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INDEBTEDNESS INDICATORS: FACTOR ANALYSIS IN THE COMPARISON BETWEEN THE LITERATURE AND THE NATIONAL ELECTRIC ENERGY AGENCY (ANEEL)

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ABSTRACT

This paper aims to verify whether the indebtedness indicator proposed by the National Electric Energy Agency (ANEEL) presents a latent relationship with the indebtedness indicators used by the literature. ANEEL systematized the economic-financial supervision of the energy distribution operators using performance indicators, among them there is the indebtedness, which differs from those used by the literature. In this study, ANEEL's indebtedness indicator was compared with different *proxy* indebtedness indicators (Ribeiro & Santos, 2004; Lima & Freire, 2008; Ribeiro,

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Macedo, & Marques, 2012; Delen, Kuzey, & Uyar, 2013; Ozório, 2015; Castro *et al.*, 2017). To verify that the ANEEL indicator follows a pattern similar to the others, the indicators were grouped employing factor analysis. We collected the financial data from the financial statements which are made available by ANEEL for the period from 2011 to 2018. The results show a latent relationship between the ANEEL indebtedness indicators and three indicators used by the literature. It is possible to identify that although the distributors and ANEEL argue that the system used is sectoral (ANEEL, 2014), the indebtedness indicator presents a pattern of behavior similar to those used in the literature.

Keywords: Indicators. Indebtedness. Electricity sector. Factor analysis.

1 INTRODUCTION

The Brazilian Electricity Sector (SEB) is regulated by the National Electric Energy Agency (ANEEL). The SEB is mainly composed of *holdings*, generators, transmitters, traders, and distributors. In recent years, ANEEL, through technical notes, has worked to promote the improvement of the economic-financial supervision of SEB, particularly in the segment of energy distribution and its financial viability. According to Huenteler, Dobozi, Balabanyan, and Banerjee (2017), the energy sector's financial viability is a prerequisite for attracting the investment needed to ensure reliable energy supply and universal reach for electricity. Also, the analysis of financial viability serves as a driver for the transition to clean energy (Huenteler *et al.* 2017).

The electricity sector's models or supervision systematics are composed of evaluation dimensions of financial viability (*e.g.*, financial and operational). The Technical Note N. 111/2016 presented the new ANEEL modeling, which follows the logic that each dimension includes a set of performance indicators. However, the need for dynamic adjustments seems to be a feature of the regulation models. Ergas and Small (2001) documented this need for periodic redefinition of distribution operators' regulation parameters. In the following year, Bakovic, Tenenbaum, and Woolf (2002) pointed out that the design of new systems used in some sectors' regulation is fundamentally flawed, according to some investors. This list includes mainly developing and transition economies, including Brazil. A few years later, Finland made the first reform of the regulatory model for electricity distribution. This reform took place in 2012 and has sparked the reform interest in other countries and other sectors (e.g., gas and telecommunications) and a debate among professionals and academics (Kuosmanen, Saastamoinen & Sipilainen, 2013).

In February 2019, the *British Columbia Hydro and Power Authority* and the *British Columbia Utilities Commission* discussed, among other issues, the opportunities and challenges associated with the adoption of Performance Based Regulation (PBR) (Lowry and Makos, 2020), indicating the need to review regulatory models to focus on performance analysis. Over the years, this dynamic has provoked new questions about regulatory models and their performance indicators. This keeps the need for complementary studies. Along the same line, Braga, Rufin, Brandão, and Torres (2016) point out the need for the study and development of regulatory models by indicating that "the financial supervision of electricity distribution companies is still at an early stage in academic centers, government agencies, and among international regulators".

The need for research on regulatory models is also documented by Huenteler *et al.* (2017), suggesting a limitation in research on institutional determinants and the prerequisites for cost recovery and financial viability. The authors also indicate that the explanatory research on economic viability should be rigorous and argue that the normative literature on cost recovery and financial viability has evolved to become increasingly empirical and pragmatic.

Over the last two decades, research has emerged to debate and study the challenges and alternatives of financial supervision and economic-financial performance from the perspectives of various regulated economic sectors in different countries (Borio, 2003); Solver, 2005; Wymeersch, 2007; Treasury, 2009; Čihák & Podpiera, 2009; Pan, 2010; Hilbers, Raaijmakers, Rijsbergen, &

De Vries, 2013; Hu, Yin, & Zheng, 2016; Ringe, Morais, & Ramos Munoz, 2019; Lowry & Makos, 2020). More specifically, Ergas and Small (2001), Pombo (2001), Arocena and Price (2002), Mehdi, Fetz, and Filipini, (2007), Ribeiro *et al.* (2012), Braga *et al.* (2016), Huenteler *et al.* (2017) have studied the models and systematics adopted in financial supervision related to the electricity sector.

In Brazil, some studies that analyze financial supervision through performance indicators in the regulated insurance, health insurance, educational institutions, energy distribution, and banking institutions (Bezerra & Corrar, 2006; Soares, 2006; Breitenbach, Alves, & Diehl, 2010; Mendonça, Souza, & Campos, 2016) also stand out. The publication of papers related to the economic-financial supervision of the energy sector in Brazil has also advanced in the last decade, especially quantitative papers (Bomfim, Almeida, Gouveia, Macedo, & Marques, 2011; Brandão *et al.*, 2016; Peris, 2016; Scalzer, Rodrigues, & Macedo, 2015; Boente & Lustosa, 2016; Scalzer, 2017, Jacob & Bragança, 2017). Studies that use financial indicators to verify sectors, organizations, or divisions' performance predominate in this literature.

This study differs from the others because we do not find any paper that has been analyzed the new systematic proposal of economic-financial supervision of ANEEL through the set of indicators proposed by the technical notes. In other words, this seems to be the first study that compares the financial indebtedness indicators studied in the literature with the corresponding ANEEL indicator. Thus, this paper's main objective is **to verify whether the indebtedness indicator proposed by the National Electric Energy Agency (ANEEL) presents a latent relationship with the indebtedness indicators used by the literature**. Ten indebtedness indicators were analyzed; nine were mentioned in the literature and one according to the ANEEL proposal. The database extracted from the agency's website. The relation between the indicators was made through factor analysis to group indebtedness *proxy* variables and identify whether the ANEEL indicator has a latent relationship with the indicators proposed by the literature.

