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Analysis of the Relationship between Accounting Information and Systematic Risk in the Brazilian Market

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ABSTRACT

According to the existing literature, accounting information represents an important predictor of a company's future cash flow and serves to assess the risk of stock investments. Because such information reflects the economic and financial reality of a company during a given period, this information relates to the systematic risk of an investment, which justifies the use of the information for decisions related to the composition of a stock portfolio. Within this context, the present study seeks to present empirical evidence on the relationship between accounting information and systematic risk in the Brazilian market. More specifically, the objective is to analyze the relationship between the accounting betas and the market betas of companies in Brazil. For this analysis, 97 companies from 15 economic sectors were selected from the Securities, Commodities, and Futures Exchange of São Paulo (Bolsa de Valores, Mercadorias e Futuros de São Paulo – BM&FBOVESPA) from the first quarter of 1995 to the third quarter of 2009. A total of 468 accounting variables were used. To operationalize the relationship between the variables, a regression model with panel data was used. One the one hand, the results show that some accounting betas may explain the market beta and do so in an anticipated manner and that these accounting betas are able to improve the prediction of the market beta when used alongside the historical market betas. On the other hand, the majority of accounting beta versions displayed a rather insignificant or even nonexistent relationship.

Keywords: Accounting information. Systematic risk. Beta. CAPM.

1 INITIAL CONSIDERATIONS

One of the crucial points in the evaluation of assets is understanding each asset's level of risk. In the evaluation of investments, for example, risk is an essential component in the discount rate used to reflect the present value of future cash flows. In evaluating companies, the discount rate reflects the risk of capital investment (Nekrasov & Shroff, 2009).

In general, risk is associated with the possibility that a certain unfavorable event will occur. However, when risk refers to investments, it may be associated with the probability of earning less than the expected return (Nakamura & Matias Filho, 2006). As a result, investors require a rate to participate in trading, the rate of return, and the greater the associated risk, the greater the required rate of return. The logic is that these variables have a positive relationship or that investors require a premium to finance projects for which the expected return is more volatile.

One of the most respected measurements of risk is the beta coefficient, β_M, proposed by Sharpe (1964) and Lintner (1965) as a component of the Capital Asset Pricing Model (CAPM). In this model, which is based on Markowitz's portfolio theory (1952), the (β_M) is a measure of relative risk. According to Brealey and Myers (2003), the (β_M) characterizes the risk of an asset as "a measure of the contribution of an individual asset to the risk of an already diversified portfolio" or "its sensitivity to market movements." Therefore, the β_M coefficient captures the systematic risk to which the assets are exposed. While the risk portion is idiosyncratic, it may be diversified in appropriately constructed investment portfolios.

One of the theoretical assumptions for this concept is the efficient market hypothesis (EMH), as developed and presented in 1970 by the University of Chicago's Eugene Fama in the Journal of Finance. This hypothesis theorized that prices reflect, in a fair, unbiased, and rapid manner or in an extremely short amount of time, the content of the available information such that the entire market will be readily priced with the relevant informational content totally absorbed in the prices.

Within this scenario, accounting information plays a fundamental role because the disclosure of financial statements possesses informational content and has an impact on asset prices (Ball & Brown, 1968; Beaver, 1968). It can also be noted that according to the Financial Accounting Standard Board (FASB) in its Statement of Financial Accounting Concepts (SFAC1, 1978), the objective of accounting consists precisely of "[…] providing the users of financial statements with information that will help them make decisions." (Iudícibus, 2000, p. 20).

Within this context, the concept of the Information Approach emerges, which considers accounting a means of making relevant information available to economic agents (Beaver, 1998; Lopes, 2002). The ability to provide access to risk parameters is among the main purposes of accounting statements in decision making, thereby allowing the current risk level of a portfolio to be revised or maintained (Ilha et al., 2009). Therefore, accounting is one of the sources of information for investors to determine share price and its β_M.

