Economics Bulletin

Volume 38, Issue 3

Corporate governance and fundamental indexation in Brazil

Raphael Moses Roquete
The Coppead Graduate School of Business at the Federal University of Rio de Janeiro

Ricardo P. C. Leal
The Coppead Graduate School of Business at the Federal University of Rio de Janeiro

Carlos Heitor Campani
The Coppead Graduate School of Business at the Federal University of Rio de Janeiro

Abstract

Fundamental indexation uses fundamental indicators to weight stocks in a portfolio but evidence about its outperformance in across countries is mixed. It is possible that different legal environments impact these results. Brazilian companies voluntarily join one of four stock exchange listing segments with incrementally more demanding listing requirements about corporate governance (CG). The Brazilian market offers, thus, an opportunity to assess fundamental indexation in the same legal environment but under different listing requirements. The sample period begins in 2003 and ends in 2015. Categorical variables indicate the CG quality according to each listing segment. The fundamentals of a company used in fundamental indexation are multiplied by the corresponding categorical variable to compute portfolio weights. Companies with hypothetically better CG practices enjoy greater weights. The results show that such fundamental portfolios did not outperform, given that their estimated alphas are not significant when estimated with a five risk-factor model. Fundamental indices seem to be a variation of a value strategy and their performance was not influenced by different listing requirements in the same legal environment. It is possible that previous mixed results across countries were simply due to sample and period biases and not to the different legal environments.

Citation: Raphael Moses Roquete and Ricardo P. C. Leal and Carlos Heitor Campani, (2018) "Corporate governance and fundamental indexation in Brazil", *Economics Bulletin*, Volume 38, Issue 3, pages 1494-1504
Contact: Raphael Moses Roquete - raphael.moses@coppead.ufrj.br, Ricardo P. C. Leal - ricardoleal@coppead.ufrj.br, Carlos Heitor Campani - carlos.heitor@coppead.ufrj.br.
Submitted: March 26, 2018. **Published:** August 05, 2018.

1. Introduction

Firm fundamentals are the ultimate sources of value since and market capitalization weighting is suboptimal because noisy prices incorrectly reflect fundamentals (Arnott, Hsu and Moore, 2005, and Basu and Forbes 2014). Arnott *et al*. (2005) proposed fundamental indexation to weight passive portfolios, which they named fundamental indices. The weight of each stock in a fundamental index corresponds to the percentage that it contributes to the sum of the values of the fundamental indicator selected. The total revenue in a year is an example of a fundamental indicator. The weight of a company in a fundamental index using total revenues is its revenue divided by the sum of the revenues of all companies in the index (portfolio).

The literature, however, presents mixed results about fundamental indexation, depending on the country it was examined. Walkshäusl and Lobe (2010), for example, did not find support for fundamental indexation in every country they studied. Thus, one possibility is that different legal environments, that influence the quality of CG practices, impact fundamental indexation.

Brazilian listed companies voluntarily choose one of the four available listing segments to trade their stock. The basic trading segment makes no additional corporate governance (CG) requirements relative to what is legally required. The three premium segments (Level 1, Level 2, and New Market) present increasingly demanding CG requirements to the companies that voluntarily contract with the exchange to trade in one of them. An example of increasingly demanding CG requirements is the composition of the board. The only requirement in the basic segment is to have at least 3 members, which is the legal requirement. "Level 1" has the same requirement but also demands a unified two-year term. "Level 2", in addition to the requirements of "Level 1", requires a minimum of 5 members with at least 20% being independent. The New Market segment requires that independent board members number at least 2 or 20% of the board seats; whichever is greatest, in addition to the requirements of "Level 2". Another example regards the minimum market liquidity. The basic segment has no minimum requirement, whereas the premium segments demand that at least 25% of the issued shares are free for trading (not in the hands of the controlling or insider group). Thus, joining trading in one of the premium segments is a proxy for the quality of CG practices of a company. The number of companies in the premium segments increased over the sample period even though the growth rate diminished after 2007, while the number of companies in the basic segment dropped substantially, due to delistings as well as to migration to the premium segments, among other reasons. Before 2008, many companies trading in the basic segment migrated to the premium segments and, more significantly, all new listings elected one of the premium listing segments. This trend diminished considerably after the global financial crisis. The Brazilian stock exchange and its four segments, thus, offer an opportunity to study fundamental indexation for portfolios of companies in the same legal environment but under different listing requirements. Even thought the increasingly demanding listing requirements correspond, by and large, to more demanding CG practices, this article tests the role of the four Brazilian listing segments in the weighting of fundamental indices.

