic measures at the country level (including religious identity, nationality, gender, blood donations, etc.) or social capital measures. In comparison, relatively few papers analyze corporate culture at the firm level (see, for example, Fiordelisi and Ricci, 2014, Guiso et al., 2015, and Cerqueti et al., 2017). The first step in solving this issue is to find a risk cultural framework that is largely accepted; we focused on the FSB (2014) framework, which sums up recognized risk culture's best practices (McConnell, 2013; Power et al., 2013). The FSB framework identifies four features of a sound risk culture: i) tone from the top (TFT)—board members and senior managers are responsible for promoting risk culture and including it in the bank's strategy; ii) accountability (ACC)—banks must develop a policy of ownership of risk in which employees are held accountable for their actions and are aware of the consequences for not adhering to the desired behaviors toward risk; iii) effective communication and challenge (COM)—top managers must encourage alternative views and pay attention to risk managers' suggestions to make informed risk decisions; iv) incentives (INC)—banks need a risk-linked rewarding system based on monetary

and non-monetary incentives. We define a selection of words to measure each of these four items extracted from the FSB framework. Then, we analyze each bank's official documents (annual reports, corporate governance reports, and Pillar 3 reports) in a QTA, an objective and replicable approach that can be applied to many firms.

The second issue is related to our identification strategy. Addressing both endogeneity and reverse causality issues in our empirical methodology is important. In our setting (in which risk culture is estimated by applying text analysis on disclosure), we may find that a bank's performance is positively related to greater risk culture. However, this may be driven by the fact that: 1) top managers use certain terms because they expect a certain outcome in terms of performance; and 2) a bank initiates projects with an aim of enhancing its risk culture (and discloses these initiatives in its official documents) only when they achieve greater performance. Previous research on this topic attempted to manage endogeneity and reverse causality issues using an instrumental variable approach and by lagging the independent variables by one year. We apply a Two Stage Least Square Instrumental Variable (2SLS IV) model using immigrated population (measured in millions) as an instrument. The entrance of foreigners in a country is an exogenous shock that modifies national preferences and belief systems (Fernandez and Fogli, 2009). Polavieja (2015) uses a similar approach by employing cultural traits of the migrant population as an instrument to study the effect of national traditionalism on female labor force participation. The central tenet of these epidemiological approaches is exploiting the portability of culture: *"Migrants take their culture with them, from one social context to another, and this provides a unique opportunity to isolate and quantify (i.e., to identify) the causal effect of culture on people's behavior"* (Polavieja, 2015, page 168).

The main contribution of our paper is that we focus on bank culture, not on bank risk-taking. We argue that bank risk-taking is the effect of the bank risk culture and that the latter drives banks to more efficient risk decisions. The idea is that a higher attention to risk culture could allow the bank to decrease the trade-off between risk-taking and stability, with a positive effect on profits. It is widely believed that corporate culture is a main determinant of most of the bank features considered in previous research (such as corporate governance mechanism, capital structure, and efficiency). We develop an objective measure of risk culture at the bank level and estimate this metric for a large sample of banks through automatic text data processing of official documents. Our approach is objective and replicable in future research. We also show that an enhanced risk culture does not negatively impact banks' performance; rather, it is related to greater profits and value. This result is very important for financial regulators and supervisors, suggesting that banks with a sound risk culture can accurately account for their risk-taking and achieve greater profits to create shareholder value. Various regulatory interventions to enhance bank risk culture are justified and appear to be an important tool for enhancing bank stability. Our findings also provide evidence of how cultural traits are likely to affect financial institutions' performances.

This is one of few studies assessing the role of corporate culture in banking based in Europe, as most papers focus on the US (as Cerqueti et al., 2017). The lack of studies in Europe is surprising because the crisis was very severe in the European Union and stability of the banking system has not yet been fully achieved, as shown by the large stock of non-performing loans (almost EUR 1 trillion at the end of 2016) and by the substantial number of bail-out and bail-in cases of large banks in the recent years. We select a large sample of banks in the Euro zone and U.K. from 2004 to 2017 with total assets greater than EUR 1 billion and with at least one annual report in English.

The remainder of the paper is structured as follows. Section 2 reviews literature, defines the concept of risk culture, and develops research hypotheses. Section 3 illustrates the sample and methodology applied to compute the SRCI. The results of the fixed effect regression models are presented in Section 4, and Section 5 contains 2SLS IV model estimations. Section 6 shows different robustness tests and Section 7 presents the conclusions.

## 2. Literature Review

In the aftermath of the recent financial crisis, the tendency of some banks to perform poorly compared to others that were more resilient was argued to be a matter of "culture" (Aebi et al., 2012; Fahlenbrach et al., 2012; Irresberger et al., 2015; Bonaccorsi and Kashyap, 2017). Although culture has become a popular topic in recent years, it is not a new issue.

Corporate culture has been traditionally considered (and measured) as a subset of the environmental or national culture. Culture is the "*collective programming of the mind that distinguishes the members of one human group from those of the others. Culture in this sense is a system of collectively held values*" (Hofstede 1991, page 5). By measuring culture through environment variables, various research shows that culture affects banks' performance and stability. Boubakri et al. (2017) show that banks in high uncertainty avoidance and power distance societies perform relatively better during the recent financial crisis. Chui et al. (2016) evidence that cultural dimensions of embeddedness and mastery negatively affect the cost of debt through bankruptcy risk and sensitivity to agency activity channels. Frijns et al. (2013) show that CEOs of firms in countries with lower levels of risk tolerance require higher premiums on takeovers and that uncertainty avoidance plays a greater role in relatively large takeovers. Carretta et al. (2015) provide empirical evidence that supervisory culture influences banks' stability.

Another part of the literature considers culture as a specific phenomenon of companies; corporate culture is "*a system of shared values that define what is important, and norms that define appropriate attitudes and behaviors for organizational members*" (O'Reilly and Chatman 1996, page 160). Research shows evidence that corporate culture influences firms' behavior and performance (Wilkins and Ouchi, 1983; Schein, 1990; Van den Steen, 2010). In the principal-agent framework, managerial "moral hazard" may be conduct consistent with the culture of the principals (Gorton, 2014). In the incomplete contract theory framework (Grossman and Hart, 1986), in which managers and employees face choices that cannot be properly regulated ex ante, corporate culture may be crucial to explain their decisions, contributions and, ultimately, corporate performance (Guiso, Sapienza and Zingales, 2015).

Risk culture is an expression of corporate culture that focuses on risk-taking and risk-control activities. A first risk culture definition was proposed by Sheedy and Griffin (2018, page 4) and Sheedy et al., (2017, page 101) as "*the shared perceptions among employees of the relative priority given to risk management, including perceptions of the risk-related practices and behaviors that are expected, valued, and supported*." However, risk culture is a concept not only related to risk management's ability, it rather influences the entire organization of a company as suggested by the Basel Committee for Banking Supervision (2015, page 2), which defines a bank's risk culture as *"A bank's norms, attitudes, and behaviors related to risk awareness, risk-taking, and risk management, and controls that shape decisions on risks. Risk culture influences the decisions of management and employees during the day-to-day activities and has an impact on the risks they assume.*"

Recalling the old adage that "one cannot manage what one does not measure," we have to define a risk culture measurement system. However, there are various problems that we need to

face. First, it is necessary to consider various items (such as ethics, incentive systems, regulatory constraints, and risk oversight) that are not routinely measured or reported. Second, a risk culture assessment focusing only on risk management practices could only be referred to the long term and should be able to identify managerial skills and/or luck (Sheedy and Griffin, 2018). Third, measurement methods based both on regular interviews and surveys are impractical on a large scale (i.e., a large number of companies), do not enable one to make objective comparisons over time and across businesses (e.g., a bank may show multiple risk culture measures in different departments, especially when it is a large company or it operates in multiple locations), and usually suffers of low response rates and measurement biases (Sheedy et al., 2017). To face these problems, we adopt a different "objective" approach focusing on the espoused risk culture and risk governance (i.e., policies, structures, and systems related to risk management) rather than culture per se[1]: specifically, we run a QTA of corporate documents (annual reports, corporate governance reports, and Pillar 3 reports)[2] to measure the risk culture espoused by banks. This technique is applied to observe, in a systematic and objective manner, the characteristics specific to a text (Stone et al., 1966).

As suggested by Kabanoff et al. (1995), corporate reports are a team product whose content is carefully reviewed by top management, thus reflecting the type of culture within which they are produced. The basic underlying idea is that the words and expressions used in corporate documents (i.e., the "vocabulary") represent the outcome of the corporate culture (Levinson, 2003). Moreover,

[1] We would like to thank the associate editor for his constructive comments and help to clarify that our measures are mainly picking up espoused risk culture and risk governance.

[2] One concern is that many financial institutions have great policies, structures, and systems related to risk management on paper that are not taken very seriously in practice. In other terms, the words used could reflect image more than substance. Despite this, the high visibility (internal and external) of these documents together with the supervisory screening of the information provided should limit their misleading content.

measures of risk culture obtained through QTA are less prone to the subjectivity of opinions of the researcher.

To implement a content analysis, we need to preliminarily identify a risk culture framework. As such, we focus on the one developed by the FSB (2015) that synthesizes various approaches (e.g., Cass Business School & New City Agenda, 2014; Institute of Risk Management, 2012; Senior Supervisors Group, 2009; McKinsey framework; KPMG framework; Charted Institute of Internal Auditors, 2014). This FSB (2015) framework refers to the following four main attributes that make a bank's risk culture "sound": i) TFT, ii) ACC, iii) COM, and iv) INC.

The first element of the FSB's scheme is TFT; the board and senior management are responsible for promoting risk culture and including it in their strategy. The top members of the organization oversee the development of an adequate risk culture, create mechanisms for implementation of risk appetite, and lead by example. The second required element is ACC. The organization must develop competences to communicate potential threats that allow for risk recognition and escalation processes (such as whistle blowing). The consequences of risk-taking that is not aligned with risk appetite (regardless of the financial result of the action) must be explained. COM refers to the possibility of making informed risk decisions; top management must encourage alternative views and pay attention to risk management's observations. Finally, the organization needs a system of rewards and penalties that is not only monetary (i.e., opportunities for training, job rotation, and successions), which is also based on both risk-taking and performance, and including all individuals in the organization (as the CEO and loan officers).

The FSB (2015) framework is not evidence based and there is no existing evidence supporting its validity. Thus, our paper is the first that uses it to measure bank risk culture using a large sample of firms. Our results provide novel empirical evidence regarding the link between a

sound (according to FSB framework) risk culture and bank performance. Our main research assumption is that a "sound" (according to FSB framework) risk culture, despite the costs for its development, improves banks' performance by enabling banks to be more efficient in risk-taking and risk management.

## 3. Data and Variables

The most challenging task of this paper is the development of the SRCI, i.e., a new measurable indicator of risk culture. We use QTA, which has been proven to be a reliable methodology in previous financial research (Hoberg and Phillips, 2010; Hoberg and Hanley, 2010).

Our approach to developing the SRCI involves the following three steps: first, we select different vectors of words that capture attributes of the SRC; second, we identify appropriate companies' publicly available documents that mirror the risk culture. Third, we define our equations to quantify the SRCI.

We follow the FSB framework that examines four attributes that constitute an SRC. The FSB specifies different qualities for each attribute (labeled as "indicators") that help identify what each attribute consists of. To measure the banks' attention to the four attributes, we select "vectors of words" from the FSB's indicator descriptions; we do not choose single words but consider combinations of two and three terms[3], labeled "Group Meaning Units" (GMUs). Our QTA algorithm enables us to examine if words belonging to the same GMU appear together in a sentence. This approach evaluates how often banks link two concepts (management and information, board and uncertainty, incentives and risk, etc.). For example, the words "board" and

[3] The vectors of words selected directly from the FSB framework are reported in Table 1 of the on-line Appendix. Each comma-separated term in the first group is searched with each term of the second group (in the "Extracted Sentences" column).

"lead" appearing alone in a sentence would not be sufficient to signal a leadership attitude of the board (ID 4.1.a in the Table 1 in the on-line Appendix), but these words together in a phrase underline a board's guidance role. To allow for a more effective analysis, our methodology includes new GMUs composed of synonyms taken from the Collins Dictionary and Thesaurus[4]. We remove all morphological affixes with a Porter's stemming algorithm implemented in Python's Snowball Stemmer package[5]. As a result, 8638 GMUs are included in the analysis[6].

In the second step, we analyze annual, corporate governance, and Pillar 3 reports. These documents contain information about performance, risk, and internal policies, respectively. The structure of these documents is partially regulated by the European Banking Authority, but banks are free to determine the documents' detail and length so we can use them to estimate bank risk culture.

In the third step, we compute the SRCI and TFTI, ACCI, COMI, and INCI indicators as:

$$(1) \qquad TFTI_{it} = ln\left(\frac{TFTD_{it}}{sd(TFTD)_{3,it}}\right), \text{with } TFTD_{it} = \frac{N_{it}^{TFT}}{tphr_{it}}$$

$$(2) \qquad ACCI_{it} = ln\left(\frac{ACCD_{it}}{sd(ACCD)_{3,it}}\right), \text{with } ACCD_{it} = \frac{N_{it}^{ACC}}{tphr_{it}}$$

$$(3) \qquad COMI_{it} = ln\left(\frac{COMD_{it}}{sd(COMD)_{3,it}}\right), \text{with } COMD_{it} = \frac{N_{it}^{COM}}{tphr_{it}}$$

$$(4) \qquad INCI_{Iit} = ln\left(\frac{INCD_{it}}{sd(INCD)_{3,it}}\right), \text{with } INCD_{it} = \frac{N_{it}^{INC}}{tphr_{it}}$$

$$(5) \qquad SRCI_{it} = ln\left(\frac{SRCD_{it}}{sd(SRCD)_{3,it}}\right), \text{with } SRCD_{it}$$

$$= TFTD_{it} + ACCD_{it} + COMD_{it} + INCD_{it}$$

[4] Table 2 in the on-line Appendix I provides details on the selected and discarded synonyms.
[5] To manage the duplicated GMUs we applied the following rule: when duplicates belonged to the same attribute, we retained only one of them; if they referred to different attributes, we deleted both.
[6] Listed in the Table 3 of the on-line Appendix.

$TFTD_{it}$, $ACCD_{it}$, $COMD_{it}$, and $INCD_{it}$ are TFT, Accountability, Communication, and Incentives attention's density, respectively. $N_{it}^{TFT}$, $N_{it}^{ACC}$, $N_{it}^{COM}$ and $N_{it}^{INC}$ are the total number of sentences[7] containing a GMU associated with the corresponding indicator (TFT, Accountability, Communication, and Incentives) for the bank-*i*'s disclosure at time *t*. $tphr_{it}$ is the total number of sentences in bank-*i*'s disclosure at time *t*. These ratios measure how much banks display a vocabulary linked with each of the four attributes of the SRC, divided by the total number of sentences correct indicator for the distortions due to a longer or shorter bank disclosure term. $SRCD_{it}$ is the sum of the four attributes' densities[8]. The cultural indicators (TFTI, ACCI, COMI, INCI)[9] are the ratios between the densities and their standard deviations, computed using a three-year rolling window[10]. The indicators measure the number of times the densities exceed their standard deviation; this allows to clean the series by jumps from one year to another.

The sample includes the main banks' holding companies in the Euro zone and U.K., active from 2004 to 2017, with total assets greater than EUR 1 billion, and with at least one annual report in English. The banks' names are obtained from *DataStream* and the register of Significant Supervised Entities published by BCE. The analysis focuses on large banks because they showed problems in ensuring a common risk culture throughout the organization. The balance sheet data are taken from *BankScope and BankFocus* databases. Data on foreign-born populations are obtained from the OECD database[11].

[7] A sentence is defined as consecutive words contained between a blank line and a dot or between two dots.
[8] The densities are hereafter referred to as TFTD, ACCD, COMD, INCD, and SRCD.
[9] Indicators, cultural indicators, culture's indicators, and sound risk culture's indicators are hereafter referred to as TFTI, COMI, and INC.
[10] Standard deviation of the SRCD in the last three years.
[11] Foreign-born populations in OECD countries (indicator). doi: 10.1787/b1fc67fa-en (Accessed on 15 March 2017).

We define a *word* as a term with more than two letters that is not an article or a conjunction. To clean the errors from the data, we retain observations with more than 5000 words and winsorize SRCIs at 1%. This allows for removal of reports with little information since they clearly show anomalous paths in an unreported graph. Table 2 provides some descriptive statistics of the main variables.

As shown in Figure 1, the average SRCD increases yearly and has a mean of 0.189, meaning that on average, 19% of the phrases in bank's disclosures contain SRC vocabulary. All indicators and densities show a high standard deviation of approximately 50% of the mean. The other variables are defined in Table 1.

**4. Preliminary investigation**

Before conducting our empirical analysis, we screen the economic meaning of our SCRI by comparing our new measure with various bank risk and performance measures.

First, we measure the correlation among performance indicators, sound risk culture, and the other dependent variables (tables 3.1 and 3.2). The strong correlation among SRC and SRCI attributes (TFTI, ACCI, COMI, and INCI) is worth mentioning. This suggests that the SRCI attributes influence each other. Figure 2 shows the mean annual SRCI and its standard deviation; there is a clear fluctuation of the indicator on all the periods. There is no high variation in the cultural indicator because culture may not change excessively from year to year. The standard deviation of the SRCI within the year is very high, meaning that banks have different levels of culture within the same year.

The timelines of the SRCD for four European banks, Banque Populaire and Caisse d'Epargne Group (BPCE), Deutsche Bank AG, Banca Monte dei Paschi di Siena SpA, and Royal

Bank of Scotland Group PLC, are shown in Figure 3. As expected, the RBS and MPS show low levels of SRCD. In this regard, the Financial Services Authority Board Report (2011) on RBS crisis states that "*the poor decisions made by RBS management and Board which made RBS highly vulnerable to failure, and the underlying aspects of RBS' management style, governance, and culture which may have contributed to those poor decisions*." Also the *Testimony of the Governor of the Bank of Italy Ignazio Visco* (2016), with reference to referring to MPS scandal, points on problems relating to organizational safeguards and controls: *"management had failed to transmit to supervisors the information that was vital for a full recognition of the scale and nature of several operations that had been carried out in violation of the law."*

Although Deutsche shows higher levels of the SRCD indicator, at least at the beginning of the considered period. Following, there is an evident decline of the SRCD indicator, especially in the years of the LIBOR scandal. Finally, BPCE shows a growing trend for the SRCD indicator.

Third, we conduct a Multi-Dimensional-Scaling (Borg and Groenen, 2005) analysis on vectors representing the Risk Dictionary (RD) of the Banks. The matrix of the distances between banks (D) was computed considering the cosine of the angle the between bank-specific vectors $v^b \in R^N$, where N is the length of the RD. A typical pattern in human languages is that phrases that are used to describe the same topic share certain common words (Mu et al., 2016). Therefore, in line with Bodnaruk et al. (2015) and Loughran and McDonald (2011), the words that included the RD are those that appear in at least 5% of the risk sentences.

A risk sentence is a sentence containing the word "risk" at least once. The distance $d_{i,j}$ between vector $v^i$and vector $v^j$is computed as $d_{i,j} = \cos(\theta_{i,j}) = \frac{v^{i,2} \cdot v^{j,2}}{\|v^{i,2}\| \cdot \|v^{j,2}\|}$, where $d_{i,j}$ is the *i-th*, *j-th* element of the distance matrix $D \in R^{B \times B}$. The vectors $v^1, \dots, v^b, \dots, v^B \in R^N$, where $B$ is the total number of banks such that the element $v_w^b$ of the vector $v^b$ is $v_w^{b,2} = \frac{n_{w,b}}{Nr_b}$, $n_{w,b}$ is the number

of significant sentences in the documents of bank $b$ in which the word $w$ appears, $Nr_b$ is the number of the bank's significant sentences, and $v_w^b$ corrects for the amount of information disclosed by the bank. Figure 4 shows the MDS scatter plot for a graphic representation of the differences in banks' RD from 2004 to 2017; the greater the distance between two points, the greater the dissimilarity of vocabulary used to talk about risk. In figure 4, some of the main banks are underlined with a label[12].

