REGULATORY RISK AND RETURN ON CAPITAL IN REGULATED INDUSTRIES: A SYSTEMATIC LITERATURE REVIEW

RISCO REGULATÓRIO E RETORNO SOBRE O CAPITAL EM SETORES REGULADOS: UMA REVISÃO SISTEMÁTICA DA LITERATURA

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ABSTRACT

The study aims to review the literature on regulated industries' regulatory risk and return with special regard to infrastructure utilities, identifying research opportunities. A systematic review of 51 articles identified from the search strategy in a scientific database was carried out, which were classified according to research hypotheses, adding the main findings about the influence of different aspects on the regulated companies' risk. This study contributes by providing an in-depth understanding of the topic, evidencing gaps, and research opportunities, as well as different concepts and sources of regulatory risk and methods most used to identify it. There is no consensus regarding the concept and the measurement of regulatory risk; as well as research method, although the CAPM is the most adopted model for its identification. The most researched countries have been the United States and the United Kingdom, and few studies go beyond this axis, especially those that address emerging countries. This study presents the ways and contexts in which the academy has investigated the subject, focusing on the possibility of future research. In addition, it can assist in the architecture of regulatory impact analysis, as required in many jurisdictions. Knowing the dynamics of the relationship between regulatory risk and capital return of regulated companies can benefit society in the exercise of social control and participation in public discussions on related aspects arising from the provision and consumption of regulated public infrastructure services.

Keywords: Regulatory risk. Capital return. Capital cost. Regulated industry. Infrastructure.

RESUMO

O artigo tem como objetivo revisar a literatura sobre risco e retorno regulatório de setores regulados, com especial atenção para concessionárias de infraestrutura, identificando oportunidades de pesquisa. Foi realizada revisão sistemática de 51 artigos identificados a partir de estratégia de busca em base de dados científica, os quais foram classificados conforme hipóteses de pesquisa, agregando os principais achados sobre a influência de diferentes aspectos sobre o risco das empresas reguladas. Este estudo contribui ao proporcionar entendimento aprofundado sobre o tema, evidenciando lacunas e oportunidades de pesquisa, bem como diferentes conceitos e fontes de risco regulatório e métodos mais utilizados para identificá-lo. Não há consenso sobre o conceito e as fontes de risco regulatório; bem como sobre método de pesquisa, embora o CAPM seja o modelo mais adotado para sua identificação. Os países mais pesquisados têm sido os Estados Unidos e o Reino Unido, sendo poucos os estudos que vão além desse eixo, principalmente os que abordam os países emergentes. O estudo apresenta formas e contextos em que a academia tem investigado o tema, com foco na possibilidade de pesquisas futuras. Além disso, pode auxiliar na arquitetura da análise de impacto regulatório, conforme exigido em muitas jurisdições. Conhecer a dinâmica da relação entre risco regulatório e retorno de capital das empresas reguladas pode beneficiar a sociedade no exercício do controle social e participação nas discussões públicas sobre aspectos relacionados à oferta e consumo de serviços regulados de infraestrutura pública.

Palavras-chave: *Risco regulatório. Retorno de capital. Custo capital. Setores regulados. Infraestrutura.*

1 INTRODUCTION

Regulated firms in infrastructure industries have different dynamics regarding returns on capital. Usually, they are monopolies, public service utilities, with revenue, prices, or costs regulated by the State. Investors in these industries expect to receive back, given the regulatory framework, through future cash flows, the principal invested, fair remuneration, and, eventually, some extra rent originated on efficiency gains.

However, risk disclosure by companies is often ambiguous, non-specific, and characterized by standardized statements, even though the capital market seems to value greater transparency concerning risks. This is what Düsterhöft, Schiemann and Walther (2023) identified, analyzing the risk reports of European public utilities companies.

According to the Capital Asset Pricing Model (CAPM), developed by Sharpe (1964), Lintner (1965), and Mossin (1966), the return on an asset is linearly related to the market premium and, consequently, to the market risk. According to Markovitz's (1952) portfolio theory, the market risk is systematic because it cannot be eliminated through diversification as the market portfolio is supposed to have diversified out every asset specific risk.

In the context of regulated industries, the degree of exposure of a regulated firm to market risk is affected not only by the regulatory framework but also by the agency's reputation. Hence, regulatory agencies need to understand the regulatory risk so they can porpoerly establish the correct rate of return allowed to investors in regulated firms. On the one hand, the agency should not excessively burden consumers who ultimately support the capital return to investors and, on the other hand, should avoid underestimating risks, affecting the return of already installed investors, to inhibit future investments (WRIGHT; MASON; MILES, 2003).

In this sense, the understanding of regulatory risk is important for consumer-oriented policy initiatives as the design of the regulatory framework has significant impact on the degree of systematic risk borne by public utilities in general, and on the consumer tariffs in particular (ARBLASTER, 2018).