The primary goal of this article, then, is to verify if fundamental indexation performs differently under different listing requirements in the same legal environment. In order to do that, it interacts the weighting method of Arnott *et al*. (2005) with the listing choice of companies using the Brazilian stock exchange premium segments between June 2003 and May 2015. Thus, the evidence in this article may suggest if the mixed country results in the literature are partially

due to the differences in country regulations. A five-factor model described in Keene and Peterson (2007), which extends the Fama and French (1993) original version, estimates alphas.

Moreover, on the local level, Carvalhal and Nobili (2011) extended the Fama and French (1993) asset-pricing model with a forth CG factor to analyze Brazilian stock returns: they found that this CG factor seems to be more powerful than firm size and book-to-market ratio. Thus, a passive management strategy of stock portfolios that uses company fundamentals and CG quality indicators might be an attractive stock investing strategy. Machado and Medeiros (2011) ascertain that value, size, momentum, and liquidity risk factors explain the returns of stock portfolios in Brazil. Nevertheless, Roquete, Leal, and Campani (2018) suggest that fundamental indices in Brazil do not present significant alphas after adjusting a five-factor model and that fundamental indexation is akin to a value stocks strategy.

The results here in, considering the interaction of CG listing categorical variables and fundamental indices, confirm that fundamental indices do not outperform. This evidence suggests that the excess returns of fundamental indexation are explained by the usual risk factors and that there are no significant excess returns to fundamental indexation after accounting for CG quality. Evidence for the significance of the value risk factor coefficient contradicts the multi-country study performed by Walkshäusl and Lobe (2010). The evidence herein also suggest that contrasting results from studies addressing several countries are possibly not due to differences in the legal or regulatory environment, but may simply reflect sample and period biases. The absence of Brazilian financial products explicitly claiming to use fundamental indexation, such as exchange-traded funds, is therefore consistent with this evidence.

2. Literature Review

2.1 Evidence about fundamental indexation

The CAPM provides theoretical support for market capitalization portfolio weighting. The return-to-risk ratio of these portfolios, however, may not be optimal because market prices are noisy and do not necessarily reflect company fundamentals (Siegel 2014, Arnott and Hsu 2008, and Treynor 2005).

Arnott *et al*. (2005) proposed passive portfolio weights that do not depend on market prices. The weights of these portfolios, which they named fundamental indices, derive from selected company fundamentals. The authors employed financial and accounting quantities, such as cash flow, earnings, dividends, book value, gross sales and revenues, as well as the number of employees, as fundamental indicators. They also preferred rebalancing annually to keep transaction costs low. They verified that the components of their fundamental indices were less liquid than corresponding market capitalization weighted portfolios but claim that this did not hurt performance.

Arnott *et al*. (2005) conveyed a 1.97 percent per year outperformance in the US relative to the S&P 500, with a similar volatility, between 1964 and 2002. They computed one fundamental index weighted according to each fundamental indicator, as stated above, as well as an equally weighted composite index using some of these individual fundamental indices. Amenc, Goltz and Le Sourd (2009) confirm that fundamental indices performed better than value-weighted indices in the US but with no statistical significance for this difference in most cases. They reach

a similar conclusion for equally weighted indices and also affirm that the outperformance of fundamental indices is due to significant value tilts.

