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Estimating the cost of equity capital for small companies: an empirical analysis of the effectiveness of an alternative method in calculating economic value added*

Estimativa do custo do capital próprio para pequenas empresas: uma análise empírica da eficácia de um método alternativo no cálculo do valor econômico adicionado

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Abstract: Although initially developed for large corporations, economic value added (EVA) is a potential performance indicator to be used in small businesses (SME)s. EVA is calculated based on the cost of capital (equity and third party´s capital). Usually, the cost of equity capital is estimated using the classical Capital Asset Pricing Model (CAPM), whose parameters are estimated by market data. In general, the CAPM becomes impracticable in SMEs due to the scarcity or absence of stocks traded on the stock exchange. As literature presents some alternative methods to calculate the cost of equity for small private companies, the objective of this study is to evaluate the effectiveness of the alternative method proposed by Boudreaux et al. (2011) compared to the classical CAPM, when both methods are used to calculate the EVA indicator. From a sample composed of 34 companies listed on the Brazilian stock exchange (B3), the results show that the method is useful for estimating the cost of equity capital in the calculation of the EVA indicator.

Keywords: Small businesses; SME; EVA indicator; Cost of equity capital; Cost of capital; Capital Asset Pricing Model; CAPM.

Resumo: Embora inicialmente desenvolvido para grandes corporações, o valor econômico adicionado (EVA) é um indicador de desempenho potencial a ser usado em micro e pequenas empresas (MPE). O EVA é calculado com base no custo de capital (próprio e de terceiros). Normalmente, o custo de capital próprio é estimado usando o clássico modelo de precificação de ativos (com a sigla em inglês CAPM), cujos parâmetros são estimados por dados de mercado. Em geral, o CAPM torna-se inviável nas PMEs devido à escassez ou ausência de ações negociadas em bolsa. Como a literatura apresenta alguns métodos alternativos de cálculo do custo de capital próprio para pequenas empresas privadas, o objetivo deste estudo é avaliar a eficácia do método alternativo proposto por Boudreaux et al. (2011) em comparação com o CAPM clássico, quando ambos os métodos são usados para calcular o indicador EVA. A partir

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de uma amostra composta por 34 empresas listadas na Bolsa de Valores brasileira (B3), os resultados mostram que o método é útil para estimar o custo do capital próprio no cálculo do indicador de EVA.

Palavras-chave: micro e pequena empresa; MPE; indicador EVA; custo de capital próprio; custo de capital; modelo de precificação de ativos; CAPM.

1 Introduction

In general, the EVA indicator measures the economic value of a company after considering the cost of capital (e.g., the value created more than the investors' required return). Usually, the cost of capital is obtained by the weighted average of the costs of equity and debt capitals (WACC). The cost of debt capital can be determined from the historical average of the rates of loans made by a company while the cost of equity is usually estimated by other quantitative methods. CAPM is the classical model used to calculate the cost of equity, usually applied to companies listed on the stock exchange.

The application of the CAPM can be impracticable due to the scarcity or absence of stocks traded on the stock exchange (in general, a characteristic of the micro and small companies). Some authors such as Moro, Lucas and Kodwani (2010), Boudreaux et al. (2011), Britzelmaier et al. (2013) and Britzelmaier (2019), present alternative methods for calculating the cost of equity in SMEs (or non-listed companies), providing sufficient conditions to apply the EVA indicator.

Specifically, the method proposed by Boudreaux et al. (2011) determines the cost of equity based on an analysis of the company's economic history (adjusted return on invested capital) for the last five fiscal years. In general, the method is suitable for calculating the cost of equity of micro and small companies due to its ease of interpretation and data collection (only historical data of the companies are used, whereas the classical methods require the use of relatively complex procedure), enabling the application of the EVA indicator in SMEs.

Despite that, there are no studies in the reviewed literature that assess the effectiveness of the method proposed by Boudreaux et al. (2011) in the calculation of economic value. In this context, this study aims to analyze the effectiveness of this method compared to the CAPM, when both methods are used to measure the economic value using the EVA indicator. The study is conducted on a sample of companies listed on the Brazilian stock exchange (B3). The results show the efficiency of the method in the calculation of the EVA indicator, strengthening its usage in small companies.

The remainder of the paper is organized as follows: Section 2 includes a brief explanation of some of the approaches used to calculate the cost of equity capital in SMEs, specifically the method proposed by Boudreaux et al. (2011); Section 3 presents the data and statistical tools; the results and analysis are presented in Section 4 and finally, Section 5 presents some remarks and considerations.

2 Cost of equity capital in SMEs

Given the difficulties and limitations related to the application of the classical methods of estimating the cost of equity in SMEs, some studies have proposed the use of alternative methods and approaches. Considering the CAPM, the literature presents some works that propose alternative procedures for calculating the market beta for non-listed companies. Britzelmaier et al. (2013) and Britzelmaier (2019) present an overview of three calculation approaches: analogy (compare the company studied with a similar company with stocks traded on the stock exchange), analytics (assume that accounting data is influenced by events and market information) and qualitative inquiry (evaluate the company's systemic risk in a qualitative way, based on subjective measures of risk indicators).

Still based on the CAPM, Roztocki and Needy (1999) propose a method for calculating WACC in SMEs, in which the cost of equity is defined by the sum of the risk-free rate and the market risk premium associated with the company. In this case, the risk premium is not determined using the market beta. The authors suggest a scale of values for the risk premium, defined based on the degree of investment risk of a company (a subjective analysis). Considering a similar structure for calculating the cost of equity, Palliam (2005) proposes a multicriteria method to determine the risk premium.