Given the above, there is significant research on the relationship between regulatory risk and the return on capital on regulated industries firms comprising many aspects that can sway that relationship.

According to Peltzman (1976), regulated firms have less risk in general than unregulated firms since regulation provides a safety cushion against risks through tariff adjustments in noncompetitive markets. For Alexander, Mayer, and Weeds (1999), however, some risk may arise from the regulatory framework itself as consequence of the economic regime to which the utility is submitted. According to Parker (2003), regulatory risk depends on different types of regulatory rules, the maturity of the regulatory system in general, and the regulatory agency's reputation in particular. Furthermore, unexpected political or external interventions on the regulation can affect the returns of regulated firms.

In addition, theories of regulation, including those applied to accounting, as described in Cardoso, Saravia, Tenório, and Silva (2009), can elucidate aspects inherent to the discussion of risk and return in the context of regulated industries. Thus, the following research question arises: how has research on regulatory risk and return on regulated industries evolved?

Accordingly, the objective of this article is to review the literature on regulated industries' regulatory risk and return regarding infrastructure utilities, identifying research opportunities. Its contributions are: to present the ways and contexts in which the academy has investigated the subject, as well as definitions and sources of regulatory risk, sample profile, and methodological options mainly used, focusing on the possibility of future research. In addition, it can assist in the architecture of regulatory impact analysis, as required in many jurisdictions.

2 THEORETICAL FRAMEWORK

Research on the risk of infrastructure companies has been limited, as there are few studies focused on specific sectors, such as public utilities or infrastructure, and most focus on financial or non-financial companies, whose risk is highly differentiated. Furthermore, many studies focus on developed countries and just one country, which must be justified by regulatory differences between jurisdictions (DÜSTERHÖFT; SCHIEMANN; WALTHER, 2023).

When looking at electricity network companies, for example, there are few studies on regulatory risk and there is a gap in the interaction of regulatory risk with market risk and business risk. In China, for example, the government has emphasized the need to clarify the boundaries between regulatory business and capital market-oriented business (ZHANG et al., 2022). This finding opens up an opportunity to review specific literature on the regulatory risk of regulated infrastructure companies, which can provide a more comprehensive understanding of this specific type of risk.

2.1 Risk and return in regulated industries

Infrastructure industries have characteristics of natural monopolies, as they are capital-intensive, have projects with long maturation periods, use specialized technology, and are subject to significant fixed and sunk costs. Natural monopolies are those cases in which it is more efficient for a particular and not easily substituted good or service to be supplied by one firm than by two or more (BAUMOL; WILING, 1981; PINDYCK; RUBINFELD, 2017). In general, this case is referred as decreasing average cost on the market demand.

In the economic literature, regulation is advocated for cases where market failures, of which natural monopolies are an example, occur. According to Baldwin, Cave, and Lodge (2012), market failures prevent the market from generating welfare and maximizing efficient allocations.

Thus, state action constrains the choices of regulated agents through regulatory mechanisms that can direct the exercise of economic activity. As a consequence, through economic regulation, the investors' return on capital is somewhat limited either by a cost reimbursement mechanism or by an incentive scheme, conditioned to the norm.

Therefore, the risk-return relationship is present in the context of regulated industries from the point of view of both the investor and the regulator. The investors, before investing their capital, figure out the alternative risk-adjusted returns from different investments and determine what is called their opportunity cost. The regulator, when influencing the allowed rate of return to the investor, needs to resort to an estimative for the investors' required return based on historical values of the industry itself or similar industries, since the equity's cost for the investor is not observable (WRIGHT; MASON; MILES, 2003).

Usually, regulators estimate the rate of return by calculating the Weighted Average Capital Cost (WACC) combined with the Capital Asset Pricing Model (CAPM), the last one used to determine the risk-adjusted cost of equity (WRIGHT; MASON; MILES, 2003; ANEEL, 2020; COUNCIL OF EUROPEAN ENERGY REGULATORS, 2021).

The CAPM is a model based on the variance of returns, whose premises establish that the expected return on an asset I, $E(R_i)$, can be approached by the equation $E(R_i) = R_f + \beta_i[(R_m - R_f)]$, where R_f is the risk-free rate; β_i is the beta coefficient of asset i with respect to the market risk premium, and R_m is the return of a well-diversified, and therefore efficient, portfolio. The difference $(R_m - R_f)$ is the market risk premium, the excess return of the market portfolio over the risk-free asset that compensates for the market, systemic undiversifiable risk. Regarding the coefficient β, which represents the historical sensitivity of the asset's return in relation to market return, it is obtained through the expression $\beta_i = Cov(R_m, R_i)/Var(R_m)$.

For Norton (1985), the cost of capital in regulated industries is endogenous to the regulatory process and, therefore, the analysis made by regulators based on observed measures of cost of capital would become questionable. This is so because regulatory risk arises from regulation imperfections, incompleteness, asymmetries, and even external interventions that might shift an asset's sensitivity to market risk and, consequently, refurbish the β parameter. Furthermore, the regulator´s actions might influence the risk of a regulated industry.