The evidence is not indisputable around the world as well. Hemminki and Puttonen (2008), Basu and Forbes (2014), and Walkshäusl and Lobe (2010) offer evidence favorable to fundamental indexation in the Eurozone, Australia, and for a global fundamental index, respectively. Walkshäusl and Lobe (2010), in particular, included 28 developed and 22 developing countries in their global fundamental index and analyzed individual country fundamental indices as well. Initially, they found that individual country fundamental indices presented higher returns, with similar volatility, than their value-weighted counterparts, which is consistent with the evidence in Arnott *et al*. (2005) and Hemminki and Puttonen (2008). Walkshäusl and Lobe (2010), however, proceeded to verify the robustness of this performance and concluded that it diminished considerably for individual country fundamental indices. These authors also assert that there is no strong evidence for individual country fundamental indices outperformance after controlling for data snooping biases. Regarding Brazilian stocks, Walkshäusl and Lobe (2010) and Roquete *et al*. (2018) did not identify statistically significant evidence for outperformance of fundamental indexation with a four-factor model between January 1999 and June 2008 and a five-factor model between June 2003 and May 2015, respectively. These authors also present evidence in favor of the value tilt mentioned in Amenc *et al*. (2009).

Thus, the initial favorable evidence about fundamental indexation does not clearly hold for individual countries after some robustness tests. Moreover, critics of fundamental indexation claim that it is a value stock investment scheme in disguise or even an active design passing as passive as a result of frequent rebalancing (Blitz and Swinkels, 2008). Yet, Walkshäusl and Lobe (2010) also find significant alphas for some countries after adjusting a four-factor model, which leaves room for speculating if country specific fixed effects could play a role. This led to another examination of Brazil and its four distinctive regulatory segments in the stock exchange in this article, as an opportunity to verify if fundamental indices interacted with different regulatory demands outperform in the same legal environment.

2.2 Influence of CG on stock prices

Gompers, Ishii and Metrick (2003) constructed an index based on twenty-four rules to measure the quality CG of 1500 US firms in the 1990s. The authors suggest a strategy that consists of buying firms in the highest CG score decile and selling those in the lowest decile. They assert it generated an excess return of 8.5% a year in the 1990s. Drobetz, Schillhofer and Zimmermann (2004) also constructed a CG index for the German market and conclude that the strategy of buying firms with the highest CG scores and selling those with the lowest generated an excess return of 12% a year between January 1998 and March 2002. Bauer, Guenster and Otten (2004) undertook a similar exercise for firms in the FTSE Eurotop 300 with similar conclusions in 2000 and 2001.

Carvalhal and Nobili (2011) showed that a CG factor, in addition to the three-factor model of Fama and French (1993), had a greater explanatory power than the size and book-to-market factors between July 1995 and June 2008 for Brazilian stocks. Contrastingly with Gompers *et al*. (2003) and Drobetz *et al*. (2004), Carvalhal and Nobili (2011) evinced that average stock returns were negatively associated to CG. A strategy of buying stocks of firms with a lower CG score and selling those with a higher led to an excess return of 10% a year in their sample period. They

argued that these results diverge from those found by Gompers *et al*. (2003) and Drobetz *et al*. (2004) possibly because CG practices are more important in developing countries, which offer less investor protection, and, thus, better CG firms should be less risky and present lower returns.

This evidence suggests that CG is a risk factor priced in stock returns, particularly in Brazil. Walkshäusl and Lobe (2010) have used a four-risk factor model to estimate the alphas generated by fundamental indices while Carvalhal and Nobili (2011) showed that there was significance for a CG risk factor in a four-factor model for Brazil. This article, therefore, interacted a proxy for CG quality with the original fundamental indexation proposal and tested whether this new fundamental indexation displayed significant alphas after adjusting a five-factor model.