Consequently, the information divulged by companies in their accounting statements tends to affect their asset prices. All new relevant information will, according to Beaver et al. (1970), exert an immediate effect over the price of a security and will alter expectations with regard to its (β_M). Watts and Zimmerman (1986, p. 118) corroborated this claim by advancing the following hypothesis:

> If accounting earnings are approximators of cash flows, a β_C (given by the covariance between the earnings of the entity and the market earnings, divided by the variance of the market earnings) could also be an approximator of the entity's beta. And it is likely that the accounting earnings may be used to obtain estimations of the β_M.

Similarly, if a company's value is equal to the present value of future free cash flows, reduced by the rate of return required by its financiers, then the required interest rates will change (implying modifications in current prices) if accounting information changes expectations about future cash flows (Fama, 1970; Lima & Terra, 2004). Therefore, as accounting earnings may be predictors of future cash flows, namely an accounting beta, β_C, they may also be predictors for the company's β_M.

Based on these arguments, the present study presents empirical evidence on the relationship between accounting information and the systematic risk of companies' stocks, therefore seeking to answer the following research question:

What is the relationship between the accounting betas, β_C, and the market betas, β_M, in the Brazilian market?

The present research is justified because the empirical results can reveal whether accounting information is important for the market while demonstrating whether the Brazilian market can be efficient, in its semi-strong form, for the available set of accounting information.

Similarly, the empirical evidence for the existence of a relationship between the variables under study, (β_C) and (β_M), may be of broad interest. This evidence serves not only the investors in the capital market but also company managers, governments, and regulatory agencies because,in addition to updating prior research, the empirical evidence demonstrates a model for estimating the β_M from accounting data, which may be applicable to several situations in which there are no available market data (e.g., privately held companies). In addition, understanding this relationship is not only important for cases in which the (β_M) is not available but also as a complement and verifier of the risk calculated by this coefficient.

Similarly, the study collaborates with those studies that link accounting information to companies' risk, stimula-

ting research on this relationship. It may even contribute to accounting regulatory agencies by aiding in the preparation of accounting rules.

The practical contribution of the results is that they may be used in various manners. For example, if the results were to indicate that liquidity has a statistically significant relationship with the market beta, then the investor would be able to monitor this index more closely and use it to make decisions. In this case, companies that have higher indicators of liquidity would tend to have less risk. Additionally, any improvement of the liquidity indicators could predict a reduction of the risk beta in the market and an increase in the price of the security.

Similarly, if a manager knows that there is a close relationship between the liquidity indicator and the market beta, this manager should make financing decisions so as not to affect his index negatively, as such an impact could elevate the decision's risk.

The present study sought to contribute to the existing literature by reviewing the main studies on this relationship and replicating them using the same variables for the national market. Therefore, this study included a large range of accounting variables (many of these have already been used in previous studies) that were applied to review previous studies and their results.

In this regard, conducting the present study was justified insofar as it sought to verify the relationship between the β_C and the β_M of the company, a relationship that has no consensus in the academic arena.

The rest of this study is structured as follows. Section 2 covers the theoretical framework of the study. Section 3 describes the methodological aspects. Section 4 presents the results of the research, and section 5 describes the study's final considerations.

2 THEORETICAL FRAMEWORK: SYSTEMATIC RISK AND ACCOUNTING INFORMATION

Based on the seminal work of Markowitz (1952) investigating the results of the portfolio theory and the market model[1], the Capital Asset Pricing Model (CAPM) was derived. CAPM calculates that the return on a security, negotiated in an efficient market and in diversified portfolios, is a function of the relationship between risk and the required rates of return, according to the following formula (Iudícibus & Lopes, 2004):

$$E(R_{i,t}) = R_f + \beta_i \ [E(R_{mt}) - R_f],$$

where $E(R_{i,t})$ is the expected return from security i, adjusted for its risk contribution for a diversified portfolio; R_f is the risk free rate; $E(R_{mt})$ is the expected return from the market portfolio; β_i is the measurement of the contribution of risk from security i for the market portfolio, measured by $\beta_i = \frac{cov((R_{i,t}),(R_{mt}))}{\sigma^2(R_{mt})}$, which corresponds to the measurement of the degree to which a particular security tends to move as a whole or not with the market (Assaf Neto, 2005; Bergmann et al., 2008; Damodaran, 2005; Iudícibus & Lopes, 2004; Nakamura et al., 2007).

