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Corporate sustainability and asset pricing models: empirical evidence for the Brazilian stock market

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Abstract

The paper investigates the impact of corporate sustainability on asset prices. For that purpose, we develop a novel corporate sustainability factor and test the extent to which this factor is priced in an augmented four-factor version of the traditional Fama & French (1993) asset pricing model. The corporate sustainability factor is based on a zero-investment portfolio which is long in stocks with high sustainability and short in stocks with low sustainability. We use data on the Brazilian stock market to estimate alternative model specifications with different combinations of four explanatory variables: the corporate sustainability premium, the market risk factor premium, the size factor premium and the book-to-market factor premium. Our results indicate that *corporate sustainability is priced* and helps to explain the variability in the cross-section of expected stock returns.

Keywords

Corporate sustainability. ISE. Fama-French Three-factor model. CAPM. Anomalies.

1. Introduction

One of the fundamental challenges faced by firms is to operate in a way they are able to manage sustainability issues. As Isaksson & Steimle (2009) point out, managing sustainability issues are working in a responsible manner in social and environmental dimensions while achieving economic goals. The integration of these three aspects is often referred to as the "triple bottom line" (TBL) and suggests that corporations and other organizations can create value in multiple dimensions (Elkington, 1998).

The TBL is a concept that is closely related to corporate sustainability (CS). CS corresponds to the commitment of companies to raise their productivity, improve their products, improve management methods, and, at the same time, contribute to the preservation of the environment. Due to the benefits of CS practices, many investors expect to obtain an above-average return (measured by a standard equilibrium asset pricing model, such as the capital asset pricing model - CAPM) by investing in companies with high standard practices of CS.

In this sense, the CS might be treated as an "anomaly", i.e. a pattern in the cross-section of expected stock returns that apparently is not explained by the CAPM; see Fama & French (1996) for a discussion. The CAPM was initially proposed by Sharpe (1964), Lintner (1965), Mossin (1966) and considers that the main pricing factor is the market portfolio. Almost three decades after the CAPM, Fama & French (1993) came up with the three-factor version of the CAPM, which seeks to explain the cross-section of expected stock returns with greater accuracy. The Fama-French three-factor model introduces two new anomalies in the CAPM: the size factor and the book-to-market factor (BE/ME).

After the Fama-French three-factor model, researchers all over the world keep trying to find new factors to increase the accuracy of the asset pricing models. For instance, Xiao et al. (2013) were pioneers

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in introducing CS as a factor to include in asset pricing models. Besides Xiao et al. (2013), many other studies tested the relationship between returns and CS. However, the results of major studies present a lack of consensus. The reason for the lack of consensus is that most of the authors did not separate the samples according to the characteristics of the companies, or analyze companies from different countries on the same sample. We believe that these methods could introduce a bias in the results.

Based on previous research on the performance of companies with practices of CS in the stock market, a knowledge gap arises in the sense that the literature cannot answer whether CS really influences the return on assets, and hence can be treated as an anomaly in the market. Based on this idea, this paper analyzes the impact of the inclusion of the corporate sustainability factor in the three-factor model of Fama and French to assess whether CS consists of an anomaly, and explains the return of Brazilian companies.

Thus, this paper aims to find a consensus and fill the gap about the impact of CS in the cross-section of expected stock returns. The inclusion of a CS factor can assist entrepreneurs in increasing their awareness of the need to adopt socially responsible practices in order to attract customers and investors. At the same time, it could make it easier to decide whether to invest in a particular asset linked to CS practices, versus a different asset that does not share this focus.

Our results demonstrate that an additional sustainability factor can improve the power of explanation of returns. Accordingly, investors could evaluate the CS of companies to improve the performance of the investments.

The structure of this paper is as follows. First, we provide a literature review of the key indicators of CS. Next, our methodological procedures demonstrate the sources of data, rating periods, and forms of analysis. Data analysis is performed using a linear regression on the data. Finally, we present the main results, discussion and the conclusions of the article.

2. Indicators of corporate sustainability

The sustainability challenge has increasingly become a key-item on the management agenda of firms since global warming and the finiteness of important resources, for instance, have caused different stakeholder groups to adjust their expectations of firms (Schrettle et al., 2014). According to the guidelines recommended by the World Business Council for Sustainable Development (WBCSD), in order to be sustainable, organizations must have a balance among the economic, environmental, and social dimensions that delineate the concept CS (Jappur et al., 2008).