3. Sample and Methodology

The stocks in the sample come from those comprising the IBrX 100 index in June of each year. Leal and Campani (2016) assert that the Ibovespa is the most widely followed Brazilian stock index but was weighted according to market liquidity of the free-floating company stocks up to December 2013. This index includes fewer stocks than the IBrX 100, which is market capitalization weighted. Bloomberg™ provided the fundamental indicators, Economática™ the stock prices and the ComDinheiro system the exchange listing segment of each company in each year. The last listing segment observed was used when this information was not available. The basic listing segment was assigned to a company when this information was not available in any year.

The sample period begins in June 2003 and ends in May 2015 when data collection ended and consists of 144 months. The sample initiates in 2003 because the first new issue listing in the premium listing segments was in 2004, even though they inaugurated in 2000. Moreover, non-voting preferred stocks, often the most liquid stock of a company, were only weighted in the IBrX 100 according to the market capitalization of their free-float from May 2002 (BM&FBovespa 2015).

The methodology herein follows Roquete *et al*. (2018). The definitions of the fundamental indicators and additional details are in the Appendix and use Brazilian currency data from the end of each sample year for the constituents of the IBrX 100 index. Rebalancing occurs every year in June using the indicators for the end of the previous calendar year.

(1) and (2) show the two stock weighting methods and omit the time subscript for clarity. The original procedure in Arnott *et al*. (2005) was modified to include the interaction with the CG categorical variable. The weight of stock i is $w_{k,i}$ in June of each year, as depicted in (1), where the fundamental indicator k for stock i ($F_{k,i}$) is multiplied by the CG categorical variable (CG_i) for the N stocks in the fundamental index in that occasion. Zero is considered when this product is negative. CG_i is equal to 1, 2, 3 or 4 for the basic, Level 1, Level 2, and New Market listing segments, respectively, ordered from the least to the most demanding listing segment (New Market). Companies with greater CG_i have greater weights, therefore, relative to a weighting without the CG_i interaction.

$$\mathrm{w_{k,i}} = \frac{\max(0, F_{k,i} \times CG_i)}{\sum_{i=1}^{N} \max(0, F_{k,i} \times CG_i)} \quad (1)$$

Outlying and negative values for a fundamental indicator k may affect company weighting. (2) portrays an ordinal method to account for their impact. This alternative procedure sorts the

products in the numerator of (1) in ascending order. The rank of each stock is $O_{k,i}$, which is equal to 1 for the lowest product, 2 for the second lowest, and so on. (2) portrays the ordinal weight of each stock ($ow_{k,i}$).

The computation of (2) preserved the negative values of the fundamental indicators instead of assigning zero to them. Thus, a larger value of CG_i could reduce the ordinal weights of firms with negative fundamental indicators. It was, therefore, adopted an inverse weighting for firms with negative fundamental indicators, with the basic segment corresponding to 4, and then 3 for Level 1, 2 for Level 2 and 1 for companies in the New Market.

$$ow_{k,i} = \frac{O_{k,i}}{\sum_{i=1}^{N} O_{k,i}} \tag{2}$$

(3) gives the number of shares for each stock i in the portfolio (fundamental index) k ($Q_{k,i}$). The value of a fundamental index is 100 monetary units in the first month. The numerator in (3) is the initial amount invested in each stock. The denominator is the closing price on the last trading day of the previous month ($P_{i,t-1}$). The number of shares of stock i ($Q_{k,i}$) remains the same from the first trading day of June until the last trading day of May of the subsequent year. (4) depicts the monthly monetary value of each fundamental index k ($I_{k,t}$). The monthly fundamental index k return ($R_{k,t}$) that appears in the following equations is calculated as the monthly percentage value change of $I_{k,t}$.