We do not find similarities in the data points of banks with common characteristics (i.e., same country, dimension, or sector), even for labeled banks, which are similar in terms of business models and dimensions. This has important implications; each bank's disclosure vocabulary is unique and firm-specific; otherwise, some points would be closer together. Therefore, we conclude that a bank's annual report vocabulary is not determined by regulation, national culture, or business model.

## 4. Analysis and Results

Our main research assumption is that a sound risk culture produces positive effects on banks' performances. To test this assumption, we use the following panel data model:

$$(6) \quad Performance_{it} = \alpha_t + \alpha_i + \beta_1 SRCI_{i(t-1)} + \sum \beta_i m_{i(t-1)} + \delta_1 GDP_{j(t-2,t-1)} + \delta_2 crisis_i + \epsilon_{it}$$

where a bank's performance is measured using various indicators such as the GI\RWA indicator (which allows for evaluation of the bank's performance, net of the taxation effect, and standardized

[12] Santander, Commerzbank, Deutsche, Raiffeisen Banking Group, KBC group, BNParibas, Mediobanca, Intesa Sanpaolo, Unicredit, Monte Paschi di Siena, Societe Generale, BBVA

by the risk-weighted assets[13]), ROA, ROE, and, similarly to Eckles, Hoyt and Miller (2014), ROA On Implied Volatility (ROA/VOL). The primary coefficient of interest is $\beta_1$, which measures the link between a bank's $SRCI_{it}$ (as defined in Equation 5) and performance. We also controlled for various bank characteristics ($m_{it}$) that have been found to be important (Molyneux and Thornton, 1992; Athanasogloua, et al., 2008; Berger and Bouwman, 2009; Goddard, et al., 2013; Tran et al., 2016) in the link between risk culture and performance. First, we use bank size, measured by the natural logarithm of the total assets (lnTA). Larger banks benefit from economies advantages and could be more profitable than smaller ones. Nevertheless, larger banks could penalize the performance due to the associated higher complexity and bureaucracy to be managed (Athanasogloua, et al., 2008). Second, we refer to the business model of the banks, proxied by the total loans on total assets (TL\TA) ratio. Loans are typically less liquid and riskier than other assets and therefore, due to the higher credit risk exposure, we may expect a lower performance. However, a higher specialization in lending may reduce intermediation costs and improve performance (Goddard, 2013). Third, capitalization is measured as equity on the total asset (E\TA). High-capitalized banks could have better access to financing sources with lower cost and risk, and better access to higher quality asset markets (Tran et al., 2016). Nonetheless, Goddard et al. (2013) find that well-capitalized banks appear to have lower profitability in eight European Union member countries from 1992 to 2007. Forth, also the bank's propensity to liquidity, approximated by the ratio of detained liquid assets (LIQA\TA), could have a mixed effect on performance. We could have a positive effect due to higher net surpluses that can be shared among stakeholders (Berger and Bouwman, 2009). However, Molyneux and Thornton (1992) and Goddard et al.

[13] As explained in Table 1, the gross income is the bank's income before taxation and the RWA is the weight of each asset based on the risk of loss of its value, according to regulation. Higher bank income due to higher risk-taking would increase the ROA but not change the GI\RWA.

(2013) find a negative effect across European countries for the periods of 1986–1989 and the mid-1990s, respectively. Fifth, loan loss provision on the gross loans (LP\L) could be considered both i) a measure of the prudency in accounting policies and, therefore, it could have a positive effect on performance; and ii) a proxy of the exposure to credit risk that could be associated with a lower performance (Athanasogloua, et al., 2008). Finally, the bank's efficiency, measured using the cost-to-income-ratio (CO\INC), is expected to have a positive effect on performance (Goddard, 2013).

We also controlled for the annual GDP growth rate ($GDP_{j,(t-2,t-1)}$), whose effect on performance is expected to be positive. To manage the omitted variable problem, such as risk management ability discussed by Ellul and Yerramilli, 2013, and control for the role of financial crisis, we included both the year-fixed effect (α_t) and the bank-fixed effect (α_i). The idea is that a strong risk culture shows its effects not only during crises but also in periods characterized by higher bank stability. On the one hand, a risk culture could emphasize excessive risk-taking for short-term profits at the expense of longer-term firm performance and sustainable shareholder value during non-crisis periods. On the other hand, influencing the decisions of management during day-to-day activities, risk culture could be an important factor for maintaining and the recovery of adequate levels of bank performance also during crisis periods. To handle the reverse causality problem, all independent variables were lagged by one period. All the variables are described in Table 1.

Table 4 reports our results for equation (6) using SRCI (columns 1 and 2) and each of the four FSB attributes (columns 3 to 6). The effect of the SRCI is positive and highly statistically significant, with a substantial economic magnitude; an increase of one SRCI standard deviation (1.050) increased the GI\RWA by 119% of the mean (0.005). The results are strongly consistent when the model is applied both with and without control variables. We obtained very similar

results when the analysis was repeated with each of the four attributes (TFTI, ACCI, COMI, and INCI), confirming previous results.

We repeated the analysis using the other performance measures, ROA, ROE, and ROA/VOL (Table 5). Consistent with previous results, we found that the coefficient estimates for the SRCI are positive and highly statistically significant, with high economic meaning; an increase of 10% in the SRCI results in an increase of 0.2 percentage points in the following year for the ROA, 0.24 percentage points for the ROE, and of 1.32 percentage points for the ROA/VOL.

These results are novel and suggest the validity of the framework elaborated by the Financial Stability Board. We showed that a sound risk culture (that bolsters effective risk management, promotes sound risk-taking, and ensures that emerging risks or risk-taking activities beyond the institution's risk appetite are recognized, assessed, escalated, and addressed in a timely manner) is a positive element in a bank's performance rather than merely a cost. Considering the dimensions of a sound risk culture, there is evidence that it has a positive effect on performance on an individual basis. This means that a bank that desires to enhance performance should pay attention to its risk culture at an overall level and at the levels of its attributes.

## 5. Managing Endogeneity

In the previous section, we included both the year-fixed effect ($\alpha_t$) and the bank-fixed effect ($\alpha_i$) to manage the omitted variable problem and lagged all independent variables by one period to manage the reverse causality problem.

To allow for a more robust analysis, we applied a 2SLS IV model (Wooldridge, 2010). IV models allow for estimating the exogenous impact of SRCI on the dependent variables, solving the problem of endogenous preferences. Our instrument is the immigration rate, measured by

annual variation in the foreign-born population's in the country (IMMIGR). New foreign-born population influences tradition and beliefs at the national level (Ditlmann et al., 2011), changing perceptions of risk and uncertainty. This effect is strengthened by people's tendency to overestimate the immigration phenomenon in terms of its dimension and impact (Alba et al., 2005; Sides and Citrin, 2007). Furthermore, immigration changes the size and skills of the labor force (Pandey and Chaudhuri, 2017). These elements modify culture at the country level and indirectly affect bank employees and management, who face the challenge of re-assessing common culture inside the firm after each cultural shock.

The only variable that could influence a bank's performance and risk and the foreign-born population at the same time is economic growth in the country (higher growth in a country could positively influence banks' performances and attract more immigrants). Thus, in the analysis, we added firm-fixed effects to the regressions, which control for underlying trends and the GDP growth rate. The literature associates immigration with increases in rents and house prices (Mussa et al., 2017) and with a decrease in direct investment in the short term (Tomohara, 2017). The performance of banks specialized in sectors affected by these variables could be directly influenced by the immigration rate. Therefore, we controlled for bank-specific characteristics such as efficiency and dimension.

We modified the model in equation (6) as follows:

$$(7) \quad GI/RWA_{it} = \alpha_t + \alpha_i + \gamma_1 \widetilde{SRCI}_{i(t-1)} + \sum \gamma_i m_{i(t-1)} + \delta_1 GDPgr_{j(i)(t-1)} + \epsilon_{it}$$

$$(8) \quad \widetilde{SRCI}_{i(t-1)} = \omega_t + \omega_i + \partial_1 IMMIGR_{j(i)(t-1)} + \sum \partial_i m_{i(t-1)} + \varphi_1 GDPgr_{j(i)(t-1)} + \epsilon_{it}$$

where $IMMIGR_{j(i)t}$ is the immigration rate of bank-*i*'s home country in year *t.* Equations (7) and (8) are the first and second stages, respectively. The $\widetilde{SRCI}_{it}$ in Equation (8) is the predicted value of the SRCI in Equation (7). Column (2) of Table 6 shows the first stage. The immigration rate has a small, highly significant negative effect on sound risk culture. Column (1) reports the second stage; the results confirm the positive effect of the SRCI on banking performance. The F-stat refers to Kleibergen–Paap statistics for weak instruments test (Kleibergen and Paap, 2006). According to the thresholds of Hausman et al. (2005), all test values are above the 10% critical value. The total number of observations decreased to 371 because IMMIGR was not available for all countries in the sample[14].

## 6. Abnormal Risk Culture Changes

One challenge in the disclosure analysis is that firms could stress the importance of values that are not followed in practice (Guiso et al., 2015; Beyer and Guttman, 2012). We detected such behavior by exploiting the characteristic of culture to vary gradually over time. We expected that attention to SRC did not vary yearly; high variation could be a signal of disclosure manipulation.

Thus, we define:

$$SRCDvar_{it} = \frac{SRCD_{it}}{SRCD_{it-1}} \quad (9)$$

$$SRCIvar_{it}^{Q4} = \begin{cases} 1 & if\ SRCDvar_{it} \in Q_4 \\ 0 & Otherwise \end{cases} \quad (10)$$

where $SRCDvar$ is the ratio of bank-*i*'s $SRCD_{it}$ to its value in the previous year. $SRCIvar_{it}^{Q4}$ is the sound risk culture variation dummy that has a value of 1 if bank-*i*'s *SRCDvar* at time *t* is in the

[14] IMMGR data were lacking for Cyprus, Lichtenstein, Luxemburg and Malta.

4th-quartile ($Q_4$) of the overall *SRCDvar* distribution. Then, we evaluated equation (6) substituting SRCI with $SRCIvar_{it}^{Q4}$ to evaluate the effect of a high SRC attention increase[15] on the GI\RWA.

The estimation results are shown in Column (1) of Table 7. The effect is slightly negative and significant at 10%, indicating that increases in the SRCD do not have an effect or even negatively affect a bank's performance, corrected for risk-taking. There were 526 observations because we used observations from 2004 to build the variation index.

Column (2) of Table 7 reports the results of the model estimation in equation (6) on the sub-sample of observations with *SRCIvar* in Q4 at *t-1* (firms with an $SRCIvar_{i(t-1)}^{Q4}$ equal to 1). The SRCI was not significant and almost zero, confirming that in cases of abnormal SRC attention increase, a higher SRCI is associated with no change in bank performance.

Finally, we also run model equation (6) by excluding all observations with high SRCD variation (we included only banks with a $SRCIvar_{i(t-1)}^{Q4}$ of 0). The results are shown in column (3). The SRCI is still significant at 1% even if the absolute value is lower. Column (4) reports the results of the IV model, excluding high SRCD variations. As in the previous analysis reported in in Table 6, SRCI is significant at 1%. Since the analysis in Column (1) of Table 7 underlines a slightly significant negative effect of $SRCDvar^{Q4}_{t-1}$, analyses in Columns (3) and (4) check if this result is driven by abnormal variation of the indicator; in both cases SRCI is still significant.

## 7. Robustness Checks

Table 8 provides the results of different robustness tests we conducted. Column (1) reports the regression coefficients of the model in equation (6) estimated on the entire sample using *SRCI2*.

[15] Even if the statistics are not reported, the SRCDvar in $Q_4$ are all greater than one. Therefore, high variations coincide with increases in the SRCD.

Because we used a two-year rolling window, we considered two years as pre-crisis (2006 and 2007). Results show a positive effect of risk culture on performance during this non-crisis period. In column (2) of Table 8, we used a modified version of the SRCI that is focused on banks' risk approaches (SRCIR). The latter was obtained by repeating the text analysis using only vectors of words in the SRC framework (reported in the on-line Appendix) that include the word "risk." The original SRCI includes various bank items that are not-related to the risk attitude (as items related to the treatment of employees), and the SRCIR allows for focusing on banks' attention to issues linked to risk. The positive effect of risk culture on performance is still confirmed. Column (3) shows the same estimation of the second column in Table 4 on years after the crisis (2009 to 2017). The latter analysis tested if the results are consistent when excluding the effect of the crisis or when considering a longer period. In all the three estimations above, the coefficients were significant and confirmed our results. In other words, the positive effect of risk culture on performance is showed not only during the non-crisis period but also during the crisis period. We also check whether our risk culture measures also capture the quality of disclosure of each institution[16]; specifically, we include the Smog (Simple Measure of Gobbledygook Grade) in the model in column (4) as a control variable. Smog is a commonly used readability measure introduced by Mc Laughlin (1969); this is calculated for each bank through the content analysis of banks' annual and Pillar 3 reports in English, made possible by the use of the Python's Textstat package, as follows:

$$(12) \quad Smog = 1.0430 * \sqrt{number\ of\ polysyllables * \frac{30}{number\ of\ sentences}} + 3.1291$$

[16] We would like to thank one of the referees for suggesting us to control whether our risk culture measures may also capture the quality of disclosure of each institution.

The results do not seem to corroborate the possibility that our measure of risk culture is affected by the quality of disclosure.

Finally, Column (5) adds the interaction term year country among regressors, which allows to control for different aspects linked to country characteristics such as legal origin and institutional differences. Our results show that the role of risk culture is confirmed also controlling for these different aspects.

## 7. Conclusion

Regulators, supervisors, and practitioners identified weak risk governance and culture as a reason for financial crisis; a debate among regulators and practitioners (Parliamentary Commission on Banking Standards, 2013; Institute of International Finance, 2009) began in 2008 concerning how to enhance sound risk culture in banking. The benefits of a sound risk culture are related to more efficient risk management and conscious risk-taking, but the development of a such culture implies high costs. There is no empirical evidence based on a large sample that establishes the relationship between bank risk culture and performance.

The main challenge for scholars investigating risk culture is the development of a reliable measure capturing risk, a "soft" variable. The FSB (2014) provides a framework to identify attributes that are best practices in the sector, which are at the basis of a sound risk culture. Following FSB's framework, we developed the SRCI to apply QTA to banks' disclosures. We selected different vectors of words that captured the SRC attributes, identified each company's publicly available documents in which we believe the risk culture was mirrored, and defined our formula to quantify the SRCI.

Our results show that bank performance improves as bank risk culture increases. As the SRCI increases, banks record an increase in their performance indicators, specifically GI/RWA, ROA, ROE, and ROA/VOL, in the following year. These results suggest that developing an SRC is convenient from an organizational perspective as well as an economic one. The benefits of more effective risk-taking and risk management are greater than the expenses in enhancing the risk culture.

Examining banks with abnormal SRCs, we observe that an abnormal increase in the SRCI decreases a bank's performance. This could be explained by the fact that banks manipulate disclosure in an attempt to promote SRC with external claims that are not associated with actual changes in the firm's shared beliefs. Robustness tests confirmed the results even when we used an IV model with IMMIGR as an instrument, when we performed the regression on the post-crisis period only or used different indicators of SRC, and when we included in the regression an indicator of quality of disclosure of each institution.

Thus, the FSB's framework captures important dimensions of a sound risk culture; RC development allows for banks to increase their profits. Our hypothesis is that as the literature suggests, this effect is driven by more efficient risk-taking by banks. However, SRC attention can become merely an exercise; banks may claim cultural improvements that are not supported by actual internal efforts. Risk culture evaluation must consider this issue using proper tools.

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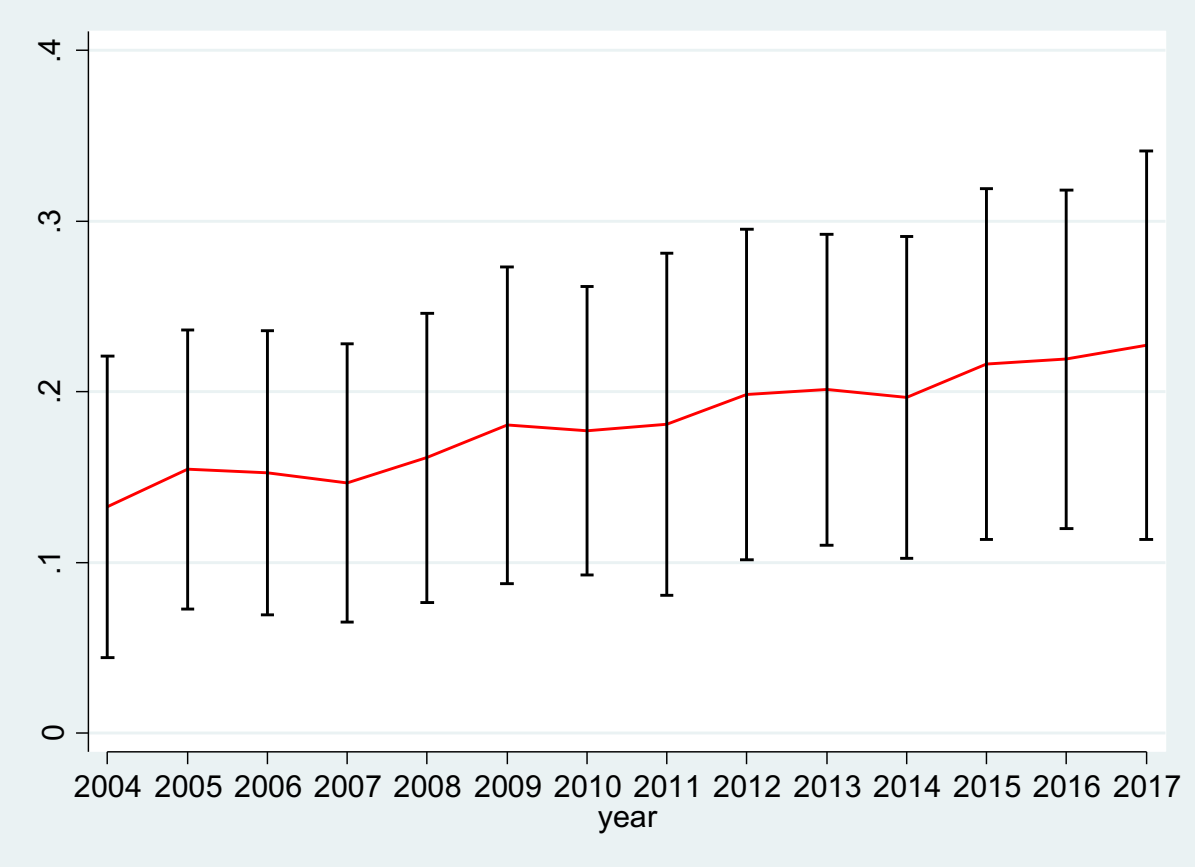
## Figure 1: Average Risk Culture Tone Density per Year

The average sound risk culture density (SRCD) per year (red line) and its standard deviation (black lines). The SRCD is the sum of four attributes of densities: Tone from the top attention density (TFTD), Accountability attention density (ACCD), Communication attention density (COMD), and Incentive attention density (INCD). The densities are the ratios between the number of the attribute's phrases in the bank's disclosure to the total number of phrases. The SRCD generally increased each year, with exceptions in 2006, 2007, 2010, and 2014. Attention to SRC is growing in the sector. The standard deviation within each year is high, meaning that the level of attention varies across banks.



## Figure 2: Average Sound Risk Culture Indicator per Year

The mean and standard deviation of the sound risk culture indicator (SRCI) per year. The SRCI is the ratio between the sound risk culture density (SRCD) and its standard deviation, using a three-year rolling window. The indicator shows fluctuations on all the periods. The standard deviation is high, meaning that banks have different culture levels within the same year.