In addition to the already mentioned approaches, there exist in the literature methods for calculating the cost of capital that do not use the CAPM model. For instance, Cheung (1999) proposes a method of estimating the cost of capital for SMEs, in which the costs of equity and debt capitals are estimated from the likelihood of survival of similar companies (or a sector). Although the proposed method does not require a historical estimate of market risk using stock prices, it is necessary to establish a probability of survival for the company (in this case, the investors are considered risk-neutral). Moro, Lucas and Kodwani (2010) propose a method of calculating the cost of capital for SMEs based on the expected rate of return of entrepreneurs and, on the optimal combination of short- and long- term interest rates (the authors consider that investors and entrepreneurs have different expectations when investing in a company).

Specifically, the method proposed by Boudreaux et al. (2011) for small private firm calculates the cost of equity based on the average of the historical economic benefits obtained by the owners and on the invested equity (total equity). In this case, according to the authors, the cost of equity represents the real average return for the company's owners, and it would be the best rate of return required by investors. Similarly, Boudreaux et al. (2012) propose a method based on the discounted cash flow model (DCF), but the authors use the book value of equity instead of the market value used in the traditional DCF method.

For this study, the method proposed by Boudreaux et al. (2011) was selected due to its ease interpretation and less technical complexity, which makes its application feasible in SMEs. Specifically, the cost of equity is defined as the average historical return adjusted to invested capital (AROI), expressed as

$$\text{AROI} = \frac{\text{EBO}}{\text{IC}},$$

where EBO represents the average of the economic benefits for the owners (net profit plus depreciation) and CI the average of the invested equity (total net equity), both evaluated in a historical period of five calendar/fiscal years. Then, the AROI represents the real average return for the owners and, theoretically, is the rate of return required by the shareholders.

3 Methods and Data

In this section, it is presented the sample studied and the statistical tools used to analyze the effectiveness of the method proposed by Boudreaux et al. (2011), called here BOUDREAUX method, compared to the CAPM method in the calculation of the EVA indicator.

3.1 Sample

Due to a lack of liquidity and scarcity of small companies listed on the Brazilian stock exchange (B3), the studied sample is composed of 34 listed large companies whose stocks codes are shown in Table 1. Thus, the results obtained show the efficiency of the method proposed by Boudreaux et al. (2011) in the context of large companies. It is important to note that this limitation does not invalidate the study's results, since the proposal is to evaluate the effectiveness of the method in the calculation of the EVA indicator. So, it is understood that the results will strengthen the use of the method to measure the cost of equity capital in SMEs.

Table 1 – The codes of the stocks (ticker symbol)

ALPA3	MGLU3	NTCO3	MRVE3	DTEX3
CGAS5	AMAR3	TIMP3	MULT3	CSMG3
CPFE3	RADL3	SHOW3	RENT3	CELPE5
CIEL3	VVAR3	TUPY3	ARZZ3	FESA3
ODPV3	LREN3	SULA3	SBSP3	CLSC4
PSSA3	WEGE3	QUAL3	CPLE3	SAPR3
LAME3	SMTO3	POMO3	CMIG3	

Source: Own elaboration.

The data needed to apply the BOUDREAUX method is obtained from the financial statements of the companies studied (Table 1), considering the last five fiscal years (in the period between 2014 to 2018), and are extracted from the Brazilian stock exchange (http://www.b3.com.br/pt_br/produtos-e-servicos/negociacao/renda-variavel/empresas-listadas.htm). The CAPM parameters are estimated using the historical series of monthly stock close prices of each company in the period from January 2014 to December 2018, obtaining 34 samples composed of 59 monthly rates of return. In this case, the prices are extracted from the Yahoo! Finance (https://finance.yahoo.com/).

3.2 Analysis tools

In general, the effectiveness of the BOUDREAUX method is analyzed in two stages: i) analysis of the behavior of the costs of equity capital determined by BOUDREAUX and CAPM methods, specifically the mean and correlation coefficient measures; ii) analysis of the behaviour of the values of the EVA indicator calculated using the respective methods, analyzing the coherence rate, the mean, and the correlation coefficient.

For the analysis of the cost of equity, the t-test for equality of means (unilateral test) and correlation test (bilateral test) are used. For this, let K_b and K_c be the costs of equity associated with the BOUDREAUX and CAPM methods, respectively, μ_b the mean of K_b, μ_c the mean of K_c and $\rho_{b,c}$ the correlation coefficient between K_b and K_c. In this way, the hypotheses (H_0 and H_1) of the t-test are specified by

$$\begin{cases} H_0 : \mu_b - \mu_c = 0 \\ H_1 : \mu_b - \mu_c > 0 \end{cases},$$

whereas the hypotheses of the correlation test are written as

$$\begin{cases} H_0 : \rho_{b,c} = 0 \\ H_1 : \rho_{b,c} \neq 0 \end{cases}.$$

For the analysis of the EVA indicator, let EVA_b and EVA_c be the economic added value determined using BOUDREAUX and CAPM methods, respectively. In this case, the same tests specified above are used, where μ_b is the mean of EVA_b, μ_c the mean of EVA_c and $\rho_{b,c}$ the correlation coefficient between EVA_b and EVA_c. Therefore, given a sample composed of n companies, from which the values of K_b, K_c, EVA_b and EVA_c are obtained for each company i (with $i = 1,\ldots,n$), the statistical tests are applied using the IBM SPSS® statistics.

Finally, let $\{(EVA_{b,i}, EVA_{c,i}); i=1,\ldots,n\}$ be a sample of EVA_b and EVA_c (with size n), and Φ_i be an indicator function such that $\Phi_i = 1$ if $EVA_{b,i}$ and $EVA_{c,i}$ have equal signs (positive or negative) and $\Phi_i = 0$ if $EVA_{b,i}$ and $EVA_{c,i}$ have opposite signs (e.g., there is no coherence between the values of EVA calculated using BOUDREAUX and CAPM methods). The coherence rate (TC) between the methods is defined by

$$TC = \frac{1}{n}\sum_{i=1}^{n}\Phi_i \,,$$

where $TC \in (0,1)$. Thus, the closer TC is to 1 the greater the coherence between EVA_b and EVA_c (there exist value aggregation when $EVA > 0$, otherwise $EVA \le 0$). On the other hand, the closer TC is to 0, the lower the coherence between EVA_b and EVA_c.