$$Q_{k,i} = (w_{k,i} \times 100)/P_{i,t-1} \tag{3}$$

$$I_{k,t} = \sum_{i=1}^{N} P_{k,i,t} \times Q_{k,i} \tag{4}$$

The metrics to assess the performance of fundamental indices include the geometric average return ($\overline{GR}_k$), standard deviation (Vol_k), and Sharpe Ratio (SR_k), depicted in (5), (6), and (7), respectively, and the excess return relative to the CDI rate, which is the difference between the monthly fundamental index k return ($R_{k,t}$) and the monthly CDI rate. The CDI rate is a prime rate that consists of the daily average of repurchase agreement transactions (repo) rates between financial institutions. It is the most common financial benchmark in Brazil and its values are very close to those of the rates on short-term government securities. The tradition to use a repo rate as a benchmark comes from the times of hyperinflation when repo transactions were very common even for smaller investors in order to protect the purchasing power of their money. A long-term debt securities market during that time was non-existent.

$$\overline{GR}_k = \prod_{t=1}^{144}(1 + R_{k,t})^{12/144} \tag{5}$$

$$Vol_k = \sqrt{12 \times \left[\frac{1}{143}\sum_{t=1}^{144}\left(R_{k,t} - \bar{R}_k\right)^2\right]} \tag{6}$$

$$SR_k = \frac{\bar{R}_k - \overline{CDI}}{\frac{1}{143}\sum_{t=1}^{144}(R_{k,t} - \bar{R}_k)^2} \tag{7}$$

(8) and (9) show alphas (α_k) estimated according to the CAPM and a five-factor model considering 144 monthly excess returns. The returns on the IBrX 100 proxy for the market

returns ($R_{M,t}$). The model depicted in (9) is the three-factor model of Fama and French (1993) plus two additional factors (Keene and Peterson 2007, and Machado and Medeiros 2011). The Appendix offers a brief definition of each risk factor.

$$R_{k,t} - CDI_t = \alpha_k + \beta_k(R_{M,t} - CDI_t) + \varepsilon_{k,t} \quad (8)$$

$$R_{k,t} - CDI_t = \alpha_k + \beta_k(R_{M,t} - CDI_t) + s_k SMB_t + h_k HML_t + w_k WML_t + i_k IML_t + \varepsilon_{k,t} \quad (9)$$

4. Results

The descriptive statistics are in Table I. The annual geometric average return shows that investors would have accumulated more wealth with all fundamental indices, except the one based on the book value of equity. The standard deviation of these indices is lower than that of the stock index in most cases. Their SRs, however, did not present significance. Three indices present significant excess returns relative to the IBrX 100 at the ten percent level with weighting according to (1) and none with the ordinal weighting of (2), suggesting that extreme and negative values of the fundamental indicators may have affected that significance. An equally weighted composite fundamental index did not show a significant excess return relative to the IBrX 100. The higher returns of fundamental indices, even though not always accompanied by statistical significance, are consistent with those in the previous literature (Arnott *et al*. 2005, Walkshäusl and Lobe, 2010, and Roquete *et al*. 2018).

There are some significant alphas with the CAPM but none with the five-factor model in Table II. The HML factor (value stock effect) largely explains the CAPM "abnormal return" because it is positive and significant for all fundamental indices, regardless if their weighting was as Arnott et al. (2005) proposed as in (1) or by means of an ordinal scheme as in (2), which supports the claim that these indices are actually value stocks portfolios. The SMB factor (size effect) is positive and significant at the five percent level for five out of the six fundamental indices weighted according to the ordinal scheme as in (2), which was designed to reduce the effect of outliers but that possibly also increases the weighting of the smaller capitalization stocks. Thus, it is not surprising that SMB is positive and significant only for the ordinal weighting but not for the original weighting scheme, denoting that there is a size effect when the magnitude of fundamental indicators is ignored. The WML (momentum effect) is also positive and significant at the five percent level for three out of six fundamental indices weighted according to the original weighting scheme as in (1) but in none with ordinal weighting as in (2). The positive and significant WML coefficient indicates that immediate past returns (winners) display fundamental indicators that are larger, and thus generate greater weights, in fundamental indices when the original weighing scheme takes place (but not with the ordinal weighing scheme, what explains the lack of significance at 5% for these indices). This significance is present in the fundamental indices formed according to dividends, free cash flow, and net operating income.