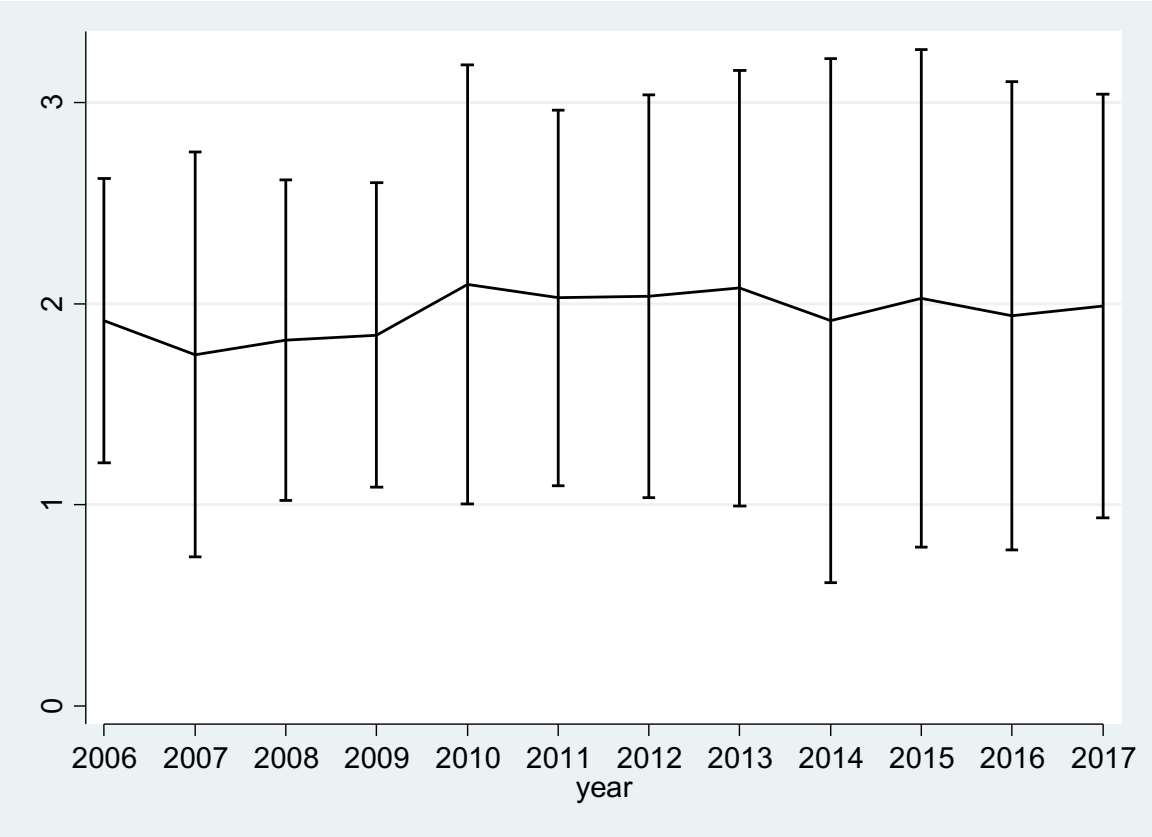
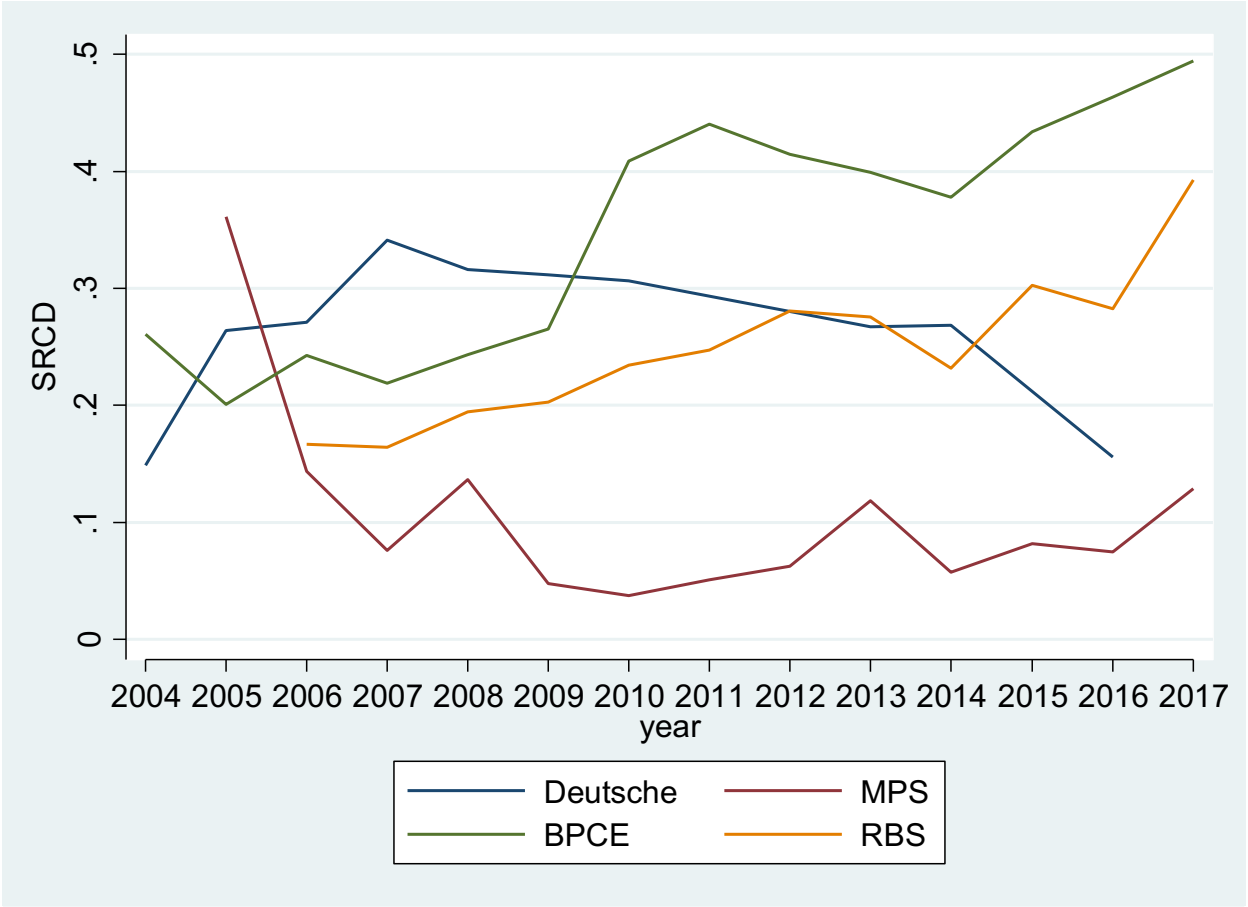


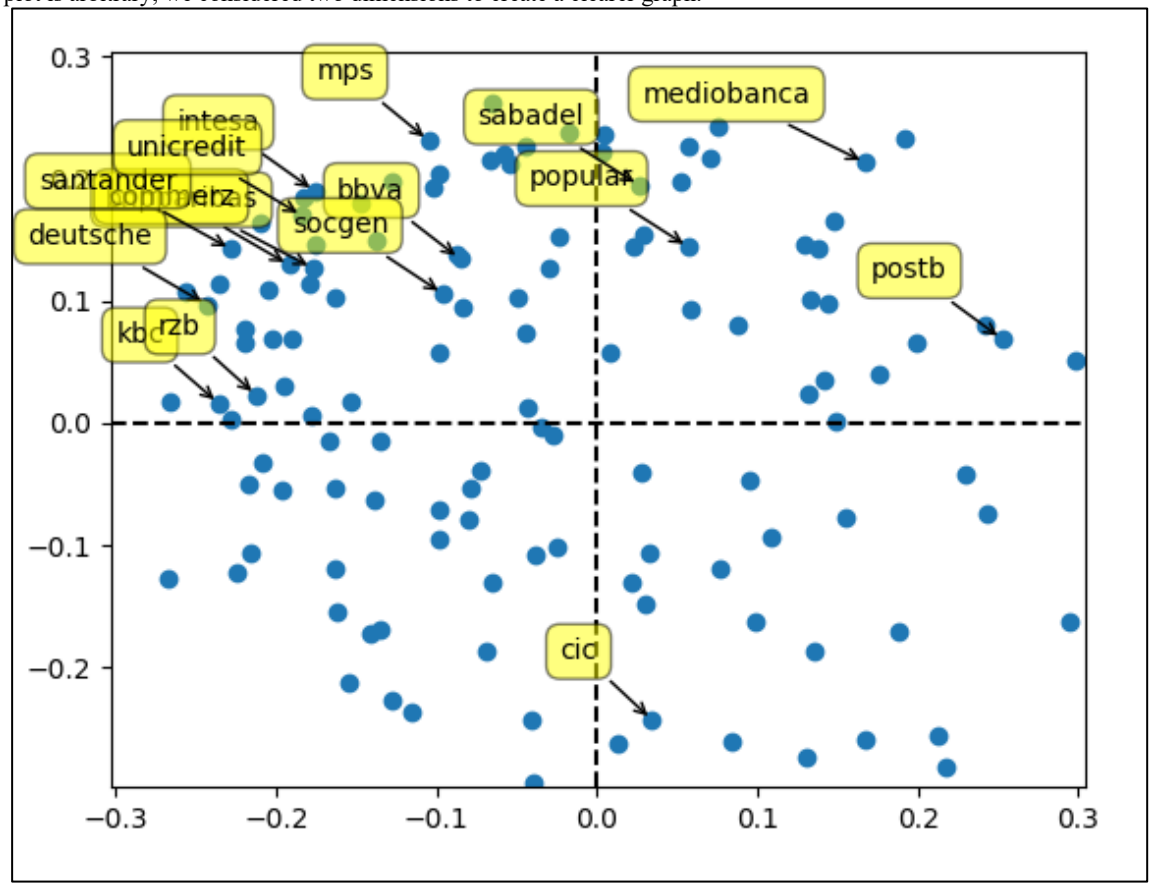
**Figure 3: Sound Risk Culture Density Indicators of Deutsche Bank, BPCE, Monte Paschi di Siena, and Royal Bank of Scotland**

Sound risk culture density indicator (SRCD) defined by equation (5) of four important European banks, Banque Populaire and Caisse d'Epargne (BPCE), Deutsche Bank AG, Banca Monte dei Paschi di Siena SpA, and Royal Bank of Scotland Group PLC. RBS and MPS show low levels of SRCD. Deutsche has higher values at the beginning of the period, but there is a decrease in the years of the LIBOR scandal.



## Figure 4: Multi-Dimensional Scaling of a Bank's Risk Dictionary

Multi-Dimensional Scaling scatter plot of a Bank's Risk Dictionary. The words included in the RD are those that appear in at least 5% of the sample from 2004 to 2017. A risk sentence is a sentence containing the word "risk" at least once. The distance $d_{i,j}$ between vector $v^i$and vector $v^j$is computed as $d_{i,j} = \cos(\theta_{i,j}) = \frac{v^{i,2} \cdot v^{j,2}}{\|v^{i,2}\| \cdot \|v^{j,2}\|}$, where $d_{i,j}$ is the *i-th*, *j-th* element of the distance matrix $D \in R^{B \times B}$. The vectors $v^1, \dots, v^b, \dots, v^B \in R^N$, where $B$ is the total number of banks, are such that the element $v_w^b$ of the vector $v^b$ is $v_w^{b,2} = \frac{n_{w,b}}{Nr_b} n_{w,b}$ is the number of *SS* in the documents of bank $b$ in which the word $w$ appears, $Nr_b$ is the total number of bank's *SS* and $v_w^b$ corrects for the amount of information disclosed by the bank. This is a graphic representation of the differences in banks' vocabularies; the higher the distance between two points, the higher the dissimilarity of the RD. The figure is just a portion of the complete graph in which some banks are underlined (Santander, Commerzbank, Deutsche, Raiffeisen Banking Group, KBC group, BNParibas, Mediobanca, Intesa Sanpaolo, Unicredit, Monte Paschi di Siena, Societe Generale, BBVA); although they have similar business models and dimensions, the data points are not close. The graph shows that there is no cluster of culture, as points did not collect in groups. The number of dimensions in the plot is arbitrary; we considered two dimensions to create a clearer graph.



## Table 1: Variable Sources and Descriptions

Variables used in the empirical analysis. Data were obtained from the following sources: (+) content analysis on banks' annual and Pillar 3 reports in English using original script in python; (*) calculation on content analysis results; (0) BankScope/BankFocus Databases, author calculation; (1*) World Bank national accounts data and OECD National Accounts data files; (2*) OECD International Migration Statistics: International migration database; (3*) DataStream (Thomson Reuters).

| Acronym | Variable | Description |
|---|---|---|
| TFTD | Tone from the top attention density | Total number of sentences containing word vectors associated with tone from the top over the bank's total phrases in the disclosure[+] |
| ACCD | Accountability attention density | Total number of sentences containing word vectors associated with accountability over the bank's total phrases in the disclosure[+] |
| COMD | Communication attention density | Total number of sentences containing word vectors associated with communication over the bank's total phrases in the disclosure[+] |
| INCD | Incentive attention density | Total number of sentences containing word vectors associated with incentives over the bank's total phrases in the disclosure[+] |
| SRCD | Sound risk culture tone density | Sum of tone from the top, accountability, communication and incentive tone densities* |
| SRCI | Sound risk culture indicator | Logarithm of sound risk culture tone density over its standard deviation in the last three years* |
| SRCI2 | Sound risk culture indicator with two-year rolling window | Logarithm of sound risk culture tone density over its standard deviation in the last two years* |
| SRCIR | Sound risk culture indicator restricted to risk vocabulary | Same as the SRCI but we computed density without using all the vectors of words in the framework (reported in the on-line Appendix I), just vectors of words containing the word "risk". * |
| TFTI | Tone from the top indicator | Logarithm of tone from the top tone density over its standard deviation in the last three years* |
| ACCI | Accountability indicator | Logarithm of accountability tone density over its standard deviation in the last three years* |
| COMI | Communication indicator | Logarithm of communication tone density over its standard deviation in the last three years* |
| INCI | Incentives indicator | Logarithm of incentives tone density over its standard deviation in the last three years* |
| SRCDvar | Sound risk culture density variation | Sound risk culture tone density in a year over the previous year's value* |
| SRCDvar$^{Q4}$ | Sound risk culture density variation dummy | Dummy with value one if the sound risk culture phrases' density variation in the year is in the fourth quartile of the sound risk culture's density variation distribution in the overall period* |
| sdSRCD3 | Sound risk culture tone density standard deviation | Standard deviation of sound risk culture phrase density in the previous three years* |
| sdSRCD2 | Sound risk culture tone density standard deviation with two-year rolling window | Standard deviation of sound risk culture phrase density in the previous two years* |
| GI\RWA | Gross income on risk-weighted assets | Income before taxes on risk-weighted assets[0] |
| ROA | Return on Assets | Gross income on total assets[0] |
| ROE | Return on equity | Gross income on equity[0] |
| lnTA | Natural logarithm of total assets | |
| TL\TA | Total loans on total assets | Gross loans (net loans plus reserves for impaired & NPLs) on total assets[0] |
| E\TA | Equity in total assets | |
| LIQA\TA | Liquid assets to total assets | Trading assets plus loans and advances with maturity less than 3 months over total assets[0] |
| LP\L | Loan provision on loans | Loan loss provision over gross loans[0] |
| CO\INC | Cost-to-income ratio | Overheads on net interest income plus other operating incomes[0] |
| ROA\VOL | ROA On Implied Volatility | Natural logarithm of the ratio between ROA and the implied volatility of stock prices[3*]. |
| crisis | | Dummy variable with a value of one from 2008 to 2017[0] |
| gdpgr | GDP growth rate | Annual percentage growth rate of the GDP at market prices based on constant local currency[1*] |
| IMMIGR | Immigrated population | Stock of foreign-born population (in millions) in the country[2*] |

| | | |
|---|---|---|
| Smog | Smog grade | Simple Measure of Gobbledygook) grade, a commonly used readability measure introduced by Mc Laughlin (1969) [+] |

## Table 2: Descriptive Statistics

The number of observations, mean, standard deviation, median, maximum, and minimum of the main analysis variables. All variables were winsorized at 1% and are described in Table 1. The total assets are expressed in EUR trillions. The sample includes the main banks' holdings in the Euro zone and U.K., active from 2004 to 2017, with total assets greater than EUR 1 billion and with at least one annual report in English. The banks' names were obtained from DataStream and the register of Significant Supervised Entities published by the BCE. The analysis focuses on large banks because they showed problems in guaranteeing a common risk culture throughout the organization. Balance sheet data were taken from BankScope/BankFocus databases. Data on the foreign-born population were obtained from the OECD database. We performed text analysis on data from documents with more than 50,000 words. After all adjustments, the sample included 92 banks, including the main European banks. Banks accounted for about 35% of the total assets of the countries' banking systems in 2017.

| | n | mean | SD | med | max | min |
|---|---|---|---|---|---|---|
| SRCD | 542 | 0.189 | 0.099 | 0.176 | 0.494 | 0.015 |
| TFTD | 542 | 0.071 | 0.043 | 0.064 | 0.224 | 0.004 |
| ACCD | 542 | 0.069 | 0.037 | 0.065 | 0.271 | 0.006 |
| COMD | 542 | 0.030 | 0.021 | 0.025 | 0.169 | 0.001 |
| INCD | 542 | 0.019 | 0.011 | 0.017 | 0.065 | 0.001 |
| SRCI | 542 | 1.946 | 1.050 | 1.945 | 6.128 | −1.810 |
| TFTI | 542 | 1.844 | 1.046 | 1.883 | 5.982 | −3.209 |
| ACCI | 542 | 1.957 | 1.081 | 1.982 | 7.408 | −2.222 |
| COMI | 542 | 1.796 | 1.105 | 1.742 | 5.484 | −1.444 |
| INCI | 542 | 1.921 | 1.049 | 1.875 | 6.419 | −3.043 |
| ROE | 542 | 0.030 | 0.225 | 0.073 | 0.509 | −1.283 |
| ROA | 542 | 0.002 | 0.016 | 0.004 | 0.039 | −0.152 |
| GI\RWA | 542 | 0.005 | 0.029 | 0.009 | 0.127 | −0.229 |
| ROA\VOL | 270 | −9.571 | 2.365 | −9.290 | −1.199 | −16.056 |
| TA(tril) | 542 | 0.405 | 0.572 | 0.119 | 2.103 | 0.001 |
| TL\TA | 542 | 0.572 | 0.182 | 0.603 | 0.915 | 0.090 |
| E\TA | 542 | 0.063 | 0.026 | 0.063 | 0.158 | 0.009 |
| LIQA\TA | 542 | 0.184 | 0.118 | 0.163 | 0.759 | 0.029 |
| LP\L | 542 | 0.011 | 0.012 | 0.007 | 0.075 | 0.000 |
| CO\INC | 542 | 0.636 | 0.231 | 0.629 | 1.601 | −0.764 |
| gdpgr | 542 | 0.579 | 3.065 | 1.145 | 25.117 | −14.274 |
| Smog | 530 | 16.723 | 2.133 | 16.500 | 40.100 | 11.500 |

**Table 3: Correlation among SRCI and SRC attributes**

We report in this table the correlation matrices. In panel A, we focus on the sound risk culture indicator (SRCI) and its attributes: Tone from the top indicator (TFTI), Accountability indicator (ACCI), Communication indicator (COMI), and Incentives indicator (INCI). In panel B, we report the correlation matrix among performance, SRCI and dependent, independent, and control variables. All variables were winsorized at 1% and are described in Table 1.

