

Revenue diversification and insolvency risk of Brazilian banks

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Abstract

This study aim to investigate the relationship between revenue diversification and banks' insolvency risk. We test the hypothesis that greater revenue diversification reduce insolvency risk. The sample was composed by financial institutions whose data referred to the period of 1997 to 2015. Using panel data models and the system GMM estimator, the results indicate that, in the period studied, banks' revenue diversification has not influenced their insolvency risk. However, when analyzing the effect of diversification between publicly-traded banks and closely held banks, we have evidence that when publicly-traded banks diversify their operations, they reduced insolvency risk, what does not occur with closely held banks. Evidence indicates that profitability increases bank insolvency risk, while capitalization is negatively related to risk.

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1. INTRODUCTION

One of the most important bank activities is the intermediation of resources between agents. These resources are used mainly to finance investments and stimulate consumption. These facts contribute to the generation of employment and income, what makes their activity relevant to a country's economic growth; therefore, financial institutions are subject to strong regulation in order to reach greater efficiency and reduce the probability of bankruptcy.

One of the ways of improving the efficiency of the banking sector is by diversifying institutions' activities, since banks can offer several services to their clients using a single administrative structure. Several theories can be applied regarding the reason for which banks diversify their operations. Montgomery (1994) mentions three approaches with respect to the reason why companies diversify their operations, namely: market power view, agency-theory view and resource-based view. They are related, respectively, to the use of profits from other markets and their application in new segments, managers' interests regarding operation diversification, and a more efficient allocation of resources controlled by the companies.

Sanya and Wolfe (2011) list some of the most important motivations for bank diversification, including the protection against insolvency risk, which reduces the occurrence of financial distress. Diversification can also be used as a mechanism to increase institution's profitability and operational efficiency, especially by increasing the scale and scope of its operations. It is also possible to mention the use of revenues other than income from credit operations so as to reduce cyclical variations in profitability, being a hedge for these variations and making accounting profit more persistent, where there is also creation of competitive pressures on banking sector for greater variety of segments that increase innovation and efficiency of the services offered (SANYA; WOLFE, 2011). Considering credit operations as traditional activities, Brazilian banks diversify their activities by providing banking services, foreign exchange and commercial lease operations, income obtained through financial investments and corporate interest.

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However, studies on bank revenue diversification have not been conclusive in terms of their impact on financial institutions, since different results were found in studies with data from emerging (SANYA; WOLFE, 2011) and developed countries (LEPETIT; NYS ROUS, TARAZI, 2008); between large and small banks (STIROH, 2004a; STIROH, 2004b); and among the several measures of diversification used in the literature (ELSAS; HACKETHAL; HOLZHÄUER, 2010).

Several lines of research have been explored with respect to the effects of diversification on financial institutions, such as their relationship with the value of the company (ELSAS; HACKETHAL; HOLZHÄUER, 2010; BAELE; De JONGUE; VERNETT, 2007), profitability (TRUJILLO-PONCE, 2013) and risk (STIROH, 2004a; STIROH, 2004b; STIROH, 2006; LEPETIT; NYS; ROUS; TARAZI, 2008; SANYA; WOLFE, 2011). This is a relevant issue especially in Brazil, because of the fact that there is a very concentrated banking market in the country, where few banks hold most of the assets traded in the financial system. Among other reasons, sector concentration, regulation and economic importance highlight the need for studying the effects of revenue diversification on banks' risk, so that it is possible to plan policies in order to avoid a generalized crisis in the sector.

However, concerns about this matter are not a new issue in Brazil, since Brazilian government has taken a great deal of effort to regulate and increase banking efficiency over time. Among the most relevant legal reforms, it is worth mentioning Law No. 4,595 of 1964, known as Banking Reform Law, which restructured the National Financial System (SFN); National Monetary Council (CMN) Resolution No. 1,524 of September 21, 1988, which created the multiple banks and encouraged the consolidation of other types of financial institutions into multiple banks, and financial system adjustment programs (PROER, PROES). The enactment of CMN Resolution No. 1,524 allowed banks to explore more than one activity, creating economies of scale to operate in several markets from a single administrative structure.

Because of the limited number of national studies on this subject and its importance, this paper seeks to contribute to the empirical literature that addresses the costs and benefits of banking activities diversification. This paper aims specifically to identify the impact of Brazilian financial institutions' operation diversification on its insolvency risk measured by the Z-Score. In general, results indicate that, contrary to previous results (such as Sanya and Wolfe, 2011), revenue concentration/diversification level does not affect banks insolvency risk in the period analyzed. This paper presents similar evidence when diversification is taken as the number of sectors in which the company operates. However, Sanya and Wolfe (2011) used only banks listed on stock exchanges of several emerging countries, while the sample in this article contains both publicly-traded banks and closely held banks.

When considering the impact of diversification on publicly-traded banks, we found out a negative relationship between revenue diversification and insolvency risk, similarly to Sanya and Wolfe's study results (2011). We see our results as a monitoring effect that takes place in publicly-traded banks (LAEVEN; LEVINE, 2009, HAAN; VLAHU, 2016). This research is organized as follows: a) theoretical framework based on the formulation of the research question, followed by some previous studies on the topic discussed; b) methodology used in data analysis; c) analysis of the results of our research; and d) final considerations on the results obtained.

