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Por: Juan S. Lemus-Esquivel,
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Jorge L. Hurtado-Guarín,
Angélica Lizarazo-Cuéllar

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Carlos A. Quicazán-Moreno†
Jorge L. Hurtado-Guarín‡
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Abstract

This paper has as main objective to build a composite metric of financial soundness for the private corporate sector in Colombia. Instead of relying on the individual and sometimes restrictive financial ratio analysis approach, the purpose of this document is to provide a single metric aimed at measuring the financial health of firms. Said metric, the financial soundness index, is derived by employing the cross-section approach of principal component analysis. For the time period of 2000-2013, the results allow to identify which industries have a weak, strong or similar balance sheet performance relative to that observed for the private corporate sector as a whole. Furthermore for firms that are debtors of the Colombian financial system, validation tests on the index confirm the apparent relationship between accounting data and the credit risk perception of and materialization for financial intermediaries.

JEL classification: L25, G30, G32, C3

***Keywords*:** firms' financial soundness, principal component analysis, financial ratios, composite indices, financial stability.

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*Specialist in Financial Stability, Financial Stability Department at Banco de la República. E-mail: jlemuses@banrep.gov.co (Corresponding author)

†Specialist in Financial Stability, Financial Stability Department at Banco de la República. E-mail: cquicamo@banrep.gov.co

‡Analyst, Financial Stability Department at Banco de la República. E-mail: jhurtagu@banrep.gov.co

§Analyst, Financial Stability Department at Banco de la República. E-mail: alizarcu@banrep.gov.co

1. Introduction

The amount of loans outstanding for the private corporate sector in Colombia[1] represented c.a. 41% of the total commercial credit issued by the Colombian financial intermediaries to the corporate sector, as of 2013Q4. For the time period between 2000Q1 to 2013Q4 this figure has been on average 48%. Consequently, it may be noted that assessing and monitoring the creditworthiness of the private non-financial sector in Colombia is a main task for the local financial and economic institutions, particularly the Banco de la República (Central Bank of Colombia), given the fact that a systemic failure of these agents may have a negative impact on financial stability at a local level.

As noted by González-Miranda (2012), a fragile corporate sector "can transmit and or magnify real or financial shocks, weakening a country's overall macroeconomics resilience." Therefore, as stress episodes on the non-financial sector may increase the macroeconomic risks of a country –and that for the Colombian case the exposure of the financial system to this sector has been significant – the construction of early warning indicators aimed at measuring balance sheet vulnerabilities and risks is crucial. The latter task attempts to fulfill the objective of providing answers relating to the effect of external shocks in firms' performance and to study the response of economic authorities to them.

For the Colombian case, in recent years, research has relied on the analysis and interpretation of financial ratios for the purpose of giving an assessment about the financial soundness of the country's private non-financial firms. Aspects relating to liquidity, leverage, profitability, operating performance, and others have been usually studied and measured using aggregate indicators (Departamento de Estabilidad Financiera (2014)). Moreover, these financial attributes of firms usually have been identified as determinants of fragility and default for non-financial firms.[2]

However, this analysis, although providing benefits to the monitoring and evaluation of the aggregate creditworthiness of the non-financial sector (for example, to get an insight of the firms' financial and economic characteristics), has also highlighted some important limitations. Firstly, there is currently no aggregate measure for financial soundness or one that allows the identification of balance sheet risks and vulnerabilities. At the Central Bank, the state of these features of non-financial firms is determined by analyzing separately a restricted set of financial ratios, at the present moment being: current ratio (as a proxy of liquidity), return on assets (as a proxy of profitability), debt-asset ratio (as a proxy of indebtedness), and non-operative expense to the earnings before interests and taxes (EBIT) ratio (as a proxy of financial burden). That being said and for a particular time period, an overall conclusion of the private corporate sector's financial health is achieved by comparing the latest figures of individual ratios with historical ones, especially with those corresponding to periods of high stress.

For the purpose of this research an individual analysis of key financial indicators may not be an appropriate benchmark for measuring financial health. It is noteworthy to recall that the latter concept refers to the aggregation of financial aspects that should be analyzed as a whole, not separately, given the fact that a single attribute or characteristic is not a necessary and sufficient condition for measuring firm's financial soundness. A composite analysis that involves a wide set of characteristics (being not exclusively those measured by financial ratios) could allow to have a more refined approach in assessing the financial situation of a company.

[1] When referring to the "private corporate sector" or "Colombian private non-financial firms" or the "non-financial sector in Colombia", what is meant is the set of firms that have been supervised by Superintendencia de Sociedades (Colombian Superintendency in charge of the supervision of the private corporate sector). Historically the share of this sector's amount of loans outstanding relative to the commercial loan-portfolio in 2000-2013 is available on section 3.

[2] For example, see Lennox (1999) and Lemus et al. (2012).

Secondly, the analysis performed at the Central Bank aimed at providing a view about the private corporate sector's financial health have found in some cases to be undermined, given that in accounting and corporate finance literature the definition of many financial ratios is far from being uniform, and there is no predefined threshold to which each ratio should meet. Furthermore, there seems no apparent rule of thumb regarding the adequate set of financial ratios to be employed for the purpose of measuring the financial aspects of a company. For this reason, there is no formal criterion or set of rules regarding the methodology a policymaker should follow when employing and interpreting financial ratios.

This research focuses in solving these caveats and limitations. The main objective is to build an aggregate financial soundness metric for the private corporate sector as a whole and by industry. This indicator is expected to offer a measurement of the private non-financial firms creditworthiness through time and warn the forthcoming periods of high stress. Instead of relying on a small number of key indicators, as it is currently performed, the idea is to build a single metric that measures the level of firms' vulnerability. Moreover, a composite indicator should allow to provide a unique view about the sector's financial health and to overcome the issue of studying individual and distinct indicators. The latter for the purpose of obtaining several conclusions about firms' balance sheet performance and implications to the country's financial stability. For the construction of the indicator, information provided by the financial statements of the Colombian private corporate sector along with other relevant variables (defined later in this document) will be used.

Moreover, from the perspective of the Banco de la República, this indicator adds to the efforts of monitoring the wide range of risks stemming from the interaction of the private corporate sector with the financial system and that may have a negative effect on Colombia's financial stability. The research will also provide a significant contribution to other local authorities (i.e., Financial Superintendency of Colombia and the Ministry of Finance and Public Credit), insofar that it will refine and enhance the methodologies employed for the evaluation and analysis of firms' performance. Moreover, the indicator will complement different metrics and tools the Financial Stability Department (FSD) has available for assessing the state of the risk to which the financial system is exposed to companies.

Last, but not least, the diffusion of this index among the public and internally within the Banco de la Republica (particularly to the Board of Governors) will improve the message conveyed by the FSD with regards to the assessment of how the recent developments in the private corporate sector may impact the country's state of the economy. Given that one of the main objectives of the Banco de la Republica is to achieve financial stability in conjunction with maintaining macroeconomic strength; the construction and monitoring of the financial soundness index proposed in this research may contribute ultimately to the accomplishment of this goal.

In the end, this study identifies a set of informative financial indicators aimed at measuring the financial health of the Colombian private corporate sector in 2000-2013. Thirty-four metrics grouped in five categories (activity, leverage, profitability, liquidity, and size) are aggregated in a composite measure, the financial soundness index, by means of principal component analysis. By industry, results allow to assess the financial situation relative to that for the private corporate sector. Of the industries with the largest concentrations in this sector, manufacturing and wholesale and retail firms have been showing in recent years a fragile financial health. Furthermore, to types of firms are defined based upon the sign of the financial soundness index: non-fragile (those with a positive index) and fragile (those with negative indices). When the credit risk perception of the subset of companies that are debtors of the financial system is analyzed, it is found that, on average, the former are associated with lower quality indices

(proxy of credit risk perception of financial institutions) than the latter. Thus, financial intermediaries expect a higher default rate from firms with a weak financial situation. In addition, when the firms that have been debtors of the financial system are discriminated between defaulting and non-defaulting companies, it is found that the former have on average a lower financial soundness index.

The remainder of this paper is organized as follows. Section 2 introduces a literature review. Section 3 presents a description of the variables employed and the data used as input in the empirical methods implemented for validating the research question. Section 4 explains the empirical approach employed in this research and section 5 describes the results. Finally, Section 6 concludes the document.