For each company i and method j (with $j = b, c$) the EVA indicator is calculated as

$$EVA_{j,i} = NOPAT_i - WACC_{j,i} \cdot CT_i$$

where $NOPAT_i$ is the net operating profit of the company i, CT_i the total invested capital and $WACC_{j,i}$ the weighted average cost of capital for the company i and method j, defined by

$$WACC_{j,i} = K_{j,i} \cdot \frac{C_{p,i}}{CT_i} + R_i \cdot \frac{C_{e,i}}{CT_i} \,,$$

where $K_{j,i}$ is the cost of equity capital (in percentage points), R_i the cost of debt (in percentage points), $C_{p,i}$ the equity capital and $C_{e,i}$ the debt (third party) capital.

Using the BOUDREAUX method (e.g., $j = b$), the cost of equity (annual rate) of the company i is calculated by

$$K_{b,i} = \frac{EBO_i}{IC_i},$$

where EBO_i represents the average value of the economic benefit for the owners of the company i and IC_i the average value of the invested equity, both evaluated in the period from 2014 to 2018. The cost of equity (annual rate) of the company i, calculated by CAPM method (e.g., $j = c$), is expressed as

$$K_{c,i} = r_f + \beta_i \cdot (\bar{r}_m - r_f),$$

where r_f is the annual risk-free rate of return, $\bar{r}_m$ the market's expected annual rate of return (represented by the Ibovespa index) and β_i the stock's beta.

The values of $\bar{r}_m$ and β_i are calculated from the monthly rates of return of the stocks and the Ibovespa index, observed in the period from 2014 to 2018 (total of $n = 59$ observations), where

$$\bar{r}_m = \left(1 + \frac{1}{n}\sum_{t=1}^{n} r_m(t)\right)^{12} - 1,$$

$$\beta_i = \frac{\mathrm{cov}(r_m, r_i)}{\mathrm{var}(r_m)},$$

where r_m is the rate of return of the market, r_i the rate of return of the stock i, $\mathrm{var}(r_m)$ the market variance, and $\mathrm{cov}(r_m, r_i)$ the covariance between r_m and r_i.

Finally, the risk-free rate (r_f) is defined as the annual Brazilian base rate (SELIC), calculated over the period 2014 to 2018. Moreover, as the study focuses on the cost of equity capital, it is assumed that all companies have the same cost of debt capital (R_i). In this case, the cost of debt capital is defined as the annual CDI rate (Brazilian interbank deposit rate), calculated over the period from 2014 to 2018. The SELIC and CDI rates can be extracted from the page of Central Bank of Brazil (https://www3.bcb.gov.br/CALCIDADAO/publico/exibirFormCorrecaoValores.do?method=exibirFormCorrecaoValores&aba=4).

4 Results and Analyses

Based on the procedures described in Section 3, this section presents the results and analyses related to the costs of equity and the values of the EVA indicator, determined using both BOUDREAUX and CAPM methods. The results presented are based on the 2018 fiscal year, although to calculate the cost of equity by BOUDREAUX method and to estimate the parameters of the CAPM, it is used the period 2014 to 2018.

4.1 Calculating the cost of equity and the EVA indicator

Columns "K_b" and "K_c" in Table 2 show the costs of equity capital determined by BOUDREAUX and CAPM methods, respectively. Also presented are the average value of the economic benefit for the owners, EBO, the average value of invested equity (total equity), IC, and the beta index (β), related to the sample of companies studied. The values of EBO and IC are determined from the financial statements of the companies and the values β are calculated according to the procedure described in Section 3.2. The annual risk-free rate is $r_f = 10.87\%$

and the expected annual rate of return of the market is $\bar{r}_m = 15.85\%$ (determined by the procedures described in Section 3.2).

Table 2 - Information regarding the sample of companies studied: the costs of equity determined by BOUDREAUX K_b (K_b) and CAPM (K_c) methods, the average value of the economic benefit for the owners (EBO), the average value of the invested equity (IC) and the beta index (β)

Code	EBO	IC	β	K_b	K_c
ALPA3	415,845.80	2,166,423.20	0.71	19.20%	14.40%
CGAS5	1,209,106.20	2,723,884.00	0.56	44.39%	13.66%
CPFE3	255,223.20	470,081.00	0.58	54.29%	13.74%
CIEL3	4,279,715.00	9,113,739.40	0.54	46.96%	13.53%
ODPV3	293,286.40	790,809.00	0.18	37.09%	11.74%
PSSA3	1,234,498.00	6,959,182.20	0.60	17.74%	13.85%
LAME3	805,585.00	4,307,880.60	0.90	18.70%	15.33%
MGLU3	353,292.20	1,300,334.00	1.66	27.17%	19.13%
AMAR3	149,515.80	1,043,930.00	1.56	14.32%	18.67%
RADL3	695,307.60	2,967,024.00	0.37	23.43%	12.70%
VVAR3	350,800.00	3,413,000.00	1.13	10.28%	16.52%
LREN3	972,105.80	2,796,183.60	0.85	34.77%	15.12%
WEGE3	1,451,007.60	6,411,574.80	0.40	22.63%	12.84%
SMTO3	551,483.60	2,804,237.40	-0.03	19.67%	10.68%
NTCO3	890,772.60	1,486,335.80	0.79	59.93%	14.80%
TIMP3	5,265,922.00	17,406,578.00	0.60	30.25%	13.82%
SHOW3	16,530.20	295,469.00	1.02	5.59%	15.93%
TUPY3	437,511.00	2,126,490.40	0.17	20.57%	11.67%
SULA3	787,499.20	5,073,051.40	0.24	15.52%	12.07%
QUAL3	558,075.00	2,227,976.20	0.79	25.05%	14.80%
POMO3	210,459.60	1,892,990.80	0.80	11.12%	14.86%
MRVE3	721,427.80	5,166,397.00	0.91	13.96%	15.39%
MULT3	546,807.00	4,653,183.00	1.76	11.75%	19.66%
RENT3	736,159.20	2,297,859.60	0.47	32.04%	13.21%
ARZZ3	156,489.00	648,039.80	0.93	24.15%	15.50%
SBSP3	3,132,061.00	15,900,983.40	0.74	19.70%	14.56%
CPLE3	1,906,677.20	14,997,626.20	1.08	12.71%	16.25%
CMIG3	2,570,573.80	13,495,292.40	1.62	19.05%	18.94%
DTEX3	876,919.20	4,629,442.80	1.09	18.94%	16.28%
CSMG3	929,375.00	5,918,815.40	1.10	15.70%	16.32%
CELPE5	257,634.80	1,597,881.60	0.00	16.12%	10.86%