2. THEORETICAL FRAMEWORK

2.1. Diversification in Financial Institutions

In 1988, CMN Resolution 1,524 permitted Brazilian banks to be organized into multiple banks, where the same institution would be able to operate in several segments through a single structure. With the creation of the Plano Real (Real Plan) in 1994, inflationary revenues from the floating were eliminated, leading financial institutions to compensate for this decrease in income by increasing credit offer, which was attractive due to the high interest rates practiced in the country at the time. These operations were also motivated by the increase in the country's economic growth, which demanded companies' investment capital (CAMARGO, 2009).

However, to protect Brazilian economy from inflationary pressure, the government imposed some restrictions to the expansion of such operations. We can mention restrictions such as capital requirements and the establishment of compulsory deposit on the loans granted by the institutions.

According to Camargo (2009, p. 93), “the replacement of profits from high rates by income from services led to an improvement of customer power [...] based on this model, banks create product differentiation and packages of services.” These facts contributed to the search for maximization of financial institutions’ profits through the use of their physical structure to offer several other services to their clients.

According to Stiroh (2004a), the change in the banking income to non-traditional revenues (income unrelated to credit operations) has begun to arise, contributing to an increase in banks total revenue. There is a common sense that this change in revenue structure may increase profits and decrease revenue volatility by reducing risk, since these new ways of generating income are less dependent on global economic conditions.

Elsas, Hackethal and Holzhäuer (2010, p. 1274) point out that, unlike most other sectors, banks maintain long-term relationships with their clients, collecting and storing their data. Data from their clients is used to offer other types of services, generating economies of scale due to the maintenance of a single structure which provides several different types of services. However, the use of an already established structure is not the only reason for the diversification of segments in which a company operates. The main theories regarding the reason behind firm diversification are cited by Montgomery (1994) as being: (a) market power view; (b) agency-theory view; and (c) resource-based view. In market power view, the benefits of diversification come from the use of profits from a market as a subsidy for the practice of aggressive prices in other markets, and from the purchase and sale of resources between the institutions of the conglomerate at more competitive prices.

According to the agency-theory view, managers may use diversification strategies to achieve their own well-being in companies where there is separation between ownership and control. Considering that the company’s shareholders may diversify their investments into several companies, reducing their investment risk, managers, on the other hand, may use the diversification inside the firm to reduce the risk in the company they work for. As such, the management team could diversify bank operations with the aim of gaining experience in the sector and, consequently, professional growth, without necessarily increasing the expected shareholders’ return due to greater risk-taking.

Finally, the resource-based view, or resources allocation view, states that by diversifying its activities, the company may use idle resources from other activities, making better use of its assets to generate the return desired by shareholders (MONTGOMERY, 1994). Baele, De Jongue and Vernet (2007) mention other dimensions in which diversification may be beneficial to financial institutions: (a) the combination of several institutions into a single conglomerate increases the capacity to generate income while decrease operational costs by economy of scale resulting from the division of labor, technology and information on several consumers of different banking products; and (b) information held by banks on the relationship with their clients may improve risk management and services offered.

2.2. Empirical Evidence

Stiroh (2004a) considered the increasing of banking industry confidence in non-traditional activities to study the potential benefits of revenue diversification, mainly in relation to profit volatility and insolvency risk. During the period analyzed (from 1984 to 2001), evidence was found that diversification may be beneficial to institutions in the way they could achieve more stable profits and income. Regarding specific sources of income, charges and fees related to services are highly correlated with the net income from credit operations. There is a negative association between bank income arising from activities not related to credit operations and profit per unit of risk. Stiroh (2004a) also found out that financial intermediation activities are the major obstacles to profitability per unit of risk, suggesting that continued expansion may result in low risk-adjusted returns. Income derived mainly from investment management is highly associated with profitability per unit of risk and greater stability of profit growth.

Stiroh (2004b) investigated the relationship between bank revenue diversification and risk-adjusted performance. By using data from small community banks (those whose assets value are lower than \$300 million and have no link with another bank, such as holding companies), for the period of 1984 to 2000, he found that that income from non-traditional activities are related to decreases in risk-adjusted performance. This relationship may be linked to the fact that community banks have been expanding their activities without enough experience and know-how to dominate the new markets. The results also show that income from commercial and industrial loans and financial intermediation is associated with decline in profits and high risk to community banks.

Stiroh (2006) analyzed the risk of banking holding companies (measured by the volatility of US publicly-traded bank stocks) from 1997 to 2004. As shown in previous studies (STIROH, 2004A; STIROH, 2004b), revenue concentration was measured by sets of two or five variables, with Herfindahl-Hirschman Index (HHI) between income from credit operations (also measured net of related expenses) and non-traditional operations. The results suggest that commercial and industrial loans, in addition to activities other than those of credit, are related to high risks of the institutions during the period studied.

In the same line of research, Mercieca, Schaeck and Wolfe (2007) analyzed annual reports of small European banks (those with assets whose value is lower than €\$450 million and not affiliated with banking holding companies), resulting in a 755-institution sample for the analyzed period of 1997 to 2003. This study aimed to analyze whether the replacement of activities related to credit operations by different ones increased banks' performance. The analysis showed a negative correlation between non-traditional activities and risk-adjusted performance. These findings suggest that small European banks are not benefiting from diversification for possibly exploring in which they do not have know-how and experience. Regarding control variables, size was positively related to profitability, indicating economy of scale in these institutions.