The fundamental indexation weighting considering a listing requirement interaction did not produce alpha results different from those in Roquete *et al*. (2018) and Walkshäusl and Lobe (2010) in Brazil. The effects of CG could be isolated through a comparison of fundamental indices formed with and without the listing requirement dummies in their weighting. Because there were no significant alphas in the Roquete et al. (2018) (without the listing requirement dummies) for the same data, any significance in this article would be due to the listing

requirement dummies. Yet, there was no significance for the alphas once more. The result regarding the positive significance of the value factor coefficient is consistent with Roquete *et al*. (2018) but not with Walkshäusl and Lobe (2010) for Brazil, indicating that sample and time period differences influence the results. This particular result should, therefore, be considered with caution but, nevertheless, is aligned with those of the critics of fundamental indexation who claim that it is nothing more than a value stock strategy (Blitz and Swinkels, 2008).

Table I
Fundamental index descriptive statistics

Index	Method	Geom. Annual Return (%)	Annual Vol. (%)	SR	Annual Excess Return (%)	Average Monthly Return (%)	Median Monthly Return (%)	Min. Monthly Return (%)	Max. Monthly Return (%)
Book.cg	1	15,11	21,81	0,06	-0,81	1,38	0,96	-20,15	15,45
	2	15,99	19,84	0,07	-0,37	1,41	1,08	-19,84	14,50
CFFree.cg	1	21,15	22,06	0,13	5,43*	1,81	1,93	-16,99	17,10
	2	18,24	18,73	0,10	1,66	1,55	1,21	-18,80	14,05
CFOp.cg	1	18,73	21,84	0,10	2,91	1,64	1,97	-19,70	15,27
	2	17,71	18,91	0,10	1,16	1,52	1,12	-18,28	14,29
Div.cg	1	17,70	20,34	0,09	1,47	1,54	1,38	-17,92	14,87
	2	18,73	19,65	0,11	2,37	1,60	1,40	-18,73	16,02
Incomeop.cg	1	18,39	21,87	0,10	2,56*	1,61	1,40	-21,38	17,67
	2	17,50	19,44	0,09	1,06	1,51	1,23	-18,54	15,86
Revenue.cg	1	19,08	22,10	0,11	3,31*	1,67	1,74	-21,85	17,37
	2	17,85	19,81	0,10	1,51	1,54	1,32	-18,07	14,66
Composite.cg	1	18,44	21,35	0,10	2,48	1,61	1,63	-19,37	15,76
	2	17,68	19,32	0,10	1,23	1,52	1,18	-18,87	14,86
IBrX100	–	15,84	21,94	0,07	–	1,43	1,56	-25,11	18,34

Note. The statistics refer to the 144 monthly returns between June 2003 and May 2015. "Index" is one of the fundamental indices or the IBrX 100. The fundamental indices were weighted according to the following fundamental indicators: dividends (Div.cg), free cash flow (CFFree.cg), operating cash flow (CFOp.cg), operating income (Incomeop.cg), net revenue (Revenue.cg) and equity book value (Book.cg), all measured in Brazilian currency. Identical weighting each of the six individual fundamental indices on rebalancing dates forms the Composite Index. More details are provided in the Appendix. All the indices are accompanied by the initials cg (corporate governance) to indicate that the weights of stocks in the indices are calculated by taking an indication of their corporate governance quality into account, according to (1). Method 1 corresponds to weighting according to (1) and method 2 to (2). The geometric annual return was defined in (5). Annual volatility was defined in (6). The Sharpe ratio (SR) relative to the CDI was defined in (7). Excess returns were calculated as the annualized average monthly return of each index subtracted from the annualized average monthly return of the IBrX 100. Sharpe (1994) shows that the number of observations multiplied by the SR is equivalent of a t statistic for the significance of the SR in (7).
* denotes significance at 10% and ** at 5%, measured by a two-tailed t test.