FESA3	239,048.40	1,448,654.00	0.80	16.50%	14.85%
CLSC4	402,641.00	2,057,424.60	0.85	19.57%	15.10%
SAPR3	834,105.40	4,731,981.40	0.16	17.63%	11.64%

Source: Own elaboration.

Taking the CDI rate over the five years period (2014 to 2018), the cost of debt capital is given by $R_i = 10.84\%$, with $i = 1,\ldots, n$. Then, from the values of K_b and K_c (Table 2), the weighted average cost of capital ($WACC$) is obtained for each company (see Section 3.2), as described in columns "$WACC_b$" and "$WACC_c$" in Table 3, respectively. Columns "C_p" and "C_e" show the values of equity and debt capitals, respectively, related to the 2018 fiscal year.

Table 3 - Values of the weighted average cost of capital (WACC), determined using BOUDREAUX ($WACC_b$) and CAPM ($WACC_c$) methods, the equity capital (C_b) and debt capital (C_e).

Code	C_p	C_e	$WACC_b$	$WACC_c$
ALPA3	648,497.00	612,934.00	15.14%	12.67%
CGAS5	1,650,032.00	3,651,545.00	21.28%	11.72%
CPFE3	240,144.00	2,137,561.00	15.23%	11.13%
CIEL3	5,700,000.00	6,298,568.00	28.00%	12.12%
ODPV3	506,557.00	0.00	37.09%	11.74%
PSSA3	4,000,000.00	0.00	17.74%	13.85%
LAME3	3,957,961.00	15,680,837.00	12.43%	11.75%
MGLU3	1,719,886.00	455,947.00	23.75%	17.40%
AMAR3	899,597.00	1,016,331.00	12.48%	14.52%
RADL3	1,808,639.00	843,150.00	19.43%	12.11%
VVAR3	2,899,000.00	4,399,000.00	10.62%	13.10%
LREN3	2,637,473.00	1,038,062.00	28.01%	13.91%
WEGE3	5,504,517.00	3,772,114.00	17.84%	12.03%
SMTO3	1,696,652.00	4,452,600.00	13.28%	10.80%
NTCO3	423,073.00	8,440,380.00	13.19%	11.03%
TIMP3	9,866,298.00	1,663,017.00	27.45%	13.39%
SHOW3	243,022.00	120,896.00	7.34%	14.24%
TUPY3	1,053,760.00	1,406,923.00	15.01%	11.20%
SULA3	3,319,882.00	1,470,935.00	14.09%	11.69%

QUAL3	1,809,071.00	615,726.00	21.44%	13.80%
POMO3	1,264,622.00	1,934,208.00	10.95%	12.43%
MRVE3	4,079,770.00	1,008,150.00	13.35%	14.49%
MULT3	2,944,514.00	2,813,732.00	11.31%	15.35%
RENT3	1,500,000.00	7,645,978.00	14.32%	11.23%
ARZZ3	341,073.00	111,418.00	20.87%	14.36%
SBSP3	15,000,000.00	13,152,796.00	15.56%	12.82%
CPLE3	7,910,000.00	11,565,438.00	11.60%	13.04%
CMIG3	7,293,763.00	14,771,828.00	13.55%	13.52%
DTEX3	1,970,189.00	2,862,604.00	14.14%	13.06%
CSMG3	3,402,385.00	3,542,068.00	13.22%	13.53%
CELPE5	663,178.00	4,714,702.00	11.49%	10.84%
FESA3	1,225,444.00	396,815.00	15.12%	13.87%
CLSC4	1,340,000.00	1,420,063.00	15.08%	12.91%
SAPR3	2,851,089.00	2,771,318.00	14.28%	11.25%

Source: Own elaboration.

Finally, columns "EVA_b" and "EVA_c" in Table 4 show the EVA indicator values for the 2018 fiscal year, determined using BOUDREAUX and CAPM methods, respectively. In this case, economic value is added when $EVA > 0$, otherwise $EVA \leq 0$. Column "NOPAT" shows the adjusted net operating profit of each company (related to the 2018 fiscal year).

Table 4 - EVA indicator values, determined using BOUDREAUX (EVA_b) and CAPM (EVA_c) methods, and the net operating profit (NOPAT), related to the 2018 fiscal year.