Lepetit et al. (2008) investigated the relationship between bank risk and revenue diversification in 14 countries from Europe. The analysis covered the period between 1996 to 2002 and used a sample of 734 banks, 156 listed on the stock exchange. In order to measure revenue diversification, the authors used the ratio of income from activities other than credit operations, net of respective expenses, divided by the operating income, net of respective expenses (this can be understood as income from credit operations, net of collection expenses, plus income not related to credit operations, net of corresponding expenses). The results showed that banks that operate in segments other than credit presented a higher risk level than those that focus on credit activities. There was also a positive relationship between risk and revenue diversification, which is more robust for small banks (those with assets lower than €\$1 billion), and the risk positively related mainly to the income from fees charged for rendering services in relation to total revenues. These results are different when compared to the ratio between risk and income from financial intermediation, which may imply risk reduction for small banks.

Sanya and Wolfe (2011) investigated the relation between banking revenue diversification, performance and risk. The sample consisted of 226 listed banks in 11 different emerging countries, for the period of 2000 to 2007. In order to verify the effects of diversification on insolvency risk, three measures of risk were used, namely: Z-score; risk adjusted by the ROE (Return on Equity) and risk adjusted by the ROA (Return on Assets). Among the results obtained, it is worth mentioning that the diversification between and within the lines of business increased the risk adjusted to profitability and decreases the insolvency risk measured by the Z-score.

Also, it is worth highlighting that there is no connection between the income from activities other than credit operations and profitability, and that income from service fees increases profitability and decreases banking risk. Finally, value creation increases as consequence of banking revenue diversification in emerging countries, another relevant result of the research.

3. METHODOLOGY

3.1. Sampling selection and composition

Our sample are composed by data from all financial institutions operating in Brazil classified as banks that had individual semi-annual balance sheets presented on Brazilian Central Bank's website (www.bcb.gov.br). We collected data from 1994 to 2015. We chose this period because it coincides with the establishment of the Plano Real, which contributed to stabilizing Brazil's inflation indexes after years of hyperinflation.

Data regarding banking revenue structure, total assets, owners' equity and loans made at the end of the semester, in addition to operating income for each period were collected from each bank during each semester. Due to the lack of data referring to the variables used in our model, some of these banks were excluded from our sample. In addition, banks that had excess of liabilities over assets in any of the sampling periods were excluded. Finally, in order to build a balanced panel, banks that failed to disclose information for any of the periods were excluded from the sample.

Since some risk measures demanded averages that included data with time lags of three years (six semesters), the risk measures have not been computed for the years 1994, 1995 and 1996, and the data analysis effectively started from the first half of 1997 and extend to the first half of 2015.

The final sample is composed of a balanced panel with 88 institutions, totalizing 3,256 observations for 37 semesters. Data collection on the type of bank (publicly-traded or closely held) was performed at the website of the Brazilian Securities and Exchange Commission (www.cvm.gov.br). Macroeconomic variables regarding Gross Domestic Product (PIB [GDP]) and inflation (IPCA [Extended National Consumer Price Index]) were collected at the websites of the Brazilian Institute of Geography and Statistics (www.ibge.gov.br) and Brazilian Central Bank.

3.2. Hypotheses Development and Model Definition

Considering there is a negative association between the level of bank diversification and insolvency risk (e.g. SANYA; WOLFE, 2011), the following research hypothesis is presented:

H_1 : *Revenue diversification positively influences the reduction of insolvency risk of financial institutions.*

In the model used to test the research hypothesis, the Z-score is used to measure the probability of insolvency of a financial institution i in year t . The higher the Z-score value the lower the probability (and consequently the risk) of insolvency of each institution. The Z-score used in this research is calculated by Boyd, De Nicoló and Jalal's approach (2006, section III.A), modified by Lepetit and Strobel (2013), and Yeyati and Micco's approach (2007). The Z-Score formula basically consists of the sum of the ROA, according to equation (1), and the ratio between owners' equity and assets, divided by the ROA standard deviation, as shown in equation (2):

$$ROA_{it} = \frac{\text{Net Income}_{it}}{\text{Total Assets}_{it}} \quad (1)$$

$$Z - \text{Score}_{it} = \frac{ROA_{it} + \frac{\text{Equity}_{it}}{\text{Total Assets}_{it}}}{\sigma ROA_{it}} \quad (2)$$

In Boyd et al.'s approach (2006), modified by Lepetit and Strobel (2013), they use the moving average ROA and the ratio between owners' equity and assets over ROA moving standard deviation for the last three years. In Yeyati and Micco's approach (2007), the moving average ROA and standard deviation are used for the last three periods, while the ratio between owners' equity and assets is calculated for the current period. To contrast these variables, we will consider Boyd et al.'s approach (2006), modified by Lepetit and Strobel (2013), as Z-Score 1, and Yeyati and Micco's approach (2007) as Z-Score 2.

In order to measure revenue diversification, the HHI was calculated by separating revenues according to their nature designed at Accounting Plan for Institutions of the National Financial System (COSIF). According to Paulo, Medeiros and Dantas (2011, p.13), the HHI for a period t is measured by the sum of the square of the percentage participation p of each type of revenue, and its calculation is shown by equation (3):

$$HHI_t = \sum_{i=1}^N p_i^2 \quad (3)$$

The index was manipulated to improve data interpretation, where the original value of HHI (1-HHI) is subtracted from the number 1 (one), which indicates that the higher the index, the greater the bank's revenue diversification. This index will be named Adjusted HHI (HHIadj). Another diversification measure used in the study was the number of operating income (N) earned in the period, which indicates the number of markets in which the institution operates. This measure was chosen because it is an alternative representation for the HHI, and the latter provides a concentration measure of the income earned, where even correlated with the number of markets in which the company operates, it does not indicate the variability of these segments with total reliability. The limitations of the variable N should also be taken into account, where small income amount may not characterize real diversification of the segments in which an institution operates.