Regulatory risk can arise for political reasons, such as uncertainty about election results, in which case political parties have incentives to negotiate their elimination through pre-election agreements. Strausz (2017), in this stance, argues that satisfactory negotiations could reduce politically induced regulatory risk.

Regulatory risk can also arise from changes in the regulatory climate, understood as the feeling of security arising from the stability of contractual rules. In this case, the regulatory risk would be contingent on the credibility of the institutional and legal systems to effectively enforce the regulatory norms and contracts, protecting from expropriations of all parties involved (FIOCCO, GUO, 2020).

According to Wright, Mason, and Miles (2003), the aspects previously mentioned can be seen as external factors in the sense that they are given to the company and the regulator alike. Besides those, Wright, Maison, and Miles (2003) also identify the so-called internal factors, such as the exercise by regulatory agencies of their legal independence, acting at their discretion.

Parker (2003) also stresses that regulatory risk is not only linked to the advancement of a country's regulatory system but also to the nature of its regulatory rules and practices. In this sense, the return on capital of regulated firms would be directly proportional to the level of regulatory risk as every investor shall demand higher returns on their investment.

This notion dates back to Stigler (1971) and Peltzman (1976). Stigler (1971) laid the foundation of the demand-based regulation under which the regulated firms seek regulation as a way to reduce the systematic risk against demand and cost shocks, making the consequent variations in profits and share prices smaller. Peltzman (1976), on the other hand, stressed the supply side arguing that the state officials offer themselves to be captured by private agents, to operate for their benefit.

2.2 Regulation Schemes and Regulatory Risk

The regulatory framework and the choice of many of its aspects, which is in most instances an agency choice, are factors that affect the degree of market risk that a company faces through the assessment of the allowed rate of return linked to a certain level of risk, as well as conditions for tariffs setting and revisions, and other issues inherent to concession contracts (ALEXANDER; ESTACHE; OLIVERI, 2000).

How the regulatory framework deals with regulated tariffs, the quantity of service provisioning, the investment prospects, and the costs incurred, among them the cost of capital invested, contributes to the degree of equity and efficiency.

Regulatory schemes can be classified according to the following criteria (LAFFONT; TIROLE, 1998): (i) the regulated firm receives all production costs plus a fixed amount (cost-plus fixed fee contracts); (ii) the regulated firm receives only a fixed amount, independent of its production costs (fixed-price contracts); or (iii) the firm receives a fraction of its costs plus a fixed amount (incentive regulation).

All three criteria mentioned above can be summarized through the expression $t = h + \tau C$, where t represents the firm's total net revenue, h denotes a fixed transfer to the firm, and τ specifies the fraction of costs covered by the regulation. As such, the regulator must present the firm with a regulatory scheme of the type. The equation encompasses the central issue of economic regulation: the trade-off between rent extraction and incentives for cost reduction. The equation represents a fixed-price contract if $\tau = 0$, a cost-plus contract if $\tau = 1$, and an incentive contract if $0 < \tau < 1$.

Suppose the firm's cost is given by, where θ is the technological parameter, and a is some activity performed to reduce costs. Suppose also that the regulator only observes C, with no knowledge of θ or a. In this setup, if the regulator wants to induce the firm to perform its activity at the lowest cost, he will use a fixed-price contract under which the cost saved will become profit for the firm. This contract is said to have a high-powered incentive cost reduction scheme since the firm does not bear any cost. Since the firm can transform cost savings into profits, the regulation allows higher profit for the firm.

Conversely, if the government offers a contract that provides full cost coverage, the firm will not be encouraged to perform cost-reducing activities, since the cost saved will not be transferred to its profit. Thus, cost-plus contracts are said to be a low-powered incentive scheme.

Therefore, this kind of contract allows the regulator greater control over the firm's return. In practice, the price cap is a fixed-fee contract are price cap; the rate of return relation is a cost-plus contract.

Between those two polar cases is what is conventionally called incentive contracts, which are regulatory schemes that balance cost reduction and profit control. One example of an incentive contract is cited by Gaggero (2007), in which the total cost of a firm is split into manageable and non-manageable items, allowing the full pass-through of the non-manageable costs to the tariff.

Thus, regulatory risk may reflect the difference between expected and allowed returns and may include regulatory process issues, such as friction in determining the rate of return and cost disallowances (MOYER, RAO, TRIPATHY, 1992). Fixed-fee contracts impose higher systematic risk exposure to a regulated firm due to market fluctuations even in the presence of pass-through clauses (PARKER, 1997). A cost-plus contract, in turn, guarantees a fixed rate of return, allowing adjustments in prices and quantities, implying a lower exposure to systemic risk.