The relevance of this paper is based on the need to study and develop the regulatory model and compare the theory discussed in the literature with the practice of evaluating the indebtedness of companies in the regulated electricity sector. Contributions to literature and practice can be highlighted.

The contribution of this paper to the literature is based on the fact that there is no other paper that does the same analysis we have done regarding the structure of the indicators. We study the latent relationships with the indicator presented by ANEEL. From this perspective, this study is part of the academic environment to identify whether these indicators used in the literature are in line with the energy sector regulatory agency's indebtedness indicator. Hence, this paper is part of the line of empirical studies that seek to assess whether the literature analyzes entities similar to the agencies that evaluate them, their main *stakeholder*.

This paper also contributes to one of SEB's most complex issues, the financial supervision practices most conducive to energy distribution operators having their concessions renewed (ANEEL, 2015). In other words, the studies of indebtedness and, consequently, financial sustainability are relevant for analyzing these companies' financial situation.

Finally, this study aims to contribute to the rationality of the indebtedness indicator proposed by ANEEL. The collaboration with ANEEL in the development of selection criteria and the application of new indicators is expected. In addition, this study hopes to help operators, regulators, and public policymakers in the constant challenges related to the improvement of the modeling and systematization of the operators' economic-financial supervision. As a consequence, it is possible that, in the future, this study may help in the comparability, reliability, specificity, and regulation of the indebtedness indicator (ANEEL, 2014).

2 THEORETICAL REFERENCE

2.1 Analysis of performance indicators and economic-financial supervision models in the electricity sector.

There are some papers in the literature that study the models and systematics developed or adopted in financial supervision related to the electricity sector. The outstanding papers are those of Ergas and Small (2001), Arocena and Price (2002), Mehdi *et al.* (2007), Jamasb and Pollitt (2008), Braga *et al.* (2016) and Huenteler *et al.* (2017). Among other analyses, these studies verify the choices between *price-cap* models and the rate of return, the form of performance evaluation, efficiency *benchmarking* or reference companies, and Performance-Based Regulation (PBR) perspectives. A common understanding provided by these papers is that financial supervision originates the modeling of the regulatory architecture. The performance of electric energy entities is tied to the regulation models because, according to the authors, this is how these companies guide the business to generate performance. In general, these supervisory models or systems are composed of several dimensions - among them, the financial - evaluated by performance indicators.

Some international studies stand out when analyzing the performance indicators of electric energy entities in several countries, such as Meenakumari and Kamaraj (2008), Tallapragada *et al.* (2009), and Kishore and Varun Kumar (2018). In Brazil, some studies on operators performance indicators stand out. Using quantitative methods Bomfim *et al.* (2011), Brandão *et al.* (2016), Peris (2016), Scalzer *et al.* (2015), Boente and Lustosa (2016), Scalzer (2017), and Jacob and Bragança (2017) evaluated the economic-financial performance of energy sector operators.

It is important to mention that there are academic contributions that have been dedicated to suggesting models and/or performance indicators in the analysis of the electricity sector entities, such as those of Carregaro (2003), Campos (2005) and Ribeiro *et al.* (2012), and Caldeira (2013). The verification of differentiated methodological proposals, such as that of Kuosmanen *et al.* (2013), analyzed the introduction of the StoNED method to estimate the efficient operating cost of electricity distributors at the sector supervision time reforms in Finland in 2012. In other countries, for the same estimation, the regulators of this sector apply different methods, such as data envelopment analysis (DEA) or stochastic frontier analysis (SFA). The authors compared the impacts of methodological choices on cost efficiency and acceptable cost estimates. Although efficiency estimates are highly correlated, cost targets reveal large differences.

However, none of the studies cited analyzed the possible interactions between the traditional performance analysis, based on the literature, and the performance supervision regulatory models or systems, especially the new regulatory model proposed by ANEEL. Thus, it is possible to highlight that the studies found in the literature depart from the performance analysis used by ANEEL to evaluate electric energy companies. However, it is possible to observe that the systematization of performance indicators built by ANEEL, according to the Technical Note N. 111/2016, follows the sector's logic. In all the indicators, there is the inclusion of specific components (sectorized) in the calculation formula, pointing to a possible distancing of the results compared to the literature. This paper compares the literature indicators to the ANEEL proposal indicators, and the composition of each one is presented in the methodology section.

2.2 Factor analysis in studies on economic-financial indicators of regulated sectors entities

Factor analysis is a multivariate statistical technique with increasing use in all business-related research areas (Hair, Black, Babin, Anderson, & Tatham, 2009). To the authors, as the number of variables considered in multivariate techniques increases, the need for greater knowledge structure and interrelationships of variables is necessary. Factor analysis was used as a technique in some papers that studied the performance indicators of companies in regulated sectors, such as Bezerra and Corrar (2006), Soares (2006), Bomfim, Macedo, and Marques (2013),

and Mendonça *et al.* (2016). These papers use the quantitative factor analysis methodology to verify the grouping of performance indicators observed in the literature.

Bezerra and Corrar (2006) uses factor analysis to identify the leading indicators in evaluating companies' financial performance in the regulated insurance sector. More specifically, the objective of the paper is to propose a methodology that reduces the degree of subjectivity in the choice of indicators that should compose companies' evaluation and allowed simultaneous analysis of the behavior of several indicators. In this case, factor analysis serves as a way to create selection criteria for financial indicators.

Soares (2006) also analyzes performance indicators to compare the indicators recommended by the literature and the indicators used in regulating entities in Brazil's supplementary health sector. The results based on the indicators adopted by the literature and by the National Supplementary Health Agency (ANS) shows that both are relevant to evaluate and classify the performance of health plan operators (HPOs), since the indicators follow a similar pattern of behavior, demonstrating that there are latent relationships between them.

Bomfim *et al.* (2013) uses the factor analysis technique to point out the most relevant financial and operational indicators in evaluating companies' performance in the oil sector. The authors thus highlighted that the indicators are related, respectively, to the profitability of commercial transactions, financial and operational leverage, continuity of operations, and the future value generation capacity of the organizations surveyed

Mendonça *et al.* (2016) uses factor analysis to identify the most relevant economic and financial indicators to evaluate the performance of the 118 institutions in the banking sector with activities in Brazil from 2011 to 2014. The results show the eight most relevant indicators for assessing these institutions' performance. These can also be replaced by three factors that explain about 89.23% of the overall data interval.