*Panel A − Sound Risk Culture Indicator and its components*

| | SRCI | TFTI | ACCI | COMI | INCI |
|---|---|---|---|---|---|
| SRCI | 1.00 | 0.92 | 0.89 | 0.78 | 0.75 |
| TFTI | 0.92 | 1.00 | 0.80 | 0.75 | 0.72 |
| ACCI | 0.89 | 0.80 | 1.00 | 0.67 | 0.71 |
| COMI | 0.78 | 0.75 | 0.67 | 1.00 | 0.59 |
| INCI | 0.75 | 0.72 | 0.71 | 0.59 | 1.00 |

*Panel B – All variables*

| | SRCI | ROE | ROA | GI\RWA | ROA\VOL | TA(tril) | TL\TA | E\TA | LIQA\TA | LP\L | CO\INC | gdpgr | Smog |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SRCI | 1.00 | 0.01 | −0.03 | 0.06 | −0.00 | 0.12 | −0.07 | −0.13 | 0.16 | −0.04 | 0.14 | 0.10 | −0.18 |
| ROE | 0.01 | 1.00 | 0.87 | 0.85 | 0.20 | −0.30 | −0.15 | 0.05 | −0.02 | −0.22 | −0.38 | 0.07 | −0.03 |
| ROA | −0.03 | 0.87 | 1.00 | 0.72 | 0.12 | −0.40 | −0.02 | 0.45 | −0.09 | −0.07 | −0.39 | 0.08 | −0.01 |
| GI\RWA | 0.06 | 0.85 | 0.72 | 1.00 | 0.25 | −0.20 | −0.26 | 0.02 | 0.02 | −0.28 | −0.35 | 0.13 | 0.03 |
| ROA\VOL | −0.00 | 0.20 | 0.12 | 0.25 | 1.00 | −0.24 | 0.21 | −0.02 | −0.28 | −0.22 | −0.10 | 0.20 | 0.04 |
| TA(tril) | 0.12 | −0.30 | −0.40 | −0.20 | −0.24 | 1.00 | −0.50 | −0.40 | 0.53 | 0.11 | −0.05 | 0.04 | −0.02 |
| TL\TA | −0.07 | −0.15 | −0.02 | −0.26 | 0.21 | −0.50 | 1.00 | 0.35 | −0.76 | 0.12 | −0.02 | −0.11 | 0.05 |
| E\TA | −0.13 | 0.05 | 0.45 | 0.02 | −0.02 | −0.40 | 0.35 | 1.00 | −0.28 | 0.27 | −0.20 | −0.01 | 0.00 |
| LIQA\TA | 0.16 | −0.02 | −0.09 | 0.02 | −0.28 | 0.53 | −0.76 | −0.28 | 1.00 | −0.01 | 0.05 | 0.14 | −0.12 |
| LP\L | −0.04 | −0.22 | −0.07 | −0.28 | −0.22 | 0.11 | 0.12 | 0.27 | −0.01 | 1.00 | −0.35 | −0.39 | 0.01 |
| CO\INC | 0.14 | −0.38 | −0.39 | −0.35 | −0.10 | −0.05 | −0.02 | −0.20 | 0.05 | −0.35 | 1.00 | 0.06 | 0.00 |
| gdpgr | 0.10 | 0.07 | 0.08 | 0.13 | 0.20 | 0.04 | −0.11 | −0.01 | 0.14 | −0.39 | 0.06 | 1.00 | 0.01 |
| Smog | −0.18 | −0.03 | −0.01 | 0.03 | 0.04 | −0.02 | 0.05 | 0.00 | −0.12 | 0.01 | 0.00 | 0.01 | 1.00 |

## Table 4: Sound Risk Culture Indicators' Effects on Risk-adjusted Performance Measures

The estimation results of equation (6) using the ratio between gross income and risk-weighted assets as the dependent variable ($y = GI\backslash RWA$). Columns (1) and (2) report our estimates using SRCI. Columns (3) to (6) report our estimates using each of the four attributes of the SRCI: Tone from the top indicator (TFTI), Accountability indicator (ACCI), Communication indicator (COMI), and Incentives indicator (INCI). We controlled for bank size (*lnTA*), business model ($TL\backslash TA$), capitalization ($E\backslash TA$), bank liquidity (LIQA\TA), loan loss provision on gross loans ($LP\backslash L$), and cost-to-income-ratio ($CO\backslash INC$). All independent variables are lagged by one year to manage a reverse causality problem. The number of observations decreased to 469 because we lost two years of data (2004 and 2005) due the rolling window applied to compute the SRCI. We considered only two years pre-crisis (2007 and 2006) and repeated the estimation in Section 6 using an SRCI built using a two-year rolling window to allow for inclusion of three years pre-crisis. We clustered the standard errors at the firm level. The standard deviations are shown in brackets, and stars correspond to the following p-value levels: * p < 0.1; ** p < 0.05; *** p < 0.01

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| $SRCI_{t-1}$ | 0.004*** | 0.004*** | | | | |
| | [0.001] | [0.001] | | | | |
| $TFTI_{t-1}$ | | | 0.004*** | | | |
| | | | [0.001] | | | |
| $ACCI_{t-1}$ | | | | 0.003*** | | |
| | | | | [0.001] | | |
| $COMI_{t-1}$ | | | | | 0.004*** | |
| | | | | | [0.002] | |
| $INCI_{t-1}$ | | | | | | 0.003** |
| | | | | | | [0.001] |
| $lnTA_{t-1}$ | | −0.015*** | −0.015*** | −0.013*** | −0.016*** | −0.014*** |
| | | [0.005] | [0.005] | [0.005] | [0.005] | [0.005] |
| $TL\backslash TA_{t-1}$ | | −0.058** | −0.061** | −0.056** | −0.055* | −0.051* |
| | | [0.028] | [0.028] | [0.028] | [0.028] | [0.028] |
| $E\backslash TA_{t-1}$ | | 0.274* | 0.285** | 0.263* | 0.269* | 0.256* |
| | | [0.140] | [0.137] | [0.140] | [0.141] | [0.140] |
| $LIQA\backslash TA_{t-1}$ | | −0.031 | −0.029 | −0.029 | −0.028 | −0.027 |
| | | [0.019] | [0.019] | [0.020] | [0.018] | [0.020] |
| $LP\backslash L_{t-1}$ | | −0.265 | −0.264 | −0.276 | −0.246 | −0.286 |
| | | [0.237] | [0.237] | [0.235] | [0.243] | [0.236] |
| $CO\backslash INC_{t-1}$ | | −0.004 | −0.004 | −0.004 | −0.003 | −0.004 |
| | | [0.007] | [0.008] | [0.007] | [0.007] | [0.007] |
| $gdpgr_{t-1}$ | | 0.002* | 0.002* | 0.002* | 0.002* | 0.002* |
| | | [0.001] | [0.001] | [0.001] | [0.001] | [0.001] |
| *N* | 469 | 469 | 469 | 469 | 469 | 469 |
| $R^2$ | 0.12 | 0.21 | 0.21 | 0.20 | 0.21 | 0.19 |
| $R^2adj$ | 0.10 | 0.17 | 0.18 | 0.17 | 0.18 | 0.16 |
| FE year | YES | YES | YES | YES | YES | YES |
| FE bank | YES | YES | YES | YES | YES | YES |

## Table 5: Sound Risk Culture's Effect on Performance Measures

Estimates of the SRCI's effect on different performance measures. Estimation results of equation (6) using the Return on Assets (*ROA*) and Return on Equity (*ROE*) as dependent variables (columns 1 and 2, respectively). In all models, we controlled for bank size (*lnTA*), business model (*TL\TA*), capitalization (*E\TA*), bank liquidity (LIQA\TA), loan loss provision on gross loans (*LP\L*), cost-to-income-ratio (*CO\INC*), and business cycle. All independent variables are lagged by one year to manage a reverse causality problem. The number of observations decreased to 469 because we lost two years (2004 and 2005) due to the rolling window applied to compute the SRCI. We consider only two years pre-crisis (2006 and 2007) and repeat the estimation in Section 6 using an SRCI built using a two-year rolling window to allow for inclusion of three years pre-crisis. The last column (3) uses the ratio between ROA and the implied volatility as dependent variables; in this last column, the number of observations drops to 256 because implied volatility was not available for all banks. We clustered the standard errors at the firm level. The standard deviations are shown in brackets, and stars correspond to the following p-value levels: * p < 0.1; ** p < 0.05; *** p < 0.01

| | $y=ROA_t$ | $y=ROE_t$ | y=ROA\VOL |
|---|---|---|---|
| | (1) | (2) | (3) |
| $SRCI_{t-1}$ | 0.002*** | 0.024*** | 0.132* |
| | [0.000] | [0.007] | [0.071] |
| $lnTA_{t-1}$ | −0.007*** | −0.207*** | −2.120*** |
| | [0.003] | [0.069] | [0.575] |
| $TL\backslash TA_{t-1}$ | −0.017 | −0.068 | 1.126 |
| | [0.021] | [0.352] | [1.525] |
| $E\backslash TA_{t-1}$ | 0.132 | 0.152 | 5.731 |
| | [0.082] | [1.444] | [12.799] |
| $LIQA\backslash TA_{t-1}$ | −0.018* | −0.072 | 0.225 |
| | [0.011] | [0.190] | [1.827] |
| $LP\backslash L_{t-1}$ | −0.177 | −2.830* | 29.583 |
| | [0.154] | [1.445] | [21.146] |
| $CO\backslash INC_{t-1}$ | −0.004 | 0.058 | 0.472 |
| | [0.004] | [0.082] | [0.608] |
| $gdpgr_{t-1}$ | 0.001* | 0.005 | −0.039 |
| | [0.001] | [0.008] | [0.105] |
| *N* | 469 | 469 | 256 |
| $R^2$ | 0.19 | 0.14 | 0.35 |
| $R^2adj$ | 0.16 | 0.11 | 0.31 |
| FE year | YES | YES | YES |
| FE bank | YES | YES | YES |

## Table 6: Sound Risk Culture Indicators' Effects on Risk-adjusted Performance Measures: 2SLS Instrumental Variable Approach

2SLS IV model estimation results. The model is described by equations (7) and (8). Column (1) reports the second stage results. We controlled for bank size (lnTA), business model (TL\TA), capitalization (E\TA), bank liquidity (LIQA\TA), loan loss provision on gross loans and bank efficiency (LP\L), and cost-to-income-ratio (CO\INC). Column (2) reports the first stage. IMMIGR is the immigration rate of a bank's home country in year *t*. The F-stat refers to the Kleibergen–Paap statistics for the weak instruments test (Kleibergen and Paap, 2006). Per the thresholds of Hausman et al. (2005), all test values were above the 10% critical value. The total number of observations decreased to 371 because IMMIGR data were not available for all countries in the sample. We clustered the standard errors at the firm level. The standard deviations are shown in brackets, and stars correspond to the following p-value levels: * p < 0.1; ** p < 0.05; *** p < 0.01

| | $GI\backslash RWA_t$ | $SRCI_{t-1}$ |
|---|---|---|
| | (1) | (2) |
| $SRCI_{t-1}$ | 0.007** | |
| | [0.003] | |
| $IMMIGR_{t-1}$ | | −0.870*** |
| | | [0.196] |
| $lnTA_{t-1}$ | −0.019*** | 0.310 |
| | [0.007] | [0.369] |
| $TL\backslash TA_{t-1}$ | −0.114*** | 2.847*** |
| | [0.036] | [1.022] |
| $E\backslash TA_{t-1}$ | 0.438* | −10.331* |
| | [0.240] | [5.815] |
| $LIQA\backslash TA_{t-1}$ | −0.032 | 1.373 |
| | [0.026] | [1.655] |
| $LP\backslash L_{t-1}$ | 0.055 | −21.533*** |
| | [0.174] | [8.155] |
| $CO\backslash INC_{t-1}$ | −0.002 | 0.201 |
| | [0.008] | [0.244] |
| $gdpgr_{t-1}$ | 0.002** | −0.052 |
| | [0.001] | [0.052] |
| *N* | 371 | 371 |
| $R^2$ | 0.23 | |
| rk F-stat | 19.6 | |
| FE year | YES | YES |
| FE bank | YES | YES |

## Table 7: Sound Risk Culture High and Low Variations' Effects on Banks Performance

Results of different models estimated considering the effect of high variation of the SRCD. Column (1) estimates the effect of the $SRCDvar^{Q4}$ (a dummy with a value of 1 if bank-*i*'s SRCDvar at time *t* is in the 4th-quartile (Q4) of the overall SRCDvar distribution). There were 407 observations because we lost observations from 2004 to build the variation index. Column (2) estimates the effect of the SRCI on the sub-sample of observations with SRCIvar in Q4 at *t*-1. Column (3) shows the previous estimation represented in equation (6), excluding all observations with high SRCD variation (we included only banks with an $SRCDvar^{Q4}$ of 0). Column (4) reports the results of the IV model on the same sample as in column (3). The F-stat refers to the Kleibergen–Paap statistics, which are above the 15% critical value. In all models, we controlled for bank size (lnTA), business model (TL\TA), capitalization (E\TA), bank liquidity (LIQA\TA), loan loss provision on gross loans and bank efficiency (LP\L), cost-to-income-ratio (CO\INC), and business cycle. We clustered the standard errors at the firm level. The standard deviations are shown in brackets, and stars correspond to the following p-value levels: * p < 0.1; ** p < 0.05; *** p < 0.01

| | $GI\RWA_t$ | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $SRCDvar^{Q4}_{t-1}$ | −0.005 | | | |
| | [0.003] | | | |
| $SRCI_{t-1}$ | | 0.000 | 0.004*** | 0.007** |
| | | [0.006] | [0.001] | [0.003] |
| $lnTA_{t-1}$ | −0.005 | −0.017 | −0.020** | −0.018** |
| | [0.007] | [0.016] | [0.008] | [0.008] |
| $TL\TA_{t-1}$ | −0.034 | −0.136 | −0.074* | −0.118*** |
| | [0.031] | [0.111] | [0.044] | [0.041] |
| $E\TA_{t-1}$ | 0.197 | 0.901*** | 0.277 | 0.484 |
| | [0.129] | [0.321] | [0.212] | [0.359] |
| $LIQA\TA_{t-1}$ | 0.014 | −0.042 | −0.027 | −0.042 |
| | [0.030] | [0.144] | [0.026] | [0.032] |
| $LP\L_{t-1}$ | −0.313 | −0.079 | −0.344 | 0.308 |
| | [0.203] | [0.726] | [0.224] | [0.367] |
| $CO\INC_{t-1}$ | −0.004 | 0.013** | −0.004 | 0.004 |
| | [0.007] | [0.006] | [0.007] | [0.007] |
| $gdpgr_{t-1}$ | 0.002* | 0.011*** | 0.001 | 0.001 |
| | [0.001] | [0.004] | [0.001] | [0.001] |
| *N* | 526 | 118 | 351 | 276 |
| $R^2$ | 0.20 | 0.59 | 0.24 | 0.25 |
| $R^2adj$ | 0.17 | 0.52 | 0.20 | |
| FE year | YES | YES | YES | YES |
| FE bank | YES | YES | YES | YES |
| rk F-stat | | | | 13.12 |

## Table 8: Robustness Checks

Results of different robustness tests. Column (1) reports the regression coefficients of the model in equation (6), estimated on the entire sample using SRCI2 (SRCI computed using a two-year rolling window). We include three years pre-crisis (2005, 2006, and 2007). In column (2), we used a modified version of the SRCI that is focused on banks' risk approaches (SRCIR). Column (3) repeats the same estimation as in column (2) in Table 4 on the years after the crisis (from 2009 to 2017). Both previous analyses tested if the results are consistent when the effects of the crisis are excluded or when a longer period is considered. The latter was obtained by repeating text analysis using only vectors of words in the SRC framework (reported in the on-line Appendix) that included the word "risk." Column (4) includes among regressors the Smog-index. Column (5) add a country*year fixed effects. We controlled for bank size (lnTA), business model (TL\TA), capitalization (E\TA), bank liquidity (LIQA\TA), loan loss provision on gross loans and bank efficiency (LP\L), cost-to-income-ratio (CO\INC), and business cycle. We clustered the standard errors at the firm level. The standard deviations are shown in brackets, and stars correspond to the following p-value levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

| | $y=GI\backslash RWA_t$ | $y=GI\backslash RWA_t$ | $y=GI\backslash RWA_t$ | $y=GI\backslash RWA_t$ | $y=GI\backslash RWA_t$ |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| $SRCI2_{t-1}$ | 0.002** | | | | |
| | [0.001] | | | | |
| $SRCIR_{t-1}$ | | 0.003*** | | | |
| | | [0.001] | | | |
| $SRCI_{t-1}$ | | | 0.005*** | 0.004*** | 0.002* |
| | | | [0.002] | [0.001] | [0.001] |
| $lnTA_{t-1}$ | −0.007 | −0.014*** | −0.015** | −0.015*** | −0.003 |
| | [0.007] | [0.005] | [0.006] | [0.005] | [0.007] |
| $TL\backslash TA_{t-1}$ | −0.039 | −0.056* | −0.063** | −0.063** | −0.044** |
| | [0.032] | [0.029] | [0.031] | [0.030] | [0.021] |
| $E\backslash TA_{t-1}$ | 0.223 | 0.241* | 0.259 | 0.249* | 0.332** |
| | [0.142] | [0.142] | [0.168] | [0.141] | [0.163] |
| $LIQA\backslash TA_{t-1}$ | 0.023 | −0.037* | −0.053* | −0.034* | −0.054 |
| | [0.030] | [0.020] | [0.028] | [0.020] | [0.038] |
| $LP\backslash L_{t-1}$ | −0.324 | −0.339 | −0.123 | −0.280 | 0.290 |
| | [0.226] | [0.250] | [0.237] | [0.245] | [0.249] |
| $CO\backslash INC_{t-1}$ | −0.004 | −0.005 | −0.003 | −0.005 | 0.002 |
| | [0.008] | [0.008] | [0.008] | [0.008] | [0.004] |
| $gdpgr_{t-1}$ | 0.002 | 0.002* | 0.002* | 0.002* | −0.001 |
| | [0.001] | [0.001] | [0.001] | [0.001] | [0.011] |
| $Smog_{t-1}$ | | | | 0.001 | |
| | | | | [0.000] | |
| *N* | 499 | 459 | 411 | 457 | 469 |
| $R^2$ | 0.20 | 0.21 | 0.17 | 0.21 | 0.19 |
| $R^2adj$ | 0.17 | 0.18 | 0.13 | 0.18 | 0.16 |
| FE year | YES | YES | YES | YES | NO |
| FE bank | YES | YES | YES | YES | YES |
| FE year*country | NO | NO | NO | NO | YES |

# Does Espoused Risk Culture Pay? Evidence from European Banks

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**Abstract**

A poor risk culture was one of the causes of the financial crisis. Surprisingly, there is no evidence of the link between risk culture and bank stability. Using a large sample of European banks from 2004 to 2017, our paper shows that a sound risk culture leads to better performance. Our research design is based on three steps. First, we developed a new Sound Risk Culture Indicator based on the Financial Stability Board (2014) risk culture framework. Second, we estimated this new metric by applying Quantitative Text Analysis. Third, we used an IV 2SLS panel data approach to establish a causal link between bank risk culture and profitability.

**Keywords:** *Risk Culture, Performance, Banking, Text Analysis, Stability*
**JEL codes:** G21; M14

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*"The pressure on the risk department to keep up and approve transactions was immense. Psychology played a big part. The risk department had a separate reporting line to the board to preserve its independence. This had been reinforced by the regulators, who believed it was essential for objective risk analysis and assessment. However, this separation hurt our relationship with the bankers and traders we were supposed to monitor. In their eyes, we were not earning money for the bank."*

*Confession of a risk manager, The Economist 2017.*

## 1. Introduction

Popular press, practitioners, and financial regulators have argued that weak risk governance and culture were shortcomings of the financial system after 2008 (Parliamentary Commission on Banking Standards, 2013; House of Commons Treasury Committee, 2009; Institute of International Finance, 2009). The Financial Stability Board (2014) states that "*Weaknesses in risk culture are often considered a root cause of the global financial crisis, headline risk and compliance events*" (FSB, 2014, p. 1). Similarly, in a letter written to FSB on January 2014, HSBC notes that "*establishing and maintaining a strong link culture is of fundamental importance in ensuring the sustainable success of an organization and to the reestablishment of trust of financial institutions and the banking sector*" (HSBC, 2014, page 1).