In the CAPM model, the return on a security is formed by two parts: the risk-free asset rate and the premium due to risk. Assuming that the investors are rational and search for the best investment options, they diversify their investments so that the individual risks are avoided (risks inherent in the individual companies/assets), thereby requiring an additional return due to the systematic risk alone. Therefore, systematic risk should be measured to aid in the search for this premium based on additional risk (Nakamura & Matias Filho, 2006).

If the total risk is the sum of the systematic risk (undiversifiable) and the non-systematic risk (diversifiable), and the market participants efficiently diversify their portfolios or, rather, eliminate their diversifiable risk, then the only component that remains for the analysis of total risk is systematic risk. If the market is in equilibrium for the risk-return ratio, then the dynamic of return is one-dimensional; thus, the systematic risk of an asset will be sufficient to quantify its required return (Perlin & Ceretta, 2004).

The basic point of the model is that the assets behave according to market fluctuations (the ups and downs of the market). By differentiating assets as a function of their adherence to market behavior, it is possible to quantify the required return as a function of its systematic risk (undiversifiable).

For this reason, what is foremost in the mind of a market investor is an asset's beta (β). This property is measured by the covariance of an asset with the market portfolio divided by the variance of the portfolio representative of the market, popularly known as the beta index, which represents the systematic risk of an investment. In other words, the beta, which is the undiversifiable risk, is directly related to the return required by an investor, which is nothing more than the net worth of a company.

In this context, an asset with a greater beta value compared to stocks with small betas should have a greater positive return or, in the case of a down market, an extreme negative return (Damodaran, 2005). This return is expected because the rational investor will require a greater return when faced with increased systematic risk for an investment.

[1] Watts and Zimmerman (1986, p. 33) consider the market model to be a statistical description of the relationship between the rate of return of an asset i($R_{i,t}$) and the rate of return of a portfolio representative of the market ($R_{m,t}$) based on the assumption that the joint distribution of these two returns is normal: bivariate (Fama, 1991, p. 63-68). The market model can be expressed by means of a linear function between two returns: $R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t}$, em que: $\alpha_i = E(R_{i,t}) - \beta E(R_{m,t})$; $\beta_i = \frac{cov(R_i R_{m,t})}{\sigma^2(R_{m,t})}$; $\varepsilon_{i,t}$ is the error term of the regression with $E(\varepsilon_{i,t} / R_{m,t}) = E(\varepsilon_{i,t}) = 0$ with variance $\sigma^2(\varepsilon^2)$. In this model, the variations in the returns of the individual securities result from the diversifiable risk α_i added to the relationship of the company with general market factors $\beta_i R_{m,t}$ and an error term. Insofar as the portfolio is diversified and other assets are included with their diversifiable risks, the diversifiable risk $\alpha_i + \varepsilon_{i,t}$ tends to disappear, and only the systematic risk , $\beta_i R_{m,t}$, remaining (Iudícibus& Lopes, 2004).

2.1 Relationship between Accounting Information and Systematic Risk.

The analysis of the relationship between accounting information and systematic risk assumes the existence of stock market efficiency and is based on the Efficient Market Hypothesis (EMH). This hypothesis predicts that a market is efficient if it manages to price stocks based on available information instantly or in a short amount of time (Weston & Brigham, 2000).

The EMH, in its semi-strong form, defines variations in stock prices as incorporating all of the expectations for the companies. According to this reasoning, publicly available information, including accounting information, would be reflected in stock prices.