Finally, it is worth mentioning that this paper is part of the literature gap, which has not yet used the factor analysis technique to analyze performance indicators in the regulated energy sector. Therefore, this study seems to be the first to group and compare the indicators recommended by the literature and the regulatory agency's indicators through factor analysis, following the articles' research line as mentioned above.

3 METHODOLOGICAL PROCEDURES

This research is classified according to Richardson (1999) and Gil (1999). As for the nature of the objectives, the study is explanatory and descriptive, not experimental as for the method. The data collection techniques are classified as bibliographic for the construction of the theoretical and documentary reference for the collection of the research variables on the ANEEL site, thus being characterized as *ex-post facto* research. Regarding temporality, the research is classified as longitudinal, analyzing a period of nine years, from 2011 to 2018. As for the approach, this study is classified as quantitative, because based on Fávero and Belfiore (2017), it uses factor analysis as a multivariate statistical technique of data analysis. Finally, regarding the type of sampling, it is characterized as an intentional non-probabilistic of the energy sector distribution companies in Brazil.

Based on the objective of this paper, which consists of verifying if the indebtedness indicator proposed by the National Electric Energy Agency (ANEEL) presents a latent relationship with the indebtedness indicators used in the literature, the factor analysis method was used. This paper aims to group together indicators that present relationships among themselves to identify how the indebtedness indicator used by ANEEL behaves in a joint analysis with the other indebtedness indicators used in the literature. The sample of this study is not balanced because some companies were consolidated over time. The number of companies varies each year, with the total sample consisting of 64 distribution companies in Brazil's electric energy sector whose

financial data was obtained through the financial statements made available by ANEEL between 2011 and 2018.

3.1 Variables Description

The indebtedness indicators proposed by the literature are listed in Table 1, with the following configuration: in the first column, the description and *label* of the one used in the statistical analyses; in the second, the formula; and in the third, a description of its evaluation scope.

ANEEL evaluates the distributors indebtedness through the indicator according to the Technical Note N. 111/2016 (ANEEL, 2016a). This indicator includes variables with particular characteristics of the regulated sector, such as the Regulatory Net Debt (RND) and the Regulatory Reintegration Quota (RRQ).

Table 1
Indebtedness indicators proposed by the literature

	Indicator/Variable	Formula	Reach
1.	Third-Party Capital Participation (TCP).	(Current Liability + Noncurrent Liability) / Total Liability	The higher the worse the performance. It indicates the company's dependence on external resources.
2.	Composition of Indebtedness (CI).	Current Liability / (Current Liability + Noncurrent Liability)	The smaller the better the performance. It informs the percentage of short-term liabilities to total liabilities, i.e., what part of the debt expires in the short term.
3.	Level of Indebtedness (LI)	(Current Liability + Noncurrent Liability) / (Net Equity)	The smaller the better the performance. It indicates how much the company took from third-party capital for every 100 monetary units of equity capital invested.
4.	Net Equity Immobilization (NEI)	Fixed Assets / Net Equity	The smaller the better the performance. It shows how much the company has invested in fixed assets (fixed assets + investments + intangible assets) for every 100 monetary net equity units.
5.	Short-term participation of third-party capital (SPTC).	Current Liability / (Current Liability + Noncurrent Liability + Net Equity)	The higher the worse the performance. Indicates the company's short-term obligations in relation to all of its obligations.
6.	Coverage of Financial Expenses (CFE).	(Operating Profit+ Financial Resources.+ Other Resources.) / Financial Expenses	The higher the better the performance. It indicates how much the company generates revenue and profit per monetary unit of financial expenses.
7.	Interest coverage index (EBT1).	EBIT / (Net financial expenses)	The higher the greater the return provided by onerous sources. The higher the rate, the greater the company's ability to honor its commitments to creditors. It assesses the company's ability to generate resources to meet its debt burden.
8.	Interest coverage index (EBT2).	EBITDA / (Net financial expenses)	
9.	EFD/EBITDA (EBT3).	(Loans and Financing - Availability) / EBITDA	

Source: Variables created based on Ribeiro e Santos (2004), Lima e Freire (2008), Ribeiro *et al.* (2012), Delen *et al.* (2013), Ozório (2015), and Castro *et al.* (2017).

The RND corresponds to sectorial financial assets and liabilities. Liabilitis are formed by loans, financing, and debentures; actuarial liabilities (private pension and other post-employment benefits); tax installments; derivative financial instruments; taxes in arrears; renegotiated sectorial costs; renegotiated sectorial charges in arrears; sectorial financial liabilities; and electricity supply for resale - short term without tariff coverage - subtracted by cash and cash equivalents; temporary investments; derivative financial instruments; sectorial financial assets; and post-employment benefits (ANEEL, 2016b). RRQ considers the depreciation and amortization of the investments

made, aiming at recomposing the assets related to the service provision throughout its useful life (ANEEL, 2009).

Table 2 presents the description of the indebtedness indicator proposed by ANEEL with the following configuration: in the first column, the description and *label* of the variable used in the statistical analysis; in the second, the formula third, a description of its evaluation range.

Table 2
Indebtedness Indicators Proposed by ANEEL

Indicator/Variable	Formula	Reach
10. Indebtedness (IND)	$\frac{\text{Regulatory Net Debt (RND)}}{\text{EBITDA adjusted LTM - QRR LTM}}$	The bigger the worse. It is the relative measure of free cash available for payment of debts subtracted from the amount needed to maintain assets. LTM: last twelve months.

Source: Technical Note N. 111/2016 (ANEEL, 2016a).

3.2 Structuring the factor analysis method

Initially, we present the descriptive analysis of the indicators (Table 3). To perform a factor analysis, it is recommended to have at least five times more observations than the number of variables to be analyzed. The ideal is a proportion of 10 to one (Hair, *et al.*, 2009). Considering that the general sample is composed of 480 observations, the ratio is approximately 37.8.

The descriptive analysis also points to the possibility of *outliers*. All variables were analyzed by the *box plot* method (omitted for space reasons), and the presence of *outliers* was verified in all of them. As this paper aims to demonstrate the sector in general, it was chosen not to operationalize a treatment of these *outliers*, maintaining the database originality.

The first step in the factor analysis process is the correlation analysis between the studied variables (Table 4). As the correlation matrix presented variables related in a high degree, both positively and negatively, and that meet the degree of significance of 5% between ANEEL variables and the literature ones, it was possible to perform two-factor analysis tests.