There is anecdotal evidence that suggests a lack of risk culture in banking prior to the financial crisis. Jean-Claude Trichet, Chairman and CEO of the Group of Thirty and former president of the European Central Bank, noted that "*Too often, bank bosses' promises to change the 'corporate culture' and ensure their employees' good conduct have not been matched by fully effective implementation*" (Trichet, 2015, page 1). Since the crisis, the largest financial institutions have been levied over $100 billion in fines, suggesting that ethical lapses in banking are not just the outcome of a few bad apples, but a reflection of systematic weaknesses (Thakor, 2016). The lack of risk culture in banking is essential in the trade-off between risk-taking and profits, as explained by the statement of a US risk manager describing the conflict between the risk

management department and business lines before the financial crisis. Not surprisingly, financial regulators have proposed various initiatives to reinforce banks' risk cultures. William C. Dudley, President and Chief Executive Officer of the Federal Reserve of New York, noted that *"In the last year, we have seen emerging approaches to supervision that aim to address culture, conduct and governance. These methods are being developed in a number of jurisdictions*" (Dudley, 2015, page 1). New regulation is pushing banks to develop internal Risk Culture; the latter requires investments and imposes costs to institutions (Basel Committee for Banking Supervision, 2015a, 2015b).

Although there is a vast literature investigating the determinants of European bank performance (Molyneux and Wilson, 2017; Cocorese and Girardone, 2017; Doumpos, et al., 2017, among the others), there is no empirical evidence based on large samples demonstrating the extent to which a risk culture influences financial institutions' behaviors or supporting that a strong risk culture negatively influences bank performance (as is generally believed by practitioners) or positively influences it (as argued by regulators and supervisors). This leads us to address the following question: Do banks with a sound risk culture achieve better returns? To empirically answer this question, we developed an indicator, labeled as Sound Risk Culture Indicator (SRCI) at the bank level, estimated this metric for a large sample of banks (through Quantitative Text Analysis [QTA] of annual reports, corporate governance reports, and Pillar 3 reports), and estimated the causal link between the SRCI and various bank performance measures (Return on Assets [ROA], Return On Equity [ROE]) and risk-adjusted performance measures (Gross income on risk-weighted assets, and ROA On Implied Volatility). Our main result is that a strong risk culture is related to better performance, measured by various financial ratios. We also considered that banks may manipulate qualitative disclosure (the text in the official documents analyzed) and

show that a bank's performance decreases in case of an abnormal SRCI increase. To test the robustness of our findings, we repeated our main analysis excluding observations with signals of manipulation and obtained very consistent results.

We face two major issues in addressing our research questions. The first is building a metric that can capture risk culture at the bank level and can be estimated in an objective and replicable manner for many banks. Economists have traditionally been reluctant to discuss culture as a determinant of economic phenomena because the notion of culture is nebulous and raises numerous measurement issues in empirical research (Guiso et al., 2006). However, in what has been labeled the "culture revolution" by Zingales (2015), there has been a burgeoning interest in objectively measuring culture. Prior research has typically proxied for culture using socio-demographic measures at the country level (including religious identity, nationality, gender, blood donations, etc.) or social capital measures. In comparison, relatively few papers analyze corporate culture at the firm level (see, for example, Fiordelisi and Ricci, 2014, Guiso et al., 2015, and Cerqueti et al., 2017). The first step in solving this issue is to find a risk cultural framework that is largely accepted; we focused on the FSB (2014) framework, which sums up recognized risk culture's best practices (McConnell, 2013; Power et al., 2013). The FSB framework identifies four features of a sound risk culture: i) tone from the top (TFT)—board members and senior managers are responsible for promoting risk culture and including it in the bank's strategy; ii) accountability (ACC)—banks must develop a policy of ownership of risk in which employees are held accountable for their actions and are aware of the consequences for not adhering to the desired behaviors toward risk; iii) effective communication and challenge (COM)—top managers must encourage alternative views and pay attention to risk managers' suggestions to make informed risk decisions; iv) incentives (INC)—banks need a risk-linked rewarding system based on monetary

and non-monetary incentives. We define a selection of words to measure each of these four items extracted from the FSB framework. Then, we analyze each bank's official documents (annual reports, corporate governance reports, and Pillar 3 reports) in a QTA, an objective and replicable approach that can be applied to many firms.

The second issue is related to our identification strategy. Addressing both endogeneity and reverse causality issues in our empirical methodology is important. In our setting (in which risk culture is estimated by applying text analysis on disclosure), we may find that a bank's performance is positively related to greater risk culture. However, this may be driven by the fact that: 1) top managers use certain terms because they expect a certain outcome in terms of performance; and 2) a bank initiates projects with an aim of enhancing its risk culture (and discloses these initiatives in its official documents) only when they achieve greater performance. Previous research on this topic attempted to manage endogeneity and reverse causality issues using an instrumental variable approach and by lagging the independent variables by one year. We apply a Two Stage Least Square Instrumental Variable (2SLS IV) model using immigrated population (measured in millions) as an instrument. The entrance of foreigners in a country is an exogenous shock that modifies national preferences and belief systems (Fernandez and Fogli, 2009). Polavieja (2015) uses a similar approach by employing cultural traits of the migrant population as an instrument to study the effect of national traditionalism on female labor force participation. The central tenet of these epidemiological approaches is exploiting the portability of culture: *"Migrants take their culture with them, from one social context to another, and this provides a unique opportunity to isolate and quantify (i.e., to identify) the causal effect of culture on people's behavior"* (Polavieja, 2015, page 168).

The main contribution of our paper is that we focus on bank culture, not on bank risk-taking. We argue that bank risk-taking is the effect of the bank risk culture and that the latter drives banks to more efficient risk decisions. The idea is that a higher attention to risk culture could allow the bank to decrease the trade-off between risk-taking and stability, with a positive effect on profits. It is widely believed that corporate culture is a main determinant of most of the bank features considered in previous research (such as corporate governance mechanism, capital structure, and efficiency). We develop an objective measure of risk culture at the bank level and estimate this metric for a large sample of banks through automatic text data processing of official documents. Our approach is objective and replicable in future research. We also show that an enhanced risk culture does not negatively impact banks' performance; rather, it is related to greater profits and value. This result is very important for financial regulators and supervisors, suggesting that banks with a sound risk culture can accurately account for their risk-taking and achieve greater profits to create shareholder value. Various regulatory interventions to enhance bank risk culture are justified and appear to be an important tool for enhancing bank stability. Our findings also provide evidence of how cultural traits are likely to affect financial institutions' performances.

This is one of few studies assessing the role of corporate culture in banking based in Europe, as most papers focus on the US (as Cerqueti et al., 2017). The lack of studies in Europe is surprising because the crisis was very severe in the European Union and stability of the banking system has not yet been fully achieved, as shown by the large stock of non-performing loans (almost EUR 1 trillion at the end of 2016) and by the substantial number of bail-out and bail-in cases of large banks in the recent years. We select a large sample of banks in the Euro zone and U.K. from 2004 to 2017 with total assets greater than EUR 1 billion and with at least one annual report in English.

The remainder of the paper is structured as follows. Section 2 reviews literature, defines the concept of risk culture, and develops research hypotheses. Section 3 illustrates the sample and methodology applied to compute the SRCI. The results of the fixed effect regression models are presented in Section 4, and Section 5 contains 2SLS IV model estimations. Section 6 shows different robustness tests and Section 7 presents the conclusions.

## 2. Literature Review

In the aftermath of the recent financial crisis, the tendency of some banks to perform poorly compared to others that were more resilient was argued to be a matter of "culture" (Aebi et al., 2012; Fahlenbrach et al., 2012; Irresberger et al., 2015; Bonaccorsi and Kashyap, 2017). Although culture has become a popular topic in recent years, it is not a new issue.

Corporate culture has been traditionally considered (and measured) as a subset of the environmental or national culture. Culture is the "*collective programming of the mind that distinguishes the members of one human group from those of the others. Culture in this sense is a system of collectively held values*" (Hofstede 1991, page 5). By measuring culture through environment variables, various research shows that culture affects banks' performance and stability. Boubakri et al. (2017) show that banks in high uncertainty avoidance and power distance societies perform relatively better during the recent financial crisis. Chui et al. (2016) evidence that cultural dimensions of embeddedness and mastery negatively affect the cost of debt through bankruptcy risk and sensitivity to agency activity channels. Frijns et al. (2013) show that CEOs of firms in countries with lower levels of risk tolerance require higher premiums on takeovers and that uncertainty avoidance plays a greater role in relatively large takeovers. Carretta et al. (2015) provide empirical evidence that supervisory culture influences banks' stability.

Another part of the literature considers culture as a specific phenomenon of companies; corporate culture is "*a system of shared values that define what is important, and norms that define appropriate attitudes and behaviors for organizational members*" (O'Reilly and Chatman 1996, page 160). Research shows evidence that corporate culture influences firms' behavior and performance (Wilkins and Ouchi, 1983; Schein, 1990; Van den Steen, 2010). In the principal-agent framework, managerial "moral hazard" may be conduct consistent with the culture of the principals (Gorton, 2014). In the incomplete contract theory framework (Grossman and Hart, 1986), in which managers and employees face choices that cannot be properly regulated ex ante, corporate culture may be crucial to explain their decisions, contributions and, ultimately, corporate performance (Guiso, Sapienza and Zingales, 2015).

Risk culture is an expression of corporate culture that focuses on risk-taking and risk-control activities. A first risk culture definition was proposed by Sheedy and Griffin (2018, page 4) and Sheedy et al., (2017, page 101) as "*the shared perceptions among employees of the relative priority given to risk management, including perceptions of the risk-related practices and behaviors that are expected, valued, and supported*." However, risk culture is a concept not only related to risk management's ability, it rather influences the entire organization of a company as suggested by the Basel Committee for Banking Supervision (2015, page 2), which defines a bank's risk culture as *"A bank's norms, attitudes, and behaviors related to risk awareness, risk-taking, and risk management, and controls that shape decisions on risks. Risk culture influences the decisions of management and employees during the day-to-day activities and has an impact on the risks they assume.*"

Recalling the old adage that "one cannot manage what one does not measure," we have to define a risk culture measurement system. However, there are various problems that we need to

face. First, it is necessary to consider various items (such as ethics, incentive systems, regulatory constraints, and risk oversight) that are not routinely measured or reported. Second, a risk culture assessment focusing only on risk management practices could only be referred to the long term and should be able to identify managerial skills and/or luck (Sheedy and Griffin, 2018). Third, measurement methods based both on regular interviews and surveys are impractical on a large scale (i.e., a large number of companies), do not enable one to make objective comparisons over time and across businesses (e.g., a bank may show multiple risk culture measures in different departments, especially when it is a large company or it operates in multiple locations), and usually suffers of low response rates and measurement biases (Sheedy et al., 2017). To face these problems, we adopt a different "objective" approach focusing on the espoused risk culture and risk governance (i.e., policies, structures, and systems related to risk management) rather than culture per se[1]: specifically, we run a QTA of corporate documents (annual reports, corporate governance reports, and Pillar 3 reports)[2] to measure the risk culture espoused by banks. This technique is applied to observe, in a systematic and objective manner, the characteristics specific to a text (Stone et al., 1966).

As suggested by Kabanoff et al. (1995), corporate reports are a team product whose content is carefully reviewed by top management, thus reflecting the type of culture within which they are produced. The basic underlying idea is that the words and expressions used in corporate documents (i.e., the "vocabulary") represent the outcome of the corporate culture (Levinson, 2003). Moreover,

[1] We would like to thank the associate editor for his constructive comments and help to clarify that our measures are mainly picking up espoused risk culture and risk governance.

[2] One concern is that many financial institutions have great policies, structures, and systems related to risk management on paper that are not taken very seriously in practice. In other terms, the words used could reflect image more than substance. Despite this, the high visibility (internal and external) of these documents together with the supervisory screening of the information provided should limit their misleading content.

measures of risk culture obtained through QTA are less prone to the subjectivity of opinions of the researcher.

To implement a content analysis, we need to preliminarily identify a risk culture framework. As such, we focus on the one developed by the FSB (2015) that synthesizes various approaches (e.g., Cass Business School & New City Agenda, 2014; Institute of Risk Management, 2012; Senior Supervisors Group, 2009; McKinsey framework; KPMG framework; Charted Institute of Internal Auditors, 2014). This FSB (2015) framework refers to the following four main attributes that make a bank's risk culture "sound": i) TFT, ii) ACC, iii) COM, and iv) INC.

The first element of the FSB's scheme is TFT; the board and senior management are responsible for promoting risk culture and including it in their strategy. The top members of the organization oversee the development of an adequate risk culture, create mechanisms for implementation of risk appetite, and lead by example. The second required element is ACC. The organization must develop competences to communicate potential threats that allow for risk recognition and escalation processes (such as whistle blowing). The consequences of risk-taking that is not aligned with risk appetite (regardless of the financial result of the action) must be explained. COM refers to the possibility of making informed risk decisions; top management must encourage alternative views and pay attention to risk management's observations. Finally, the organization needs a system of rewards and penalties that is not only monetary (i.e., opportunities for training, job rotation, and successions), which is also based on both risk-taking and performance, and including all individuals in the organization (as the CEO and loan officers).

The FSB (2015) framework is not evidence based and there is no existing evidence supporting its validity. Thus, our paper is the first that uses it to measure bank risk culture using a large sample of firms. Our results provide novel empirical evidence regarding the link between a

sound (according to FSB framework) risk culture and bank performance. Our main research assumption is that a "sound" (according to FSB framework) risk culture, despite the costs for its development, improves banks' performance by enabling banks to be more efficient in risk-taking and risk management.

## 3. Data and Variables

The most challenging task of this paper is the development of the SRCI, i.e., a new measurable indicator of risk culture. We use QTA, which has been proven to be a reliable methodology in previous financial research (Hoberg and Phillips, 2010; Hoberg and Hanley, 2010).

Our approach to developing the SRCI involves the following three steps: first, we select different vectors of words that capture attributes of the SRC; second, we identify appropriate companies' publicly available documents that mirror the risk culture. Third, we define our equations to quantify the SRCI.

We follow the FSB framework that examines four attributes that constitute an SRC. The FSB specifies different qualities for each attribute (labeled as "indicators") that help identify what each attribute consists of. To measure the banks' attention to the four attributes, we select "vectors of words" from the FSB's indicator descriptions; we do not choose single words but consider combinations of two and three terms[3], labeled "Group Meaning Units" (GMUs). Our QTA algorithm enables us to examine if words belonging to the same GMU appear together in a sentence. This approach evaluates how often banks link two concepts (management and information, board and uncertainty, incentives and risk, etc.). For example, the words "board" and

[3] The vectors of words selected directly from the FSB framework are reported in Table 1 of the on-line Appendix. Each comma-separated term in the first group is searched with each term of the second group (in the "Extracted Sentences" column).

"lead" appearing alone in a sentence would not be sufficient to signal a leadership attitude of the board (ID 4.1.a in the Table 1 in the on-line Appendix), but these words together in a phrase underline a board's guidance role. To allow for a more effective analysis, our methodology includes new GMUs composed of synonyms taken from the Collins Dictionary and Thesaurus[4]. We remove all morphological affixes with a Porter's stemming algorithm implemented in Python's Snowball Stemmer package[5]. As a result, 8638 GMUs are included in the analysis[6].

In the second step, we analyze annual, corporate governance, and Pillar 3 reports. These documents contain information about performance, risk, and internal policies, respectively. The structure of these documents is partially regulated by the European Banking Authority, but banks are free to determine the documents' detail and length so we can use them to estimate bank risk culture.

In the third step, we compute the SRCI and TFTI, ACCI, COMI, and INCI indicators as:

$$(1) \qquad TFTI_{it} = ln\left(\frac{TFTD_{it}}{sd(TFTD)_{3,it}}\right), \text{with } TFTD_{it} = \frac{N_{it}^{TFT}}{tphr_{it}}$$

$$(2) \qquad ACCI_{it} = ln\left(\frac{ACCD_{it}}{sd(ACCD)_{3,it}}\right), \text{with } ACCD_{it} = \frac{N_{it}^{ACC}}{tphr_{it}}$$

$$(3) \qquad COMI_{it} = ln\left(\frac{COMD_{it}}{sd(COMD)_{3,it}}\right), \text{with } COMD_{it} = \frac{N_{it}^{COM}}{tphr_{it}}$$

$$(4) \qquad INCI_{Iit} = ln\left(\frac{INCD_{it}}{sd(INCD)_{3,it}}\right), \text{with } INCD_{it} = \frac{N_{it}^{INC}}{tphr_{it}}$$

$$(5) \qquad SRCI_{it} = ln\left(\frac{SRCD_{it}}{sd(SRCD)_{3,it}}\right), \text{with } SRCD_{it}$$

$$= TFTD_{it} + ACCD_{it} + COMD_{it} + INCD_{it}$$

[4] Table 2 in the on-line Appendix I provides details on the selected and discarded synonyms.
[5] To manage the duplicated GMUs we applied the following rule: when duplicates belonged to the same attribute, we retained only one of them; if they referred to different attributes, we deleted both.
[6] Listed in the Table 3 of the on-line Appendix.

$TFTD_{it}$, $ACCD_{it}$, $COMD_{it}$, and $INCD_{it}$ are TFT, Accountability, Communication, and Incentives attention's density, respectively. $N_{it}^{TFT}$, $N_{it}^{ACC}$, $N_{it}^{COM}$ and $N_{it}^{INC}$ are the total number of sentences[7] containing a GMU associated with the corresponding indicator (TFT, Accountability, Communication, and Incentives) for the bank-*i*'s disclosure at time *t*. $tphr_{it}$ is the total number of sentences in bank-*i*'s disclosure at time *t*. These ratios measure how much banks display a vocabulary linked with each of the four attributes of the SRC, divided by the total number of sentences correct indicator for the distortions due to a longer or shorter bank disclosure term. $SRCD_{it}$ is the sum of the four attributes' densities[8]. The cultural indicators (TFTI, ACCI, COMI, INCI)[9] are the ratios between the densities and their standard deviations, computed using a three-year rolling window[10]. The indicators measure the number of times the densities exceed their standard deviation; this allows to clean the series by jumps from one year to another.

The sample includes the main banks' holding companies in the Euro zone and U.K., active from 2004 to 2017, with total assets greater than EUR 1 billion, and with at least one annual report in English. The banks' names are obtained from *DataStream* and the register of Significant Supervised Entities published by BCE. The analysis focuses on large banks because they showed problems in ensuring a common risk culture throughout the organization. The balance sheet data are taken from *BankScope and BankFocus* databases. Data on foreign-born populations are obtained from the OECD database[11].

[7] A sentence is defined as consecutive words contained between a blank line and a dot or between two dots.
[8] The densities are hereafter referred to as TFTD, ACCD, COMD, INCD, and SRCD.
[9] Indicators, cultural indicators, culture's indicators, and sound risk culture's indicators are hereafter referred to as TFTI, COMI, and INC.
[10] Standard deviation of the SRCD in the last three years.
[11] Foreign-born populations in OECD countries (indicator). doi: 10.1787/b1fc67fa-en (Accessed on 15 March 2017).

We define a *word* as a term with more than two letters that is not an article or a conjunction. To clean the errors from the data, we retain observations with more than 5000 words and winsorize SRCIs at 1%. This allows for removal of reports with little information since they clearly show anomalous paths in an unreported graph. Table 2 provides some descriptive statistics of the main variables.

As shown in Figure 1, the average SRCD increases yearly and has a mean of 0.189, meaning that on average, 19% of the phrases in bank's disclosures contain SRC vocabulary. All indicators and densities show a high standard deviation of approximately 50% of the mean. The other variables are defined in Table 1.

**4. Preliminary investigation**

Before conducting our empirical analysis, we screen the economic meaning of our SCRI by comparing our new measure with various bank risk and performance measures.

First, we measure the correlation among performance indicators, sound risk culture, and the other dependent variables (tables 3.1 and 3.2). The strong correlation among SRC and SRCI attributes (TFTI, ACCI, COMI, and INCI) is worth mentioning. This suggests that the SRCI attributes influence each other. Figure 2 shows the mean annual SRCI and its standard deviation; there is a clear fluctuation of the indicator on all the periods. There is no high variation in the cultural indicator because culture may not change excessively from year to year. The standard deviation of the SRCI within the year is very high, meaning that banks have different levels of culture within the same year.