2.3 Development of the Research Hypothesis

Based on the theoretical discussion above we formulate eight hypotheses which will be the object of the systematic literature review:

Table 1 - Hypothesis to be investigated through a systematic literature review

Hypothesis	Statement
A	Political or regulatory events influence risk
B	The regulatory climate affects risk
C	Regulation reduces business risk
D	The regulatory scheme influences the financing mix
E	High-powered incentive regulation is associated with greater risk
F	Accounting regulation influences risk
G	The cost of capital is endogenous to the regulatory process
H	The cost of capital estimation techniques adequately reflect the risk

Source: survey data

3 METHODOLOGY AND SAMPLE SELECTION

The systematic literature review conducted adheres to the stages recommended by Tranfield, Denyer, and Smart (2003), combined with Wright, Brand, Dunn, and Spindler (2007). The method starts with a broad research question that allows the choice of words and expressions that are used, in turn, to identify articles published in peer-reviewed journals. With a sample of articles in hand, the method involves an individual analysis of each article that results in a subset formed by articles of recognized high quality. Table 2 summarizes the method applied.

Table 2 - Summary of the methodology applied for the selection of the sample

Step		Definition	Specifics
1	Research question	How has research on regulatory risk developed over time?	-
2	Main sample selection strategy	Database: Scopus Elsevier. Publication period: no limit Knowledge areas: economics, business, social sciences and engineering. Selection criteria: must contain the "*word*", including variations, synonyms or combinations. In its title, abstract or keywords.	"*Word*": *((regulation OR regulatory) AND (risk OR effect OR impact OR change OR stability OR announcement OR choice OR selection OR predictability OR economic OR scheme OR regime OR framework OR design OR selection OR predictability OR stability OR climate OR environment OR "price cap" OR "revenue cap" OR "rate of return" OR "service cost") AND/OR (beta OR CAPM OR "market reaction" OR "cost of capital" OR "cost of equity" OR "capital cost" OR "equity cost" OR (stock AND (price OR reaction)) OR ((systematic OR idiosyncratic OR business OR specific OR market) AND risk) OR ((equity OR market OR stock) AND (return)) OR "asset pricing" OR (beta AND (volatility OR stability)) AND/OR ((electric OR electricity) AND (transmission OR distribution)) OR ((regulated OR utility OR infrastructure OR network) AND (firm OR company OR corporate OR industry)))*
3	Subsample, or final sample, selection strategy	Article quality evaluation: First filter: identification of the articles published in journals that belong to the first and the second quartile (Q1 and Q2) of the Scimago Journal Rank 2020. Second filter: qualitative analysis based on the article´s objective, research problem, results and conclusion.	The Scimago Journal Rank 2020 is the quality index of the Scopus database. The second filter used the hypotheses A-H.
4	Data extraction	At this stage each article was considered consistent or not with one or more of the hypotheses A-I.	The following information was tabulated: authors, title, year of publication, journal, hypotheses, sector, country, period, methodology, main results.

Source: survey data

Steps 1 and 2 were applied to the Scopus Elsevier database without period restriction, up to the last year available which, at the time of the search, was 2020. It returned references beginning in 1983. The search returned an initial sample consisting of 1,435 articles. Step 3 reduced the initial sample to 51 articles seen as relevant to the analysis according to both quality evaluation criteria. Table 3 summarizes the sampling procedure.

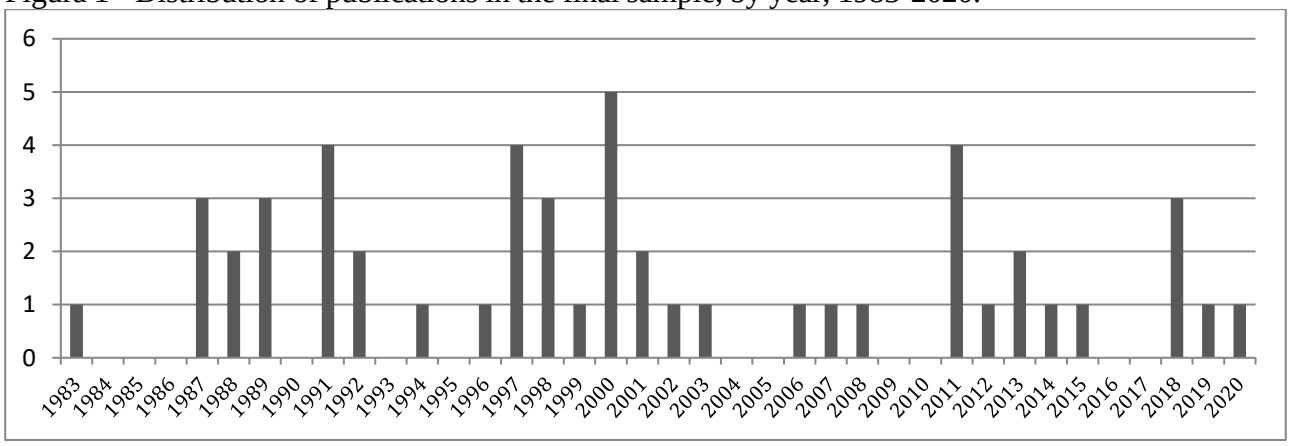
Table 3 - Sample selection

Main Sample		**1,435**
(-) excluded after quality criterion (first filter)		225
(-) excluded after quality criterion (second filter)	analysis of abstract	1,020
	non-quantitative	65
	analysis of objective, problem, result and conclusion	74
(=) Final Sample		**51**

Source: Scopus Elsevier, 1983-2020.