The first test consists in applying factor analysis with all variables. In the second test, only the IND variables and those that are significantly related to IND are added to verify if the IND would group with the variables that presents significant correlation, even in a more detailed analysis.

First, we apply the factor analysis with the ten indicators (Table 5). According to the Kaiser criterion, the corresponding eigenvalue must be greater than 1 to form a factor. Based on this first analysis results, instead of working with the ten indebtedness indicators, only four factors are used, since they are responsible for explaining 86.07% of the total association between the data. Thus, a minimum number of factors are identified that explain the maximum portion of the indicator's variance. These factors represent five dimensions underlying the data, useful in analyzing the distributors' indebtedness, the object of this study.

Then, we analyze the factor loads of the factor analysis. The factor loads are Pearson's correlations between each variable and each factor; the sum of this relation's squares in each line of the matrix, variable, and factor, determines the communality. Moreover, in the matrix of factor loads, there is the column *uniqueness*, or exclusivity, whose values represent, for each variable, the percentage of variance lost to compose the extracted factors. The difference between 1 and these values results in communality, representing the percentage of each original variable's shared variance. According to Hair *et al.* (2009), a statistical guideline for practical consideration is a minimum level of 0.5 for communalities; all analyzed variables exceed this level. This analysis can identify that there was no need to exclude variables to increase the explanation of variance. The KMO test points to factor analysis's global adequacy; a minimum of 0.5 is recommended for the investigation to be considered appropriate (Fávero & Belfiore, 2017).

To identify the most significant indebtedness indicators for the evaluation of the distributors and establish the composition of the four factors generated by the factor analysis, we

rotate the components in an analysis of the matrix generated by the Varimax method. Thus, we proceed with an orthogonal rotation, the matrix of components aims to extreme or maximize the factor loads values of each variable to a certain factor, so that each variable is associated with only one factor.

4 RESULTS

The SEB, particularly the distribution segment, presents a heterogeneity of contractual characteristics regarding concession and financial operations. There are small, medium, and large operators controlled by public capital and others by private capital, complex processes of large territorial extensions, and typically urban operations. In this context, the database may reflect these characteristics. In the descriptive analysis of the indicators (Table 3), it is verified that the number of variables observations (n) changes in size, being 503 for the largest and 480 for the smallest number of indicators. Thus, the pairing of data, given the occurrence, limited the general sample (n) used for the analyses to 480 observations.

Table 3
Descriptive analysis of indicators

Var.	No. Obs.	Average	p50	St.Error	Min.	Min.	Amplitude	Variance
TCP	503	0.635	0.537	0.478	0.085	4.523	4.438	0.228
CI	503	0.519	0.477	0.183	0.13	1.000	0.861	0.033
LI	503	1.866	1.942	33.248	-678.21	217.883	896.094	1105.459
NEI	503	1.933	2.176	24.883	-523.377	118.751	642.128	619.146
SPTC	503	0.388	0.327	0.311	0.090	3.537	3.447	0.097
CFE	503	-2.607	-1.941	4.793	-66.174	32.406	98.580	22.97
EBT1	503	1.016	0.726	3.767	-44.612	53.714	98.326	14.19
EBT2	503	1.679	1.231	4.223	-42.821	58.103	100.924	17.837
EBT3	480	1.041	1.412	11.086	-169.266	103.799	273.065	122.893
IND	503	29.43	2.648	638.08	-1046.7	14246.0	15292.7	407139.8

Note. TCP: Third-Party Capital Participation; CI: Composition of Indebtedness; LI: Level of Indebtedness; NEI: Net Equity Immobilization; SPTC: Short-term Participation of Third-Party Capital; CFE: Coverage of Financial Expenses; EBT1: Ebit divided by net financial expenses; EBT2: EBITDA divided by net financial expenses; EBT3: EFD divided by EBITDA; IND: Indebtedness.

The descriptive analysis results, presented in Table 3, seem to corroborate with the different characteristics of the distribution operators mentioned above, because the amplitude values - difference between the minimum and maximum values - is relevant. The standard deviations extrapolate the mean, except the TCP, CI, and SPTC indicators only, pointing to a high discrepancy between the values of the sample and demonstrating the size variation among the companies in the electric energy sector. Additionally, it is important to emphasize that, although we recognize the limitations of the results of this study, when analyzing the observations with negative NE, we chose to maintain the observations in the way ANEEL treats in its database, considering the entire sample. Table 4 presents the correlation analysis of the variables.

Table 4
Correlation Matrix with ten variables

Ind.	TCP	CI	LI	NEI	SPTC	CFE	EBT1	EBT2	EBT3	IND
TCP	1.000									
CI	-0.117*	1.000								
LI	-0.866*	0.193*	1.000							
NEI	-0.123*	0.123*	0.110*	1.000						
SPTC	0.209*	-0.369*	-0.427*	-0.203*	1.000					
CFE	0.117*	-0.031	0.132*	-0.034	0.249*	1.000				
EBT1	-0.067	0.053	0.113*	0.007	0.343*	0.864*	1.0000			
EBT2	-0.045	0.040	0.081	-0.048	0.328*	0.876*	0.939*	1.000		
EBT3	-0.397*	0.013	0.217*	0.237*	0.038	0.045	0.023	0.015	1.000	
IND	-0.405*	0.232*	-0.538*	0.083	0.004	0.674	-0.062	-0.605	0.720*	1.000

Note. * for 5%. TCP: Third-Party Capital Participation; CI: Composition of Indebtedness; LI: Level of Indebtedness; NEI: Net Equity Immobilization; SPTC: Short-term Participation of Third-Party Capital; CFE: Coverage of Financial Expenses; EBT1: Ebit divided by net financial expenses; EBT2: Ebitda divided by net financial expenses; EBT3: EFD divided by EBITDA; END: Indebtedness.

Table 4 shows that the TCP, CI, LI, and EBT3 variables are significantly correlate with the IND variable. Thus, the matrix presents the first relevant result for this paper, since there are statistically significant correlations of 5%, positive or negative, between the indicator proposed by ANEEL (IND) and the other indicators verified in the literature.

Table 5 presents the first factor analysis results with ten indicators, which presents the eigenvalues of the correlations matrix with the respective shared variance percentages of the non-rotated factors' original variables.