However, not all authors agree with the view that it is possible to reconcile shareholder economic value and CS. According to Dasgupta et al. (2001), capital markets may react negatively to the announcement of adverse environmental incidents (such as violation of permits, spills, court actions, complaints) or positively to the announcement of superior environmental performance. Orsato et al. (2015) add that the intangible value created by voluntary environmental initiatives, such as access to knowledge about social and environmental issues, new capabilities, and reputational gain, can explain the efforts that companies make to be listed in the ISE index. Nevertheless, Dyllick & Hockerts (2002) infer that because of the stock market, companies focus attention on short-term gains, as investors attach great importance to quarterly results released by the companies. This obsession with short-term results is contrary to the spirit of sustainable development, which assumes that a company must meet the needs of its stakeholders in the future as well as today. The authors also point out that the calculation of fair value of the companies is based on a discount rate that tends to assign a higher weight to larger short-term gains and tends to give less importance to cost reductions in long-term caused by management practices that respect the environment.

In this context, Lankoski (2008) explains that the link between CS and economic performance is examined through the incremental impact on net present value (*i.e.* through the adjusted net cash flows that incorporate all increases in costs related to CS), and also through reductions in costs and revenue increases generated over time. This cash flow is then brought into the present, discounted by an interest rate that reflects the risk of such investments. Moreover, the author points out that one must be very careful to determine that incremental impact, since besides the direct and immediate expenditures, investing in CS has less obvious effects on items such as corporate image, relations with regulators, employee health, and motivation.

Due to the great complexity of measuring this kind of investment, is a widely recognized necessity by individuals, organizations, and society to find models, metrics, and tools to express the degree of sustainability (Singh et al., 2009). For instance, Trierweiller et al. (2013) develop a measurement of Environmental Management Disclosure using Item Response Theory. Thus, based on the perception of social groups and stockholders that principles and ethical limits for the business activities should be

stipulated, sustainability indicators arise (Marcondes & Bacarji, 2010).

Regarding the usefulness of these indices, Pinto (2012) infers that it is likely that in the very near future, companies will find themselves compelled to provide good sustainability indicators in order to get funding and partners for their economic processes and, thus, seek new levels of profitability. According to Azevedo (2006), indicators of CS are used by companies that want to demonstrate their actions towards the environment and society. One example of the incorporation of sustainability into business practices is the growing number of environmental and sustainability reports. Indeed, the publication of such reports is increasingly becoming an essential part of corporate business activities at a global level (Lee & Saen, 2012). In this sense, Bell & Morse (2008) show that on the one hand, indicators of CS make it easy to identify the efforts of companies in the economic, social and environmental dimensions, but on the other hand, they bring a reduction of information and leave the interpretation more limited. Because of these factors, it may be said that quantifying sustainability by means of indices is not a precise process (Harrington, 1992). At the same time, finding the right way to represent a particular topic through an indicator is sometimes very difficult (Rametsteiner et al., 2011).

Despite these difficulties and constraints, CS indices provide to governments, investors, and entrepreneurs a way to compare the financial performance of the best-ranked companies in relation to social and environmental responsibility and, no doubt, this a major step to improve sustainability by enterprises. The main sustainability indices include the Dow Jones Sustainability Index (DJSI), FTSE Good index, CS Index (ISE), Global Reporting Initiative (GRI), and Ethos Indicators of Social Responsibility.

Because there are several indicators, there is a need for a comparison of their characteristics and methodologies. In this study, we compare five different indicators of CS according to the following criteria: the country of origin of the analyzed companies; an indicator whether a company is listed on the Stock Exchange; the specific spheres of the triple bottom line are analyzed by the indicator; and the main goal of the indicator. These data are provided in Table 1.

Starting from the assumption that one of the goals of this study is to identify the indicator that represents the best proxy of CS for the Brazilian stock market, it appears that the ISE has the best features because it is intended to evaluate the companies of Brazil. It focuses on the stock exchange and still meets important economic, social and environmental objectives.

Marcondes & Bacarji (2010) explain that the ISE offers investors an option of a portfolio comprised of companies committed to recognized CSR and Corporate Sustainability practices since the index expands the understanding of companies, differentiating them in terms of commitment level of sustainable development, transparency, nature of the products, as well as the business performance in the economic, financial, social, environmental, and the climate change dimensions. However, despite the ISE being the best option as a proxy for CS, the indicator has little transparency regarding the ranking of the companies and the criteria for including or excluding companies in the index.

Table 1. Comparison of corporate sustainability indicators.