Some control variables have been included to reflect other characteristics that may affect insolvency risk. These variables were divided into sector-specific and macroeconomic variables. Among the sector-specific variables, we considered those used in Sanya and Wolfe's work (2011) which include bank size, leverage, profitability, credit operations index and asset growth. Bank size was measured by the logarithm of banks' total assets, as well as in several previous studies that used this measure as a control variable (STIROH, 2004A; STIROH, 2004B; MERCIECA et al., 2007; SANYA; WOLFE, 2011) under the justification that some large banks are 'too big to fail'. The too-big-to-fail hypothesis states that due to the larger scale of their operations and the risk their downfall would generate for the economy, large banks have implicit guarantee of government aid in the case of financial distress. This implicit assurance may lead larger institutions to operate in riskier markets as a way of obtaining higher returns.

On the other hand, because of the systemic importance of the institution, the government may regulate these banks in order to limit their risk taking. This characteristic also generates more diversification opportunities due to its larger structure. The advantage that large banks have in carrying out larger and better-quality credit operations can be listed as another reason for a positive relationship between size and low risk levels (SANYA; WOLFE, 2011). For this measure, we adjusted asset value by the inflation index for the same date. Still, we used an alternative measure of size of the institution, represented by two dummy variables named Small and Big, which respectively represent the 25% smallest and largest banks each year. This measure aims to capture any non-linear relationship between the size of the institutions and their insolvency risk.

The variable representing capitalization, also called leverage, was also used in previous researches as a control variable for insolvency risk (STIROH, 2004A; STIROH, 2004B; MERCIECA et al., 2007; LEPETIT et al., 2008; SANYA; WOLFE, 2011), based on the assumption that greater capitalization (lower leverage) reduces the probability of insolvency of a bank. We measured this variable by the ratio between Equity and Total Assets.

Profitability was represented by the ROA under the assumption that if a bank with small profitability decides to diversify, greater insolvency risk may be incorrectly attributed to the decision to diversify. This same variable was employed in previous papers on income diversification (Lepetit et al., 2008; Sanya & Wolfe, 2011).

In order to measure the credit operations index, one used the variable Total Loans over Total Assets (STIROH, 2004B; MERCIECA et al., 2007; LEPETIT et al., 2008; SANYA; WOLFE, 2011), because loans are less liquid in relation to other credit operations receipt time, and not available immediately for the settlement of debts, therefore influencing the insolvency risk of financial institutions.

An important firm-specific variable added to the model was asset annual growth (from t-2 to t) taking into account that disorderly growth may cause an institution to face liquidity problems, where investments in fixed capital or working capital can reduce cash flow for debt payment. We used the actual rate of growth/reduction of banking activities (above inflation). This variable was used in other papers in the same line (STIROH, 2004A; STIROH, 2004B; MERCIECA et al., 2007; LEPETIT et al., 2008; SANYA; WOLFE, 2011).

Another institutional characteristic investigated in risk studies is whether banks negotiate their securities in the capital market. We added a dummy variable (Publicly-traded) to capture the effect of a bank trading its securities in the Brazilian capital market on insolvency risk. The variable has a value of 1 (one) for publicly-traded banks, and 0 (zero) otherwise. Lepetit et al. (2008) used a sub-sample with banks listed on stock exchange to assess the impact of diversification on insolvency risk. Publicly-traded banks are expected to be more risk tanking because of stockholder pressure. On the other hand, faster access to capital markets, higher quality of the disclosed financial information and best practices of corporate governance (expected characteristics in listed companies) may lower capital cost and lower risk (HAAN, VLAHU, 2016).

Macroeconomic variables used in the model are representative of the systematic risk to which all banks are subject, and these variables may influence the insolvency risk and the diversification of banks' investments portfolio. Based on previous studies, GDP growth index, provided by the IBGE, and inflation rate (SANYA; WOLFE, 2011), measured by the IPCA, were chosen, assuming that changes in the economy may reduce or boost institutions' certain types of operation, as well as their risk.

Additionally, variables related to market competition were added, represented by the HHI measured from the Assets value of all financial institutions operating in a given period t. The index indicates higher competition for lower values and lower competition for higher values. The consolidation of all these variables have equation (4) as a result, which we use to assess the effects of revenue diversification on insolvency risk of Brazilian banks in the period of 1997 to 2015.

$$Z - \text{Score}_{it} = \beta_0 + \beta_1 \text{HHIadj}_{it} + \beta_2 \text{N}_{it} + \beta_3 \text{Size}_{it} + \beta_4 \text{D/E}_{it} + \beta_5 \text{ROA}_{it} + \beta_6 \text{CreditOp/Assets}_{it} + \beta_7 \text{AssetGrowth}_{it} + \beta_8 \text{PubTraded}_{it} + \beta_9 \text{GDP}_t + \beta_{10} \text{Inflation}_t + \beta_{11} \text{Competition}_t + \varepsilon_{it} \quad (4)$$

Since each institution may contain specific non-observable characteristics, we use fixed effect estimators (Fixed Effects – FE) to investigate the relationship between bank diversification and insolvency risk. In addition, some features that affect banking risk are difficult to measure or identify in an equation (unobservable heterogeneity). Not considering the influence of these characteristics induce the coefficients to become biased by the correlation between the coefficients and the explanatory variables (SANYA; WOLFE, 2011; TRUJILLO-PONCE, 2013). To solve this problem, we used Generalized Method of Moments (GMM), an estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998), also known as system GMM.