Table 5
Total Variance Explained

	Original data			Rotated Factors		
Factor	**Eigenvalues**	**% variance**	**% cumulative variance**	**Variance**	**% of variance**	**% accumulated**
Factor1	2.99259	0.2993	0.2993	2.83705	0.2837	0.2837
Factor2	2.61940	0.2619	0.5612	2.63182	0.2632	0.5469
Factor3	1.85948	0.1859	0.7471	1.87493	0.1875	0.7344
Factor4	1.13595	0.1136	0.8607	1.26361	0.1264	0.8607
Factor5	0.77660	0.0777	0.9384			
Factor6	0.29314	0.0293	0.9677			
Factor7	0.13196	0.0132	0.9809			
Factor8	0.10477	0.0105	0.9914			
Factor9	0.04787	0.0048	0.9914			
Factor10	0.03824	0.0038	1.0000			

Note. Research Data. TCP: Third-Party Capital Participation; CI: Composition of Indebtedness; LI: Level of Indebtedness; NEI: Net Equity Immobilization; SPTC: Short-term Participation of Third-Party Capital; CFE: Coverage of Financial Expenses; EBT1: Ebit divided by net financial expenses; EBT2: Ebitda divided by net financial expenses; EBT3: EFD divided by EBITDA; END: Indebtedness.

Table 5 shows that the number of factors formed and retained was equal to four. It is possible to verify in the column "% accumulated" that the degree of explanation reached by such factors is high (86.07%). That is, the four retained factors represent 86.07% of the ten variables variance.

Thus, a minimum number of factors are identified that explain the maximum portion of the indicator's variance. These factors represent five dimensions underlying the data, useful in analyzing the distributors' indebtedness, the object of this study.

Table 6 shows the factor loads of each variable. The results indicated that there was no need to exclude variables to increase the explanation of variance.

Table 6
Factor Loads ans Communalities

Variable	Factor1	Factor2	Factor3	Factor4	Uniqueness	Communality
TCP	-0.0593	**0.9331**	-0.1429	0.0741	0.0999	0.9001
CI	-0.0481	0.1436	**0.8578**	-0.0351	0.2399	0.7601
LI	0.0404	**-0.9605**	0.0657	-0.0122	0.0713	0.9287
NEI	0.064	0.1077	0.1999	**0.8811**	0.1679	0.8321
SPTC	0.0155	0.365	**-0.8604**	-0.2008	0.086	0.914
CFE	**0.9607**	0.0172	-0.0378	0.0199	0.075	0.925
EBT1	**0.9729**	-0.0576	-0.0195	0.0353	0.0485	0.9515
EBT2	**0.9773**	-0.0455	0.0075	0.0078	0.0428	0.9572
EBT3	-0.0029	**-0.5564**	-0.4408	0.554	0.1893	0.8107
IND	0.0272	**0.5982**	0.3715	-0.3625	0.3721	0.6279

Note. TCP: Third-Party Capital Participation; CI: Composition of Indebtedness; LI: Level of Indebtedness; EBT3: EFD divided by EBITDA; IND: Indebtedness.

The result of the KMO analysis is 0.623, pointing to the global adequacy of factor analysis. From the chi-square statistics of Barlett's sphericity test, it is possible to affirm, for the significance level of 1% and 45 degrees of freedom, that Pearson's correlation matrix is statistically different from the identity matrix of the same dimension, since x^2 presented a value of 1396.32 and p-value of 0.000, that is, p-value < 0.01. These tests point out the adequacy of factor analysis for the analysis and treatment of data.

The analysis results of the rotated components matrix can also be checked in Table 6 (values in bold). In a joint analysis of the results presented in Tables 5 and 6, it can be seen that Factor 1, composed of the indicators CFE, EBT1, and EBT2, is responsible for 28.37% of the indicators variance (% of variance, Table 5). It is also verified that Factor 2, composed of TCP, LI, EBT3, and IND indicators, is responsible for 26.32% of the indicator's variance. Factor 3, composed of the CI and SPTC indicators, is responsible for 18.75% of the indicator's variance. Finally, Factor 4, composed of the NEI indicator, alone explains 12.64% of the indicator's variance.

The factor analysis is then applied to the five indicators: IND and the four variables that correlated significantly with it: TCP, CI, LI, and EBT3. The results of the Explained Total Variance Matrix are in Table 7, which presents the eigenvalues of the correlations matrix with the respective percentages of shared variance of the non-rotated factors original variables.

Table 7
Total Variance Explained

	Original data			Rotated Factors		
Factor	**Eigenvalues**	**% variance**	**% cumulative variance**	**Variance**	**% of variance**	**% accumulated**
Factor1	2.92919	0.5858	0.5858	2.92919	0.5858	0.5858
Factor2	0.98920	0.1978	0.7837			
Factor3	0.79227	0.1585	0.9421			
Factor4	0.23272	0.0465	0.9887			
Factor5	0.05661	0.0113	1.0000			

Note. Research Data.

Table 7 shows that the number of factors formed and retained was equal to one, thus meeting the Kaiser criterion. It is possible to verify in the column "% accumulated" that the degree of explanation reached by such factors is more than half; thus the retained factor represents 58.58% of the five variables variance.

Based on the first results, instead of working with the six indebtedness indicators, only one factor that includes the five indicators was formed. They are responsible for explaining 58.58% of the total association between the data. Thus, a minimum number of factors are identified that

explain the maximum portion of the indicator's variance. These factors represent five dimensions underlying the data, useful in analyzing the distributors' indebtedness, the object of this study.

Table 8 shows the factor loads of each variable. As previously discussed, according to Hair *et al.* (2009), a statistical guideline for the practical consideration of values is a minimum level of 0.5 for communalities. Table 8 shows that all the variables analyzed exceed the value of 0.5, with the exception of the CI variable, which had a value of 0.281. Therefore, this variable seems to be the one that most deviates from the behavior presented by the other variables grouped in the factor. Besides presenting a communality lower than 0.5, the CI variable was grouped in a different factor in the first factor analysis presented in this article.

Table 8
Factor Loads ans Communalities

Variable	Factor1	Uniqueness	Communality
TCP	0.8144	0.3367	0.6633
CI	0.5301	0.7190	0.2810
LI	-0.8773	0.2304	0.7696
EBT3	-0.7954	0.3674	0.6326
IND	0.7633	0.4173	0.5827

Note. TCP: Third-Party Capital Participation; CI: Composition of Indebtedness; LI: Level of Indebtedness; EBT3: EFD divided by EBITDA; IND: Indebtedness.