Indicator	Country	Stock Exchange	Spheres	Goal
Dow Jones Sustainability Index (DJSI)	U.S.	Yes	Economic Social Environmental	Provide investors further insight into the performance of corporate sustainability through a number of sustainability indices related to financial market (Searcy & Elkhawas, 2012)
FTSE Good Index	U.K.	Yes	Economic Social Environmental	Evaluate the performance of companies that meet the standards of corporate responsibility and also facilitate investment in those companies (Singh et al., 2009)
Corporate Sustainability Index (ISE)	Brazil	Yes	Economic Social Environmental	Track the performance of leading companies in corporate sustainability listed on the BM&FBovespa
Global Reporting Initiative (GRI)	Netherlands	No	Economic Social Environmental	Promoting Sustainable Development in the business world by reconciling profitability and social-environmental responsibility (Curi, 2011)
Ethos Indicators of Social Responsibility	Brazil	No	Social	Measure the effectiveness of corporate sustainability strategies, favoring the continuous monitoring of their progress in different areas (Curi, 2011)

Moreover, it is worth mentioning that there is no consensus about the benefits for a company if it joins the ISE, due to the fact only companies that seek to enter the index are those that hope to get some feedback to compensate for the increased costs inherent in the process. Likewise, investors who devote resources to sustainable companies expect to have a better risk-return relation. Table 2 presents articles that assess this subject.

After reviewing the major works on the subject, it is clear that there is a knowledge gap, in the sense that the studies mentioned present different results and calculation methodologies. Furthermore, none of the mentioned articles seek the inclusion of a factor related to sustainability in any asset-pricing model for the Brazilian market, we fill this gap in out study.

Next, we present the methodological procedures for creating an asset-pricing model with four factors, including the Corporate Sustainability factor.

3. Materials and methods

3.1. Data collection

Our initial sample includes monthly data for all companies listed on the Sao Paulo Stock Exchange (BM&FBovespa) from December 2005 to November 2013. We choose the initial period based on the fact that ISE was created in November 2005.

In order to improve our model accuracy, as well as follow the same parameters as Fama & French (1993), we exclude certain variables from the sample:

- Financial Companies.
- Companies that did not have consecutive monthly quotations during the 12-month period from the formation of the portfolios.
- Companies that did not present market value at December 31 and June 30, with a tolerance of five days.
- Companies that did not present Positive Net Equity on December 31, with a tolerance of five days.
- Companies that did not participate in at least 50% of the sessions of the stock exchange in the last twelve months for each year.
- Companies that were not among the 150 most liquid stocks in the last 12 months for portfolios from 2006 to 2010, or among the 200 most liquid stocks in the last twelve months for portfolios from 2011.
- Companies that were not among the 150 most liquid stocks of the stock exchange in the period between May of the year (t-2) and April of (t-1) between the years 2006 and 2010.

Table 2. Major studies about expected return and corporate sustainability.

Authors	Goal	Conclusions
Andrade et al. (2013)	Examine whether the membership of the ISE companies has a relation with the market value of companies.	Evidence of a negative relationship between companies included in ISE and the market value of them in the post-financial crisis period in 2008.
Cavalcante et al. (2009)	Compare the performance of a theoretical portfolio consisted of stocks included in the Corporate Sustainability Index (ISE) with the performance of the theoretical portfolios that comprise the Bovespa Index (Ibov) and Brazil Index (IBrX).	There is no evidence of superior performance of the ISE in the period after its creation. However, there are indications that the retroactive effect of the ISE portfolio showed better performance in the period before the creation of the index.
Consolandi et al. (2009)	Assess whether practices of corporate social responsibility influence the performance of companies on the stock market.	The assessment of practices of CSR was an important criterion for the activities of asset allocation.
Cunha & Samanez (2013, 2014)	Analyze the performance of sustainable investments in the Brazilian stock market.	Although sustainable investments have interesting characteristics, such as low diversifiable risk and increasing liquidity, they did not achieve satisfactory financial performance.
Knoepfel (2001)	Compares the components of the Dow Jones Sustainability Group Index (DJSGI) and those of its benchmark, the Dow Jones Group Index (DJGI).	The index of companies with sustainable practices showed better average returns on equity, on investments and on assets.
López et al. (2007)	Analyze whether the performance of the business was affected by the adoption of practices included under the Corporate Social Responsibility term.	Adherence to CS practices brought a negative short-term impact on performance.
Machado et al. (2009)	Analyze whether the average profitability of the ISE was statistically different from the profitability of other indices of BM&FBovespa.	The profitability of the ISE in relation to other indices of BM&FBovespa was not statistically different.
Vital et al. (2009)	Compares the financial performance of listed companies in the Top 500 of *Exame* Magazine; those that were part of the ISE and the ones that were not.	Companies that were not part of the ISE had better financial performance.
Xiao et al. (2013)	Empirically investigate whether the stock market assigns a premium for sustainability factor by including the premium in the three-factor model of Fama and French.	Sustainability does not have a significant impact on the expected return of the shares.

- Companies that were not among the 200 most liquid of the stock exchange in the period between May of the year (t-2) and April of (t-1) between the years 2011 and 2013.
- Companies that had no trading in the BM&FBovespa in at least 50% of the sessions, analyzed between the period of May of the year (t-2) and April of the year (t-1), from the formation of portfolios.