4. ANALYSIS OF THE RESULTS

4.1. Descriptive statistics

Table 1 shows the sample descriptive statistics. Our analysis begins by looking at the dependent variables on the model, which represent the insolvency risk of the banks: Z-Score1 and Z-Score2. Z-Score measures the insolvency risk in relation to the probability that negative results may deplete the bank's capital reserves, thus, the lower the Z-Score, the greater the insolvency risk. Both Z-Score indicators show means close to 9.50. For a sample composed of small European banks (MERCIECA, SCHAEK, WOLFE, 2007) and emerging countries (SANYA; WOLFE, 2011), means of 58.8 and 17.69 were found, respectively. Therefore, we can observe that our sample present higher risk than those studied by the mentioned authors.

The adjusted HHI shows a mean value of approximately 0.549, close to the median value of the distribution, indicating a central trend for this variable. When studying Spanish financial institutions, Trujillo-Ponce (2013) found means for this index close to 0.725, indicating greater segregation between gains from different types of operating activities compared with Brazilian institutions. However, different results were found compared to the aforementioned study, which classified the main activities of the banks into four, our paper uses COSIF criteria, which classify the types of income into 9 (nine) groups. The minimum value of 0.0000 for this variable indicates a bank that explores only one economic activity.

At the same time, we observe that the number of activities in which banks operate (N) presents mean close to 6 (six), as well as their median, indicating an exploration of a high number of activities. In our sample, the most diversified institutions explore a total of eight different productive activities, which is the limit established by COSIF. The minimum number for this variable indicates a bank focused in only one activity to generate income over a period. It is important to note that this minimum value corresponds to only one observation contained in the sample.

In the presentation of statistics on the size of the institutions, we used the original values, since in regression models these values were adjusted to consider the impact of inflation on the size of the banks. The variability of banks' size, measured by their total assets value, shows that our database was composed of both banks with trillions of assets and banks with a little more than R\$ 13 million in assets. Banks have assets with average values of R\$ 193 billion. Comparing this value with the median, it is observed that most of the sample consists of small and medium banks.

As stated before, the nature of banking operations causes them to use mainly debt to make profit, and the ratio of equity to assets is usually low. This assertion is corroborated by the mean and median of the ratio between equity and total assets, where, on average, only 8.67% of total assets of banks are financed by equity. The institutions that presented negative values for this variable were excluded from the sample. The minimum value for this variable reaches 0.03%, where it is possible to imagine that minimum values represent banks whose owners' equity was possibly affected by successive losses. Low capitalized banks may pose serious risks to the financial system, and the Brazilian Central Bank is responsible for avoiding the excessive leverage of these institutions. Finally, the maximum values represent, possibly, institutions that do not carry out activities of resource intermediation, for which high amounts of debt are required.

An analysis of the profitability of our sample in the period studied indicates that, on average, the institutions recorded positive returns in relation to their assets, with a return close to 9.41%, where the maximum and minimum values stand out. In relation to maximum values, a bank earned profits that corresponded to approximately 4 times the value of its total assets. At the other extreme, a bank earned a small profit margin of only 0.04% the value of its total assets.

Credit operations (loans) represented, on average, 8.67% of the banks' assets in the period studied, indicating that these operations are among the least prominent in these institutions. This shows a deviation from the model of banks as financial intermediaries. Maximum and minimum extremes show institutions in their active applications and are represented in more than half by loans, while others do not use these operations for income generation.

When analyzing asset growth of Brazilian banks, it is observed high growth in the Brazilian market, where there was actual 37.46% average growth from one year to other. The maximum values possibly indicate the growth of the banks by incorporation and merger of institutions, which are operations of great magnitude. The minimum values possibly indicate the dissolution of companies through the sale of their operations, spin-off into different companies or abandonment of some market segment. Publicly-traded banks were 15.97% of the observations in our sample.

Table 1. Descriptive statistics

Variables	Mean	Median	S.D.	Maximum	Minimum
Z-Score1	9.4589	5.3340	12.4358	113.8787	0.5038
Z-Score2	9.4241	5.1219	12.6688	119.3953	0.4478
HHIadj	0.5486	0.5865	0.1825	0.8421	0.0000
N	6.1809	6.0000	1.2012	8.0000	1.0000
Assets (\$mi)	193,294.03	6,251.41	741,211.77	8,752,261.20	13.12
Equity/Assets	0.0891	0.0382	0.1428	0.9527	0.0003
ROA	0.0941	0.0656	0.1387	4.3205	0.0004
Loans/Assets	0.0867	0.0611	0.0891	0.6637	0.0000
GrowthAssets	0.3746	0.0667	3.5529	162.3632	-0.9968
Publicly-traded	0.1597	0.0000	0.3664	1.0000	0.0000
GPD	0.0183	0.0217	0.0414	0.1182	-0.0587
Inflation	0.0317	0.0294	0.0167	0.0931	-0.0062
HHIAssets	0.1098	0.1005	0.0498	0.1982	0.0496

Source: Elaborated by the authors

Considering the institutions index concentration, Trujillo-Ponce (2013) establishes that values for HHI above 0.18 indicate highly concentrated markets, while values below 0.10 indicate more competitive markets. Our sample covers periods of high and low concentration of banks in the country. The mean of this indicator is close to that of markets with competitive equilibrium.