The KMO analysis result is 0.6314, pointing out that there is global adequacy of factor analysis. From the chi-square statistics of Barlett's sphericity test, it is possible to affirm, for the significance level of 1% and 10 degrees of freedom, that Pearson's correlation matrix is statistically different from the identity matrix of the same dimension, since x^2 presented a value of 767.90 and p-value of 0.000, that is, p-value < 0.01. Thus, these tests point out the adequacy of factor analysis for the analysis and treatment of data. As all the variables were grouped in a single factor, the factor analysis was not tested with the rotated factor, because the results would be the same.

In a joint analysis of the results presented in tables 5, 6, 7, and 8, it can be seen that the ANEEL indicator, IND, is grouped with the variables used in the literature - TCP, LI, and EBT. This grouping can be verified in both factor analyses because IND was grouped both in the first analysis with all the variables included in the test and only with those that presented significant correlation with IND. Although IND shows a significant correlation with the CI variable, it is not grouped to the IND variable in the first analysis. It does not present a high communality value in the second-factor analysis test. Therefore, it was decided not to identify this variable as a variable that has a latent relationship with IND.

Based on the results, it is possible to point out that the indicator proposed by ANEEL was grouped with other debt indicators used in the accounting research in the electric energy sector: PCT, LI, and EBT3. These results respond to this study's main objective, which sought to evaluate the possibility that the indebtedness indicator proposed by the regulatory model may present a correlation or latent relationship with those identified in the literature. Significant correlations with IND were verified, and latent relationships were found between the indebtedness variable used by ANEEL and three other indicators recommended in the literature. We chose to not name the Factors, since the objective of this paper is not to create factors to replace the indicators analysis, but to analyze how the indebtedness indicators used by the literature behaves concerning the variable used by ANEEL.

This study compares the financial indicators of indebtedness studied in the literature with the ANEEL indebtedness indicator. The lack of equivalent studies not allowed comparing the results with those of other authors, this being a limitation of this research.

5 CONCLUSIONS

This paper aims to verify whether the indebtedness indicator calculated in the distributors' financial statements and proposed by the new ANEEL control systematic, may be correlated, or present a latent relationship with the indebtedness indicators used by the literature. This study verifies possible relationships between the indicators proposed by the regulatory agency and the indicators verified in the literature.

In general, studies assessing the relevance of performance indicators indicate that those related to indebtedness form one of the most relevant groups for evaluating the performance of companies in the regulated segments in Brazil (Bomfim *et al.*, 2011; Ribeiro *et al.* 2012; Bomfim *et al.*, 2013; Scalzer *et al.*, 2015; Mendonça, Souza & Campos, 2016; Mendonça *et al,* 2016; Scalzer, 2017). ANEEL also gives this importance to indebtedness indicators.

Our paper fits in the line of research that includes the analysis of economic-financial supervision. This line covers the modeling and systematic supervision of regulatory sectors and, in turn, also consists of the indicators proposed by agencies to monitor these modeling or systematic and obtain the performance of entities.

We use factor analysis, and the division of indicators among the factors pointed out that there are latent relationships between the indebtedness indicator proposed by ANEEL and three other indicators used in the literature. These results, in which it is possible to identify these latent relationships between the agency and the literature indicators, were also found by Soares (2006) in the health sector. Thus, it is possible to indicate that the literature does not deviate from the practice in the matter of analyzing performance indicators in some regulated sectors.

It can be concluded that, although ANEEL developed the indebtedness indicator to conduct a sectoral analysis, it presents a pattern similar to other indicators used in the literature. In addition to mainly fulfilling its mission of generating subsidies for the moment of concessions renewal, the indebtedness indicator also presents latent relationships with some others used by literature. Thus, the insertion of SEB components in the composition of the proposed indebtedness indicator (IND), for example, the QRR and the RND, maybe a differential compared to other indebtedness indicators. Still, it does not seem to be a fundamental factor to detach it from other indicators, making it typically sectoral.

Given the findings of this study, it would be unwise to point out that the indebtedness indicator proposed by ANEEL is relevant for the economic-financial supervision of distributors just because it presents behavior similar to those found in the literature. However, it is possible to point out that the indicators grouped with the ANEEL indicator are probably the most appropriate to analyze the indebtedness of companies in the electric energy sector.

In practice, our results can contribute to the rationality of the agents involved in the electric energy sector. *Stakeholders* can better understand how commonly used indebtedness indicators can relate to the regulatory agency's indebtedness indicator, ANEEL. In the literature, this paper fills the gap between comparing the indebtedness indicators used by the literature and the regulatory agency in the electric energy sector. It thus contributes to the development of studies that accompany the dynamics of the economic-financial supervision of SEB from an empirical-quantitative perspective, analyzing the operators' interactions with the modeling of performance indicators both in literature and practice (regulatory agency).

However, this paper has limitations, and among them, there is the contractual issue of the sector, which can influence the entity's indebtedness analysis. The electric energy distribution segment has several contractual specificities that were not considered in this paper, such as operational, financial, shareholder (public or private control), and regulatory objectives, differentiated for each distributor. There are also problems with the quality of the information, it is verified in the financial statements; for example, operators with negative net equity. These and other possible specificities have not been addressed in this paper. As a limitation, the approach from a single quantitative perspective is also considered because one can use, for example, Data Envelopment Analysis.

As suggestions for future research, we suggest that it is possible to apply the same idea of this paper observing some of the distribution segment's specificities, such as operators segmented by size or by the division between those controlled by public capital or private initiative. The analyses can also be developed under a new perspective of quantitative methodology. In addition, this paper only analyzes the dimension of indebtedness, and it is known that the new financial supervision of the distributors includes other dimensions. Thus, it is also possible to analyze the other dimensions, such as investment and profitability, each with its respective indicators proposed by ANEEL. Finally, it is possible to point out that the analysis we present in this paper can also be done in other sectors, using the sectorial indicators of other regulatory agencies.

REFERENCES

ANEEL. (2009). *Resolução Normativa nº 386/2009*. Estabelece os conceitos gerais, as metodologias aplicáveis e os procedimentos para realização do Segundo Ciclo de Revisões Tarifárias Periódicas das concessionárias de serviço público de transmissão de energia elétrica. Brasília. 2009. Recuperado em 01 abril, 2019, de http://www2.aneel.gov.br/cedoc/ren2009386.pdf

ANEEL. (2014). *Nota Técnica no 353/2014-SFF/ANEEL*. Brasília. Recuperado em 29 março, 2019 de http://www2.aneel.gov.br/aplicacoes/consulta_publica/documentos/NT_Indicadores%20de%20Sustentabilidade.pdf

ANEEL. (2015). *Manual de Contabilidade do Setor Elétrico*. Brasília.