3.2. Research model

In this paper, we assess the impact of the inclusion of the Corporate Sustainability factor of Xiao et al. (2013) into the three-factor model of Fama and French. It is noteworthy that we choose the three-factor model of Fama & French (1993) because, according to the authors, the model with three factors - market (Beta); size; and the BE/ME index - is superior to the CAPM and is able to explain a big portion of the expected return on assets. Yet, we choose the model of Xiao et al. (2013) to represent CS, because the model is most suited to the goal of this work.

The Corporate Sustainability factor possibly has different correlations with each of the other three factors studied, so that only the pure inclusion of the Corporate Sustainability factor on the Fama-French three-factor model could bring a bias to the study. Thus, it is essential to create and analyze different models, obtained by combining the four factors studied, in order to make a fair analysis of the impact of the corporate sustainability factor in the three-factor model.

Being aware of that, we compare six models: CAPM (Equation 1), the two-factor model (Equation 2), the three-factor model of Fama and French (Equation 3), the three-factor model with SMB and SUS factors (Equation 4); the three-factor model with the SUS and HML factors (Equation 5) and the four-factor model (Equation 6). The equations are described as follows:

$$R_{ct} - RF_t = a + b\left(RM_t - RF_t\right) + \varepsilon_t \quad (1)$$

$$R_{ct} - RF_t = a + b\left(RM_t - RF_t\right) + cSUS_t + \varepsilon_t \quad (2)$$

$$R_{ct} - RF_t = a + b\left(RM_t - RF_t\right) + sSMB_t + hHML_t + \varepsilon_t \quad (3)$$

$$R_{ct} - RF_t = a + b\left(RM_t - RF_t\right) + sSMB_t + cSUS_t + \varepsilon_t \quad (4)$$

$$R_{ct} - RF_t = a + b\left(RM_t - RF_t\right) + hHML_t + cSUS_t + \varepsilon_t \quad (5)$$

$$R_{ct} - RF_t = a + b\left(RM_t - RF_t\right) + sSMB_t + hHML_t + cSUS_t + \varepsilon_t \quad (6)$$

Where: R_{ct} is Portfolio c return at month t, RM_t is the Return on the market portfolio in month t, RF_t is the Return on the risk-free asset in month t, SMB_t is the Size factor premium in month t, s is the Slope of the size factor premium, HML_t is the BE/ME factor premium in month t, h is the Slope of the BE/ME factor premium, SUS is the CS factor premium, S is the Slope of the CS factor premium and, $å_t$ is the residual of the model for the portfolio i in month t.

3.3. Determination of explanatory variables

In this paper, we use the method of portfolios to test the models, similar to that used by Fama & French (1993). Altogether, we calculated four monthly premiums (HML), (SMB), (RM-RF), and (SUS), which were used as explanatory variables in the temporal regressions to validate the model and the hypothesis test.

3.3.1. Monthly premiums of the Fama and French study

In June of each year t, starting in 2006 and ending in 2013, we sorted all shares in ascending order according to the value of each market. We used the median market to divide the sample into two groups, classified as Big (B) and Small (S) containing companies with higher and lower market value, respectively (Fama & French, 1993). In addition to this approach, all sample stocks are sorted according to the BE/ME index in June of each year t, starting in 2006 and ending in 2013. We calculated this index with book values and market equity referent to December of the previous year (t-1) to the formation of the portfolio. After sorting, we divided the sample into three groups: 30% High, 40% Medium, and 30% Low (Fama & French, 1993). In June of each year, after the prior two groupings, we constructed six portfolios (S/L, S/M, S/H, B/L, B/M, B/H), resulting from the intersection of the two groups ordered, according to the market value variable and the three groups sorted by the BE/ME (Fama & French, 1993).

After the creation of the portfolios from July of year t to June of year t+1, we calculated the actual monthly return on each stock in each of the years. Using the stock returns from July of year t to June of year t+1, we calculated the actual monthly returns on each of the six portfolios by weighting the stock returns that comprise them. This weighting was applied by dividing the value of the stock market relative to the market value of the portfolio (Fama & French, 1993). Then, for each month, we calculated the size factor (SMB) premium as the difference between the average monthly returns of the three portfolios (S)

described above and the average monthly returns of the three portfolios (B) (Fama & French, 1993). In addition to this, each month we calculated the Premium for BE/ME factor (HML), as the difference between the average monthly returns of the two portfolios High (H), and the average monthly returns of the two portfolios Low (L) (Fama & French, 1993). Similarly, for each month, we calculated the market risk factor (RM-RF) Premium by subtracting the return of the market portfolio from the risk-free rate. We found the return on the market portfolio by weighting the return of all stocks in the sample by the market value. However, besides these three premia were based on the three-factor Model of Fama & French (1993), this study calculated the Sustainability Factor Premium as well.