The timelines of the SRCD for four European banks, Banque Populaire and Caisse d'Epargne Group (BPCE), Deutsche Bank AG, Banca Monte dei Paschi di Siena SpA, and Royal

Bank of Scotland Group PLC, are shown in Figure 3. As expected, the RBS and MPS show low levels of SRCD. In this regard, the Financial Services Authority Board Report (2011) on RBS crisis states that "*the poor decisions made by RBS management and Board which made RBS highly vulnerable to failure, and the underlying aspects of RBS' management style, governance, and culture which may have contributed to those poor decisions*." Also the *Testimony of the Governor of the Bank of Italy Ignazio Visco* (2016), with reference to referring to MPS scandal, points on problems relating to organizational safeguards and controls: *"management had failed to transmit to supervisors the information that was vital for a full recognition of the scale and nature of several operations that had been carried out in violation of the law."*

Although Deutsche shows higher levels of the SRCD indicator, at least at the beginning of the considered period. Following, there is an evident decline of the SRCD indicator, especially in the years of the LIBOR scandal. Finally, BPCE shows a growing trend for the SRCD indicator.

Third, we conduct a Multi-Dimensional-Scaling (Borg and Groenen, 2005) analysis on vectors representing the Risk Dictionary (RD) of the Banks. The matrix of the distances between banks (D) was computed considering the cosine of the angle the between bank-specific vectors $v^b \in R^N$, where N is the length of the RD. A typical pattern in human languages is that phrases that are used to describe the same topic share certain common words (Mu et al., 2016). Therefore, in line with Bodnaruk et al. (2015) and Loughran and McDonald (2011), the words that included the RD are those that appear in at least 5% of the risk sentences.

A risk sentence is a sentence containing the word "risk" at least once. The distance $d_{i,j}$ between vector $v^i$and vector $v^j$is computed as $d_{i,j} = \cos(\theta_{i,j}) = \frac{v^{i,2} \cdot v^{j,2}}{\|v^{i,2}\| \cdot \|v^{j,2}\|}$, where $d_{i,j}$ is the *i-th*, *j-th* element of the distance matrix $D \in R^{B \times B}$. The vectors $v^1, \dots, v^b, \dots, v^B \in R^N$, where $B$ is the total number of banks such that the element $v_w^b$ of the vector $v^b$ is $v_w^{b,2} = \frac{n_{w,b}}{Nr_b}$, $n_{w,b}$ is the number

of significant sentences in the documents of bank $b$ in which the word $w$ appears, $Nr_b$ is the number of the bank's significant sentences, and $v_w^b$ corrects for the amount of information disclosed by the bank. Figure 4 shows the MDS scatter plot for a graphic representation of the differences in banks' RD from 2004 to 2017; the greater the distance between two points, the greater the dissimilarity of vocabulary used to talk about risk. In figure 4, some of the main banks are underlined with a label[12].

We do not find similarities in the data points of banks with common characteristics (i.e., same country, dimension, or sector), even for labeled banks, which are similar in terms of business models and dimensions. This has important implications; each bank's disclosure vocabulary is unique and firm-specific; otherwise, some points would be closer together. Therefore, we conclude that a bank's annual report vocabulary is not determined by regulation, national culture, or business model.

## 4. Analysis and Results

Our main research assumption is that a sound risk culture produces positive effects on banks' performances. To test this assumption, we use the following panel data model:

$$(6) \quad Performance_{it} = \alpha_t + \alpha_i + \beta_1 SRCI_{i(t-1)} + \sum \beta_i m_{i(t-1)} + \delta_1 GDP_{j(t-2,t-1)} + \delta_2 crisis_i + \epsilon_{it}$$

where a bank's performance is measured using various indicators such as the GI\RWA indicator (which allows for evaluation of the bank's performance, net of the taxation effect, and standardized

[12] Santander, Commerzbank, Deutsche, Raiffeisen Banking Group, KBC group, BNParibas, Mediobanca, Intesa Sanpaolo, Unicredit, Monte Paschi di Siena, Societe Generale, BBVA

by the risk-weighted assets[13]), ROA, ROE, and, similarly to Eckles, Hoyt and Miller (2014), ROA On Implied Volatility (ROA/VOL). The primary coefficient of interest is $\beta_1$, which measures the link between a bank's $SRCI_{it}$ (as defined in Equation 5) and performance. We also controlled for various bank characteristics ($m_{it}$) that have been found to be important (Molyneux and Thornton, 1992; Athanasogloua, et al., 2008; Berger and Bouwman, 2009; Goddard, et al., 2013; Tran et al., 2016) in the link between risk culture and performance. First, we use bank size, measured by the natural logarithm of the total assets (lnTA). Larger banks benefit from economies advantages and could be more profitable than smaller ones. Nevertheless, larger banks could penalize the performance due to the associated higher complexity and bureaucracy to be managed (Athanasogloua, et al., 2008). Second, we refer to the business model of the banks, proxied by the total loans on total assets (TL\TA) ratio. Loans are typically less liquid and riskier than other assets and therefore, due to the higher credit risk exposure, we may expect a lower performance. However, a higher specialization in lending may reduce intermediation costs and improve performance (Goddard, 2013). Third, capitalization is measured as equity on the total asset (E\TA). High-capitalized banks could have better access to financing sources with lower cost and risk, and better access to higher quality asset markets (Tran et al., 2016). Nonetheless, Goddard et al. (2013) find that well-capitalized banks appear to have lower profitability in eight European Union member countries from 1992 to 2007. Forth, also the bank's propensity to liquidity, approximated by the ratio of detained liquid assets (LIQA\TA), could have a mixed effect on performance. We could have a positive effect due to higher net surpluses that can be shared among stakeholders (Berger and Bouwman, 2009). However, Molyneux and Thornton (1992) and Goddard et al.

[13] As explained in Table 1, the gross income is the bank's income before taxation and the RWA is the weight of each asset based on the risk of loss of its value, according to regulation. Higher bank income due to higher risk-taking would increase the ROA but not change the GI\RWA.

(2013) find a negative effect across European countries for the periods of 1986–1989 and the mid-1990s, respectively. Fifth, loan loss provision on the gross loans (LP\L) could be considered both i) a measure of the prudency in accounting policies and, therefore, it could have a positive effect on performance; and ii) a proxy of the exposure to credit risk that could be associated with a lower performance (Athanasogloua, et al., 2008). Finally, the bank's efficiency, measured using the cost-to-income-ratio (CO\INC), is expected to have a positive effect on performance (Goddard, 2013).

We also controlled for the annual GDP growth rate ($GDP_{j,(t-2,t-1)}$), whose effect on performance is expected to be positive. To manage the omitted variable problem, such as risk management ability discussed by Ellul and Yerramilli, 2013, and control for the role of financial crisis, we included both the year-fixed effect (α_t) and the bank-fixed effect (α_i). The idea is that a strong risk culture shows its effects not only during crises but also in periods characterized by higher bank stability. On the one hand, a risk culture could emphasize excessive risk-taking for short-term profits at the expense of longer-term firm performance and sustainable shareholder value during non-crisis periods. On the other hand, influencing the decisions of management during day-to-day activities, risk culture could be an important factor for maintaining and the recovery of adequate levels of bank performance also during crisis periods. To handle the reverse causality problem, all independent variables were lagged by one period. All the variables are described in Table 1.

Table 4 reports our results for equation (6) using SRCI (columns 1 and 2) and each of the four FSB attributes (columns 3 to 6). The effect of the SRCI is positive and highly statistically significant, with a substantial economic magnitude; an increase of one SRCI standard deviation (1.050) increased the GI\RWA by 119% of the mean (0.005). The results are strongly consistent when the model is applied both with and without control variables. We obtained very similar

results when the analysis was repeated with each of the four attributes (TFTI, ACCI, COMI, and INCI), confirming previous results.

We repeated the analysis using the other performance measures, ROA, ROE, and ROA/VOL (Table 5). Consistent with previous results, we found that the coefficient estimates for the SRCI are positive and highly statistically significant, with high economic meaning; an increase of 10% in the SRCI results in an increase of 0.2 percentage points in the following year for the ROA, 0.24 percentage points for the ROE, and of 1.32 percentage points for the ROA/VOL.

These results are novel and suggest the validity of the framework elaborated by the Financial Stability Board. We showed that a sound risk culture (that bolsters effective risk management, promotes sound risk-taking, and ensures that emerging risks or risk-taking activities beyond the institution's risk appetite are recognized, assessed, escalated, and addressed in a timely manner) is a positive element in a bank's performance rather than merely a cost. Considering the dimensions of a sound risk culture, there is evidence that it has a positive effect on performance on an individual basis. This means that a bank that desires to enhance performance should pay attention to its risk culture at an overall level and at the levels of its attributes.

## 5. Managing Endogeneity

In the previous section, we included both the year-fixed effect ($\alpha_t$) and the bank-fixed effect ($\alpha_i$) to manage the omitted variable problem and lagged all independent variables by one period to manage the reverse causality problem.

To allow for a more robust analysis, we applied a 2SLS IV model (Wooldridge, 2010). IV models allow for estimating the exogenous impact of SRCI on the dependent variables, solving the problem of endogenous preferences. Our instrument is the immigration rate, measured by

annual variation in the foreign-born population's in the country (IMMIGR). New foreign-born population influences tradition and beliefs at the national level (Ditlmann et al., 2011), changing perceptions of risk and uncertainty. This effect is strengthened by people's tendency to overestimate the immigration phenomenon in terms of its dimension and impact (Alba et al., 2005; Sides and Citrin, 2007). Furthermore, immigration changes the size and skills of the labor force (Pandey and Chaudhuri, 2017). These elements modify culture at the country level and indirectly affect bank employees and management, who face the challenge of re-assessing common culture inside the firm after each cultural shock.

The only variable that could influence a bank's performance and risk and the foreign-born population at the same time is economic growth in the country (higher growth in a country could positively influence banks' performances and attract more immigrants). Thus, in the analysis, we added firm-fixed effects to the regressions, which control for underlying trends and the GDP growth rate. The literature associates immigration with increases in rents and house prices (Mussa et al., 2017) and with a decrease in direct investment in the short term (Tomohara, 2017). The performance of banks specialized in sectors affected by these variables could be directly influenced by the immigration rate. Therefore, we controlled for bank-specific characteristics such as efficiency and dimension.

We modified the model in equation (6) as follows:

$$(7) \quad GI/RWA_{it} = \alpha_t + \alpha_i + \gamma_1 \widetilde{SRCI}_{i(t-1)} + \sum \gamma_i m_{i(t-1)} + \delta_1 GDPgr_{j(i)(t-1)} + \epsilon_{it}$$

$$(8) \quad \widetilde{SRCI}_{i(t-1)} = \omega_t + \omega_i + \partial_1 IMMIGR_{j(i)(t-1)} + \sum \partial_i m_{i(t-1)} + \varphi_1 GDPgr_{j(i)(t-1)} + \epsilon_{it}$$

where $IMMIGR_{j(i)t}$ is the immigration rate of bank-*i*'s home country in year *t.* Equations (7) and (8) are the first and second stages, respectively. The $\widetilde{SRCI}_{it}$ in Equation (8) is the predicted value of the SRCI in Equation (7). Column (2) of Table 6 shows the first stage. The immigration rate has a small, highly significant negative effect on sound risk culture. Column (1) reports the second stage; the results confirm the positive effect of the SRCI on banking performance. The F-stat refers to Kleibergen–Paap statistics for weak instruments test (Kleibergen and Paap, 2006). According to the thresholds of Hausman et al. (2005), all test values are above the 10% critical value. The total number of observations decreased to 371 because IMMIGR was not available for all countries in the sample[14].

## 6. Abnormal Risk Culture Changes

One challenge in the disclosure analysis is that firms could stress the importance of values that are not followed in practice (Guiso et al., 2015; Beyer and Guttman, 2012). We detected such behavior by exploiting the characteristic of culture to vary gradually over time. We expected that attention to SRC did not vary yearly; high variation could be a signal of disclosure manipulation.

Thus, we define:

$$SRCDvar_{it} = \frac{SRCD_{it}}{SRCD_{it-1}} \quad (9)$$

$$SRCIvar_{it}^{Q4} = \begin{cases} 1 & if\ SRCDvar_{it} \in Q_4 \\ 0 & Otherwise \end{cases} \quad (10)$$

where $SRCDvar$ is the ratio of bank-*i*'s $SRCD_{it}$ to its value in the previous year. $SRCIvar_{it}^{Q4}$ is the sound risk culture variation dummy that has a value of 1 if bank-*i*'s *SRCDvar* at time *t* is in the

[14] IMMGR data were lacking for Cyprus, Lichtenstein, Luxemburg and Malta.

4th-quartile ($Q_4$) of the overall *SRCDvar* distribution. Then, we evaluated equation (6) substituting SRCI with $SRCIvar_{it}^{Q4}$ to evaluate the effect of a high SRC attention increase[15] on the GI\RWA.

The estimation results are shown in Column (1) of Table 7. The effect is slightly negative and significant at 10%, indicating that increases in the SRCD do not have an effect or even negatively affect a bank's performance, corrected for risk-taking. There were 526 observations because we used observations from 2004 to build the variation index.

Column (2) of Table 7 reports the results of the model estimation in equation (6) on the sub-sample of observations with *SRCIvar* in Q4 at *t-1* (firms with an $SRCIvar_{i(t-1)}^{Q4}$ equal to 1). The SRCI was not significant and almost zero, confirming that in cases of abnormal SRC attention increase, a higher SRCI is associated with no change in bank performance.

Finally, we also run model equation (6) by excluding all observations with high SRCD variation (we included only banks with a $SRCIvar_{i(t-1)}^{Q4}$ of 0). The results are shown in column (3). The SRCI is still significant at 1% even if the absolute value is lower. Column (4) reports the results of the IV model, excluding high SRCD variations. As in the previous analysis reported in in Table 6, SRCI is significant at 1%. Since the analysis in Column (1) of Table 7 underlines a slightly significant negative effect of $SRCDvar^{Q4}_{t-1}$, analyses in Columns (3) and (4) check if this result is driven by abnormal variation of the indicator; in both cases SRCI is still significant.

## 7. Robustness Checks

Table 8 provides the results of different robustness tests we conducted. Column (1) reports the regression coefficients of the model in equation (6) estimated on the entire sample using *SRCI2*.

[15] Even if the statistics are not reported, the SRCDvar in $Q_4$ are all greater than one. Therefore, high variations coincide with increases in the SRCD.

Because we used a two-year rolling window, we considered two years as pre-crisis (2006 and 2007). Results show a positive effect of risk culture on performance during this non-crisis period. In column (2) of Table 8, we used a modified version of the SRCI that is focused on banks' risk approaches (SRCIR). The latter was obtained by repeating the text analysis using only vectors of words in the SRC framework (reported in the on-line Appendix) that include the word "risk." The original SRCI includes various bank items that are not-related to the risk attitude (as items related to the treatment of employees), and the SRCIR allows for focusing on banks' attention to issues linked to risk. The positive effect of risk culture on performance is still confirmed. Column (3) shows the same estimation of the second column in Table 4 on years after the crisis (2009 to 2017). The latter analysis tested if the results are consistent when excluding the effect of the crisis or when considering a longer period. In all the three estimations above, the coefficients were significant and confirmed our results. In other words, the positive effect of risk culture on performance is showed not only during the non-crisis period but also during the crisis period. We also check whether our risk culture measures also capture the quality of disclosure of each institution[16]; specifically, we include the Smog (Simple Measure of Gobbledygook Grade) in the model in column (4) as a control variable. Smog is a commonly used readability measure introduced by Mc Laughlin (1969); this is calculated for each bank through the content analysis of banks' annual and Pillar 3 reports in English, made possible by the use of the Python's Textstat package, as follows:

$$(12) \quad Smog = 1.0430 * \sqrt{number\ of\ polysyllables * \frac{30}{number\ of\ sentences}} + 3.1291$$

[16] We would like to thank one of the referees for suggesting us to control whether our risk culture measures may also capture the quality of disclosure of each institution.

The results do not seem to corroborate the possibility that our measure of risk culture is affected by the quality of disclosure.

Finally, Column (5) adds the interaction term year country among regressors, which allows to control for different aspects linked to country characteristics such as legal origin and institutional differences. Our results show that the role of risk culture is confirmed also controlling for these different aspects.

## 7. Conclusion

Regulators, supervisors, and practitioners identified weak risk governance and culture as a reason for financial crisis; a debate among regulators and practitioners (Parliamentary Commission on Banking Standards, 2013; Institute of International Finance, 2009) began in 2008 concerning how to enhance sound risk culture in banking. The benefits of a sound risk culture are related to more efficient risk management and conscious risk-taking, but the development of a such culture implies high costs. There is no empirical evidence based on a large sample that establishes the relationship between bank risk culture and performance.

The main challenge for scholars investigating risk culture is the development of a reliable measure capturing risk, a "soft" variable. The FSB (2014) provides a framework to identify attributes that are best practices in the sector, which are at the basis of a sound risk culture. Following FSB's framework, we developed the SRCI to apply QTA to banks' disclosures. We selected different vectors of words that captured the SRC attributes, identified each company's publicly available documents in which we believe the risk culture was mirrored, and defined our formula to quantify the SRCI.

Our results show that bank performance improves as bank risk culture increases. As the SRCI increases, banks record an increase in their performance indicators, specifically GI/RWA, ROA, ROE, and ROA/VOL, in the following year. These results suggest that developing an SRC is convenient from an organizational perspective as well as an economic one. The benefits of more effective risk-taking and risk management are greater than the expenses in enhancing the risk culture.

Examining banks with abnormal SRCs, we observe that an abnormal increase in the SRCI decreases a bank's performance. This could be explained by the fact that banks manipulate disclosure in an attempt to promote SRC with external claims that are not associated with actual changes in the firm's shared beliefs. Robustness tests confirmed the results even when we used an IV model with IMMIGR as an instrument, when we performed the regression on the post-crisis period only or used different indicators of SRC, and when we included in the regression an indicator of quality of disclosure of each institution.

Thus, the FSB's framework captures important dimensions of a sound risk culture; RC development allows for banks to increase their profits. Our hypothesis is that as the literature suggests, this effect is driven by more efficient risk-taking by banks. However, SRC attention can become merely an exercise; banks may claim cultural improvements that are not supported by actual internal efforts. Risk culture evaluation must consider this issue using proper tools.

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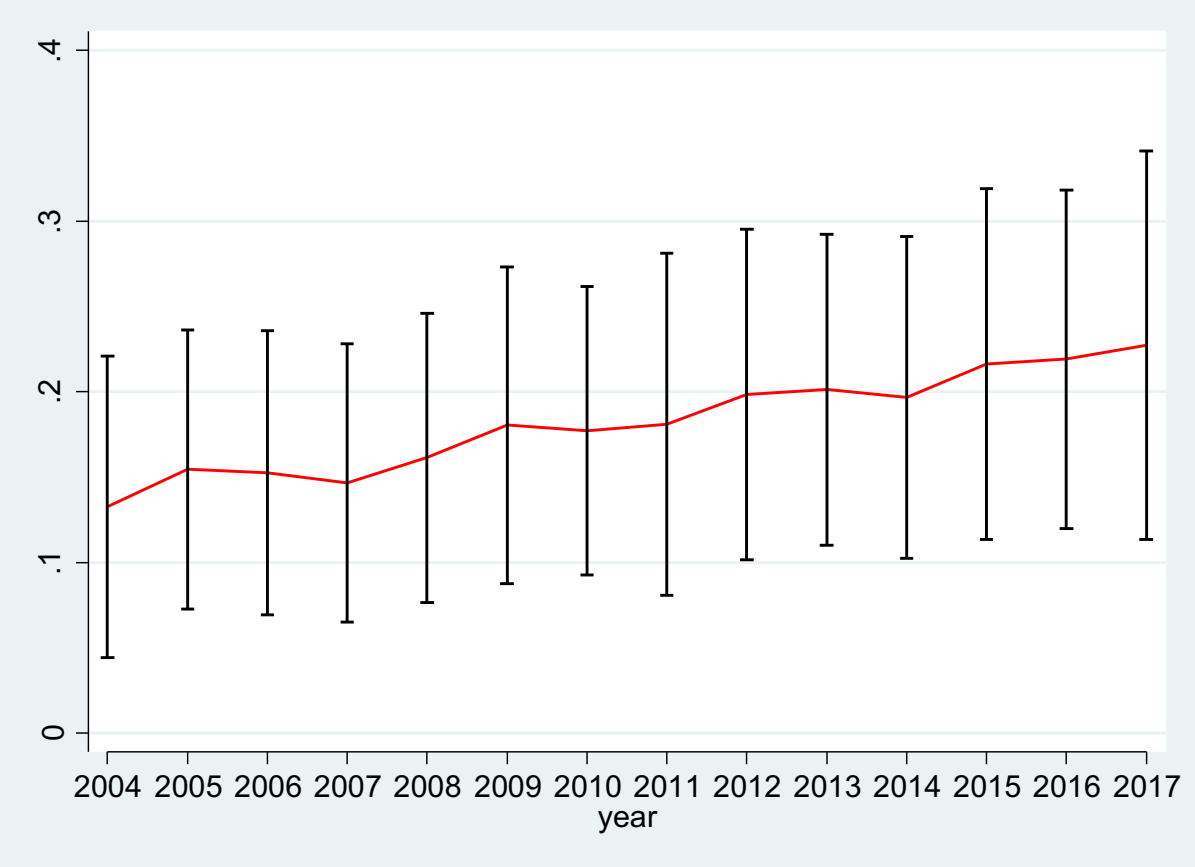
## Figure 1: Average Risk Culture Tone Density per Year

The average sound risk culture density (SRCD) per year (red line) and its standard deviation (black lines). The SRCD is the sum of four attributes of densities: Tone from the top attention density (TFTD), Accountability attention density (ACCD), Communication attention density (COMD), and Incentive attention density (INCD). The densities are the ratios between the number of the attribute's phrases in the bank's disclosure to the total number of phrases. The SRCD generally increased each year, with exceptions in 2006, 2007, 2010, and 2014. Attention to SRC is growing in the sector. The standard deviation within each year is high, meaning that the level of attention varies across banks.