4.2. Relation between Revenue Diversification and Banks' Risk

The results obtained by regression estimates are shown in table 2. We compared the results obtained by FE and system GMM estimators. We observed some differences between the results of the estimators, which can be justified by the possible endogeneity mitigated by the system GMM approach³, which makes the latter a more reliable estimator. Through statistic F (FE estimators) and the Wald test for joint significance of the regressors (system GMM estimators) at 1% significance level, we rejected the null hypothesis that any of the regression models were incorrectly specified.

We can observe that diversification, measured both in relation to revenue concentration and in relation to the number of activities explored by banks in a given period, is not statistically significant in any of the models studied, indicating that a company's choice to concentrate either in one or several economic activities does not influence its insolvency risk.

Due to our results, we can infer that diversification does not bring benefits to banks as risk reduction, even with the advantages of this practice discussed in the literature, where the diversification into several economic sectors may improve the results of these institutions in scenarios of economic changes. In this case, banks are less dependent on cyclical revenues when the economic scenario does not allow a better profit-making through these revenues. These results differ from Stiroh (2004a), Stiroh (2006) and Sanya and Wolfe (2011), who found a positive relationship between diversification and risk reduction of financial institutions. However, Stiroh (2004b) and Lepetit et al. (2008) found different results, where diversification increases the risk of banks. Mercieca et al. (2007) found no statistically significant relationship between both variables, similar to the results found by this research.

According to Baele, De Jongue and Vernet (2007), the institution's idiosyncratic risk tends to decrease according to its size. When examining the regression coefficients for the size variable, we observed a divergence between the results obtained by FE and system GMM estimators. Considering the latter more efficient than FE estimators, we conclude that there is no evidence to confirm the hypothesis that the size of the institution would be related to decreases in banking risk (STIROH, 2006; BAELE; DE JONGUE; VERNETT, 2007; SANYA; WOLFE, 2011).

In all estimated models, we observe statistical significance between capitalization, profitability and insolvency risk. The positive coefficient of capitalization variable indicates that the higher the bank's capitalization, the lower its insolvency risk. This result is consistent with Lehar (2005), who states that equity protects banks from a breach when the value of their assets decreases, thereby reducing insolvency risk. However, the result differs from Baele, De Jongue and Vernet (2007), who found a negative relation between risk level and bank capitalization, where Carlson (2004) argues that because equity has higher cost than debt, a high level of capitalization can decrease bank's performance if owners decide to protect their capital through conservative, and, therefore, less profitable investments.

In contrast to most of the empirical literature, where higher profitability is connected to lower risk, we obtained results that diverge from Sanya and Wolfe (2011), which found a positive and significant relationship for this variable, where greater profitability makes the results of banks more stable, decreasing their insolvency risk. These results may be related to the fact that banks use a large amount of debt to increase their profitability. Their risk increases at the same time their earnings grow, and in the same proportion.

The variable Loans/Assets presented significance in only one model analyzed. In a more detailed analysis of the literature on the variable Loans/Assets, some authors indicate that this type of income is more stable, since clients are less likely to change from bank to bank when requesting credit operations (DEYOUNG & ROLAND, 2001), but only a small effect of this variable was observed on bank insolvency risk in the analysis.

The negative coefficient for the growth variable indicates that reinless growth of an institution causes increases in its insolvency risk. However, this variable did not show statistical significance in any of the model under analysis. The literature indicates that a strategy of sudden growth provides indiscriminate diversification of investments, and the pressure for growth makes the managers "myopic" to the investments executed (SANYA; WOLFE, 2011), but this phenomenon was not observed in the results of this work.

By analyzing macroeconomic variables, we see that GDP growth had impact in the insolvency risk of banks, where economic growth creates opportunities for banks to reduce their risk, and the opposite may lead to serious financial problems that cause difficulties to be addressed by these institutions. Such variable is statistically significant in most of the estimations, with coefficients presenting a positive sign. The results for this variable are divergent from Sanya and Wolfe (2011), who found that banks expose themselves to higher risk level in periods of economic growth.

The competition measured by the HHI presents a negative coefficient for all the EF models, indicating statistical significance at 1% level. However, the results are not confirmed by system GMM estimators. Thus, it is observed that the concentration of the sector does not play an important role in the insolvency risk of the Brazilian financial institutions in the studied period. The results obtained by replacing the variable LogAssets by dummy variables that represent the size of the institutions (Small and Big) are similar to those shown in Table 2. Thus, we did not find any evidence of relationship (both linear and non-linear) between the size of the banks and their insolvency risk.