3.3.2. Sustainability factor premium

According to Xiao et al. (2013), this risk factor is based on a zero-investment portfolio, consisting of a position bought in companies with high sustainability and simultaneously sold in low sustainability companies. The definition of firms with high and low sustainability is given by the ISE of the Stock Exchange of São Paulo so that companies belonging to the ISE would be considered as having high sustainability and companies that do not belong would be considered as having low sustainability. The rebalancing was annual and was always held on the first business day of July, based on the classification of the companies belonging to the ISE of the current year. Thus, the stock returns were calculated from July of the year t to June of the year t + 1. From these data, we calculated the monthly return of each of the two portfolios, computed by the stock returns that compose them weighted by the value of each share of the market in relation to the market value of the portfolio.

Finally, we calculated the monthly Corporate Sustainability factor premium as the difference between the average returns of stocks with high sustainability (RI_t) and the average returns of stocks with low sustainability (RO_t). After the determination of the explanatory variables of the study, the next step was the determination of the dependent variables. The data are presented in the next section.

3.4. Determination of the dependent variables

As established by Fama & French (1993), the dependent variables of the regression consisted of the monthly excess returns on portfolios of stocks based on the BE/ME risk and size factors in relation to the risk-free rate. However, this study differs from Fama & French (1993) in terms of the number of portfolios. While Fama & French (1993) used 25 portfolios grouped by the intersection of five grouped portfolios based on the BE/ME index and five portfolios based on the size factor, we employed only nine portfolios, due to the fact that Brazil has less stocks in the Stock Exchange. The nine portfolios were obtained through the intersection of three grouped portfolios based on the BE/ME and three index portfolios grouped based on the size factor. This adaptation was necessary due to the smaller number of listed companies in Brazil than in the United States.

The construction of the three portfolios based on market value was made in June of each year *t*. We ordered all shares based on the market value of June of the sample companies. Then, we divided this ordinance into tertiles, i.e. three portfolios that differed at market value.

We also tested the construction of the three portfolios based on the BE/ME index using data from June of each year *t* by sorting the sample according to the BE/ME index. It is noteworthy that this index was calculated using the book and market values of equity related to the previous year's (*t-1*) formation of the portfolios. After ordering, we divided the sample into tertiles, in order to form three portfolios that differed by the value of the BE/ME index.

Thus, in June of each year, after the aforementioned ordinances, nine portfolios were built or rebalanced. The nine portfolios were called: *SL* (Small and Low), SM (Small and Medium), SH (Small and High: Shares with low market value and high BE/ME index, ML (Medium and Low), MM (Medium and Medium), MH (Medium and High), BL (Big and Low), BM (Big and Medium) and, BH (Big and High). We weighted the monthly return of all nine portfolios by the market value of the shares that compose them. After the construction of the nine portfolios, it was possible to calculate the excess returns.

We calculated the excess monthly return of the nine portfolios by subtracting the monthly return of each portfolio from the CDI (Interbank Deposit Certificate from Brazil) monthly return. We used the CDI as a proxy for the risk-free rate because it matches the negotiated rate on transactions between banks. After the construction of the dependent variables and the explanatory variables, the last part of this section explains our method of data analysis.

3.5. Data analysis

In this paper, we used regression with time series, using the model ordinary least squares (OLS) as the statistical method, as in the study of Fama & French (1993). The results are shown below.

4. Results

In this section, we first present our analysis of the explanatory variables. Next, we provide a summary of the models from the perspective of the coefficient of determination and significance of the coefficients of the variables is presented.

4.1. Analysis of the explanatory variables

As mentioned in item 3, the explanatory variables in this study consist of market risk factor (*RM – RF*) Premium, the size factor (*SMB*) Premium, the BE/ME factor (*HML*) Premium, and the Corporate Sustainability factor (*SUS*) Premium. In Table 3, the monthly mean values, the standard deviations and correlation matrix among the premiums are presented.

In Table 3, we find that the monthly market risk (*RF – RM*) premium is 0.08%. Yet, the SMB premium is 0.19% per month, which is a value close to the premium of 0.27% found by Fama & French (1993). In a study about the impact of size and B/M on returns among Brazilian companies in the period from July 1999 to May 2013, Blank et al. (2014) also find that smaller companies have higher average returns than big companies. The HML Premium is –0.42% per month. Thus, because the HML premium is negative, it is not possible to prove the hypothesis of Fama & French (1993) and Blank et al. (2014) that companies with high BE/ME possess higher average returns than companies with low BE/ME.