Regarding the characteristics of the final sample, as there was no filter by date, the articles that remained in the final sample were published between 1983 and 2020, with the higher number (16) appearing in the 90s. Figure 1 shows the distribution of articles by year.

Figura 1 - Distribution of publications in the final sample, by year, 1983-2020.



Source: Scopus Elsevier, 1983-2020.

Regarding the country subject of the articles in the final sample, most studied regulatory risk issues in the United States (31), and the United Kingdom (5). Ten articles study more than one country at once. As for the industry studies, the majority of the articles in the final sample investigated issues related to electricity (33). Table 4 shows the distribution of the articles in the sample by country and by industry.

Table 4 - Distribution of publications in the final sample, by country and industry, 1983-2020.

Country	**Quantity**	**Industry**	**Quantity**
United States of America	31	Electricity	33
Mixed	10	Mixed	12
United Kingdom	5	Water	3
Australia	2	Telecomunications	2
Finland	1	Aviation	1
India	1	Transport	1
Italy	1		
Total	**51**	**Total**	**51**

Source: Scopus Elsevier, 1983-2020.

The search scrutinized 26 journals. The "Journal of Regulatory Economics" published the highest number of articles in the sample (10), followed by the "Journal of Economics and Business" and the "Utilities Policy" (4 each). Table 5 shows the number of articles published per journal along with each journal impact factor, H-index, and SJR-Index.

Table 5 - Distribution of publications in the final sample, by journal, 1983-2020

Journal	Nº of articles	Impact Factor	H Index	SJR Index
Annals of Public and Cooperative Economics	1	1,75	37	0,526
Applied Economics	3	1,81	85	0,569
Construction Management and Economics	1	3,80	94	0,880
Contemporary Accounting Research	1	3,37	99	2,769
Contemporary Economic Policy	1	0,96	49	0,454
Economics Letters	1	2,19	100	0,844
Electricity Journal	3	2,05	47	0,750
Energy Economics	3	7,10	152	2,500
Energy Policy	2	6,29	217	2,093
Engineering Economist	1	0,73	34	0,277
European Financial Management	1	1,80	64	1,311
Financial Review	2	1,09	47	0,621
Global Finance Journal	1	2,79	34	0,516
International Journal of Emerging Markets	1	2,53	30	0,433
Journal of Accounting and Public Policy	2	2,64	7	1,264
Journal of Air Transport Management	1	4,68	75	1,220
Journal of Business Finance and Accounting	1	2,54	77	1282
Journal of Business Research	2	7,38	195	2,049
Journal of Economics and Business	4	3,94	50	0,636
Journal of Financial Economics	1	6,88	256	11,673
Journal of International Accounting, Auditing and Taxation	1	2,47	41	0,444
Journal of Regulatory Economics	10	1,31	53	0,751
Quarterly Review of Economics and Finance	1	2,52	50	0,628
Review of Accounting Studies	1	3,42	74	345
Strategic Management Journal	1	8,24	286	11,035
Utilities Policy	4	3,17	51	0,860

Note. Impact factor is a measure of the frequency with which the average article in a journal has been cited in a particular year; H-Index is the number of journal articles (h) that received at least (h) citations. SJR-Index is the average number of weighted citations received in the year by articles published in the selected journal in the three previous years. Source: Scimago Journal & Country Rank. Consult: https://www.resurchify.com/.

4 RESULTS

The studies were classified according to their main hypotheses, as shown below.

4.1 Political or regulatory events influence risk

Twelve articles in the final sample studied and found evidence of political interference or regulatory event effect on regulated firms exposure to systemic risk. Except for Cox and Portes (1998), every other article used a version of the CAPM model to measure the firms' systemic risk. The hypothesis was tested through event studies used to assess changes in the sensibility of the stock returns of the regulated firms about the market volatility after a political or regulatory event.

4.2 The regulatory climate affects the risk

All seven papers in the final sample that tested confirmed the hypothesis that the regulatory climate affects the risk faced by regulated firms. Three applied some version of the CAPM model to track the firms' systemic risk. On the other hand, the other four articles dealt with firms' overall risk.