Table 2. Specific effects of diversification on insolvency risk of banks operating in Brazil (1997-2015)

Variables	Panel Data (Fixed Effects)		System GMM	
	Z-Score1	Z-Score2	Z-Score1	Z-Score2
Z-score	–	–	0.8435*** (0.0230)	0.7145*** (0.0578)
Z-score	–	–	-0.0794 (0.0543)	-0.0471 (0.1018)
HHIadj	-4.1396 (2.8155)	-2.4029 (2.4181)	0.2154 (1.0906)	1.2283 (1.9468)
N	-0.5312 (0.7769)	-0.6568 (0.8864)	-0.1014 (0.4435)	-0.0693 (0.4807)
LogAssets	2.0844 (1.2063)	2.8355** (1.2153)	0.6034 (0.6760)	0.9070 (1.4793)
Equity/Assets	27.3362*** (6.6909)	37.7277** (7.8503)	11.9644*** (2.1509)	29.6480*** (5.0295)
ROA	-9.3783*** (2.2577)	-8.8773** (2.2192)	-3.6825** (1.5384)	-3.7670** (1.6349)
Loans/Assets	3.8635 (9.4935)	4.2030 (7.9859)	15.4839 (5.2561)	19.6183** (9.7267)
GrowthAssets	-0.0259 (0.0418)	-0.0929 (0.0727)	-0.0079 (0.0166)	-0.0257 (0.0432)
Publicly-traded	-2.0363* (1.1776)	-1.9831 (1.2051)	-0.9632 (1.3140)	0.1152 (1.6981)
GDP	10.4975*** (3.5251)	9.2264** (3.6003)	3.2203** (1.5467)	2.1171 (2.0099)
HHIAssets	-29.4516*** (8.6933)	-26.1128*** (8.2264)	9.7270 (6.5746)	10.8918 (10.0763)
Intercept	-5.2606 (14.5521)	-14.3008 (14.8968)	-5.9196 (6.6345)	-10.8173 (17.9189)
F/Wald χ^2 (a) Test	6.02***	5.56***	2,913.02(13)***	1,279.69(13) ***
R ² overall	0.1821	0.2029	–	–
Wald intra-group (b)	2.4e+05***	2.8e+05***	–	–
Wooldridge (c)	223.886***	41.624***	–	–
Highest VIF (d)	2.03	2.03	–	–
Arellano-Bond (1) (e)	–	–	-3.6114***	-2.7226***
Arellano-Bond (2) (e)	–	–	0.6888	0.9145
Sargan test (f)	–	–	77.32(101)	80.92(101)
Number of instruments	–	–	115	115
Number of groups	88	88	88	88
Number of observations	3,256	3,256	3,080	3,080
Model	(1)	(2)	(3)	(4)

Source: Elaborated by the authors

4.3. Sensitivity tests

The opaque and complex nature (MORGAN, 2002; JONES; LEE; YEAGER, 2012) of the financial system “increases the informational asymmetries of banks”; in this sense, there is some contradictory evidence regarding the level of risk taking depending on banks ownership structure (HAAN; VLAHU, 2016, p.35).

To exemplify these contradictory evidences, based on an extensive review of the literature on the theme (HAAN, VLAHU, 2016, p.35), at the beginning of the research on bank ownership structure (very concentrated, dispersed, publicly-traded or closely held, etc.), the consensus was that capital concentration (monitoring effect) was considered a good strategy of controlling banks' risk taking. Recent evidence has shown that the concentration does not play an important role in monitoring the risks taken by banks. Still, in the pre-crisis subprime period, banks with more concentrated ownership structure have taken more risks.

In addition to the question of ownership structure, when analyzing the informational asymmetry between banks and their investors, there is evidence that some specific types of banking activities (HAGGARD; HOWE, 2012) are more opaque (with more informational asymmetry) than others, which may increase even more the concern about banking risk. Based on this, this section examines whether publicly-traded banks, which theoretically have a more dispersed ownership structure than closely held banks, have a stronger diversification effect on their insolvency risk.

The results on Table 3 show that the revenue diversification, as measured by the adjusted HHI, reduces the risk of Brazilian publicly-traded banks (variable HHIadj * Publicly-traded). This result is possibly due to the dispersion of share capital and the monitoring effect exercised by capital market agents, since besides Brazilian Central Bank's regulation, publicly-traded companies are regulated by the CVM and other investors (Brazilians and foreign investors, as well as institutional investors). This result corroborates those presented, for example, by Laeven and Levine (2009), where the risk, measured by Z-Score, is usually high to banks with a more concentrated ownership structure.

Table 3. Specific Effects of diversification on the insolvency risk of publicly-traded banks and closely held banks

Variables	Estimator		Arellano-Bover/Blundell-Bond	
	Z-Score1	Z-Score2	Z-Score1	Z-Score2
Z-score	0.8408*** (0.0223)	0.7152*** (0.0529)	0.8401*** (0.0227)	0.7125*** (0.0548)
Z-score	-0.0757 (0.0542)	-0.0474 (0.1019)	-0.0757 (0.0550)	-0.0494 (0.0988)
HHIadj	-0.5518 (1.1217)	0.9421 (2.1016)	-0.2419 (1.0391)	0.6508 (2.2086)
N	-0.0183 (0.4651)	-0.1933 (0.5395)	0.0725 (0.4563)	-0.0740 (0.5004)
N * Publicly-traded	-0.6911 (3.0267)	1.7742 (2.7170)	-0.6129 (2.8030)	1.8536 (2.6469)
LogAssets	0.5688 (0.7536)	0.9002 (0.9404)	–	–
Small	–	–	0.5206 (1.0808)	-0.0923 (0.7092)
Big	–	–	0.1948 (0.4165)	0.3013 (0.7215)
Equity/Assets	12.5557*** (2.3013)	29.3772*** (4.2463)	10.6318*** (2.1577)	27.5642*** (3.5116)
ROA	-3.5985** (1.6158)	-3.8095** (1.6159)	-4.0637** (1.6719)	-3.6144*** (1.4482)
Loans/Assets	14.8863*** (5.1711)	18.2503*** (9.3628)	13.2575*** (5.0569)	16.9532** (8.7418)
GrowthAssets	-0.0089 (0.0160)	-0.0274 (0.0462)	-0.0051 (0.0140)	-0.0161 (0.0347)
Publicly-traded	-3.2433 (19.0751)	-16.2386 (19.4695)	-3.1894 (18.3349)	-16.8095 (19.0799)
GDP	3.2844** (1.6109)	2.1062 (4.3077)	3.3547** (1.6502)	2.0738 (2.1243)
Inflation	-9.0285 (7.7601)	-10.2723 (8.6687)	-8.4203 (6.9596)	-11.5553 (8.0728)
HHIAssets	9.4613 (6.3164)	10.5282 (8.9215)	8.9600 (7.2730)	10.1919 (9.3560)