The interaction of listing requirement dummies with the original fundamental index weighting did not offer any indication that CG could be an important fundamental indicator for fundamental indexation. Even though Carvalhal and Nobili (2011) identified a significant contribution of CG to Brazilian stock pricing after adding a CG risk factor to the three factors of Fama and French (1993), the method employed herein does not employ CG as a risk-factor, but as a component of portfolio weighting. The main reason to include CG in the weighting is because our goal was to provide a practical weighting scheme for fundamental portfolios considering easily observable trading list segments, and not to analyze a CG risk factor. Thus, a comparison of the results in this article with theirs is not possible.

Table II
Analysis of fundamental index alphas

		CAPM			Five-Factor Model							
Index	M	α (% aa)	β	R^2	α (% aa)	β	h	s	w	i	R^2	F
Book.cg	1	-0,41	0,95	0,91	-0,50	0,94	0,21**	0,06	-0,10	-0,03	0,93	357
	2	0,56	0,84	0,86	0,14	0,81	0,17**	0,20**	0,04	-0,05	0,89	227
Div.cg	1	2,97	0,83	0,86	0,42	0,91	0,13**	-0,01	0,08**	-0,01	0,93	401
	2	1,85	0,89	0,92	2,12	0,82	0,10**	0,13	0,07	0,02	0,87	196
CFFree.cg	1	5,11**	0,92	0,83	3,18	0,93	0,15**	0,02	0,11**	-0,02	0,84	147
	2	2,66	0,77	0,82	1,68	0,74	0,11**	0,24**	0,09*	-0,03	0,86	173
CFOp.cg	1	2,72*	0,96	0,92	1,75	0,96	0,13**	0,02	0,05	0,00	0,93	372
	2	2,15	0,79	0,84	1,36	0,77	0,13**	0,19**	0,07	0,00	0,87	191
Incomeop.cg	1	2,32*	0,98	0,96	1,20	0,98	0,10**	0,07	0,07**	-0,03	0,97	792
	2	1,89	0,82	0,86	1,08	0,79	0,11**	0,20**	0,07	-0,04	0,88	212
Revenue.cg	1	3,00**	0,97	0,93	1,99	0,96	0,12**	0,11*	0,06*	-0,09	0,94	428
	2	2,22	0,83	0,85	1,56	0,80	0,16**	0,23**	0,06	-0,06	0,88	210
Composite.cg	1	2,43*	0,94	0,94	1,34	0,95	0,14**	0,05	0,06**	-0,03	0,95	514
	2	2,07	0,81	0,85	1,32	0,79	0,13**	0,19**	0,07	-0,03	0,88	212

Note. The statistics refer to the 144 monthly returns between June 2003 and May 2015. "Index" is one of the fundamental indices. The fundamental indices were weighted according to the following fundamental indicators: dividends (Div.cg), free cash flow (CFFree.cg), operating cash flow (CFOp.cg), operating income (Incomeop.cg), net revenue (Revenue.cg), and equity book value (Book.cg), all measured in Brazilian currency. Identical weighting forms the Composite Index for each of the six individual indices on rebalancing dates. More details are provided in the Appendix. All the indices are accompanied by the initials cg (corporate governance) to indicate that the weights of stocks in the indices are calculated by taking an indication of their corporate governance quality into account, according to (1). "M" is the weighting method. Method 1 corresponds to weighting according to (1) and method 2 to (2). The CAPM model was estimated as in (8) and the five-factor model as in (9) (h, s, w and i represent the coefficients of the model's four additional factors). Alphas were annualized for the purpose of presentation in the form $(1+\alpha)^{12}-1$. The two models were estimated with robust errors to correct heteroskedasticity and autocorrelation in the residuals, according to the Newey-West method. R^2 is the determination coefficient of each regression and the last column denotes the F-statistic for the tests.