Some results showed a positive relationship between the quality of the regulatory climate and the market-to-book ratio of the regulated firm (CLAGGETT; TYLOR; MOYER, 1997); that price responses to unusual windfalls may be more favorable for regulated utilities in mild climates than in strict ones (NWAEZE, 2000a); and that negative abnormal returns may be associated with the unpredictability of the regulatory climate, with systematic risk being lower when regulation is stricter, as a sign of regulatory maturity (BUTLER; MCNERTNEY, 1991; PARKER, 1997).

Furthermore, one article mentioned that changes in the regulatory environment that induced liberalization increased firms' exposure to systematic risk as occurred in the European energy sector (TULLOCH; DIAZ-RAINEY; PREMACHANDRA, 2018). Two articles argued that the effect of the regulatory climate on systemic risk is asymmetrical between domestic and international firms, showing that international firms tend to be more risk averse (PINTO, 2003; GARCÍA-CANAL, GUILLÉN, 2008).

4.3 Regulation reduces business risk

Nine articles investigated Peltzman's (1976) hypothesis that regulation would cushion the risks to which regulated firms are subjected. Of these, four rejected the hypothesis, evidencing the lack of consensus.

The most used model to test this hypothesis is the CAPM, confronting the beta coefficient of regulated vis-à-vis unregulated firms under the assumption that any difference would capture the effect of regulation on systematic risk. Three articles, however, did not adopt the CAPM, but earnings variability tests (NWAEZE, 2000b), multifactorial model (BIRD; LIEM; THORP, 2014), or a long-term price path (ASBLASTER, 2018).

Among articles that used the CAPM, one detected a regulation-induced complete elimination of systemic risk (Riddick, 1992). On the other hand, others have found less robust results, identifying even an increase in systemic risk as a result of regulation in economic crisis (GOLDENBERG, 1987; BINDER; NORTON, 1999) or in times of rising production costs (DAVIDSON; RAGAN; ROSENSTEIN, 1997).

One article drew attention to the fact that, since the beta coefficient encompasses several risk factors, it would be better to separate them to generate more significant results (FERRIS; MAKHIJA, 1987). Lastly, was suggested that those tests lack control over eventual short-term effects on the betas of a widespread increase in the systemic risk that would be mistakenly interpreted as a result of the regulation itself (NWAEZE, 2000b).

4.4 The regulatory scheme influences the financing mix

No article tested this hypothesis to compare the financing mix of regulated firms under distinct regulatory schemes. However, two articles show evidence that even small differences in regulatory frameworks can have consequences on asset structure and financing mix. Still, none of them used the CAPM.

Peles (1996) argued that rate-of-return regulation implemented by reference to results reported under distinct frameworks, as is the case of electricity sector regulation in Hong Kong and the United States, could induce not only the use of more fixed assets but also that these assets are financed proportionately more by equity.

Sanyal and Bulan (2011) presented evidence that regulatory policies that encourage competition and, therefore, increase regulated firms´ exposure to market uncertainty, induced lower leverage and, consequently, lower regulatory risk.

4.5 High-powered incentive regulation is associated with greater risk

The relationship between risk and high-powered incentive regulatory schemes was confirmed by all seven but one article that investigated this hypothesis. Gaggero (2007) was the only article to reject the hypothese. Three out of the six articles that found evidence of the hypothese did so, however, for a small marginal effect (DIETRICH; HECKERMAN, 1983; TAHVANAINEN *et al.*, 2012; PARKER, 1997).

In addition to CAPM used in three articles, other methodological options observed were price-reversion-to-average, return on equity differences, real options, and questionnaire or interview

4.6 Accounting regulation influences risk

Zeff (1978) defined the economic consequences of accounting as all possible effects of changes in accounting rules on stakeholders, such as investors, creditors, and governments, among others, behavior. Three articles in the final sample investigated the economic consequences of specific accounting rules imposed by the regulator, identifying positive market reaction to expenditures accounting regulation, such as the Statement of Financial Accounting Standards – SFAS (D'SOUZA, 2000); negative market reaction to specific accounting regulations to abandoned capital projects, even though these regulations have been favorable to the regulated firms (ARNOLD; CHENG, 2000); and favorable reaction from investors about the Sarbanes–Oxley, the SOX Act, a piece of legislation that aims to ensure the creation of reliable audit and security mechanisms in companies, on regulated firms (FILBECK, GORMAN, ZHAO, 2011).

Regarding the estimation of the cost of capital, four out of five studies used some version of the CAPM model.

4.7 The cost of capital is endogenous to the regulatory process

The hypothesis of endogeneity of the cost of capital to the regulatory process was addressed by two articles based on CAPM estimations, both evidencing some level of endogeneity in regulated electric utilities. Brewer and Mann (1989) presented some evidence of higher returns and lower risks for equity owners of regulated utilities when regulators were appointed in comparison to elected ones. Devaney (1991) also presented evidence for the assertion that the cost of capital is endogenous to the regulatory process by demonstrating frequency dependence in systematic risk when regulators are elected.