Table 3. Specific Effects of diversification on the insolvency risk of publicly-traded banks and closely held banks (continued)

Variables	Estimator			
	Arellano-Bover		Blundell-Bond	
	Z-Score1	Z-Score2	Z-Score1	Z-Score2
Intercept	-5.7499 (7.1512)	-9.7455 (12.6674)	-0.5076 (3.8238)	-0.9325 (5.0631)
Wald χ^2 (a)	3,299.16(15)***	1,118.33(15)***	2,837.92(16)***	1,578.58(16)***
Arellano-Bond (1) (e)	-3.6056***	-2.7165***	-3.6034***	-2.7093***
Arellano-Bond (2) (e)	0.7006	0.9155	0.7019	0.9209
Sargan test (f)	77.34(101)	81.23(101)	78.22(101)	78.95(101)
Number of instruments	117	117	118	118
Number of groups	88	88	88	88
Number of observations	3,080	3,080	3,080	3,080
Model	(5)	(6)	(7)	(8)

Source: Elaborated by the authors

Notes: Coefficients (standard errors). Statistical significance: 1%***, 5%** , 10%*. (a) F (FE) Test or Wald test (system GMM) of regression model general significance. (e) Test of serial correlation of order (n) using residues of first differences, under the null hypothesis of absence of serial correlation. (f) Sargan test for overidentification of constraints.

5. CONCLUSION

The use of diversification as a risk reduction strategy has been subject of several studies. In a scenario of economic volatility, with sharp variations in interest rates, rising inflation and few opportunities for economic growth, financial institutions may use their plant and know-how to offer a wide range of products and services other than those from traditional financial intermediation (credit operations).

In this sense, the aim of this paper was to analyze whether revenue diversification has an impact on banks' insolvency risk. We sought to reduce the sampling selection bias of previous studies (SANYA; WOLFE, 2011), which analyzed only publicly-traded banks, and therefore both publicly-traded banks and closely held banks were included on the database. In general, the results showed that revenue diversification measured by banks' concentration level, and from the point of view of the number of economics sectors in which banks operate, does not affect the risk of the sample studied. The results we found differ from the findings of Stiroh (2004a), Stiroh (2004b), Stiroh (2006), Lepetit et al. (2008) and Sanya and Wolfe (2011), who found out a significant relationship for the variables representing the diversification. However, Mercieca et al. (2007) found no relationship between diversification and insolvency risk when analyzing European banks.

However, after conducting sensitivity tests, we observed that, considering only publicly-traded banks, diversification is related to decreases in insolvency risk. This result may be connected to the greater monitoring in publicly-traded financial institutions, where diversification can be exercised more efficiently as a result of investor pressure for risk reduction.

When analyzing control variables, the results indicate that more capitalized banks can use this higher equity proportion when financial difficulties occur, which reduces their insolvency risk. Contrary to the specific literature, the results for the variable profitability suggest that banks that obtain a higher return also present higher risk levels. This may be linked to the fact that in order to obtain higher returns, banks use more debt to fund their operations, obtaining returns through efficient application of these funds, but at the same time increasing the risk to which they are exposed. Finally, asset growth was not related to a higher risk level presented by banks. The opportunities generated by economic growth were considered factors of impact on the insolvency risk of these institutions.

In spite of the limitations arising from the adoption of individual financial statements, this paper stands out for having analyzed data from a longer period of time, that is, from the period of economic stabilization achieved by the Brazilian economy to the present date. In addition, due to the lack of a national bibliography on the subject, this paper can be considered a pioneer in presenting evidence, in the Brazilian market, on the relationship between diversification and insolvency risk, a theme quite explored in international literature.

The difference between the results achieved by this research and past studies may be due to the different regulations to which the banks are exposed in each country, as well as to the specific practices related to habits and customs between different countries that impact the products and services offered by banks and their social function.

It should be emphasized that these results should not be taken as definitive, since the lack of research in the national scenario opens room for further studies. For example, when analyzing the financial statements of economic groups rather than individual ones, the results may be different from those obtained in this paper, and this is a suggestion for future research on the matter. One hypothesis is that banks can obtain the benefits of diversification for their structure as an economic group and not for individual institutions.

For future research it is also suggested the use of other econometric models, study of other economic sectors and the use of several other measures for insolvency risk (e.g., SANFINS; MONTE-MOR, 2014) and revenue diversification, or even the use of other control variables to better assess the influence of diversification on banks' insolvency risk. The study of the effect of diversification on risk, dividing firms according to their size, also appears as option for future research, since past literature indicates that smaller banks may face difficulties when decide to diversify their operations, while this path is easier for larger banks.

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