ANEEL. (2016a). *Nota Técnica no 67/2016-SFF/ANEEL* - Instituição de indicadores públicos de sustentabilidade econômico-financeira. Brasília.

ANEEL. (2016b). *Nota Técnica no 111/2016–SFF/ANEEL* - Instituição de indicadores públicos de sustentabilidade econômico-financeira. Brasília.

Arocena, P., & Price, C. W. (2002). Generating efficiency: economic and environmental regulation of public and private electricity generators in Spain. *International Journal of Industrial Organization*, *20*(1), 41-69. doi: 10.1016/S0167-7187(00)00073-4

Bakovic, T., Tenenbaum, B., & Woolf, F. (2002). *Regulation by contract: a new way to privatize electricity distribution?* The World Bank.

Bezerra, F. A., & Corrar, L. J. (2006). Utilização da análise fatorial na identificação dos principais indicadores para avaliação do desempenho financeiro: uma aplicação nas empresas de seguros. *Revista Contabilidade & Finanças*, *17*(42), 50-62. doi: 10.1590/S1519-70772006000300005

Boente, D. R., & Lustosa, P. R. B. (2016). Um estudo comparativo da eficiência de distribuidoras brasileiras de energia elétrica privadas e públicas. *Revista Ambiente Contábil - Universidade Federal do Rio Grande do Norte, 8*(2), 263-286.

Bomfim, P. R. C. M., Almeida, R. S., Gouveia, V. A. L., Macedo, M. A. da S., & Marques, J. A. V. C. (2011). Utilização de Análise Multivariada na Avaliação do Desempenho Econômico-Financeiro de Curto Prazo: uma Aplicação no Setor de Distribuição de Energia Elétrica. *Revista*

do Mestrado em Administração e Desenvolvimento Empresarial da Universidade Estácio de Sá, 15(1), 75-92.

Bomfim, P. R. C. M., Macedo, M. A. da S., & Marques, J. A. V. da C. (2013). Indicadores Financeiros e Operacionais para a Avaliação de Desempenho de Empresas do Setor de Petróleo e Gás. *Revista Ambiente Contábil, 16*(1), 112-131.

Borio, C. (2003). Towards a macroprudential framework for financial supervision and regulation? *CESifo Economic Studies*, *49*(2), 181-215.

Braga, K., Rufin, C., Brandão, R., & Torres, E. (2016). Financial Regulation of the Electricity Distributors: Necessity and Feasibility. *Energy Procedia*, *106*, 166-174. doi: 10.1016/j.egypro.2016.12.113

Brandão, R., Macedo, M. A., Ozorio, L. M., Scalzer, R., Tavares, A., Gomes, R. O., & Pereira, R. M. R. Análise de Sustentabilidade Econômica e Financeira das Distribuidoras de Energia Elétrica no Brasil no período de 2009-2015. *Congresso de Inovação Tecnológica em Energia Elétrica*, 9.

Breitenbach, M., Alves, T. W., & Diehl, C. A.(2010). Indicadores financeiros aplicados à gestão de instituições de ensino de educação básica. *Contabilidade Vista & Revista*, *21*(3).

Caldeira, T. C. M. (2013) *Indicador de desempenho global das distribuidoras de energia elétrica.* (Dissertação de mestrado) Mestrado profissional em Regulação e Gestão de Negócios, Universidade de Brasília, Brasília, DF. Brasil.

Campos, J. J. F. D. (2005). *Sustentabilidade energética no brasil: proposta de indicadores para elaboração de relatórios de sustentabilidade por empresas do setor elétrico* (Dissertação de mestrado). Fundação Getúlio Vargas, Escola de Administração de Empresas de São Paulo, São Paulo, SP, Brasil.

Carregaro, J. C. (2003). *Proposta de indicadores de desempenho às distribuidoras de energia federalizadas do setor elétrico brasileiro*. (Dissertação de mestrado) - Universidade Federal de Santa Catarina, Centro Tecnológico, Programa de Pós-Graduação em Engenharia de Produção, Florianópolis, SC, Brasil.

Castro, N., Brandão, R., Ozorio, L. M., Macedo, M. Á., Rodrigues, A., Torres Filho, E., Rufín C., Gomes, R. O., Scalzer, R., Tavares, A., Martins, N., Braga, K., & Martins, N. (2017). Indicadores de Sustentabilidade Econômico-Financeira das Empresas de Distribuição de Energia Elétrica. *Grupo de Estudos do Setor Elétrico UFRJ (GESEL)*. Rio de Janeiro.

Čihák, M., & Podpiera, R. (2008). Integrated financial supervision: Which model? *The North American Journal of Economics and Finance*, *19*(2), 135-152. doi: 10.1016/j.najef.2008.03.003

Delen, D., Kuzey, C., & Uyar, A. (2013) Measuring firm performance using financial ratios: A decision tree approach. *Expert Systems with Applications, 40*(10), 3970-3983. doi: 10.1016/j.eswa.2013.01.012

Ergas, H., & Small, J. (2001). Price caps and rate of return regulation. *Network Economics Consulting Group*.

Fávero, L. P. & Belfiore, P. (2017). *Manual de Análise de Dados*. Rio de Janeiro: Elsevier.

Gil, A. C. (1999). *Métodos e técnicas de pesquisa social*. São Paulo: Atlas.

Hair, J. F., Black, B., Babin, B., Anderson, R. E., & Tatham, R. L. (2009). *Análise Multivariada de Dados*. Porto Alegre: Bookman.

Hilbers, P., Raaijmakers, K., Rijsbergen, D. R., & De Vries, F. (2013). Measuring the effects of financial sector supervision. *DNB Working Papers 388*, Netherlands Central Bank, Research Department.