Code	NOPAT	EVA_b	EVA_c
ALPA3	471,618.00	280,684.40	311,792.00
CGAS5	2,369,914.00	1,241,579.73	1,748,582.45
CPFE3	420,656.00	58,519.03	155,916.32
CIEL3	4,590,959.00	1,231,408.51	3,136,706.23
ODPV3	415,274.00	227,407.80	355,825.54
PSSA3	2,740,443.00	2,030,878.02	2,186,305.12
LAME3	2,487,405.00	47,138.48	180,677.94
MGLU3	786,863.00	270,147.48	408,347.16
AMAR3	686,496.00	447,461.47	408,345.83
RADL3	793,293.00	278,032.89	472,173.33

VVAR3	353,000.00	(421,909.17)	(602,713.81)
LREN3	1,472,985.00	443,508.90	961,716.77
WEGE3	2,384,705.00	730,001.38	1,268,759.57
SMTO3	845,563.00	29,146.85	181,618.89
NTCO3	3,313,114.00	2,144,456.49	2,335,408.51
TIMP3	4,161,451.00	996,346.49	2,617,268.52
SHOW3	43,162.00	16,458.43	(8,649.14)
TUPY3	471,589.00	102,246.33	196,053.41
SULA3	2,889,884.00	2,215,053.67	2,329,835.12
QUAL3	719,187.00	199,284.49	384,652.93
POMO3	506,348.00	156,042.45	108,660.03
MRVE3	981,473.00	302,476.45	244,263.56
MULT3	817,235.00	166,152.89	(66,746.74)
RENT3	1,422,540.00	113,011.52	395,469.83
ARZZ3	196,631.00	102,188.56	131,671.46
SBSP3	4,720,286.00	339,667.18	1,109,792.78
CPLE3	3,207,962.00	948,422.85	668,733.09
CMIG3	4,564,998.00	1,574,124.57	1,581,981.02
DTEX3	855,175.00	171,613.76	224,024.44
CSMG3	1,040,203.00	121,927.76	100,751.87
CELPE5	1,588,113.00	970,017.04	1,004,922.38
FESA3	424,494.00	179,255.70	199,543.90
CLSC4	640,583.00	224,379.72	284,277.17
SAPR3	1,429,994.00	626,966.64	797,669.98

Source: Own elaboration.

4.2 Analysis of the cost of equity capital

This section analyzes the cost of equity determined by BOUDREAUX method (K_b) compared to the cost of equity determined by the CAPM method (K_c). The t-test for equality of means and correlation are conducted at a significance level of 5%, whose hypotheses H_0 and H_1 are specified in Section 3.2. From data presented in Table 2, the test statistics and p-values are calculated using IBM SPSS® statistics.

From Table 5, it is possible to visualize that the cost of equity determined by BOUDREAUX method has average value and standard deviation higher than those determined in the case of the CAPM method. To verify whether such differences are statistically significant, the t-test for quality of means and the Levene test for equality of variances are applied. However, as described in Table 6, the cost of equity determined by BOUDREAUX method (K_b) does not have a normal distribution (from KS and SW tests), violating the premise of the independent samples t-test. Given that the sample has a size greater than 30, it is assumed that K_b has a normal distribution (approximately). Table 7 presents the information related to the t-test for equality of means, such that the equality of means hypothesis H_0 is rejected. Thus, on average, the cost of equity calculated by BOUDREAUX method (K_b) is higher than the cost of equity calculated by CAPM method. Finally, note that by Levene test (Table 7), the equality of variances hypothesis is rejected, such that K_b and K_c have different standard deviations.

Table 5 – Mean and standard deviation of the cost of equity capital, determined by BOUDREAUX (K_b) and CAPM (K_c) methods

	BOUDREAUX method	**CAPM method**
Mean	23.43%	14.66%
Standard deviations	12.57%	2.28%

Source: Own elaboration.

Table 6 – Results of the Kolmogorov-Smirnov and Shapiro-Wilk normality tests, related to the costs of equity capital K_b e K_c

	Kolmogorov-Smirnov (KS)			**Shapiro-Wilk (SW)**		
	Statistic	gl	p-value.	Statistic	gl	p-value.
K_b	0.21	34	0.00%	0.86	34	0.0%
K_c	0.09	34	20.0%	0.96	34	27%

Source: Own elaboration.

Table 7 – Results of the t-test for equality of means, related to the K_b e K_c

	Levene's Test		t-test			
	F	p-value.	t	df	p-value (unilateral)	Mean difference
Equal variances assumed	27.59	0.00%	4.00	66	0.01%	8.77%
Equal variances not assumed			4.00	35.17	0.02%	8.77%

Source: Own elaboration.

From the values described in Table 2, the correlation coefficient between K_b and K_c is equal to -0.24 (that is, $\rho_{b,c} = -0.24$). Applying the t-test for equality correlation, we have $p-\text{value} = 18.03\%$ (with test statistics $t = -1.370$), so that, at the significance level of 5%, the hypothesis H_0 is accepted (null correlation hypothesis). Thus, there is no significant correlation between the costs of equity capital calculated by BOUDREAUX and CAPM methods, as shown in Figure 1.

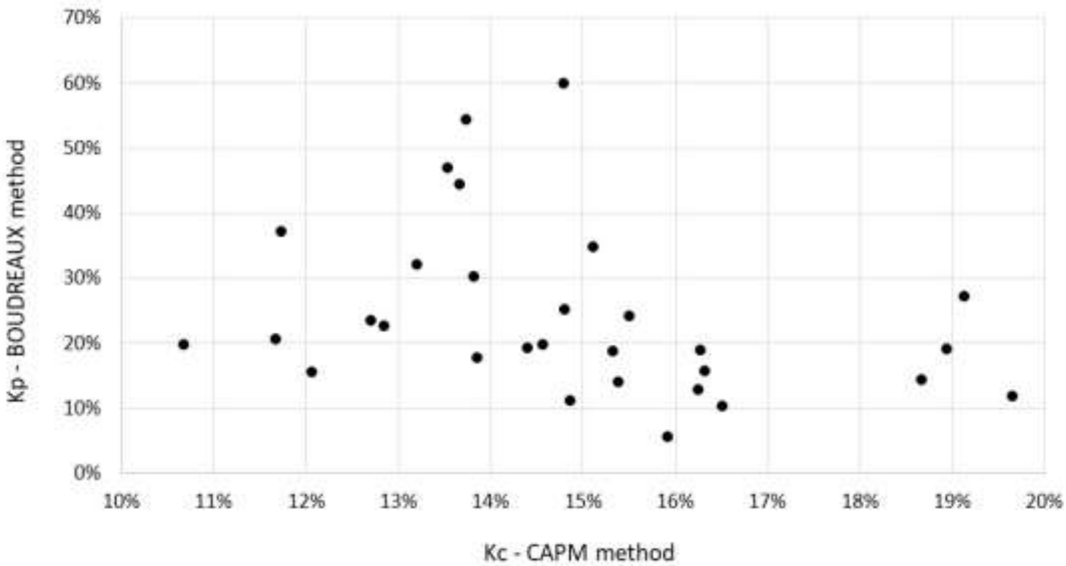


Figure 1 – Scatter plot between the costs of equity capital calculated by BOUDREAUX (K_b) and CAPM (K_c) methods

Source: Own elaboration.