In Table 3, we also observe a Premium for the Corporate Sustainability factor of 0.47%, which would indicate that in the period analyzed, sustainable enterprises achieve a return higher than the other companies did. The correlation matrix indicates that, in a confidence interval of 95%, there is no correlation between the factors because none of the factors obtains a correlation above 0.2084 or below –0.2084. The results of the analysis of the models are presented below.

4.2. Analysis of the models

According to Table 4 it is possible to analyze the coefficients of the factors: Market Risk Premium (b), SML (s), HML (h), and Corporate Sustainability (c), in each of the six models studied. The table presents the slopes and the Student's t-test. The significance level is 0.05.

Based on Table 4, Model 1 obtains significant and non-zero coefficients for all portfolios, these results confirm the studies of Fama & French (1993). Yet, Model 2 has the second highest number of portfolios (four altogether) with significant coefficients.

The model 3 has only one of the nine portfolios with altogether significant coefficients. We can observe that in seven portfolios the coefficients of SMB factor are significant. Furthermore, there is evidence that the intensity of these slopes is related to the size of the portfolios, as in Fama & French (1993), for the reason that in every book-to-market tertile, the slopes on SMB decrease monotonically from smaller- to bigger-size tertiles. When analyzing the results of the HML coefficient, we can identify that just in three portfolios the slope coefficients are statistically significant. Our results cannot confirm the findings of the cross-sectional results of Blank et al. (2014) since the authors did not find a significant impact of the size on cross-sectional returns, but they find a positive and significant impact of the B/M on returns.

The other model with more portfolios in which all coefficients are significant is Model 4, with three portfolios in which all coefficients are significant. Regarding the SUS factor, we can note that in seven of the nine portfolios the slope coefficients are negative. We can imply that, in this model, the sustainability may have a negative influence on stock returns. Furthermore, the SUS factor is significant in four of the nine portfolios.

The model 5 has two of the nine portfolios with altogether significant coefficients. Differently than in Model 4, the SUS factor coefficients are shown

Table 3. Analysis of explanatory variables.

Premium	Monthly Mean returns	Standard Deviation	Correlation Matrix			
			SUS	(RM-RF)	SMB	HML
SUS	0.47	4.72	1.00	0.07	–0.11	–0.09
RM-RF	0.08	6.01		1.00	–0.20	–0.07
SMB	0.19	4.24			1.00	0.10
HML	–0.42	4.33				1

RM-RF is the value-weighted return on the market portfolio of all sample stocks minus the CDI rate. At the end of each June, stocks are assigned to two Size groups using the median market cap as the breakpoint. Stocks are then also assigned to three book-to-market equity (B/M) groups, using the 30th and 70th percentiles. The HML (high minus low) factor is calculated as the value-weighted (VW) portfolios with high (B/M) minus portfolios with low (B/M). The SMB (small minus big) factor is calculated as the VW portfolios with small stocks minus the portfolios with big stocks. Finally, the SUS factor is based on a zero-investment portfolio, which is long in stocks with high sustainability and short in stocks with low sustainability.

Table 4. Comparison of the models.