2. Literature Review

According to Gadanecz & Jayaram (2009), when multiple leading indicators that serve an objective are available (such as the measurement of the private corporate sector financial soundness), it is desirable to aggregate them in a composite metric that captures conveniently all the interactions between the individual metrics. The literature review aimed at supporting this research has been able to identify three predominant methodologies which are usually employed for the purpose of constructing a financial index: variance-equal weight method[3], factor analysis[4], and probit/count data regression models[5]. Usually, a main goal of the index is to identify episodes of stress in the banking sector. In what follows, a synthesis of the literature review of these aggregation schemes is presented, insofar that they may serve as possible methodologies for the purpose of building the financial soundness index for the Colombian private sector.

The literature reviewed focuses in the building of composite financial stability indicators for the banking/financial sectors, yet they are perfectly applicable to the balance sheet data and other variables available for Colombian non-financial firms. With the exception of Morales & Estrada (2010), who use balance sheet data, and Bordo et al. (2002), the rest of the consulted authors build their aggregate indices using market data.

Morales & Estrada (2010) construct a financial stability index for the Colombian financial system using three aggregation schemes: principal component analysis (PCA), equal-variance approach and weights derived by regressions models with count data. The authors find that among these methods similar results are obtained. Bordo et al. (2002) build a quantitative and qualitative index for the period 1934-1997 that measure financial conditions using four times series: banks loan charge-offs, businesses failure rate, an ex-post real interest rate, and an interest quality rate. The index has yearly periodicity and for each period, because of skewness in the time series, each one is transformed into a modified Z-score[6]. When employing a simple average the authors derive the aggregation of the standardized series. Hanschel &

[3]In this technique the variables that make up the index are standardized in order that all are expressed in the same units. The aggregation consists in employing the arithmetic mean as as measure of central tendency. The presence of anomalies in the data (e.g. outliers, asymmetry, and skewness), makes it possible (and necessary) to substitute the mean and standard deviation by robust estimators.

[4]The most common technique belonging to the factor analysis and employed in the consulted studies is principal component analysis (PCA). One of the usual applications of PCA is to construct an index by using a weighted average of the financial and economic variables taking as weights the elements of the first component (loading vector). Usually this extracts the maximum variance of the data (set of variables) if and only if the correlation among the variables is significantly high.

[5]An econometric model is specified in which the dependent variable (categorical variable) is explained by the financial indicators. The estimated coefficients are used then as weights when calculating the financial stress indicator.

[6]For more information, see Iglewicz & Hoaglin (1993) and Barnett & Lewis (1994).

Monnin (2005)[7] and Cardarelli et al. (2009) use similar methodological approaches for building a stress index for the Swiss Banking sector and for 17 advanced economies, respectively.

Illing & Liu (2006) build a Financial Stress Index for the Canadian financial system from 1977 to 2006 by identifying financial crisis/stress episodes and then aggregating different variables in indices. Of the methodologies tested, the 'credit aggregate weighting technique', provides "economically meaningful weights, and it has the lowest Types I and II errors". The index is built as a weighted average of the variables using as weights their relative size in the market to which they belong. The larger the market as a share of total credit in the economy, the higher the weight assigned to the variable proxying stress in the marked. Variance-equal weight method (using arithmetic and geometric means) and factor analysis are also tested.

Blix Grimaldi (2010), by first building a timeline of stressful events in advanced economies, models a financial stress indicator for the Euro Zone. The author specifies a logit-model in which the dependent variable is binary and identifies if the period of state t is of financial stress or not (i.e., 1 or 0 respectively) and as covariates two indices of the weekly financial variables used in the study (i. an aggregate index of the variables and ii. an aggregate index of the rate-of-change of the variables). According to the author, the fitted probability of the specified model is the financial stress index.

This paper deals with a similar objective found to be common among the aforementioned literature: to build an aggregate financial index that can identify periods of high stress. Instead of building a metric of this kind and that may assess the Colombian financial system's stability, it is intended as an objective to construct a composite index aimed at measuring non-financial firms' creditworthiness.

For the Colombian case, Morales & Estrada (2010) develop a stress indicator for the financial system. Nevertheless, there has been yet no attempt to derive a composite indicator that measures financial soundness as a whole and identifies periods of high stress in the non-financial sector. Currently, for the fulfillment of this task economic and financial authorities are still relying on financial ratios analysis. This makes it difficult to estimate the fragility and vulnerabilities of the private corporate sector in Colombia as a whole, and to assess the impact of the risks stemming from the exposure of the latter to the financial system. Therefore, there is a clear motivation to have an indicator which allows a periodic monitoring of the stress levels for the private corporate sector and that provides a composite view about its financial health.

3. Data

The study will restrict to 34 financial ratios. They are calculated using the yearly financial statements (balance sheet, income statement, and cash flow statement) provided by the Superintendencia de Sociedades–Colombian Superintendency that monitors and supervises the private corporate sector in Colombia–. The latter is comprised by a sample of private firms that during 2000-2013 accumulated c.a. 48% of the commercial loan portfolio, implying that this sector has been one of the most important debtors of the Colombian financial system (Table 1). Vulnerabilities stemming from this sector, particularly those that could be anticipated or evidenced by means of financial ratio analysis, may affect the financial system if firms make or are prone to make default in their obligations to creditors.

[7]The authors mention that no other alternative was suitable for their investigation. Factor analysis was disregarded given that, as a whole, the grouping of the variables didn't yield the expected results.

TABLE 1: **Per year, number of firms belonging to the private corporate sector and share of the amount of loans, outstanding in the commercial loan portfolio**

Year	Number of firms	% of commercial loan portfolio
2000	10,158	51.7
2001	9,577	52.9
2002	8,927	46.4
2003	8,931	48.9
2004	9,653	47.8
2005	19,027	48.2
2006	22,787	51.0
2007	21,000	47.9
2008	21,959	51.3
2009	23,973	47.0
2010	22,523	49,9
2011	26,638	49.2
2012	26,042	41.4
2013	25,297	41.3

Source: Superintendencia Financiera de Colombia, Superintendencia de Sociedades; authors' calculations.

The variables are classified into five groups, each corresponding to a financial attribute. The latter defined as an important feature of a firm, which is relevant for measuring financial soundness: activity and or efficiency (11 indicators), leverage (8 indicators), profitability (7 indicators), liquidity (6 indicators) and size (2 indicators). On the tables below (2, 3, 4, 5 and 6), for each indicator, a label, formula (if applicable), description and or intuition, unit of measurement, and "expected sign" are provided.

'Expected sign' should be read with caution, insofar that it does not refer to the actual sign for the indicator but to the direction (greater than or less than) it is expected to take for the purpose of assessing the state of a firm's financial health. For instance, if there is a '+' symbol, it means that higher values of the variable indicate that on an individual basis and *ceteris paribus* the firm is exhibiting a good financial health. Likewise, if there is a '-' symbol, then higher values of the variable indicate that the company is exhibiting a poor financial health. For some indicators, their sign interpretation is ambiguous ('+/-'). Take the sales to total assets ratio as an example. Higher values of this indicator suggest a higher growth of the firm's sales relative to the expansion rate of the total assets. Clearly, this is a positive feature due to the fact that the company's operation contributes to an increment of the firm's left-hand side of the balance sheet. Nevertheless, lower values of the indicator, i.e. a higher growth rate of assets relative to that calculated for sales (excluding the case where is negative or close to zero) does not necessarily imply a fragile financial health for the firm.

Moreover, the reader may notice that for defining the 'expected sign' column it is necessary to make some assumptions. Financial health for a firm is highly affected when there are high levels of debt, and the firm's debt share in total assets is higher than that observed for the equity. Therefore, financial soundness is favored by low levels of debt and high levels of equity relative to total assets size (a preference for financing via shareholder's resources instead of relying on those provided by third parties). In addition, it is assumed that high levels of earnings, in conjunction with low expense, favors the financial situation of the firm, as the case where liquid assets are superior than non-liquid ones (i.e., those with long term duration). Furthermore, larger firms are associated with higher levels of financial health. For the Colombian case, usually these companies have had greater access to financial markets and the funds offered by local creditors. Thus, their capacity and possibilities of executing investment projects and materializing their growth prospects is higher when compared to the case for the small and medium-sized companies.