Huenteler, J., Dobozi, I., Balabanyan, A., & Banerjee, S. G. (2017). *Cost recovery and financial viability of the power sector in developing countries: A literature review*. doi: 10.1596/1813-9450-8287

Hu, B., Yin, Z., & Zheng, L. (Eds.). (2016). *Development of China's Financial Supervision and Regulation*. Springer. doi: 10.1057 / 978-1-137-52225-2

Jacob, F. E., & Bragança, G. G. F. D. (2017). *Eficiência Financeira das Distribuidoras de Energia no Período de 2011 a 2014: uma análise comparativa usando DEA*. Texto para discussão / Instituto de Pesquisa Econômica Aplicada. Brasília: Rio de Janeiro, RJ.

Jamasb, T., & Pollitt, M. (2008). Security of supply and regulation of energy networks. *Energy Policy*, *36*(12), 4584-4589. doi: 10.1016/j.enpol.2008.09.007

Kishore, L., & Varun K., S. G. (2018). Operational and financial performance optimization of power distribution utilities in India. *International Journal of Pure and Applied Mathematics*, *119*(15 Special Issue C), 1559-1566.

Kuosmanen, T., Saastamoinen, A., & Sipiläinen, T. (2013). What is the best practice for benchmark regulation of electricity distribution? Comparison of DEA, SFA and StoNED methods. *Energy Policy*, *61*, 740-750. doi: 10.1016/j.enpol.2013.05.091

Lima, L. C. G. B., & Freire, F. S. (2008). Composição de Capital versus Desempenho Financeiro de Empresas de Distribuição de Energia Elétrica. *Anais do Congresso Brasileiro de Custos-ABC*.

Lowry, M. N., & Makos, M. (2020). Performance-Based Regulation: Basic Features and Possible Applications to BC Hydro. *Economist*.

Meenakumari, R., & Kamaraj, N. (2008). Measurement of relative efficiency of state-owned electric utilities in India using data envelopment analysis. *Modern Applied Science*, *2*(5), 61-71. DOI: 10.5539/mas.v2n5p61

Mehdi, F., Fetz, A., & Filippini, M. (2007). Benchmarking and regulation in the electricity distribution sector. In *Servizi pubblici: nuove tendenze nella regolamentazione nella produzione e nel finanziamento, 54*, 159-176. CEPE Working Paper.

Mendonça, D. J., Souza, J. A., & Campos, R. S. (2016). Análise do desempenho dos maiores bancos brasileiros: um estudo com a análise envoltória de dados (DEA) aplicada a um conjunto

de indicadores econômico-financeiros. *Revista Observatório de La Economia Latino-americana*, Brasil, setembro.

Mendonça, D. J., Souza, J. A. E., Carvalho, F. D. M., & Benedicto, G. C. (2016). Utilização da análise fatorial para identificação dos principais indicadores de avaliação de desempenho econômico-financeiro: uma aplicação em instituições financeiras bancárias. *Congresso USP de Controladoria e Contabilidade*, 16.

Ozório, L. D. M. (2015). Análise do Desempenho Econômico-Financeiro de Distribuidoras de Energia Elétrica no Brasil. *Grupo de Estudos do Setor Elétrico UFRJ (GESEL*).

Pan, E. J. (2010). Challenge of international cooperation and institutional design in financial supervision: beyond transgovernmental networks. *Chi. J. Int'l L.*, 11, 243.

Peris, R. W. (2017). *Análise do desempenho do setor elétrico no Brasil - 2010 a 2015*. (Dissertação de Mestrado) Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo, São Paulo. doi: 10.11606/D.12.2017.tde-24032017-124815

Pombo, C. (2001). Regulatory reform in Colombia's electric utilities. *The Quarterly Review of Economics and Finance, 41*(5), 638-671. doi: 10.1016/S1062-9769(01)00098-9

Ribeiro, M. G. C., Macedo, M. Á. S., & Marques, J. A. V. C. (2012). Análise da relevância de indicadores financeiros e não financeiros na avaliação de desempenho organizacional: um estudo exploratório no setor brasileiro de distribuição de energia elétrica. *Revista de Contabilidade e Organizações*, *6*(15), 60-79.

Ribeiro, M. S., & Santos, A. (2004). A remuneração dos capitais utilizados para financiamento dos ativos de empresas distribuidoras de energia elétrica medida por meio da DVA. *BBR-Brazilian Business Review*, *1*(1), 17-30.

Richardson, R. J. (1999). *Pesquisa social: métodos e técnicas.* São Paulo: Atlas.

Ringe, W. G., Morais, L. S., & Ramos Muñoz, D. (2019). A Holistic Approach to the Institutional Architecture of Financial Supervision and Regulation in the EU. *Oxford Legal Studies Research Paper No. 56/2019, European Banking* Institute Working Paper Series 2019 – n. 50. doi: dx.doi.org/10.2139/ssrn.3466649

Scalzer, R. S. (2017). *Insolvência Empresarial: Um Estudo sobre as Distribuidoras de Energia Elétrica Brasileiras*. Universidade Federal do Rio de Janeiro, Rio de Janeiro.

Scalzer, R. S., Rodrigues, A., & da Silva Macedo, M. Á. (2015). Insolvência empresarial: um estudo sobre as distribuidoras de energia elétrica brasileiras. *Revista Contemporânea de Contabilidade*, *12*(27), 27-60.

Soares, M. A. (2006). *Análise de indicadores para avaliação de desempenho econômico-financeiro de operadoras de planos de saúde brasileiras: uma aplicação da análise fatorial.* (Dissertação de Mestrado) Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo, São Paulo. doi: 10.11606/D.12.2006.tde-15122006-121519

Solver, T. (2005). *Reliability in performance-based regulation.* (Trabalho de conclusão de curso) Department of Electrical Systems, Royal Institute of Technology, Sweden. Recuperado em 01 maio, 2020, de https://www.diva-portal.org/smash/get/diva2:14598/FULLTEXT01.pdf

Tallapragada, V. S. N., Shkaratan, M., Izaguirre, A. K., Helleranta, J., Rahman, S., & Bergman, S. (2009). *Monitoring performance of electric utilities: indicators and benchmarking in sub-Saharan Africa*. World Bank Other Operational Studies 13030, The World Bank.

Treasury, U. S. (2009). Financial Regulatory Reform: A New Foundation: Rebuilding Financial Supervision and Regulation. *US White Paper on Financial Regulatory Reform*.

Wymeersch, E. (2007). The structure of financial supervision in Europe: about single financial supervisors, Twin Peaks and multiple financial supervisors. *European Business Organization Law Review*, *8*(2), 237-306. doi: https://doi.org/10.1017/S1566752907002376

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