Model	Coef.	SL	SM	SH	ML	MM	MH	BL	BM	BH
Model 1	b	1.00	0.96	0.85	0.65	0.81	0.73	0.93	1.11	0.77
	b (t)	(8.88)*	(8.93)*	(8.41)*	(8.22)*	(11.06)*	(8.69)*	(14.47)*	(22.85)*	(8.72)*
Model 2	b	1.00	0.96	0.85	0.65	0.81	0.73	0.93	1.11	0.77
	b (t)	(9)*	(9.1)*	(8.7)*	(8.38)*	(11.64)*	(8.64)*	(14.8)*	(28.34)*	(9.24)*
	c	1.00	0.96	0.85	0.65	0.81	0.73	0.93	1.11	0.77
	c (t)	(–1.39)	(–1.59)	(–2.12)*	(–1.55)	(–2.77)*	(–0.23)	(–1.97)	(7.3)*	(–2.85)*
Model 3	b	1.00	0.96	0.85	0.65	0.81	0.73	0.93	1.11	0.77
	b (t)	(12.09)*	(15.55)*	(16.22)*	(13.97)*	(13.44)*	(12.93)*	(22.31)*	(23)*	(11.52)*
	s	1.00	0.96	0.85	0.65	0.81	0.73	0.93	1.11	0.77
	s (t)	(6.94)*	(10.8)*	(12.22)*	(10.34)*	(5.42)*	(6.01)*	(1.85)	(–3.41)*	(–0.85)
	h	1.00	0.96	0.85	0.65	0.81	0.73	0.93	1.11	0.77
	h (t)	(–1.83)	(0.15)	(1.14)	(–1.43)	(–1.11)	(5.26)*	(–11.82)*	(1.14)	(7.97)*
Model 4	b	1.00	0.96	0.85	0.65	0.81	0.73	0.93	1.11	0.77
	b (t)	(12.09)*	(15.79)*	(16.66)*	(14.09)*	(14.08)*	(10.99)*	(14.5)*	(28.85)*	(8.94)*
	s	1.00	0.96	0.85	0.65	0.81	0.73	0.93	1.11	0.77
	s (t)	(6.59)*	(10.79)*	(12.39)*	(10.07)*	(5.24)*	(5.65)*	(0.33)	(–3.51)*	(–0.39)
	c	1.00	0.96	0.85	0.65	0.81	0.73	0.93	1.11	0.77
	c (t)	(–1.07)	(–1.4)	(–2.34)*	(–1.32)	(–2.66)*	(0.27)	(–1.92)	(7.4)*	(–2.86)*
Model 5	b	1.00	0.96	0.85	0.65	0.81	0.73	0.93	1.11	0.77
	b (t)	(8.92)*	(9.08)*	(8.78)*	(8.29)*	(11.54)*	(10)*	(24.67)*	(28.68)*	(12.68)*
	h	1.00	0.96	0.85	0.65	0.81	0.73	0.93	1.11	0.77
	h (t)	(–1.12)	(0.59)	(1.19)	(–0.49)	(–0.81)	(4.86)*	(–13.11)*	(1.66)	(8.03)*
	c	1.00	0.96	0.85	0.65	0.81	0.73	0.93	1.11	0.77
	c (t)	(–1.48)	(–1.52)	(–2.02)*	(–1.58)	(–2.83)*	(0.16)	(–4.51)*	(7.49)*	(–3.06)*
Model 6	b	1.00	0.96	0.85	0.65	0.81	0.73	0.93	1.11	0.77
	b (t)	(12.17)*	(15.68)*	(16.69)*	(14.11)*	(14.07)*	(12.85)*	(24.77)*	(29.47)*	(12.24)*
	s	1.00	0.96	0.85	0.65	0.81	0.73	0.93	1.11	0.77
	s (t)	(6.83)*	(10.69)*	(12.27)*	(10.24)*	(5.36)*	(6.04)*	(1.65)	(–3.73)*	(–1.16)
	h	1.00	0.96	0.85	0.65	0.81	0.73	0.93	1.11	0.77
	h (t)	(–1.93)	(0.04)	(0.99)	(–1.55)	(–1.37)	(5.28)*	(–13.34)*	(2.07)*	(8.11)*
	c	1.00	0.96	0.85	0.65	0.81	0.73	0.93	1.11	0.77
	c (t)	(–1.24)	(–1.38)	(–2.26)*	(–1.44)	(–2.77)*	(0.71)	(–4.4)*	(7.68)*	(–3.16)*

At the end of each June, stocks are assigned to three Size groups using the 33th and 67th percentiles. Stocks are then also assigned to three book-to-market equity (B/M) groups, using the 33th and 67th percentiles. Thus, after the aforementioned ordinances, nine portfolios were built or rebalanced. The nine portfolios were called: SL (Small and Low), SM (Small and Medium), SH (Small and High): Shares with low market value and high BE/ME index, ML (Medium and Low), MM (Medium and Medium), MH (Medium and High), BL (Big and Low), BM (Big and Medium) and BH (Big and High). We weighted the monthly return of all nine portfolios by the market value of the shares that compose them. After the construction of the nine portfolios, it was possible to calculate the excess returns. * indicate two-tailed significance at the 5% level.

to be significant in five portfolios. Furthermore, we can identify that the values of the t-Student have greater significance coefficients in seven of the nine portfolios, in relation to model 4. These values could correspond to evidence that the SUS factor is more related to the HML factor than to the SMB factor. Furthermore, again the values of the coefficients SUS showed negative values in seven of the nine portfolios. In Model 6, only one of the nine portfolios presents all significant coefficients.

4.3. Summary of the models

In Table 5, we observe that Model 6 has the highest coefficients of determination, this occurs naturally because it is the only model that includes all four factors. However, when analyzing the

Table 5. Comparison of determination coefficients.