TABLE 2: **Activity and or Efficiency indicators**

Label	Formula	Unit	Description	Expected Sign
X_1	$\left(\frac{Sales_t}{Sales_{t-1}} - 1\right) \times 100$	%	Measures the nominal annual growth of firm's sales.	+
X_2	$\left[\frac{Sales_t}{(Total\,Assets)_t}\right] \times 100$	%	Commonly referred to as the "asset turnover ratio". It measures the amount of gross sales generated per unit of total assets.	+/-
X_3	$\left[\frac{(S\&AE)_t}{Sales_t}\right] \times 100$	%	Defined as the ratio of selling and administrative expense (S&AE) to gross sales.	-
X_4	$\left[\frac{(NOI)_t}{Sales_t}\right] \times 100$	%	Defined as the ratio of non-operating income (NOI) to gross sales.	+/-
X_5	$\left[\frac{(NOE)_t}{Sales_t}\right] \times 100$	%	Defined as the ratio of non-operating expense (NOE) to gross sales.	-
X_6	$\left[\frac{(Gross\,Income)_t}{Sales_t}\right] \times 100$	%	Commonly referred to as the "gross profit margin ratio". Gross Income is defined as gross sales minus cost of goods sold. Therefore, firms ratio provides the relationship between the gross income and the gross sales.	+
X_7	$\left(\frac{Sales_t}{PPE_t}\right) \times 100$	%	Commonly referred to as the "fixed-asset turnover ratio". Measures the extent to which the investment in tangible assets-net of depreciation (PPE or property, plant and equipment) translates in the generation of gross sales.	+
X_8	$\left[\frac{Sales_t}{(Current\,Assets)_t}\right] \times 100$	%	Commonly referred to as the "current assets turnover ratio". It measures the efficiency of current assets for generating gross sales.	+/-
X_9	$\left[\frac{Sales_t}{(ST\,AR+LT\,AR)_t}\right] \times 100$	%	Measures the relationship between the gross sales and the accounts receivable aimed at giving a figure of the velocity at which a firm collects its debts. ST AR stands for "short term accounts receivable" while LT AT stands for "long term accounts receivable".	+/-
X_{10}	$\left(\frac{Sales_t}{Inventory_t}\right) \times 100$	%	Commonly referred to as the "inventory turnover ratio". Describes the relationship between the gross sales and inventory, particularly the number of times the inventory has been sold and replaced in a year.	+
X_{11}	$\left[\frac{Sales_t}{(ST\,AP+LT\,AP)_t}\right] \times 100$	%	Defined as the ratio of gross sales to accounts payable. ST AP stands for "short term accounts payable" while LT AP stands for "long term accounts payable". Likewise to X_9, it is intended to quantify the velocity at which a firm pays to its creditors.	+

Source: Author's calculations

TABLE 3: **Leverage indicators**

Label	Formula	Unit	Description	Expected Sign
X_{12}	$\frac{(Total\ Assets)_t}{Equity_t}$	# of times	Defined as the ratio of total assets to equity. Higher levels of the indicator are related with higher –and perhaps– unsustainable levels of debt relative to the size of equity.	-
X_{13}	$\left[\frac{(Total\ Debt)_t}{(Total\ Assets)_t}\right] \times 100$	%	Measures the share of the liabilities in the total assets.	-
X_{14}	$\left[\frac{(CurrentLiabilities)_t}{(Equity)_t}\right] \times 100$	%	Defined as the ratio of current liabilities to equity.	-
X_{15}	$\left[\frac{(STFO+LTFO)_t}{(Total\ Assets)_t}\right] \times 100$	%	STFO stands for "short-term financial obligations" and LTFO stands for "long-term financial obligations". The ratio measures the share of the assets financed by financial liabilities.	-
X_{16}	$\left(\frac{LTDebt_t}{SE_t+LTDebt_t}\right) \times 100$	%	Commonly referred to as "debt-to-capital ratio". The indicator gives an idea of a firm's financial structure, where $LTDebt_t$ denotes long-term debt and SE_t stands for shareholder's equity.	-
X_{17}	$\left[\frac{(LT\ Debt)_t}{(Total\ Debt)_t}\right] \times 100$	%	Measures the share of long-term debt in the total liabilities.	+/-
X_{18}	$\left[\frac{(LT\ Debt)_t}{(WK)_t}\right] \times 100$	%	Long-term debt to working capital ratio (WK_t), where working capital equals current assets minus current liabilities. The indicator provides the share of debt that could be payed by the working capital. A positive figure for working capital implies that the current liabilities may be payed without requiring to use the total stock of current assets.	-
X_{19}	$\frac{EBIT_t}{(interest\ expense)_t}$	# of times	Commonly referred to as "interest coverage ratio". Measures the ability of the firm for paying interest on its outstanding debt by means of its operational income (EBIT-"earnings before interest and taxes").	+

Source: Author's calculations

TABLE 4: **Profitability indicators**

Label	Formula	Unit	Description	Expected Sign
X_{20}	$\left[\frac{(Net\ income)_t}{Equity_t}\right] \times 100$	%	A proxy for return on total equity (ROE). Measures the share of profit due to shareholder's financing.	+
X_{21}	$\left[\frac{(Net\ income)_t}{(Total\ Assets)_t}\right] \times 100$	%	A proxy for return on total assets (ROA). Analogous to X_{20}, it shows the profit due to the investment in assets.	+
X_{22}	$\left[\frac{EBIT_t}{(Total\ Assets)_t}\right] \times 100$	%	A proxy for return on total assets (ROA). In the same spirit of X_{21}, this indicator shows the efficiency of assets for generating gross sales. However the numerator takes the earnings derived by the firm's operation prior to non-operating expense and taxes.	+
X_{23}	$\left(\frac{EBIT_t}{Equity_t}\right) \times 100$	%	A proxy for return on total equity (ROE). Shows the share of operating income (EBIT) financed by shareholder's resources.	+
X_{24}	$\left[\frac{(Gross\ Income)_t}{Equity_t}\right] \times 100$	%	A proxy for return on total equity (ROE). Measures the share of profit due to shareholder's financing, specifically to the generation of gross sales (regardless of the cost of good sold).	+
X_{25}	$\left[\frac{EBIT_t}{Sales_t}\right] \times 100$	%	The indicator compares earnings with revenue. Given that EBIT equals gross sales minus cost of goods sold minus operating expense plus operating income, the indicator provides insight of the firm's ability to generate high earnings maintaining operating expense low.	+
X_{26}	$\left[\frac{(Net\ income)t}{Sales_t}\right] \times 100$	%	The interpretation is similar to the provided for X_{25}. However, net income equals EBIT minus non-operating income plus non-operating expense minus taxes, which yields the firm's final profits/losses.	+

Source: Author's calculations

TABLE 5: **Liquidity indicators**

Label	Formula	Unit	Description	Expected Sign
X_{27}	$\left[\frac{WK_t}{(Total\ Assets)_t}\right] \times 100$	%	Measures the relationship of the firm's working capital and the total assets. Working capital (WK) provides insight of a company's current liquidity situation. Therefore, the ratio evaluates the representativeness of WK on the firm's assets.	+
X_{28}	$\left[\frac{(Current\ Assets)_t}{(Current\ Liabilities)_t}\right]$	# of times	Commonly referred to as the current ratio. Measures the number of times the current assets represent the current liabilities. A figure above 1 shows a solid liquidity position insofar that the firm is not required to employ its total current assets for paying its short-term liabilities.	+
X_{29}	$\left[\frac{(Current\ Assets - Inventory)_t}{(Current\ Liabilities)_t}\right] \times 100$	%	Similar to X_{28}, however the numerator excludes inventories given that a firm should not be required to sell them under the scenario of covering its short-term liabilities.	+
X_{30}	$\left[\frac{(Current\ Assets)_t}{(Total\ Assets)}\right] \times 100$	%	Shows the share of the current assets in the total assets.	+/-
X_{31}	$\left(\frac{Cash_t}{Sales_t} \times 365\, days\right)$	# of days	Commonly referred to as the "cash-turnover ratio". Measures the amount of days in which gross sales may be converted to cash and available funds.	+
X_{32}	WK_t	COP	Working capital. It's the difference of current assets and current liabilities.	+

Source: Author's calculations

TABLE 6: **Size indicators**

Label	Formula	Unit	Description	Expected Sign
X_{33}	$Log\left[(Total\ Assets)_t\right]$	COP	Natural logarithm of total assets.	+
X_{34}	$\left[\frac{(Total\ Assets)_t}{(Total\ Assets)_{t-1}} - 1\right] \times 100$	%	Measures the annual growth of the firm's total assets in real terms.	+

Source: Author's calculations

4. Empirical approach

The development of the empirical approach comprises three stages. In the first stage, firms with missing data and those that filed a winding-up resolution[8] are deleted. Then, in the second stage, by

[8]In Colombia, a firm must file a winding-up resolution if its ratio of equity to subscribed capital falls below 0.5 times.

financial attribute and economic activity, outlier detection and removal processes are performed for each year. Per year and by financial attribute, the PCA methodology is applied in the final stage. At the firm level, a composite metric of the private corporate sector's financial soundness is then obtained by averaging the financial attributes subindices.