As described in Section 3.2, the parameters of the CAPM method (r_f, $\bar{r}_m$ e β) are estimated using stock prices from the period 2014 to 2018 (five years), so that the results obtained previously are restricted to this period. The same previous analysis is carried out considering four different time periods for estimating the parameters of the CAPM model: one year (2018), two years (2017-2018), three years (2016-2018) and four years (2015-2018). In this case, at the significance level of 5%, the means difference between K_b and K_c are not the same among the analyzed periods (there are zero and positive differences), as presented in Table 8. Moreover, there are no significant linear correlations between K_b and K_c for all time periods (at the significance level of 5%).

Table 8 – Mean difference and correlation between K_b and K_c calculated by BOUDREAUX (K_b) and CAPM (K_c) methods, which the CAPM model is estimated over different time periods.

Period	Mean difference	p-value (unilateral)	Correlation	p-value (bilateral)
2018	-5.34%	31.67%%	0.02	90.19%
2017 - 2018	-2.60%	31.10%	-0.15	38.81%
2016 - 2018	-3.81%	14.68%	-0.18	31.66%
2015 - 2018	7.19%	0.14%	-0.28	10.75%

Source: Own elaboration.

4.3 Analysis of the EVA indicator

This section analyzes the EVA indicator determined using BOUDREAUX method (EVA_b) compared to the EVA indicator determined using CAPM method (EVA_c). As considered in Section 4.2, the t-test for equality of means and correlation are conducted at a significance level of 5%, whose hypotheses H_0 and H_1 are specified in Section 3.2 (from data presented in Table

4, the test statistics and p-values are calculated using the IBM SPSS® statistics). In addition, it is presented the analysis of the coherence rate (TC).

From Table 9, it is possible to visualize that the EVA indicator determined using BOUDREAUX method has an average value and standard deviation below than those determined in the case of the CAPM method. To verify whether such differences are statistically significant, the t-test for equality of means and the Levene test for equality of variances are applied. However, as described in Table 10, the EVA indicator determined using BOUDREAUX and CAPM methods do not have normal distributions (from KS and SW tests), violating the premise of the independent samples t-test. Given that the sample has a size greater than 30, it is assumed that EVA_b and EVA_c have normal distributions (approximately). Table 11 presents the information related to the t-test for equality of means, such that the equality of means hypothesis H_0 is accepted. Thus, on average, the EVA indicator calculated using BOUDREAUX method (EVA_b) is equal to the EVA indicator calculated using CAPM method (EVA_c). Finally, note that by Levene test (Table 11), the equality of variances hypothesis is accepted, such that EVA_b and EVA_c have equal standard deviations.

Table 9 – Mean and standard deviation of the EVA indicator, determined using BOUDREAUX (EVA_b) and CAPM (EVA_c) methods

	BOUDREAUX method	**CAPM method**
Mean	546,002.90	759,224.63
Standard deviations	653,891.32	888,022.68

Source: Own elaboration.

Table 10 – Results of the Kolmogorov-Smirnov and Shapiro-Wilk normality tests, related to the EVA_b and EVA_c

	Kolmogorov-Smirnov (KS)			**Shapiro-Wilk (SW)**		
	Statistic	gl	p-value.	Statistic	gl	p-value.
EVA_b	0.24	34	0.00%	0.82	34	0.00%
EVA_c.	0.24	34	0.00%	0.85	34	0.00%

Source: Own elaboration.

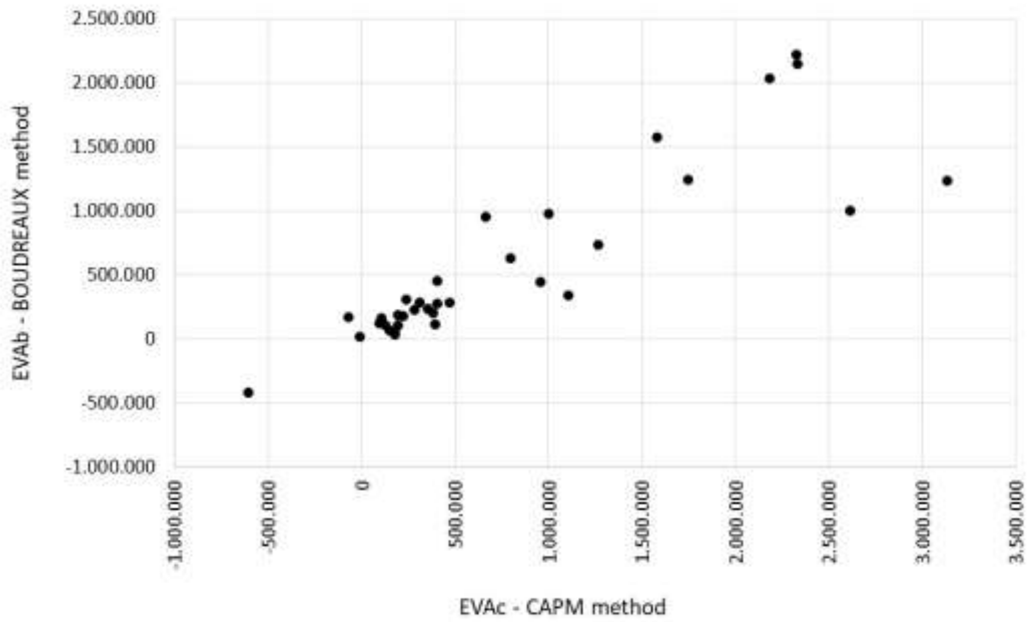
Table 11 – Results of the t-test for equality of means, related to the EVA_b and EVA_c

	Levene's Test		t-test			
	F	p-value.	t	df	p-value (unilateral)	Mean difference
Equal variances assumed	2.88	9.40%	-1.13	66	13.18%	-213221.73
Equal variances not assumed			-1.13	61	13.20%	-213221.73

Source: Own elaboration.