## Figure 2: Average Sound Risk Culture Indicator per Year

The mean and standard deviation of the sound risk culture indicator (SRCI) per year. The SRCI is the ratio between the sound risk culture density (SRCD) and its standard deviation, using a three-year rolling window. The indicator shows fluctuations on all the periods. The standard deviation is high, meaning that banks have different culture levels within the same year.

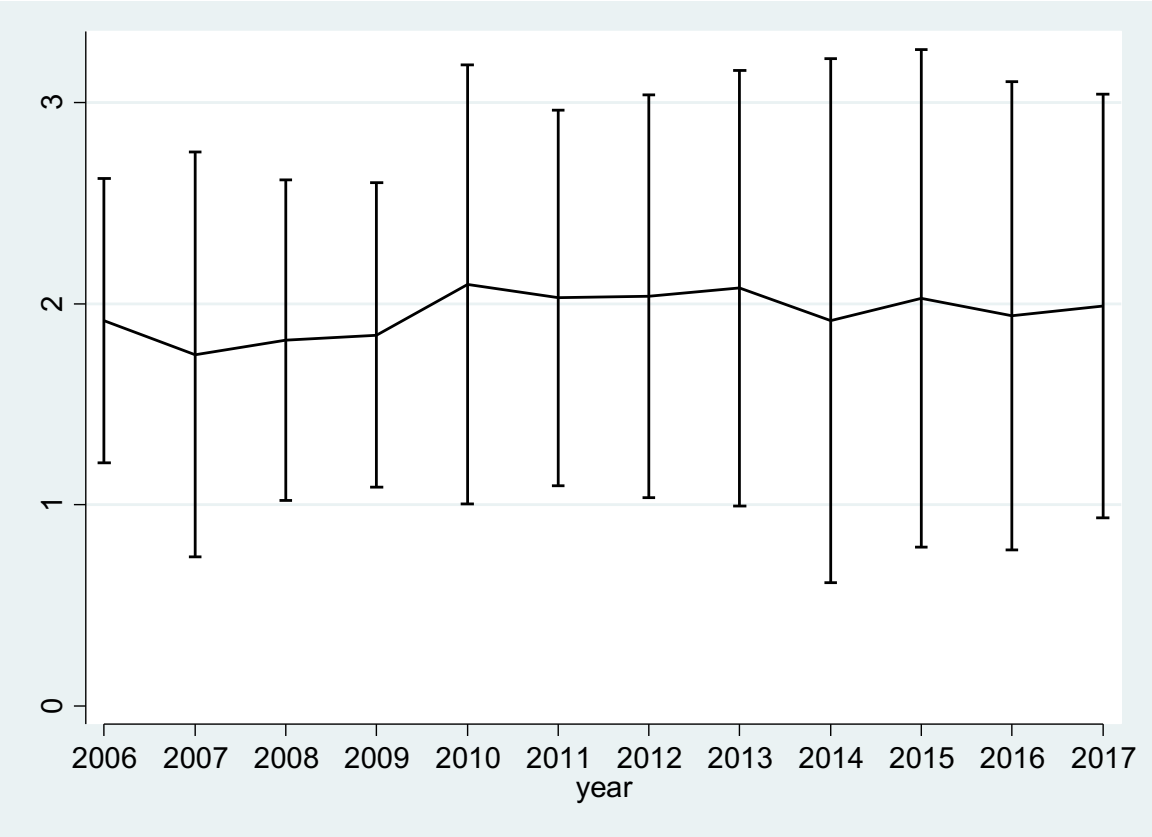
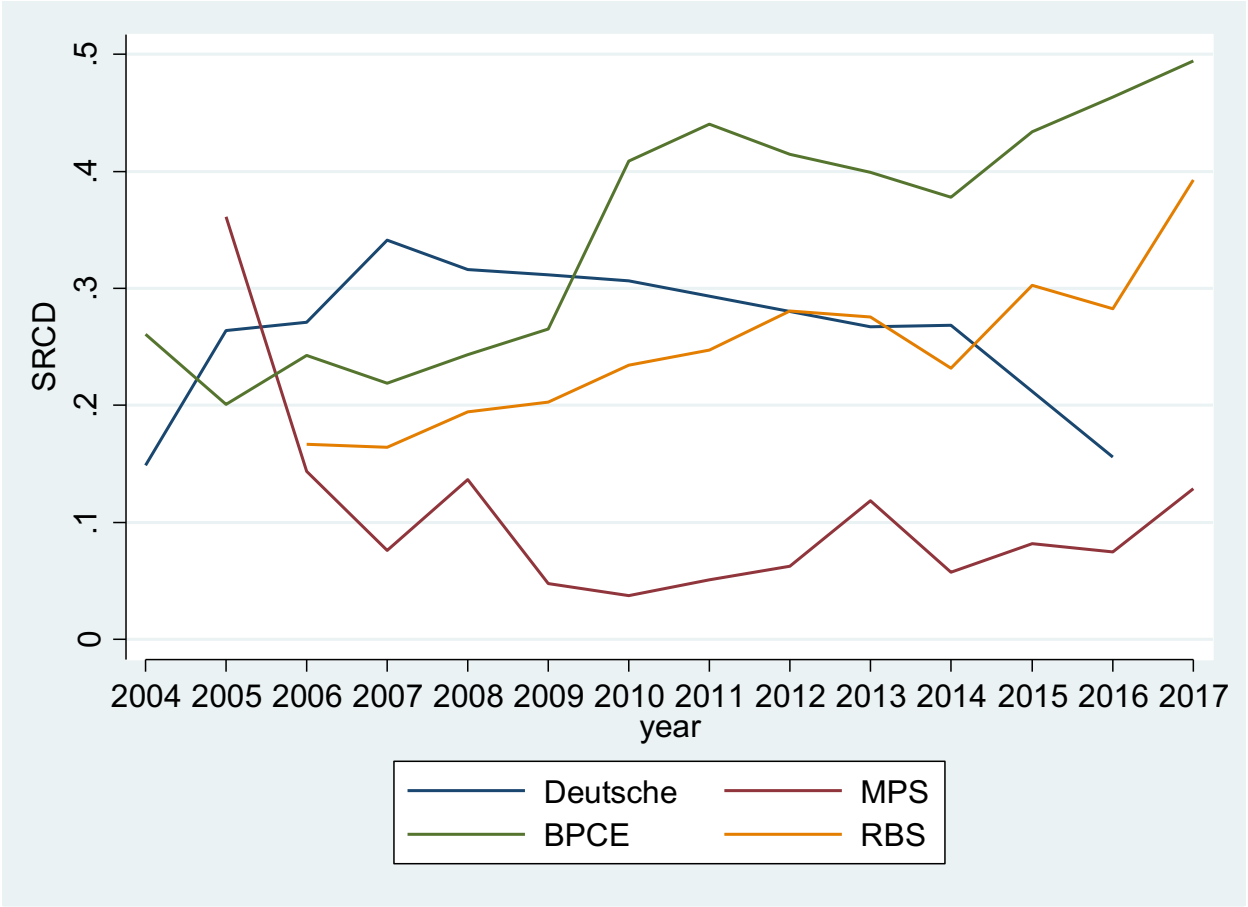


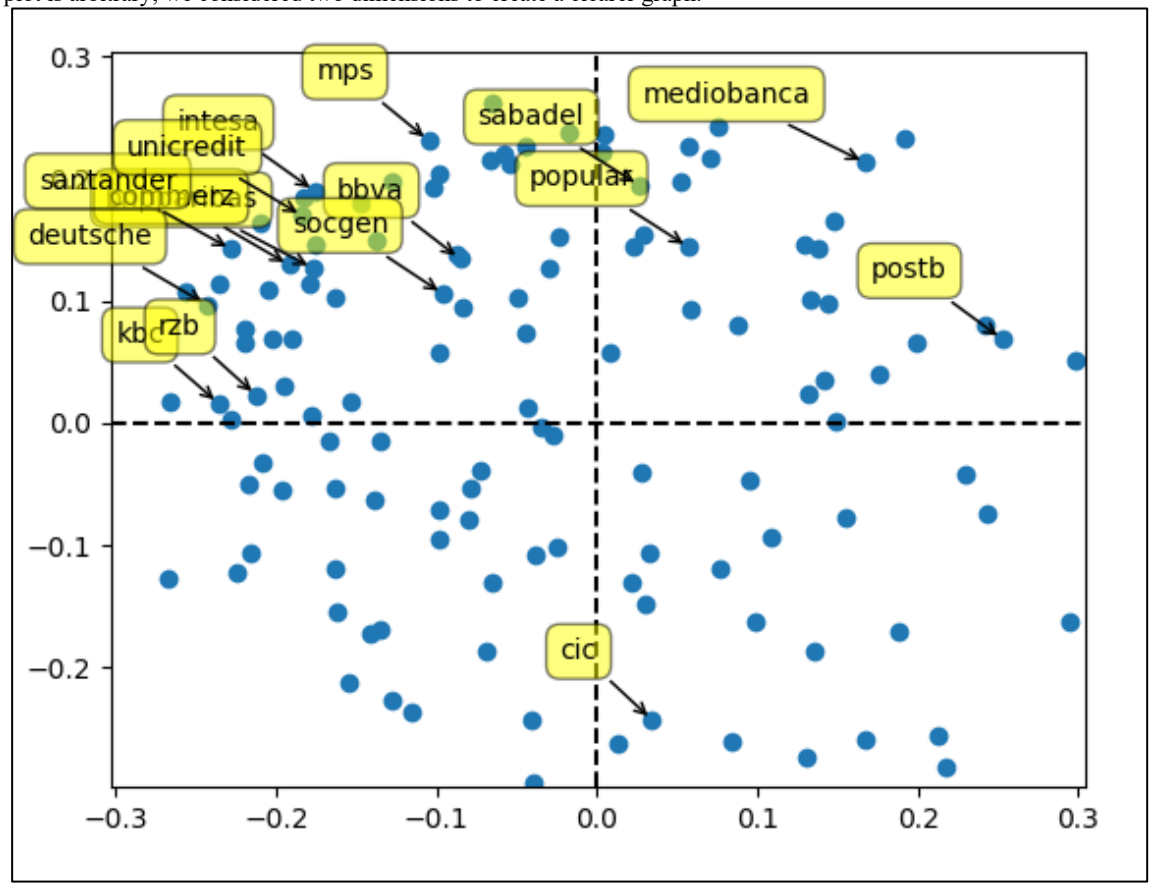
**Figure 3: Sound Risk Culture Density Indicators of Deutsche Bank, BPCE, Monte Paschi di Siena, and Royal Bank of Scotland**

Sound risk culture density indicator (SRCD) defined by equation (5) of four important European banks, Banque Populaire and Caisse d'Epargne (BPCE), Deutsche Bank AG, Banca Monte dei Paschi di Siena SpA, and Royal Bank of Scotland Group PLC. RBS and MPS show low levels of SRCD. Deutsche has higher values at the beginning of the period, but there is a decrease in the years of the LIBOR scandal.



## Figure 4: Multi-Dimensional Scaling of a Bank's Risk Dictionary

Multi-Dimensional Scaling scatter plot of a Bank's Risk Dictionary. The words included in the RD are those that appear in at least 5% of the sample from 2004 to 2017. A risk sentence is a sentence containing the word "risk" at least once. The distance $d_{i,j}$ between vector $v^i$and vector $v^j$is computed as $d_{i,j} = \cos(\theta_{i,j}) = \frac{v^{i,2} \cdot v^{j,2}}{\|v^{i,2}\| \cdot \|v^{j,2}\|}$, where $d_{i,j}$ is the *i-th*, *j-th* element of the distance matrix $D \in R^{B \times B}$. The vectors $v^1, \dots, v^b, \dots, v^B \in R^N$, where $B$ is the total number of banks, are such that the element $v_w^b$ of the vector $v^b$ is $v_w^{b,2} = \frac{n_{w,b}}{Nr_b} n_{w,b}$ is the number of *SS* in the documents of bank $b$ in which the word $w$ appears, $Nr_b$ is the total number of bank's *SS* and $v_w^b$ corrects for the amount of information disclosed by the bank. This is a graphic representation of the differences in banks' vocabularies; the higher the distance between two points, the higher the dissimilarity of the RD. The figure is just a portion of the complete graph in which some banks are underlined (Santander, Commerzbank, Deutsche, Raiffeisen Banking Group, KBC group, BNParibas, Mediobanca, Intesa Sanpaolo, Unicredit, Monte Paschi di Siena, Societe Generale, BBVA); although they have similar business models and dimensions, the data points are not close. The graph shows that there is no cluster of culture, as points did not collect in groups. The number of dimensions in the plot is arbitrary; we considered two dimensions to create a clearer graph.



## Table 1: Variable Sources and Descriptions

Variables used in the empirical analysis. Data were obtained from the following sources: (+) content analysis on banks' annual and Pillar 3 reports in English using original script in python; (*) calculation on content analysis results; (0) BankScope/BankFocus Databases, author calculation; (1*) World Bank national accounts data and OECD National Accounts data files; (2*) OECD International Migration Statistics: International migration database; (3*) DataStream (Thomson Reuters).

| Acronym | Variable | Description |
|---|---|---|
| TFTD | Tone from the top attention density | Total number of sentences containing word vectors associated with tone from the top over the bank's total phrases in the disclosure[+] |
| ACCD | Accountability attention density | Total number of sentences containing word vectors associated with accountability over the bank's total phrases in the disclosure[+] |
| COMD | Communication attention density | Total number of sentences containing word vectors associated with communication over the bank's total phrases in the disclosure[+] |
| INCD | Incentive attention density | Total number of sentences containing word vectors associated with incentives over the bank's total phrases in the disclosure[+] |
| SRCD | Sound risk culture tone density | Sum of tone from the top, accountability, communication and incentive tone densities* |
| SRCI | Sound risk culture indicator | Logarithm of sound risk culture tone density over its standard deviation in the last three years* |
| SRCI2 | Sound risk culture indicator with two-year rolling window | Logarithm of sound risk culture tone density over its standard deviation in the last two years* |
| SRCIR | Sound risk culture indicator restricted to risk vocabulary | Same as the SRCI but we computed density without using all the vectors of words in the framework (reported in the on-line Appendix I), just vectors of words containing the word "risk". * |
| TFTI | Tone from the top indicator | Logarithm of tone from the top tone density over its standard deviation in the last three years* |
| ACCI | Accountability indicator | Logarithm of accountability tone density over its standard deviation in the last three years* |
| COMI | Communication indicator | Logarithm of communication tone density over its standard deviation in the last three years* |
| INCI | Incentives indicator | Logarithm of incentives tone density over its standard deviation in the last three years* |
| SRCDvar | Sound risk culture density variation | Sound risk culture tone density in a year over the previous year's value* |
| SRCDvar$^{Q4}$ | Sound risk culture density variation dummy | Dummy with value one if the sound risk culture phrases' density variation in the year is in the fourth quartile of the sound risk culture's density variation distribution in the overall period* |
| sdSRCD3 | Sound risk culture tone density standard deviation | Standard deviation of sound risk culture phrase density in the previous three years* |
| sdSRCD2 | Sound risk culture tone density standard deviation with two-year rolling window | Standard deviation of sound risk culture phrase density in the previous two years* |
| GI\RWA | Gross income on risk-weighted assets | Income before taxes on risk-weighted assets[0] |
| ROA | Return on Assets | Gross income on total assets[0] |
| ROE | Return on equity | Gross income on equity[0] |
| lnTA | Natural logarithm of total assets | |
| TL\TA | Total loans on total assets | Gross loans (net loans plus reserves for impaired & NPLs) on total assets[0] |
| E\TA | Equity in total assets | |
| LIQA\TA | Liquid assets to total assets | Trading assets plus loans and advances with maturity less than 3 months over total assets[0] |
| LP\L | Loan provision on loans | Loan loss provision over gross loans[0] |
| CO\INC | Cost-to-income ratio | Overheads on net interest income plus other operating incomes[0] |
| ROA\VOL | ROA On Implied Volatility | Natural logarithm of the ratio between ROA and the implied volatility of stock prices[3*]. |
| crisis | | Dummy variable with a value of one from 2008 to 2017[0] |
| gdpgr | GDP growth rate | Annual percentage growth rate of the GDP at market prices based on constant local currency[1*] |
| IMMIGR | Immigrated population | Stock of foreign-born population (in millions) in the country[2*] |

| | | |
|---|---|---|
| Smog | Smog grade | Simple Measure of Gobbledygook) grade, a commonly used readability measure introduced by Mc Laughlin (1969) [+] |

## Table 2: Descriptive Statistics

The number of observations, mean, standard deviation, median, maximum, and minimum of the main analysis variables. All variables were winsorized at 1% and are described in Table 1. The total assets are expressed in EUR trillions. The sample includes the main banks' holdings in the Euro zone and U.K., active from 2004 to 2017, with total assets greater than EUR 1 billion and with at least one annual report in English. The banks' names were obtained from DataStream and the register of Significant Supervised Entities published by the BCE. The analysis focuses on large banks because they showed problems in guaranteeing a common risk culture throughout the organization. Balance sheet data were taken from BankScope/BankFocus databases. Data on the foreign-born population were obtained from the OECD database. We performed text analysis on data from documents with more than 50,000 words. After all adjustments, the sample included 92 banks, including the main European banks. Banks accounted for about 35% of the total assets of the countries' banking systems in 2017.

| | n | mean | SD | med | max | min |
|---|---|---|---|---|---|---|
| SRCD | 542 | 0.189 | 0.099 | 0.176 | 0.494 | 0.015 |
| TFTD | 542 | 0.071 | 0.043 | 0.064 | 0.224 | 0.004 |
| ACCD | 542 | 0.069 | 0.037 | 0.065 | 0.271 | 0.006 |
| COMD | 542 | 0.030 | 0.021 | 0.025 | 0.169 | 0.001 |
| INCD | 542 | 0.019 | 0.011 | 0.017 | 0.065 | 0.001 |
| SRCI | 542 | 1.946 | 1.050 | 1.945 | 6.128 | −1.810 |
| TFTI | 542 | 1.844 | 1.046 | 1.883 | 5.982 | −3.209 |
| ACCI | 542 | 1.957 | 1.081 | 1.982 | 7.408 | −2.222 |
| COMI | 542 | 1.796 | 1.105 | 1.742 | 5.484 | −1.444 |
| INCI | 542 | 1.921 | 1.049 | 1.875 | 6.419 | −3.043 |
| ROE | 542 | 0.030 | 0.225 | 0.073 | 0.509 | −1.283 |
| ROA | 542 | 0.002 | 0.016 | 0.004 | 0.039 | −0.152 |
| GI\RWA | 542 | 0.005 | 0.029 | 0.009 | 0.127 | −0.229 |
| ROA\VOL | 270 | −9.571 | 2.365 | −9.290 | −1.199 | −16.056 |
| TA(tril) | 542 | 0.405 | 0.572 | 0.119 | 2.103 | 0.001 |
| TL\TA | 542 | 0.572 | 0.182 | 0.603 | 0.915 | 0.090 |
| E\TA | 542 | 0.063 | 0.026 | 0.063 | 0.158 | 0.009 |
| LIQA\TA | 542 | 0.184 | 0.118 | 0.163 | 0.759 | 0.029 |
| LP\L | 542 | 0.011 | 0.012 | 0.007 | 0.075 | 0.000 |
| CO\INC | 542 | 0.636 | 0.231 | 0.629 | 1.601 | −0.764 |
| gdpgr | 542 | 0.579 | 3.065 | 1.145 | 25.117 | −14.274 |
| Smog | 530 | 16.723 | 2.133 | 16.500 | 40.100 | 11.500 |

**Table 3: Correlation among SRCI and SRC attributes**

We report in this table the correlation matrices. In panel A, we focus on the sound risk culture indicator (SRCI) and its attributes: Tone from the top indicator (TFTI), Accountability indicator (ACCI), Communication indicator (COMI), and Incentives indicator (INCI). In panel B, we report the correlation matrix among performance, SRCI and dependent, independent, and control variables. All variables were winsorized at 1% and are described in Table 1.