The first stage consists of the removal of missing observations for each year. Given the amount of the potential indicators to employ in this research, an average of 45% of the observations are deleted year-to-year. This significant number of missing values is due to the fact that a firm is deleted if at least one of the 34 indicators is not observed, and to the initial filtering of firms which filed a winding-up resolution. The purpose of removing these companies obeys to the situation that they are prone to dissolution and their financial indicators are usually atypical relative to those calculated for the sample employed as a proxy of the private corporate sector.

In the second stage, the MCD (Minimum Covariance Determinant) algorithm for detection and elimination of multivariate outliers, proposed by Rousseeuw & Van Driessen (1999) is applied. Following these authors suggestion, "robust estimation of multivariate location and scatter is a key tool to robustify other multivaratiate techniques such as principal component analysis and discriminant analysis". The former is the multivariate method employed in this research and its results are highly dependent upon the presence of outliers. The classical approach of employing the Mahalanobis Distance for detecting and removing atypical data was not found useful, primarily due to its employment of classical estimators of location and scatter. That said, we employed the aforementioned technique insofar that it is based upon robust distance and variance estimators, not affected by the masking effect and applicable to large samples.

The process of outlier removal was applied to the data grouped by year, financial attribute and economic activity. Said separation was implemented to avoid the removal of firms belonging to sectors that have special attributes and that the algorithm may consider as outliers. For example, firms belonging to the agriculture sector are usually associated with low leverage levels given that their access to the financial system is usually restricted as they are considered riskier relative to other industries. Thus, these types of firms could be identified as outliers if the algorithm is performed over the whole sample, which could result in the removal of a complete economic activity. Furthermore, the final step of this stage is to join the 11 data sets of economic industry for each financial attribute, generating five data sets per year.

Finally, the third stage involves the calculation of indices for each financial attribute: activity, leverage, profitability, liquidity, and size. PCA was applied to identify the optimal combination of variables that explains at least 60% of data variability, and to obtain the aggregate component of each attribute[9]. It must be noted that PCA was applied over the standardized variables. The arithmetic mean of the five indices at the firm level corresponds to the composite index of financial soundness for the non-financial sector. However, for some companies it was not possible to calculate the five subindexes. Thus, when aggregating these dimensions, observations with all the information (i.e., those that allowed the calculations of the five subindices) were retained and those with missing values were discarded. It is noteworthy mentioning that before calculating the composite index, the signs of the loadings of each subindex is evaluated, so it corresponds to the intuition presented in tables 2, 3, 4, 5 and 6.

The aforementioned procedure is a cross section PCA technique applied repeatedly for each yearly dataset. As the available data is not a cross section but a panel data set, it would be desirable to use a

[9]For a more detailed explanation of PCA, please see Appendix A. Also, the optimal combination of variables and their weights for each subindex are presented in Appendix C

panel data approach instead of a cross section one in order to incorporate the time correlation among the observed variables. However, the available dataset is a type of unbalanced panel known as rotating panel (Wooldridge (2010)), and that is characterized by the rotation of the observed individuals along the time dimension. In our particular case, firms enter and leave the sample every year based on different rules, and the result is a highly unbalanced panel structure. In addition to being a rotating panel, the data has an incidental truncation feature, i.e. some variables cannot be observed for some individuals in each time period. These two characteristics of the data set, which are basically sample selection problems, leave little space for employing panel data techniques. The latter insofar that most of the methodologies developed for these types of data structures are associated to the linear regression models.

An alternative approach would be to employ a pooled cross section technique given that it does not require to observe the total units for each period. Nevertheless, the data set may not fulfill the assumptions of a temporary approach of PCA, particularly the absence of serial correlation. This issue arises from the fact that year-to-year, financial firms' ratios tend to have a high persistency, which may indicate a high time correlation of individual observations. Being a highly unbalanced panel, controlling time correlation by means of differentiation causes to drop a significant share of the observations.

Taking these limitations into account, the approach that best suits the data set available for this research is the cross section technique of PCA and its application on a yearly basis. Although it does not allow for a direct time dimension interpretation, it is useful for evaluating the performance of individual industries per year, and even the change of the relative performance of industries on a given time period.

5. Results

In this section, a description of the results obtained via the application of the empirical approach is presented for 2000-2013 and on a yearly periodicity. For the purpose of this research, it is not possible to obtain an aggregate index for the Colombian private corporate sector given the limitations and restrictions of the methodology employed and that were previously discussed. That being said, the results also permit to make an analysis at the firm and industry level. Per year, the median index is plotted by industry. It is noteworthy mentioning that extracting principal components from the correlation matrix (i.e., using standardized variables) implies that the arithmetic mean of the index is zero. Thus, positive values of the index are associated to a higher performance (i.e., a better financial health) relative to the average calculated for the private corporate sector. In contrast, a negative value corresponds to a fragile financial health when compared to that observed for the total sample.

Moreover, given that the index is calculated per year using the cross section approach of PCA, an intertemporal comparison of the metric is not straightforward. The latter given that the average performance of the private corporate sector is not static through time. However, it is possible to provide conclusions about changes in the performance of a particular industry across different points in time. For example, assume the case where an industry has a negative index in t_0 but a nonnegative figure in t_1. Under this scenario, the industry happens to improve its financial health on a year-to-year basis, relative to the average performance of the private corporate sector. Such approach is relevant to the study and maintenance of financial stability in Colombia due to the identification of fragile economic industries and the potential impact of a default in their financial obligations on the financial system as a whole.

Finally, results of some validation tests are offered. For the period 2000-20013, the credit risk exposure proxy for Colombian financial intermediaries (quality index) is calculated and discriminated by firms with

a better financial health (positive index) and those with a fragile financial situation (negative index). In addition, the empirical distribution of the index is obtained and contrasted for two groups of firms, the defaulting and non-defaulting ones. The purpose of these analysis is to establish a connection between firms' balance sheet performance and the credit risk exposure of local financial intermediaries and its materialization.