* denotes significance at the 10% and ** at the 5% levels, measured by a two-tailed t-test. All betas, in both models, are significant at the five percent level and asterisks were not included to save space. No five-factor model alpha is significant at the ten percent level or less. All p-values of the F-statistic are virtually zero and the significance indicators were omitted to save space.

This article examined fundamental indexation in a single legal environment, but considered four different regulatory segments for the companies, according to listing requirements, which they voluntarily contracted with the Brazilian stock exchange. The evidence suggests that the mixed results regarding fundamental indexation across countries, as in Walkshäusl and Lobe (2010), for example, were possibly not due to differences in CG rules across countries. On the other hand, the contrasts about the alphas across countries, with very few being significant in Walkshäusl and Lobe (2010), as well as for the significance or not of the value risk-factor coefficient for fundamental indices in Brazil, indicate that fundamental indexation, in general, does not outperform and that the occasional significant outperformance may be due to sample and period selection.

5. Conclusions

Fundamental indexation did not generate positive and significant alphas in Brazil. The fundamental indicators were interacted with a corporate governance variable assuming the values of 1, 2, 3, and 4 according to the four listing segments of the Brazilian exchange, the first (basic) with no additional requirements relative to the law, and the others (premium) with increasing CG requirements. Companies voluntarily join the premium segments. This interaction did not change previous results that fundamental indexation is largely explained by the value stocks effect in Brazil. Thus, it is not surprising that there were no financial products, such as exchange-traded funds, using fundamental indexation in Brazil, to the best of our knowledge at the time of the writing of this article. Furthermore, the analysis suggests that differences in CG rules do not influence fundamental indexation. Thus, even though fundamental indexation across countries does not outperform in general, the occasional outperformance in certain countries is probably due to sample and period selection bias. The analysis comprised the June 2003 through May 2015 period.

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Appendix

Definition of fundamental indicators

Variable	**Definition (Bloomberg code)**
Book.cg	Equity book value times CG. Book equity is the total equity capital including retained earnings (TOT_COMMON_EQY).
CFFree.cg	Free cash flow times CG. Free cash flow is the cash flow from operating activities less total capital spending (acquisition of tangible assets) (CF_FREE_CASH_FLOW)
CFOp.cg	Operating cash flow times CG. Operating cash flow is net income plus depreciation, amortization, changes in working capital, and other adjustments unrelated to cash flow (CF_CASH_FROM_OPER).
CG	Equal to 1, 2, 3 or 4 for the basic, Level 1, Level 2, and New Market listing segments, respectively.
Div.cg	Dividends times CG. Dividends include cash dividends and interest on net equity (CF_DVD_PAID).
Incomeop.cg	Net operating income times CG. Net operating income includes all types of operating income minus the costs of goods sold and other operating losses (IS_OPER_INC).
Revenue.cg	Net revenue times CG. Net revenues is the total operating revenues, less various adjustments to gross sales, such as returns, provisions, retained taxes, insurance charges, sales taxes and value-added taxes (SALES_REV_TURN).

Definition of risk factors in (9)

Variable	**Definition**
IML	*IML (illiquid-minus-liquid)* is the illiquidity factor and its monthly ILM returns are the differences between the monthly returns of the equally weighted least liquid (I) and most liquid (L) portfolios.
HML	*HML (high-minus-low)* is the value factor and its monthly returns are the differences between the monthly returns of the equally weighted high (H) and low book-to-market (L) portfolios.
SMB	*SMB (small-minus-big)* is the size factor and its monthly returns are the differences between the monthly returns of the equally weighted small (S) and

	large market capitalization (B) portfolios.
WML	*WML (winners-minus-losers)* is the momentum factor and its monthly returns are the differences between the monthly returns of the equally weighted highest (W) and lowest past return (L) portfolios.

Note. A study center at the University of São Paulo computes these risk factors. For more details and free downloading of the factors go to www.nefin.com.br.