*Panel A − Sound Risk Culture Indicator and its components*

| | SRCI | TFTI | ACCI | COMI | INCI |
|---|---|---|---|---|---|
| SRCI | 1.00 | 0.92 | 0.89 | 0.78 | 0.75 |
| TFTI | 0.92 | 1.00 | 0.80 | 0.75 | 0.72 |
| ACCI | 0.89 | 0.80 | 1.00 | 0.67 | 0.71 |
| COMI | 0.78 | 0.75 | 0.67 | 1.00 | 0.59 |
| INCI | 0.75 | 0.72 | 0.71 | 0.59 | 1.00 |

*Panel B – All variables*

| | SRCI | ROE | ROA | GI\RWA | ROA\VOL | TA(tril) | TL\TA | E\TA | LIQA\TA | LP\L | CO\INC | gdpgr | Smog |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SRCI | 1.00 | 0.01 | −0.03 | 0.06 | −0.00 | 0.12 | −0.07 | −0.13 | 0.16 | −0.04 | 0.14 | 0.10 | −0.18 |
| ROE | 0.01 | 1.00 | 0.87 | 0.85 | 0.20 | −0.30 | −0.15 | 0.05 | −0.02 | −0.22 | −0.38 | 0.07 | −0.03 |
| ROA | −0.03 | 0.87 | 1.00 | 0.72 | 0.12 | −0.40 | −0.02 | 0.45 | −0.09 | −0.07 | −0.39 | 0.08 | −0.01 |
| GI\RWA | 0.06 | 0.85 | 0.72 | 1.00 | 0.25 | −0.20 | −0.26 | 0.02 | 0.02 | −0.28 | −0.35 | 0.13 | 0.03 |
| ROA\VOL | −0.00 | 0.20 | 0.12 | 0.25 | 1.00 | −0.24 | 0.21 | −0.02 | −0.28 | −0.22 | −0.10 | 0.20 | 0.04 |
| TA(tril) | 0.12 | −0.30 | −0.40 | −0.20 | −0.24 | 1.00 | −0.50 | −0.40 | 0.53 | 0.11 | −0.05 | 0.04 | −0.02 |
| TL\TA | −0.07 | −0.15 | −0.02 | −0.26 | 0.21 | −0.50 | 1.00 | 0.35 | −0.76 | 0.12 | −0.02 | −0.11 | 0.05 |
| E\TA | −0.13 | 0.05 | 0.45 | 0.02 | −0.02 | −0.40 | 0.35 | 1.00 | −0.28 | 0.27 | −0.20 | −0.01 | 0.00 |
| LIQA\TA | 0.16 | −0.02 | −0.09 | 0.02 | −0.28 | 0.53 | −0.76 | −0.28 | 1.00 | −0.01 | 0.05 | 0.14 | −0.12 |
| LP\L | −0.04 | −0.22 | −0.07 | −0.28 | −0.22 | 0.11 | 0.12 | 0.27 | −0.01 | 1.00 | −0.35 | −0.39 | 0.01 |
| CO\INC | 0.14 | −0.38 | −0.39 | −0.35 | −0.10 | −0.05 | −0.02 | −0.20 | 0.05 | −0.35 | 1.00 | 0.06 | 0.00 |
| gdpgr | 0.10 | 0.07 | 0.08 | 0.13 | 0.20 | 0.04 | −0.11 | −0.01 | 0.14 | −0.39 | 0.06 | 1.00 | 0.01 |
| Smog | −0.18 | −0.03 | −0.01 | 0.03 | 0.04 | −0.02 | 0.05 | 0.00 | −0.12 | 0.01 | 0.00 | 0.01 | 1.00 |

## Table 4: Sound Risk Culture Indicators' Effects on Risk-adjusted Performance Measures

The estimation results of equation (6) using the ratio between gross income and risk-weighted assets as the dependent variable ($y = GI\backslash RWA$). Columns (1) and (2) report our estimates using SRCI. Columns (3) to (6) report our estimates using each of the four attributes of the SRCI: Tone from the top indicator (TFTI), Accountability indicator (ACCI), Communication indicator (COMI), and Incentives indicator (INCI). We controlled for bank size (*lnTA*), business model ($TL\backslash TA$), capitalization ($E\backslash TA$), bank liquidity (LIQA\TA), loan loss provision on gross loans ($LP\backslash L$), and cost-to-income-ratio ($CO\backslash INC$). All independent variables are lagged by one year to manage a reverse causality problem. The number of observations decreased to 469 because we lost two years of data (2004 and 2005) due the rolling window applied to compute the SRCI. We considered only two years pre-crisis (2007 and 2006) and repeated the estimation in Section 6 using an SRCI built using a two-year rolling window to allow for inclusion of three years pre-crisis. We clustered the standard errors at the firm level. The standard deviations are shown in brackets, and stars correspond to the following p-value levels: * p < 0.1; ** p < 0.05; *** p < 0.01

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| $SRCI_{t-1}$ | 0.004*** | 0.004*** | | | | |
| | [0.001] | [0.001] | | | | |
| $TFTI_{t-1}$ | | | 0.004*** | | | |
| | | | [0.001] | | | |
| $ACCI_{t-1}$ | | | | 0.003*** | | |
| | | | | [0.001] | | |
| $COMI_{t-1}$ | | | | | 0.004*** | |
| | | | | | [0.002] | |
| $INCI_{t-1}$ | | | | | | 0.003** |
| | | | | | | [0.001] |
| $lnTA_{t-1}$ | | −0.015*** | −0.015*** | −0.013*** | −0.016*** | −0.014*** |
| | | [0.005] | [0.005] | [0.005] | [0.005] | [0.005] |
| $TL\backslash TA_{t-1}$ | | −0.058** | −0.061** | −0.056** | −0.055* | −0.051* |
| | | [0.028] | [0.028] | [0.028] | [0.028] | [0.028] |
| $E\backslash TA_{t-1}$ | | 0.274* | 0.285** | 0.263* | 0.269* | 0.256* |
| | | [0.140] | [0.137] | [0.140] | [0.141] | [0.140] |
| $LIQA\backslash TA_{t-1}$ | | −0.031 | −0.029 | −0.029 | −0.028 | −0.027 |
| | | [0.019] | [0.019] | [0.020] | [0.018] | [0.020] |
| $LP\backslash L_{t-1}$ | | −0.265 | −0.264 | −0.276 | −0.246 | −0.286 |
| | | [0.237] | [0.237] | [0.235] | [0.243] | [0.236] |
| $CO\backslash INC_{t-1}$ | | −0.004 | −0.004 | −0.004 | −0.003 | −0.004 |
| | | [0.007] | [0.008] | [0.007] | [0.007] | [0.007] |
| $gdpgr_{t-1}$ | | 0.002* | 0.002* | 0.002* | 0.002* | 0.002* |
| | | [0.001] | [0.001] | [0.001] | [0.001] | [0.001] |
| *N* | 469 | 469 | 469 | 469 | 469 | 469 |
| $R^2$ | 0.12 | 0.21 | 0.21 | 0.20 | 0.21 | 0.19 |
| $R^2adj$ | 0.10 | 0.17 | 0.18 | 0.17 | 0.18 | 0.16 |
| FE year | YES | YES | YES | YES | YES | YES |
| FE bank | YES | YES | YES | YES | YES | YES |

## Table 5: Sound Risk Culture's Effect on Performance Measures

Estimates of the SRCI's effect on different performance measures. Estimation results of equation (6) using the Return on Assets (*ROA*) and Return on Equity (*ROE*) as dependent variables (columns 1 and 2, respectively). In all models, we controlled for bank size (*lnTA*), business model (*TL\TA*), capitalization (*E\TA*), bank liquidity (LIQA\TA), loan loss provision on gross loans (*LP\L*), cost-to-income-ratio (*CO\INC*), and business cycle. All independent variables are lagged by one year to manage a reverse causality problem. The number of observations decreased to 469 because we lost two years (2004 and 2005) due to the rolling window applied to compute the SRCI. We consider only two years pre-crisis (2006 and 2007) and repeat the estimation in Section 6 using an SRCI built using a two-year rolling window to allow for inclusion of three years pre-crisis. The last column (3) uses the ratio between ROA and the implied volatility as dependent variables; in this last column, the number of observations drops to 256 because implied volatility was not available for all banks. We clustered the standard errors at the firm level. The standard deviations are shown in brackets, and stars correspond to the following p-value levels: * p < 0.1; ** p < 0.05; *** p < 0.01

| | $y=ROA_t$ | $y=ROE_t$ | y=ROA\VOL |
|---|---|---|---|
| | (1) | (2) | (3) |
| $SRCI_{t-1}$ | 0.002*** | 0.024*** | 0.132* |
| | [0.000] | [0.007] | [0.071] |
| $lnTA_{t-1}$ | −0.007*** | −0.207*** | −2.120*** |
| | [0.003] | [0.069] | [0.575] |
| $TL\backslash TA_{t-1}$ | −0.017 | −0.068 | 1.126 |
| | [0.021] | [0.352] | [1.525] |
| $E\backslash TA_{t-1}$ | 0.132 | 0.152 | 5.731 |
| | [0.082] | [1.444] | [12.799] |
| $LIQA\backslash TA_{t-1}$ | −0.018* | −0.072 | 0.225 |
| | [0.011] | [0.190] | [1.827] |
| $LP\backslash L_{t-1}$ | −0.177 | −2.830* | 29.583 |
| | [0.154] | [1.445] | [21.146] |
| $CO\backslash INC_{t-1}$ | −0.004 | 0.058 | 0.472 |
| | [0.004] | [0.082] | [0.608] |
| $gdpgr_{t-1}$ | 0.001* | 0.005 | −0.039 |
| | [0.001] | [0.008] | [0.105] |
| *N* | 469 | 469 | 256 |
| $R^2$ | 0.19 | 0.14 | 0.35 |
| $R^2adj$ | 0.16 | 0.11 | 0.31 |
| FE year | YES | YES | YES |
| FE bank | YES | YES | YES |

## Table 6: Sound Risk Culture Indicators' Effects on Risk-adjusted Performance Measures: 2SLS Instrumental Variable Approach

2SLS IV model estimation results. The model is described by equations (7) and (8). Column (1) reports the second stage results. We controlled for bank size (lnTA), business model (TL\TA), capitalization (E\TA), bank liquidity (LIQA\TA), loan loss provision on gross loans and bank efficiency (LP\L), and cost-to-income-ratio (CO\INC). Column (2) reports the first stage. IMMIGR is the immigration rate of a bank's home country in year *t*. The F-stat refers to the Kleibergen–Paap statistics for the weak instruments test (Kleibergen and Paap, 2006). Per the thresholds of Hausman et al. (2005), all test values were above the 10% critical value. The total number of observations decreased to 371 because IMMIGR data were not available for all countries in the sample. We clustered the standard errors at the firm level. The standard deviations are shown in brackets, and stars correspond to the following p-value levels: * p < 0.1; ** p < 0.05; *** p < 0.01

| | $GI\backslash RWA_t$ | $SRCI_{t-1}$ |
|---|---|---|
| | (1) | (2) |
| $SRCI_{t-1}$ | 0.007** | |
| | [0.003] | |
| $IMMIGR_{t-1}$ | | −0.870*** |
| | | [0.196] |
| $lnTA_{t-1}$ | −0.019*** | 0.310 |
| | [0.007] | [0.369] |
| $TL\backslash TA_{t-1}$ | −0.114*** | 2.847*** |
| | [0.036] | [1.022] |
| $E\backslash TA_{t-1}$ | 0.438* | −10.331* |
| | [0.240] | [5.815] |
| $LIQA\backslash TA_{t-1}$ | −0.032 | 1.373 |
| | [0.026] | [1.655] |
| $LP\backslash L_{t-1}$ | 0.055 | −21.533*** |
| | [0.174] | [8.155] |
| $CO\backslash INC_{t-1}$ | −0.002 | 0.201 |
| | [0.008] | [0.244] |
| $gdpgr_{t-1}$ | 0.002** | −0.052 |
| | [0.001] | [0.052] |
| *N* | 371 | 371 |
| $R^2$ | 0.23 | |
| rk F-stat | 19.6 | |
| FE year | YES | YES |
| FE bank | YES | YES |

## Table 7: Sound Risk Culture High and Low Variations' Effects on Banks Performance

Results of different models estimated considering the effect of high variation of the SRCD. Column (1) estimates the effect of the $SRCDvar^{Q4}$ (a dummy with a value of 1 if bank-*i*'s SRCDvar at time *t* is in the 4th-quartile (Q4) of the overall SRCDvar distribution). There were 407 observations because we lost observations from 2004 to build the variation index. Column (2) estimates the effect of the SRCI on the sub-sample of observations with SRCIvar in Q4 at *t*-1. Column (3) shows the previous estimation represented in equation (6), excluding all observations with high SRCD variation (we included only banks with an $SRCDvar^{Q4}$ of 0). Column (4) reports the results of the IV model on the same sample as in column (3). The F-stat refers to the Kleibergen–Paap statistics, which are above the 15% critical value. In all models, we controlled for bank size (lnTA), business model (TL\TA), capitalization (E\TA), bank liquidity (LIQA\TA), loan loss provision on gross loans and bank efficiency (LP\L), cost-to-income-ratio (CO\INC), and business cycle. We clustered the standard errors at the firm level. The standard deviations are shown in brackets, and stars correspond to the following p-value levels: * p < 0.1; ** p < 0.05; *** p < 0.01

| | $GI\RWA_t$ | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $SRCDvar^{Q4}_{t-1}$ | −0.005 | | | |
| | [0.003] | | | |
| $SRCI_{t-1}$ | | 0.000 | 0.004*** | 0.007** |
| | | [0.006] | [0.001] | [0.003] |
| $lnTA_{t-1}$ | −0.005 | −0.017 | −0.020** | −0.018** |
| | [0.007] | [0.016] | [0.008] | [0.008] |
| $TL\TA_{t-1}$ | −0.034 | −0.136 | −0.074* | −0.118*** |
| | [0.031] | [0.111] | [0.044] | [0.041] |
| $E\TA_{t-1}$ | 0.197 | 0.901*** | 0.277 | 0.484 |
| | [0.129] | [0.321] | [0.212] | [0.359] |
| $LIQA\TA_{t-1}$ | 0.014 | −0.042 | −0.027 | −0.042 |
| | [0.030] | [0.144] | [0.026] | [0.032] |
| $LP\L_{t-1}$ | −0.313 | −0.079 | −0.344 | 0.308 |
| | [0.203] | [0.726] | [0.224] | [0.367] |
| $CO\INC_{t-1}$ | −0.004 | 0.013** | −0.004 | 0.004 |
| | [0.007] | [0.006] | [0.007] | [0.007] |
| $gdpgr_{t-1}$ | 0.002* | 0.011*** | 0.001 | 0.001 |
| | [0.001] | [0.004] | [0.001] | [0.001] |
| *N* | 526 | 118 | 351 | 276 |
| $R^2$ | 0.20 | 0.59 | 0.24 | 0.25 |
| $R^2adj$ | 0.17 | 0.52 | 0.20 | |
| FE year | YES | YES | YES | YES |
| FE bank | YES | YES | YES | YES |
| rk F-stat | | | | 13.12 |

## Table 8: Robustness Checks

Results of different robustness tests. Column (1) reports the regression coefficients of the model in equation (6), estimated on the entire sample using SRCI2 (SRCI computed using a two-year rolling window). We include three years pre-crisis (2005, 2006, and 2007). In column (2), we used a modified version of the SRCI that is focused on banks' risk approaches (SRCIR). Column (3) repeats the same estimation as in column (2) in Table 4 on the years after the crisis (from 2009 to 2017). Both previous analyses tested if the results are consistent when the effects of the crisis are excluded or when a longer period is considered. The latter was obtained by repeating text analysis using only vectors of words in the SRC framework (reported in the on-line Appendix) that included the word "risk." Column (4) includes among regressors the Smog-index. Column (5) add a country*year fixed effects. We controlled for bank size (lnTA), business model (TL\TA), capitalization (E\TA), bank liquidity (LIQA\TA), loan loss provision on gross loans and bank efficiency (LP\L), cost-to-income-ratio (CO\INC), and business cycle. We clustered the standard errors at the firm level. The standard deviations are shown in brackets, and stars correspond to the following p-value levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

| | $y=GI\backslash RWA_t$ | $y=GI\backslash RWA_t$ | $y=GI\backslash RWA_t$ | $y=GI\backslash RWA_t$ | $y=GI\backslash RWA_t$ |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| $SRCI2_{t-1}$ | 0.002** | | | | |
| | [0.001] | | | | |
| $SRCIR_{t-1}$ | | 0.003*** | | | |
| | | [0.001] | | | |
| $SRCI_{t-1}$ | | | 0.005*** | 0.004*** | 0.002* |
| | | | [0.002] | [0.001] | [0.001] |
| $lnTA_{t-1}$ | −0.007 | −0.014*** | −0.015** | −0.015*** | −0.003 |
| | [0.007] | [0.005] | [0.006] | [0.005] | [0.007] |
| $TL\backslash TA_{t-1}$ | −0.039 | −0.056* | −0.063** | −0.063** | −0.044** |
| | [0.032] | [0.029] | [0.031] | [0.030] | [0.021] |
| $E\backslash TA_{t-1}$ | 0.223 | 0.241* | 0.259 | 0.249* | 0.332** |
| | [0.142] | [0.142] | [0.168] | [0.141] | [0.163] |
| $LIQA\backslash TA_{t-1}$ | 0.023 | −0.037* | −0.053* | −0.034* | −0.054 |
| | [0.030] | [0.020] | [0.028] | [0.020] | [0.038] |
| $LP\backslash L_{t-1}$ | −0.324 | −0.339 | −0.123 | −0.280 | 0.290 |
| | [0.226] | [0.250] | [0.237] | [0.245] | [0.249] |
| $CO\backslash INC_{t-1}$ | −0.004 | −0.005 | −0.003 | −0.005 | 0.002 |
| | [0.008] | [0.008] | [0.008] | [0.008] | [0.004] |
| $gdpgr_{t-1}$ | 0.002 | 0.002* | 0.002* | 0.002* | −0.001 |
| | [0.001] | [0.001] | [0.001] | [0.001] | [0.011] |
| $Smog_{t-1}$ | | | | 0.001 | |
| | | | | [0.000] | |
| *N* | 499 | 459 | 411 | 457 | 469 |
| $R^2$ | 0.20 | 0.21 | 0.17 | 0.21 | 0.19 |
| $R^2adj$ | 0.17 | 0.18 | 0.13 | 0.18 | 0.16 |
| FE year | YES | YES | YES | YES | NO |
| FE bank | YES | YES | YES | YES | YES |
| FE year*country | NO | NO | NO | NO | YES |