From the values described in Table 4, the correlation coefficient between EVA_b and EVA_c is equal to 0.87 (that is, $\rho_{b,c} = 0.87$). Applying the t-test for equality correlation, we have $p - value = 0.00\%$ (with test statistics $t = 10.15$), so that at the significance level of 5%, the hypothesis H_0 is rejected (null correlation hypothesis). Thus, there is significant correlation between the EVA indicators calculated using BOUDREAUX and CAPM methods, as shown in Figure 2. This result shows that (on average) there is a coherence between EVA_b and EVA_c.

Figure 2 – Scatter plot between the EVA indicators calculated using the BOUDREAUX (EVA_b) and CAPM (EVA_c) methods



Source: Own elaboration.

As highlighted in Section 4.2, the parameters of the CAPM method (r_f , $\bar{r}_m$ e β) are estimated using stock prices from the period 2014 to 2018 (five years), so that the results obtained previously are restricted to this period. The same previous analysis is carried out considering four different time periods for estimating the parameters of the CAPM model: one year (2018), two years (2017-2018), three years (2016-2018) and four years (2015-2018). In this case, at the significance level of 5%, there are no significant mean differences for all time periods, as presented in Table 12. Moreover, there are significant linear correlations between EVA_b and EVA_c for all time periods (at the significance level of 5%).

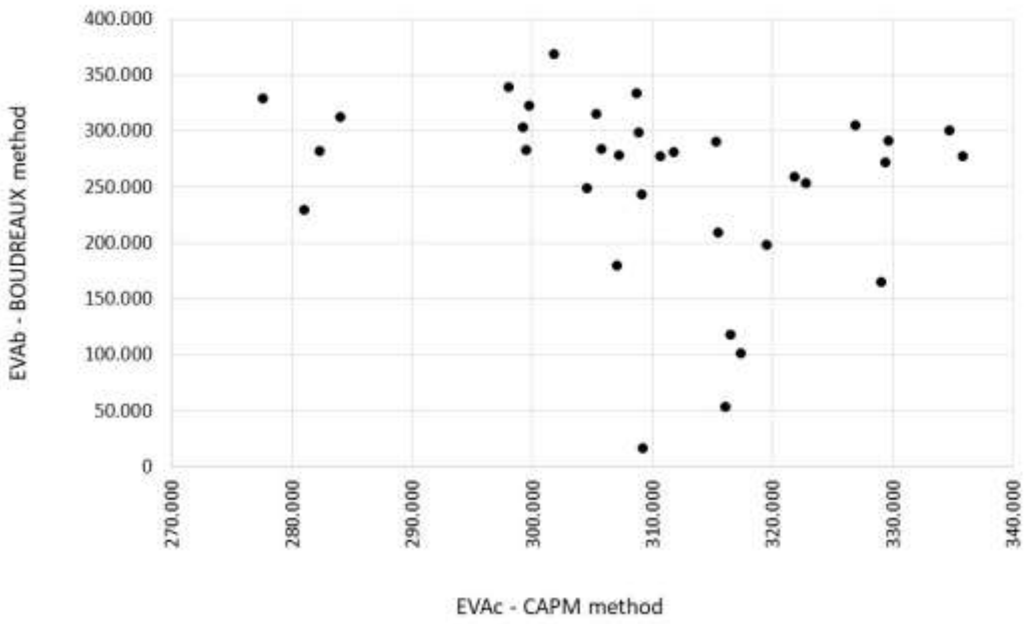
Table 12 – Mean difference and correlation between EVA indicators calculated using BOUDREAUX and CAPM methods, which the CAPM model is estimated over different time periods.

Period	**Mean difference (in 1000s of units)**	**p-value (unilateral)**	**Correlation**	**p-value (bilateral)**
2018	81.78	39.03%	0.61	0.01%
2017 - 2018	103.98	32.19%	0.71	0.00%
2016 - 2018	173.86	19.52%	0.74	0.00%
2015 - 2018	-318.36	19.91%	0.87	0.00%

Source: Own elaboration.

It is possible to visualize that the linear behavior observed between EVA_b and EVA_c is due to the degree of variability of the variables equity capital (C_p), debt capital (C_e) and net operating profit ($NOPAT$). When the standard deviation of these variables tends to zero, the value of the correlation coefficient between EVA_b and EVA_c tends to the value of the correlation between K_b and K_c (that is, $\rho_{b,c} = -0.24$). In this case, at the significance level of 5%, there is no significant correlation between EVA_b and EVA_c ($p - value = 18.03\%$, with test statistic $t = -1.370$). Figure 3 shows such behavior for the case which constant values are attributed to the variables equity capital ($C_{p,i} = 648{,}497.00$), debt capital ($C_{e,i} = 612{,}934.00$) and net operating profit ($NOPAT_i = 471{,}618.00$), for each company i (with $i = 1, \ldots, 34$). Thus, for the case in which the companies have similar values of C_p, C_e and $NOPAT$, the behavior between EVA_b and EVA_c will be similar to the behavior between K_b and K_c, since in this situation the variability of the EVA indicator is dominated by the variability of costs K_b and K_c (this result corroborates the results obtained in Section 4.2).

Figure 3 - Scatter plot between the EVA indicators calculated using BOUDREAUX (EVA_b) and CAPM (EVA_c) methods, assuming that the companies studied have the same values of equity (C_b), debt capital (C_e) and net operating profit ($NOPAT$)



Source: Own elaboration.