5.1. Financial Soundness Index for the Private Corporate Sector in Colombia by industry

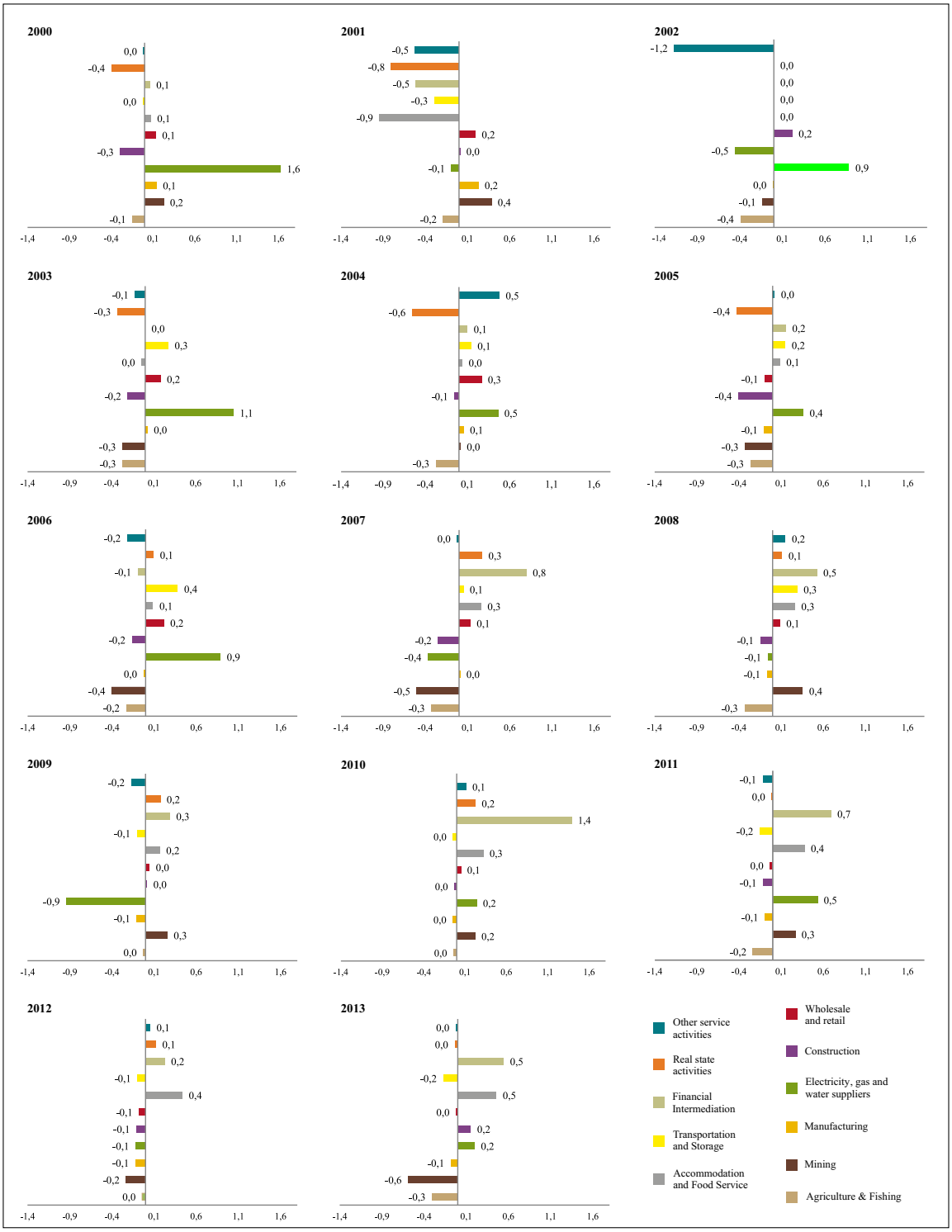
For the time period considered, results allow to identify three clearly distinct industry groups in terms of the historically 50th percentile financial soundness index: consistently high performance, volatile performance, and consistently low performance. The first one includes the financial, wholesale and retail, and electricity, water and gas suppliers industries. The second one is comprised by the firms belonging to the manufacturing, transportation and storage, accommodation and food services, and other services industries. Moreover, the third group consists of the construction, agriculture and mining companies.

Historically, the largest concentrations in the sample of the private corporate sector have been observed for the firms belonging to the wholesale and retail, manufacturing and – recently – real estate activities. Through time, it is noteworthy mentioning that the index calculated for manufacturing firms has been negative for some periods, being only positive in 2000-2001, 2003-2004, 2007, and 2009. Additionally, since 2010, results for this industry suggest a fragile financial health insofar that it has presented consistently negative indices. In contrast, as for the firms belonging to the wholesale and retail activities, there has been fewer periods with negative indices relative to those when the index has been positive. Nevertheless, likewise to the manufacturing case, since 2011 the index has been consistently negative. Finally, for the real estate activities industry, during 2000-2005, the index showed negative values. This trend reverted as of 2006 and since then, excluding 2009, 2011 and 2013, this sector has exhibited a good financial health relative to that observed for the private corporate sector. It is relevant to analyze the performance of these economic industries insofar that the largest exposures of credit establishments are concentrated in these three sectors.

As of 2013, the latest figures of the index calculated by industry show a strong performance of firms (i.e. a positive index) relative to that for the private corporate sector for four economic activities: financial intermediation, accommodation and food service, construction and the electricity, gas and water suppliers. Industries that depicted a weak balance sheet performance are mining, agriculture and fishing, transportation and storage, and manufacturing. For the remaining sectors, their financial health assessment is close to that for the private corporate sector. Furthermore, it is found relevant to highlight the performance of two industries, construction and accommodation and food services. For the former, firms had a surge in their profitability, being mainly explained by an increase in their activity, as well as a rise in construction prices (housing, other buildings and engineering). As for the latter, albeit prices did not grow, occupancy rates did rise, which implied an overall good financial health for this industry (Figure 1).

As a final remark and important consideration to take into account when reading this section's results, the composition of the private corporate sector is not a result of a random sampling performed by the Superintendencia de Sociedades. Although this statement cannot be formally proved, it is deduced from the fact that some economic industries (e.g. agriculture and fishing, electricity, gas and water suppliers, and mining) are underrepresented, while others such as manufacturing and wholesale and retail firms

FIGURE 1: **Financial soundness index in 2000-2013, by industry**



Source: Superintendencia de Sociedades; Authors' calculations.

are overweighed within the sample. The empirical approach does not deal with this issue, thus, making the index highly dependent upon the sample. That said, results of this research may be enhanced if the sampling process for the purpose of building up the database that serves as a proxy of the private corporate sector could be improved.

5.2. Validation Tests

5.2.1. Financial soundness index versus credit risk perception of local creditors

In terms of financial stability, it is relevant to establish a connection between firms' creditworthiness to financial creditors and their balance sheet performance, insofar that the latter may serve as an indicator of financial distress. Taking into account the large exposure of the local financial system to private firms, it is crucial to determine if high and positive levels of the financial soundness index for a corporate debtor correlates with a low credit risk perception from its creditors. Likewise, it is expected that low and negative indices to be related with high perceptions of credit risk.

For the Colombian case, the *ex ante* credit risk perception of a financial intermediary is measured via the quality index (QI). The QI is the ratio of risky loans and total gross loans. The former are defined as the the amount of loans outstanding with ratings *B, C, D*, and *E*.[10]

For the time period considered, when the QI calculated for the good financial health firms is compared against the indicator derived for the fragile companies, it can be found that firms with a positive financial soundness index have had consistently lower QI figures relative to firms with a negative index. When contrasting the aforementioned hypothesis, this result depicts that creditors have a higher perception of credit risk to firms with a lower balance sheet performance (i.e., a negative financial soundness index). In addition, it can be stated that a company's financial health may be used as an indicator by the creditor when calculating the firm's repayment probability, thus, tightening its lending standards to agents facing financial constraints and that materialize in a lower financial health.

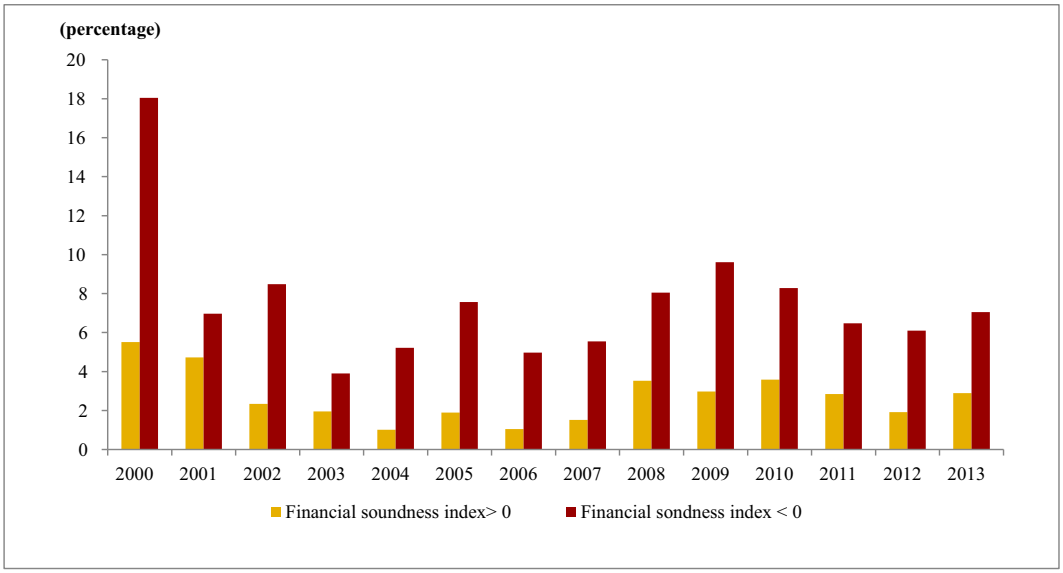
During the last twenty years, Colombia faced a recession in 1999-2001 and a strong economic slowdown in 2009 due to the late impact of the 2007-2008 global financial turmoil. For both samples, the QI reached its absolute maximum in 2000. Since 2001, the highest QI for the firms with a negative non financial index was observed in 2009. Nevertheless, this fact is not found to be true for companies with a positive financial soundness index (Figure 2).