Size Tertiles	Book-to-market equity (BE/ME) tertiles					
	Low	2	High	Low	2	High
	R^2 Model 1			R^2 Model1 2		
Small	0.48	0.48	0.45	0.49	0.49	0.48
2	0.44	0.58	0.46	0.45	0.62	0.46
Big	0.71	0.86	0.47	0.72	0.91	0.51
	R^2 Model 3			R^2 Model 4		
Small	0.67	0.78	0.80	0.66	0.79	0.81
2	0.75	0.69	0.71	0.75	0.71	0.61
Big	0.89	0.88	0.69	0.72	0.92	0.51
	R^2 Model 5			R^2 Model 6		
Small	0.49	0.50	0.48	0.67	0.79	0.82
2	0.45	0.62	0.58	0.76	0.72	0.71
Big	0.91	0.91	0.72	0.91	0.93	0.73

models 3, 4 and 5 it is possible to make a more fair comparison since all models have only three factors. Among these factors, Model 3 (three-factor model of Fama and French) is the model that reaches the highest coefficient of determination (0.76), followed by Model 4 (the three-factor model with SMB and SUS factors), which has a coefficient of determination of 0.72 (very close to the value achieved by Model 3). Thus, there is evidence that the replacement of the HML factor by the SUS factor resulted in a small loss of only 0.04 points in the coefficient of determination. Yet, Model 5 obtains an average R^2 of 0.63 and, therefore, is the model with three factors that has the lowest average coefficient of determination.

Comparing the coefficients of determination of the Model 1 and Model 2, we can verify the increase of the explanatory power in CAPM by including the Corporate Sustainability factor. The coefficient of determination of Model 2 is 0.57, whereas the average R^2 of Model 1 is 0.55. The highest increase in the coefficient of determination of Model 1 compared to Model 2 happens in the BM portfolio, where the coefficient raises from 0.86 to 0.91.

5. Discussion

Comparing the results of this study with those of Xiao et al. (2013), one of the most surprising results was relative to the Corporate Sustainability factor. While the average premium of the Corporate Sustainability factor of our study obtained a value of 0.47%, the average premium for Corporate Sustainability of Xiao et al. (2013), for a global sample, was –0.3%. In other words, while Brazilian companies with sustainable practices showed a return that is greater than those of other companies, in global sample results were the opposite. In addition, our results cannot confirm the findings of Cunha & Samanez (2013, 2014) that sustainable investments did not achieve satisfactory financial performance in the period from December 2005 to December 2010, since the authors found that ISE was outperformed by most of the other benchmark index in the Brazilian market in the studied period. Nevertheless, Cavalcante et al. (2009) find that portfolios formed by sustainable companies have better performance in the period before the creation of ISE, indicating that the precification could have happened before the official divulgation of the index.

Regarding the Premium for Corporate Sustainability factor, we found in this study that in at least four of the nine analyzed portfolios the factor was significant, whereas, in the study of Xiao et al. (2013), the premium for Corporate Sustainability factor was insignificant. Furthermore, Model 2, as well as Models 4 and 5, showed a higher number of significant portfolios than the three-factor model of Fama and French. Furthermore, the results of Model 6 showed that the inclusion of the Corporate Sustainability factor in the three-factor model of Fama and French has not decreased the number of significant portfolios and simultaneously increased the R^2. Thus, we infer that the Corporate Sustainability factor may be an anomaly in the Brazilian market and consequently may help scholars and investors in the asset pricing process in the Brazilian market.

Again commenting on the result of applying the three-factor model of Fama and French (Model 3) in the Brazilian market, in our study only one of the nine portfolios registers all significant coefficients with a confidence interval of 95%. Moreover, Fama & French (1993) had all three significant factors in 20 of the 25 portfolios in a sample for the US market. In terms of the coefficient of determination, we obtain values between 0.67 and 0.89, while Fama & French (1993) obtained values between 0.83 and 0.97.

In the present study, the standard deviations of the monthly premiums of the nine portfolios range between 5.92% and 8.71%, while Fama & French (1993) had standard deviations of 4.27% and 7.76% in the US market. Thereby, when analyzing the standard deviation as risk proxy, it can be said that Brazil had a higher risk than the US.

Our result for the arithmetic average of the monthly premiums for market risk factor (RM-RF) was 0.08%, while Xiao et al. (2013) obtained a premium of 1.8% for a global sample, and Fama & French (1993) found 0.43% in the US market. These data indicate that the return of the market portfolio was very close to the return achieved by the risk-free rate, and investors should consider whether a risk premium of 0.08% would be enough to invest in the stock market rather than investing in risk-free securities.

6. Conclusion

It is important to highlight that the purpose of this study is to analyze the impact of including the Corporate Sustainability factor in the three-factor model of Fama and French in order to explain the return of listed companies in the BM&FBovespa between the period of 2006 and 2013. The main contribution of this study is to further understanding of the impact of corporate sustainability indicators on the stock market and to help improve asset pricing models in the Brazilian market.

We state in this paper that even though the present study finds statistical evidence that corporate sustainability influences the performance of the shares,

a change in the period of the study or the methodology can completely alter the results. Furthermore, it is not possible to assess whether investors actually led the composition of the ISE into account to make decisions about the companies in which they should invest.

We stress that this field of knowledge is quite extensive and there are still many knowledge gaps. Among the suggestions for further studies, we recommended that research cover a longer time span and that data analysis should be performed using a regression with panel data.

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