Finally, from the data presented in Table 4, it is possible to visualize that the coherence rate between the EVA indicators determined using BOUDREAUX and CAPM methods is $TC = 94.12\%$ (see the calculation procedure in Section 3.2), such that for 94.12% of the companies studied the indicators EVA_b and EVA_c converge to the same conclusion regarding the aggregation ($EVA > 0$) or not ($EVA \leq 0$) of economic value in the 2018 fiscal year. As discussed in the cases of the cost of equity and the EVA indicator, the coherence rate also is influenced by the period used to estimate the parameters of the CAPM method (r_f , $\bar{r}_m$ e β). To corroborate this aspect, the same previous analysis is carried out in the periods of one year (fiscal year 2018), two years (2017-2018), three years (2016-2018) and four years (2015-2018), obtaining the respective coherence rates: $TC_1 = 100\%$, $TC_2 = 88.24\%$, $TC_3 = 64.71\%$ e $TC_4 = 94.12\%$.

The coherence rate is also affected by the variables equity capital (C_p), debt capital (C_e) and net operating profit ($NOPAT$). As an illustrative example, Table 13 presents a sample composed of thirty simulated values for the coherence rate (TC), considering equity capital ($C_{p,i}$) varying between $C_{p,min} = 240{,}144.00$ and $C_{p,max} = 15{,}000{,}000.00$ (minimum and maximum values observed in the studied sample), where the average coherence rate is equal to $\overline{TC} = 84.69\%$ and the standard deviation is equal to 7.34%.

Table 13 - Simulated values for the coherence rate (TC), considering equity capital ($C_{p,i}$) varying between $C_{p,mim} = 240{,}144.00$ and $C_{p,max} = 15{,}000{,}000.00$

Coherence rate			
91.18%	94.12%	88.24%	82.44%
73.53%	76.47%	73.53%	79.41%
76.47%	91.18%	94.12%	85.29%
79.41%	85.29%	82.35%	76.47%
91.18%	88.24%	88.24%	79.41%
88.24%	82.44%	85.29%	88.24%
97.06%	70.59%	97.06%	70.59%
91.18%	85.29%	82.35%	
79.41%	94.12%	91.18%	

Source: Own elaboration.

In addition, the average coherence rate $\overline{TC}$ increases with a reduction in the degree of variability of the variables equity capital (C_p), debt capital (C_e) and net operating profit ($NOPAT$). Assuming that the studied companies have the same values of C_p, C_e and $NOPAT$ (e.g., there is no variability), where the parameters of the CAPM method are estimated using the period 2014 to 2018, the value of $\overline{TC}$ change from 94.12% to 100%. The same behavior occurs in cases where different periods are used to estimate the parameters of the CAPM method. For instance, in the period 2017 to 2018 (two years) the average coherence rate $\overline{TC}$

varies from 88.24% to 94.12%, in the period 2016 to 2018 (three years) the rate varies from 64.71% to 97.06% and in the period 2015 to 2018 (four years) the rate varies from 94.12% to 100%. Besides corroborating the coherence between the EVA_b and EVA_c, such result indicates that if the objective is to evaluate a group of companies, then the use of the BOUDREAUX method is more effective (compared to the CAPM method) when the companies present similar values of C_p, C_e and $NOPAT$.

5 Conclusions

The objective of this study was to analyze the effectiveness of the cost of equity calculation method proposed by Boudreaux et al. (2011) in the assessment of economic value using the EVA indicator, compared to the method based on the CAPM method. For this purpose, an empirical analysis was conducted to study the behavior of the cost of equity capital and the EVA indicator (determined using BOUDREAUX and CAPM methods). Specifically, the t-test for equality of means and correlation were conducted at a significance level of 5%.

According to the results presented in Section 4.2, on average, the value of the cost of equity capital calculated by BOUDREAUX method is higher than the value calculated by CAPM method, considering the period 2014 to 2018 (five years). However, the same result was not observed when another period is used to estimate the parameters of the CAPM method. It was verified that the difference between the average of the costs K_b and K_c varies among the periods analyzed (there are zero and positive differences). In all analyzed periods , there was no linear correlation between K_b and K_c (at a significance level of 5%). It was an expected result due to the different approaches used by BOUDREAUX and CAPM methods.

When analyzing Section 4.3, it was observed a positive correlation between EVA_b and EVA_c, and there were no significant mean differences for all analyzed periods (at the significance level of 5%). However, in the case of companies with similar values of C_p, C_e and $NOPAT$, the difference between EVA_b and EVA_c is similar to the difference between K_b

and K_c, since in this situation the variability of the EVA indicator is dominated by the variability of the costs K_b and K_c. In addition, based on the coherence rate (TC) between the values of the EVA indicator calculated using BOUDREAUX and CAPM methods, it was verified that the EVA_b and EVA_c converge to the same conclusion regarding the aggregation ($EVA > 0$) or not ($EVA \leq 0$) of economic value. Finally, the value of the average coherence rate $\overline{TC}$ increased with the reduction in the degree of variability of the variables equity capital (C_p), debt capital (C_e) and net operating profit ($NOPAT$).

Compared to the CAPM method, it was concluded that the BOUDREAUX method is effective for measuring the economic value using the EVA indicator, which can support its use to measure the cost of equity capital in SMEs. However, this conclusion is restricted to the sample of companies studied and to the analyzed periods. Moreover, due to the lack of liquidity and the scarcity of small companies listed on the Brazilian stock exchange (B3), the studied sample was composed of large companies, and because of that, the results cannot be generalized for SMEs.

Future research may focus on the following themes: evaluate the effectiveness of the BOUDREAUX method in the context of micro and small companies, enlarge the samples and periods of analysis, and analyze the effectiveness of the BOUDREAUX method compared to other methods of cost of equity proposed to small companies (exe. beta-factor).

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