5.2.2. Empirical distributions of the financial soundness index discriminating by defaulting and non-defaulting firms

Following Lemus et al. (2012), the sample of firms analyzed through time and debtors of the local financial system are divided among two groups: defaulting and non-defaulting firms. For the purpose of this research, the former are defined as those companies for which any of its outstanding loans has been downgraded from *A* or *B* to any lower rating (*C*, *D*, or *E*) over a one-year period. For each group the financial soundness index distribution is estimated by means of an Epanechnikov kernel.

[10] In Colombia, outstanding commercial loans can be discriminated among five ratings, labeled *A* through *E*. A firm rated *A* means that there is a high repayment probability and the firm is currently repaying its debt. The *B* rating indicates that there is a slight reduction in the probability of repayment, mainly due to risk factors or because the firm's financial obligations are overdue for less than three months. Credit rating *C* exhibits that a loan is overdue for more than 3 months and less than 6 months. As for the *D* rating, it is implied that a loan is overdue for more than 6 months and less than a year. Finally, rating *E* indicates default for more than a year and that there is no probability of recovering the debt.

FIGURE 2: **Quality index discriminated by sound and fragile firms**



Source: Financial Superintendency of Colombia and Superintendencia de Sociedades; Authors' calculations.

Through 2000-2013, the distribution of non-defaulting firms tends to be symmetric. Nevertheless, given the fewer observations of defaulting companies relative to the number of cases for non-defaulting firms, the estimation of the distribution for the financial soundness index for the former might not fit to the population distribution as accurately when compared to the latter. Additionally, the 50th percentile of non-defaulting firms has been consistently higher than the median index for defaulting companies. This clearly reflects the fact that firms with positive financial soundness indices are on average less prone to default on their financial obligations. As of December of 2013, the 50th percentile of the financial soundness index for non-defaulting firms was -0.054, and for defaulting companies this figure was found to be -0.43 (Figure 3).[11]

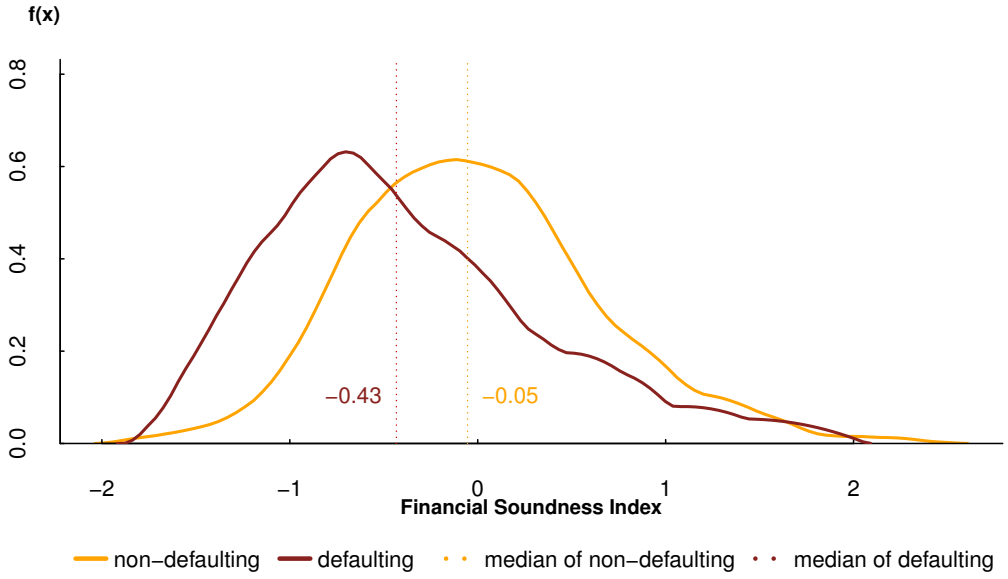
6. Concluding Remarks and Policy Implications

The main objective of this research was to refine the current analysis and monitoring of the private corporate sector's financial soundness in Colombia performed by the Financial Stability Department in the Banco de la República. In the fulfillment of this objective, the sector's financial soundness index built in this paper adds to the efforts and current activities aimed at providing a thorough view about firms' financial performance. This composite metric aggregates five financial attributes that are usually studied individually and in the context of the financial ratio analysis for the purpose of providing a view about the financial health of a firm. Instead of relying on individual ratio analysis and thus to deal with many interpretations and conclusions of firms' creditworthiness, this research allows to summarize in one metric the different dimensions that make up the financial situation of a company.

Given the low frequency and sampling process of the database employed as a proxy of the Colombian private corporate sector, the empirical approach did not allow the construction of an index comparable

[11]The empirical distributions on a yearly periodicity for the period 2000-2013 are presented in Appendix B.

FIGURE 3: **Financial soundness index's empirical distribution for defaulting and non-defaulting firms as of December 2013**



Source: Authors' calculations.

through time and for the sector as a whole. However, and taking advantage of the heterogeneity at the micro level within the sample, it was possible to construct the financial soundness index by firm and industry. Per year, results allow to identify the balance sheet performance relative to the private corporate sector. In fact, a positive index relates to a good financial health, a negative indicator is a sign of fragility, and a metric close to zero suggests a financial performance close to that observed for the total sample.

The validation tests performed on the index suggest a negative correlation between local financial intermediaries credit risk exposure and the financial soundness index of their debtors. Moreover, companies that have made default on their financial obligations have on average a negative and lower financial index. Furthermore, the empirical distribution of financial soundness index for defaulting firms is located to the left of the one obtained for non-defaulting firms.

In terms of policy implications, the index may be a useful tool for policymakers interested in assessing and identifying fragile industries and to make the appropriate countermeasures aimed at maintaining soundness within the private corporate sector. Given the large exposure of Colombian credit establishments to this sector, the main contribution of this research is to validate that balance sheet performance is a good indicator of potential sources of credit risk exposures for financial intermediaries.

Future work of this research should be focused primarily on finding a suitable methodology aimed at building a dynamic index and that best fits the data structure of the sample employed. An index of this kind will be the right catalyst for establishing and testing causal relationships with other variables (such as the quality index and the probability of default), as well to anticipate risks and vulnerabilities of firms' balance sheet.

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Appendix A. Principal Component Analysis

Let $\mathbf{X}$' $= [X_1, X_2, ..., X_p]$ be a $n \times p$ matrix that represents p variables over n observations, with variance-covariance matrix $\mathbf{\Sigma}$. The spectral decomposition of $\mathbf{\Sigma}$ has p positive eigenvalues $(\lambda_1, \lambda_2, ..., \lambda p)$. Following Judge et al. (1988), the linear combinations of the system $\mathbf{Y} = \mathbf{AX}$ are:

$$Y_1 = \mathbf{a}_1'\mathbf{X} = a_{11}X_1 + a_{12}X_2 + ... + a_{1p}X_p \tag{1}$$
$$Y_2 = \mathbf{a}_2'\mathbf{X} = a_{21}X_1 + a_{22}X_2 + ... + a_{2p}X_p \tag{2}$$
$$... \tag{3}$$
$$Y_p = \mathbf{a}_p'\mathbf{X} = a_{p1}X_1 + a_{p2}X_2 + ... + a_{pp}X_p \tag{4}$$
$$\tag{5}$$

Furthermore, it is possible to prove that the following expressions are satisfied:

$$Var(Y_i) = \mathbf{a}_i'\mathbf{\Sigma}\mathbf{a}_i, \qquad \forall i \in 1, 2, ..., p \tag{6}$$
$$Cov(a_i, a_j) = \mathbf{a}_i'\mathbf{\Sigma}\mathbf{a}_j, i \neq j, \qquad \forall i, j \in 1, 2, ..., p \tag{7}$$

It can be noted that the principal components correspond to the p linear combinations $(Y_1, Y_2, ..., Y_p)$, which overall variance must be maximum. Then, the principal components can be restated as follows:

- The first component is the linear combination defined as $\mathbf{a}_1'\mathbf{X}$ so that it maximizes $Var\left(\mathbf{a}_1'\mathbf{X}\right)$ subject to:

$$\mathbf{a'}_1\mathbf{a}_1 = 1 \tag{8}$$

- The second component corresponds to $\mathbf{a}_2'\mathbf{X}$, such that $Var\left(\mathbf{a}_2'\mathbf{X}\right)$ is maximum, and satisfies:

$$\mathbf{a'}_1\mathbf{a}_1 = 1 \tag{9}$$
$$Cov\left(\mathbf{a'}_i\mathbf{X}, \mathbf{a'}_j\mathbf{X} = 0\right), k < i \tag{10}$$

For details on the derivation of expressions (6) and (8), see Judge et al. (1988). It is important to note that the principal components are non-correlated variables. Furthermore, let $\mathbf{P'} = [\mathbf{e}_1, \mathbf{e}_2, \mathbf{e}_p]$ be the transposed vector of the p principal components, so $\mathbf{\Sigma}$ can be restated as:

$$\mathbf{\Sigma} = P\Lambda P' \tag{11}$$

where,

$$\mathbf{\Lambda} = \begin{bmatrix} \lambda_1 & 0 & \dots & 0 \\ 0 & \lambda_2 & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & \lambda_p \end{bmatrix} \tag{12}$$

and $\mathbf{e}_i$ is the eigenvector of $\mathbf{\Sigma}$ related to the eigenvalue λ_i. The trace of $\mathbf{\Sigma}$, using (11) is:

$$tr(\mathbf{\Sigma}) = tr(P\Lambda P') = tr(\Lambda)PP' = tr(\Lambda) = \sum_{i=1}^{p} \lambda_i \tag{13}$$

Additionally,

$$\sum_{i=1}^{p} Var(\mathbf{X}_i) = tr(\mathbf{\Sigma}) = tr(\Lambda) = \sum_{i=1}^{p} Var(Y_i) \tag{14}$$

Hence, it can be deduced that the proportion of variance of the original data in $\mathbf{X}$ which is explained by the k-ith principal component is given by:

$$\frac{\lambda_k}{\sum_{i=1}^{p} \lambda i}, \forall k \in 1, 2, ..., p \tag{15}$$

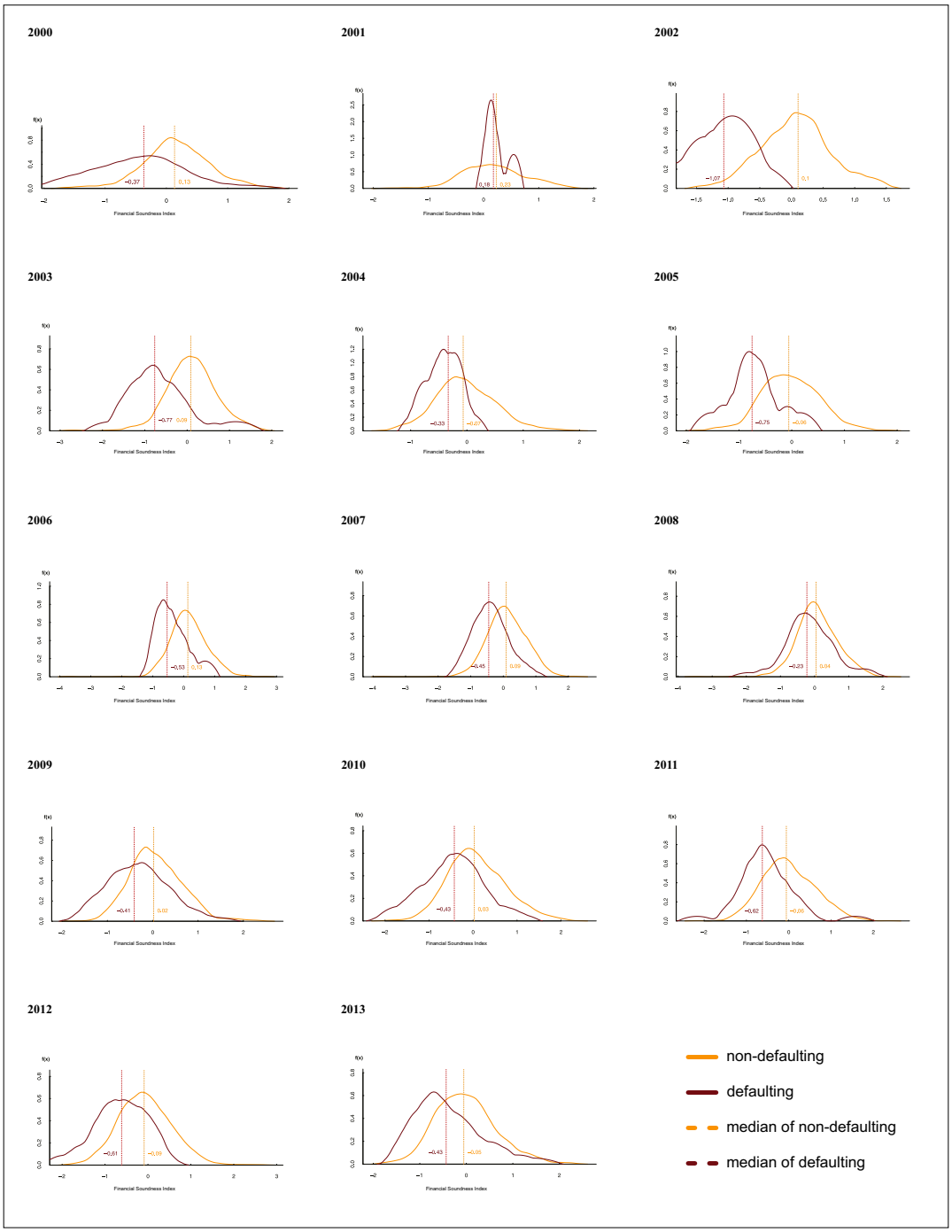
Next, some final comments are presented to explain, in a more detailed way, some theoretically relevant facts. First, it can be noted that the principal component calculation is the solution of an optimization problem. For each equation of the system, $\mathbf{Y} = \mathbf{AX}$, the objective function is the variance of the linear combination of the original variables (contained in $\mathbf{X}$) and the constraint is defined as the coefficient vector norm being equal to 1. This can induce a problem with the interpretation of the principal component coefficients if the variables included in the analysis are measured in different units.

On that topic, Dunteman (1969) demonstrates that the loadings of the variables with greater levels of variance will be higher when compared against those for variables with lower levels of dispersion. Thus, it is convenient to standardize variables and use the correlation matrix $\mathbf{R}$ instead of the variance-covariance matrix $\mathbf{\Sigma}$. It is important to mention that Johnson & Wichern (1998) proof that the eigenvectors calculated from $\mathbf{R}$ are different from those calculated using $\mathbf{\Sigma}$, since the trace of $\mathbf{R}$ by definition is 1.

Secondly, Díaz (2002) states that principal components are subject to comply with some desired properties such as independence, normality and absence of correlation. In case the correlation among the original variables is zero or close to zero, the application of this technique will yield no fruitful results. The latter insofar that the objective of transforming the original variables into orthogonal ones will be not be fulfilled.

Appendix B. Financial soundness index's empirical distribution for defaulting and non-defaulting firms in 2000-2013

FIGURE 4: **Financial soundness index's empirical distribution for defaulting and non-defaulting firms in 2000-2013**



Source: Authors' calculations.