4.8 The cost of capital estimation techniques adequately reflect the risk

Regarding the techniques frequently used to estimate the cost of capital and, consequently, the just rate of return of regulated utilities, only two out of nine articles in the final sample tested some related hypothesis – the remaining seven used a normative approach.

Fitzpatrick, Settle, and Petry (1988) suggested that rate-of-return regulation for US electricity utilities based on the CAPM model allowed returns on equity not based on the equity market value and did not appear to be affected by company-specific regulatory provisions. In the same stance, Buckland, Williams, and Beecher (2015) found that the use of CAPM by UK regulators overestimated the systematic risks, allowing for higher-than-needed returns.

On the normative side, all seven articles argued that the shortcomings of the CAPM model would compromise its effectiveness in correctly predicting the risk premium of regulated utilities. In this sense, each article proposed some superior alternative: an augmented discounted cash flow model (BUSSA; LINKE; ZUMWALT, 1987), a general consumption model to specify the risk-return relationship (Ahern, Hanley & Michelfelder, 2011), beta-Blume adjusted CAPM (MICHELFELDER; THEODOSSIOU, 2013); Gordon Discounted Cash Flow Model (MICHELFELDER *et al.*, 2013); not to make ad hoc beta adjustments, in particular the Blume adjustment (MICHELFELDER; THEODOSSIOU, 2013). Kayo,

Martelanc, Brunaldi, and Silva (2020) prescribed the use of an improved form of CAPM, introducing changes in its implementation to generate superior results. Homaifar & Graddy (1991), on the other hand, demonstrated that a lower partial moment method-based market model is not superior to conventional CAPM since the LPM beta tends to overestimate the systematic risk of utility companies.

5 RESULTS DISCUSSION

Through the protocol of systematic review of the literature on regulatory risk and capital return of regulated industry, 51 articles were selected and classified according to eight research hypotheses related to regulatory risk. The summary of the findings is presented in Table 6.

Table 6 - Summary of the findings from the systematic literature review, by hypothesis, 1983-2020 (continua)

Article	Was the hypothesis rejected?	Was CAPM used?
Hypothesis A: Political or regulatory events influence risk		
Fraser, Uselton and Kolari (1988)		x
Fields and Janjigian (1989)		x
Spudeck and Moyer (1989)		x
Farber (1991)		x
Fan and Cowing (1994)		x
Dnes, Kodwani, Seatin and Wood. (1998)		x
Cox and Portes (1998)		
Buckland and Fraser (2001a)		x
Buckland and Fraser (2001b)		x
Buckland and Fraser (2002)		x
Grout and Zalewska (2006)		x
Yalla, Bhattacharyya and Jain (2018)		x
Hypothesis B: The regulatory climate affects the risk		
Butler and McNertney (1991)		x
Moyer, Rao and Tripathy (1992)		
Claggett Jr and Moyer (1997)		
Nwaeze (2000a)		x
Tulloch, Diaz-Rainey and Premachandra (2018)		x
Pinto (2003)		
García-Canal and Guillén (2008)		
Hypothesis C: Regulation reduces business risk		
Ferris and Makhija (1987)	x	x
Goldenberg (1987)		x
Riddick (1992)		x
Davidson, Ragan and Rosenstein (1997)		x
Robinson and Taylor (1998)	x	x
Binder and Norton (1999)		x
Nwaeze (2000b)	x	
Bird, Liem and Thorp (2014)	x	
Arblaster (2018)		
Hypothesis D: The regulatory scheme influences the financing mix		
Peles (1996)		
Sanyal and Bulan (2011)		

Table 7 - Summary of the findings from the systematic literature review, by hypothesis, 1983-2020 (conclusão)

Article	Was the hypothesis rejected?	Was CAPM used?
Hypothesis E: High-powered incentive regulation is associated with greater risk		
Dietrich and Heckerman (1983)		x
Nwaeze (1997)		
Parker (1997)		
Alexander, Estache and Oliveri (2000)		x
Gaggero (2007)	x	x
Pellegrino, Ranieri, Costantino and Mummolo (2011)		
Tahvanainen, Honkapuro, Partanen and Viljainen (2012)		
Hypothesis F: Accounting regulation influences risk		
D'Souza (2000)		
Filbeck, Gorman and Zhao (2011)		x
Arnold and Cheng (2000)		x
Hypothesis G: The cost of capital is endogenous to the regulatory process		
Brewer and Mann (1989)	x	x
Devaney (1991)		x
Hypothesis H: The cost of capital estimation techniques adequately reflect the risk		
Bussa, Linke and Zumwalt (1987)	n.a.	
Fitzpatrick et al. (1988)	x	
Homaifar and Graddy (1991)	n.a.	
Ahern, Hanley and Michelfelder (2011)	n.a.	
Michelfelder, Ahern, D'Ascendis and Hanley (2013)	n.a.	x
Michelfelder and Theodossiou (2013)	n.a.	x
Buckland et al. (2015)	x	x
Rode and Fischbeck (2019)	n.a.	x
Kayo et al. (2020)	n.a.	x

Source: survey data. Note: n.a.: not applicable (the study has a normative approach).