Appendix C. Variables and Weights (Loadings) included in the Financial Soundness Index

TABLE 7: **Activity and Efficiency Subindex**

Year	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11
2000	0.00	0.52	0.00	0.00	0.00	0.00	0.00	0.62	0.58	0.00	0.00
2001	0.00	0.37	-0.65	0.00	0.00	-0.66	0.00	0.00	0.00	0.00	0.00
2002	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.61	0.57	0.00	0.00
2003	0.00	0.52	0.00	0.00	0.00	0.00	0.00	0.62	0.58	0.00	0.00
2004	0.00	0.52	0.00	0.00	0.00	0.00	0.00	0.63	0.58	0.00	0.00
2005	0.00	0.54	0.00	0.00	0.00	0.00	0.00	0.63	0.56	0.00	0.00
2006	0.00	0.54	0.00	0.00	0.00	0.00	0.00	0.63	0.56	0.00	0.00
2007	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.62	0.56	0.00	0.00
2008	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.62	0.55	0.00	0.00
2009	0.00	0.54	0.00	0.00	0.00	0.00	0.00	0.63	0.56	0.00	0.00
2010	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.64	0.54	0.00	0.00
2011	0.00	0.56	0.00	0.00	0.00	0.00	0.00	0.63	0.54	0.00	0.00
2012	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.62	0.56	0.00	0.00
2013	**0.00**	**0.54**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.63**	**0.56**	**0.00**	**0.00**

Source: Author's calculations

TABLE 8: **Leverage Subindex**

Year	X12	X13	X14	X15	X16	X17	X18	X19
2000	-0.58	-0.51	-0.57	-0.29	0.00	0.00	0.00	0.00
2001	-0.55	-0.54	-0.54	-0.33	0.00	-0.11	0.00	0.00
2002	-0.54	-0.53	-0.53	-0.37	0.00	-0.09	0.00	0.00
2003	-0.54	-0.53	-0.54	-0.36	0.00	-0.10	0.00	0.00
2004	-0.58	-0.42	-0.57	-0.39	0.00	0.00	0.00	0.00
2005	-0.58	-0.49	-0.57	-0.30	0.00	0.00	0.00	0.00
2006	-0.59	-0.47	-0.59	-0.27	0.00	0.00	0.00	0.00
2007	-0.57	-0.52	-0.56	-0.32	0.00	0.00	0.00	0.00
2008	-0.56	-0.53	-0.55	-0.33	0.00	0.00	0.00	0.00
2009	-0.56	-0.50	-0.57	-0.32	0.00	0.00	0.00	0.00
2010	-0.56	-0.54	-0.53	-0.33	0.00	0.00	0.00	0.07
2011	-0.55	-0.54	-0.54	-0.34	0.00	-0.08	0.00	0.00
2012	-0.55	-0.54	-0.52	-0.37	-0.07	0.00	0.00	0.00
2013	**-0.56**	**-0.53**	**-0.54**	**-0.35**	**0.00**	**0.00**	**0.00**	**0.00**

Source: Author's calculations

TABLE 9: **Profitability Subindex**

Year	X20	X21	X22	X23	X24	X25	X26
2000	0.49	0.47	0.49	0.48	0.26	0.00	0.00
2001	0.48	0.47	0.49	0.48	0.25	0.14	0.00
2002	0.49	0.47	0.50	0.49	0.24	0.00	0.00
2003	0.48	0.49	0.48	0.45	0.00	0.24	0.22
2004	0.48	0.47	0.48	0.48	0.27	0.10	0.00
2005	0.48	0.47	0.48	0.48	0.27	0.12	0.00
2006	0.48	0.46	0.48	0.48	0.28	0.10	0.00
2007	0.48	0.46	0.48	0.48	0.29	0.07	0.00
2008	0.48	0.46	0.48	0.48	0.28	0.10	0.00
2009	0.48	0.46	0.48	0.48	0.29	0.10	0.00
2010	0.48	0.46	0.48	0.48	0.29	0.09	0.00
2011	0.48	0.46	0.48	0.48	0.29	0.09	0.00
2012	0.56	0.55	0.54	0.00	0.31	0.00	0.00
2013	**0.48**	**0.46**	**0.48**	**0.48**	**0.30**	**0.07**	**0.00**

Source: Author's calculations

TABLE 10: **Liquidity Subindex**

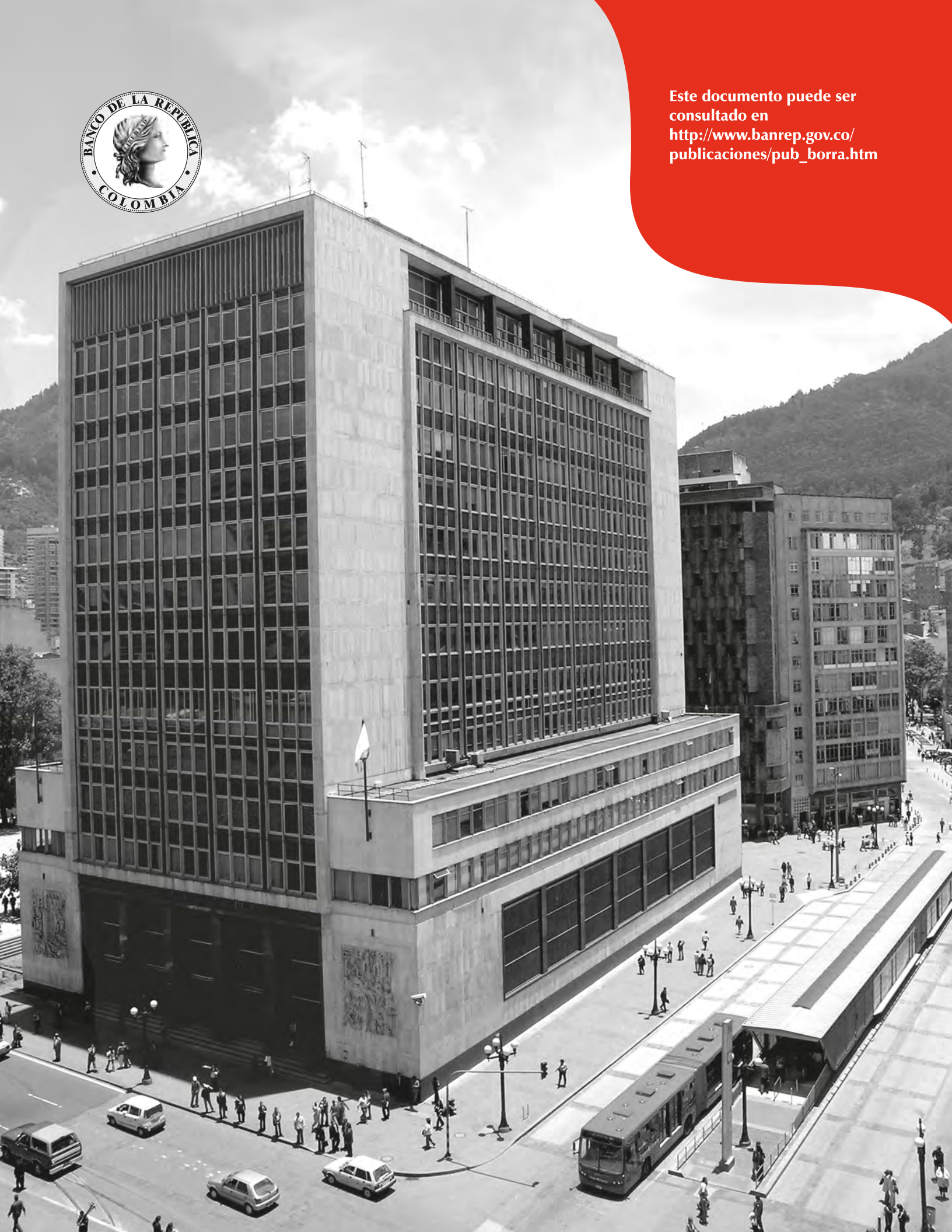
Year	X27	X28	X29	X30	X31	X32
2000	0.48	0.57	0.52	0.00	0.00	0.41
2001	0.62	0.00	0.00	0.56	0.00	0.54
2002	0.63	0.00	0.00	0.56	0.00	0.54
2003	0.62	0.00	0.00	0.57	0.00	0.54
2004	0.00	0.69	0.69	0.00	0.20	0.00
2005	0.00	0.68	0.68	0.00	0.29	0.00
2006	0.50	0.58	0.51	0.00	0.00	0.39
2007	0.47	0.59	0.54	0.00	0.00	0.38
2008	0.50	0.59	0.53	0.00	0.00	0.36
2009	0.47	0.58	0.53	0.00	0.00	0.41
2010	0.52	0.57	0.50	0.00	0.00	0.39
2011	0.50	0.58	0.52	0.00	0.00	0.37
2012	0.49	0.58	0.53	0.00	0.00	0.38
2013	**0.48**	**0.58**	**0.54**	**0.00**	**0.00**	**0.36**

Source: Author's calculations

TABLE 11: **Size Subindex**

Year	**X33**	**X34**
2000	0.71	0.71
2001	0.71	0.71
2002	0.71	0.71
2003	0.71	0.71
2004	0.71	0.71
2005	0.71	0.71
2006	0.71	0.71
2007	0.71	0.71
2008	0.71	0.71
2009	0.71	0.71
2010	0.71	0.71
2011	0.71	0.71
2012	0.71	0.71
2013	**0.71**	**0.71**

Source: Author's calculations



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