Controversial results were observed, especially regarding the assertion that regulation reduces the risk of regulated firms by providing a cushion against systemic shocks. That hypothesis attests to the existence of a regulatory risk inherent to the regulatory framework, but it has had conflicting results for 45 years.

There is greater interest in countries considered mature in terms of regulation, such as the United States and the United Kingdom. That opens opportunities for comparative research outside this axis, including Brazil and Latin America.

Regarding the methodology used, there is an opportunity for meta-analysis research, which, based on a research question and hypothesis, summarizes past research, calculating the total magnitude of the effect using the same samples and sub-samples. Surveys of this type can improve the analytical power of a model, such as the CAPM.

In addition, although most articles used the CAPM, the use of other methods to measure systematic risk is possible. Examples are the time-variant beta and the Kalman-Filter improved beta, as well as multifactorial models.

Only one study investigated the behavior of Jensen´s alpha to compare the performance of regulated industry with defensive assets in terms of risk.

Another opportunity is to differentiate the beta in terms of the effect of debt (leveraged or unleveraged) and tax level. Few works refer to this differentiation (Binder and Norton, 1999).

There is also the question of the frequency of samples for the beta determination, whether daily, weekly, or monthly. According to Write *et al*., (2003) and Alexander *et al*. (1999), if, on the one hand, shorter frequencies provide a greater number of observations, which leads to lower standard error in the

estimates, on the other hand, they are more susceptible to problems of autocorrelation and heteroscedasticity, being preferable only for shorter periods.

Some articles used conditional models, causality, or Value-at-Risk (VAR) tests. In this aspect, it is worth reflecting on the improvement of methodologies and evaluating the possibility of using more recent formulations such as differences-in-differences, discrete choice models, and random utility models.

There is an extensive opportunity for studies in the field of accounting regulation. For example, analyzing the effect of regulating financial disclosure, using more modern methodologies such as machine learning and automated content analysis (DÜSTERHÖFT; SCHIEMANN; WALTHER, 2023); About the effect of regulation on company behavior, for example concerning tax aggressiveness (KAYS, 2022); and on the spillover effect of accounting regulation, reaching unregulated companies and encouraging them to reduce their disclosures in the presence of disclosures from regulated companies (BREUER; HOMBACH; MULLER, 2022).

Still, on accounting regulation, research on value relevance remains in vogue (BARTH; LI; MCCLURE, 2022); on regional differences in convergence with international accounting standards (FLORES; LOPES, 2020; AKAMAH; MASON; SHAFRON, 2022).

In Brazil, there is also the opportunity to assess the regulatory risk for electricity distributors in the context of market opening, which will allow the migration of high-voltage consumers to the free market, reducing the market served by distributors, as determined by the Ministry of Mines and Energy (MME, 2022). This is a movement towards the complete opening of the market, which presents itself as a research opportunity in the coming years.

In this sense, the effect of incomplete accounting separation between regulated and competitive businesses can be an object of study, considering issues of abuse of market power that affect fair competition in the energy market, as happened in the Chinese market (ZHANG et al., 2022).

6 FINAL CONSIDERATIONS

The systematic literature review on the relationship between regulatory risk and capital return of regulated industry was conducted to evaluate the current state of the literature to identify research opportunities.

It presents the different concepts and sources of regulatory risk, research methods, and profile of the most used data sample and methodological options, making it possible to identify gaps and possible improvements that can be considered in further research on regulatory risk and return of regulated industry.

Most of the articles addressed developed countries, especially the United Kingdom and the United States, opening opportunities for research in other areas, especially emerging countries.

It appears that although the most adopted methodological option focuses on the behavior of the CAPM beta parameter (β), adjustments were observed in the model with the inclusion of other variables, as well as conditional and volatility models of price and earnings indices. Therefore, it is worth reflecting on the possibility of using more recent methodologies, such as discrete choice models and random utilities, or even methods such as differences in differences, among others.

This research provides input for analysis and decision-making by investors, analysts, regulators, consumers, and academia, by demonstrating situations in which regulatory risk may arise and key methods for detecting it as well as research opportunities.

Furthermore, multiple research opportunities were identified in the field of accounting regulation, such as, for example, the effect of financial disclosure regulation, the spillover effect of accounting regulation, research on value relevance and the adoption of international accounting standards.

It may be opportune in the coming years to assess the regulatory risk of market opening that will encourage the migration of consumers from the regulated to the free environment in Brazil's electricity

market. Regulatory risk, in this case, can be moderated by regulatory action motivated by aspects inherent to competition and market power.

As a limitation of the research, it is mentioned that only the Scopus Elsevier database was used. Furthermore, it may be that the search strategy was not the most efficient, with the risk of excluding a relevant study due to this strategy.

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