As the market operates based on future expectations by looking at expected cash flows, the implication is that the market incorporates expected accounting information into the price of the stocks in advance. These prices would change only if surprises arose at the moment the information is divulged because unexpected new information would enter the market (Cunha & Lustosa, 2007). The variations in earnings will only have informational content insofar as they signal the occurrence of unexpected cash flows.

The surprises caused by accounting information, such as the case of unexpected earnings, is the vector that directs an abnormal return on stock prices. The EMH formed the basis for researchers to be able to verify how the market is related to accounting information and how efficient the market is based on this information.

The Information Approach, in which accounting is considered to be a means of transmitting information, is included in this context. In the Information Approach, accounting variables, such as net worth and income, have informational capacity. This informational capacity corresponds to the potential to transmit information that would influence user expectations (Lima et al., 2008; Sarlo Neto et al., 2004).

Hendriksen and Van Breda (1992, p.184) explain the link between the EMH and CAPM in the following way:

> The EMH and CAPM mean that the new relevant information will exert an immediate effect over a security's price, either by changing expectations with regard to the average return of a security or by changing expectations with regard to its beta. If the expectations of all investors were homogeneous, a variation in the price of a security relative to the prices of all the securities in the market would be an indication that the new information affects expectations. One of the important implications of the CAPM resides in providing a way of testing the effect of divulging new information.

The link between accounting data and the CAPM is direct, as accounting provides past data on various cash flows and information that allows for a projection of future data. As stated above, earnings are one of the main accounting figures used as substitutes for cash flow. Thus, past earning may be large sources of information on future earnings and, indirectly, on future cash flows (Iudícibus & Lopes, 2004).

Thus, the CAPM and accounting are essential components for the formation of the value of a company, and they operate jointly in the formula to evaluate assets. According to Iudícibus and Lopes (2004, pp. 91-92),

> Another relevant aspect regarding the CAPM and accounting information are the possible indications for risk that this information may possess. If the alterations in accounting information are related to alterations in risk, the information will be relevant and will change the rate of return required by the company. If the change has no relationship to risk, the information may not be irrelevant and may confirm market expectations.

Therefore, the CAPM and EMH offer important accounting tools to empirically test the impact of accounting information on security prices. The information derived from accounting may also contribute to the calculation of the CAPM whenever the information influences a company's risk outlook. In this regard, such theories serve as the theoretical foundation for the present study.

2.1.1 Previous Studies on the Relationship between Accounting Information and Systematic Risk.

Several of the studies that have sought to identify the relationship between accounting information and systematic risk have used proxies. These studies mostly use the β_M as a proxy for systematic risk. Meanwhile, accounting variables, or the accounting beta, β_C, are often used as proxies for accounting information.

The pioneers were Ball and Brown, who, in a 1969 article titled "Portfolio Theory and Accounting," examined the ability of accounting figures to reflect information on a company's risk. More precisely, these researchers "empirically tested the intensity with which the accounting figures are sensitive to the company's joint risk" (Ball & Brown, 1969, p. 314). According to the authors, a problem found in the design of this type of test is the need to estimate expected returns given that it is only possible to measure historical returns. One possibility is to assume that (a) the beta is stable over time, and (b) the relationship is identical both for the ex-ante returns and for the ex-post returns (Ball & Brown, 1969, p. 315). The test consisted of an analysis of the association between the measurements of the joint movement of the ex-post return rates of stocks and accounting earnings.

Regressions were used for 261 companies between 1946 and 1966, and the relationship was observed for net income, operating income, and earnings per share with the company's risk β_M. The results show that the joint movement of earnings with regard to the market profit moderately predicts the degree of association between the returns of the company's shares and the market return, therefore demonstrating that they are still effective predictors of cyclical risk. The results also indicate that the variations (first differences) in the profits are apparently more appropriate specifications than the absolute levels in this estima-

tion model. In general, the relationship between the three types of earnings explains 35% to 40% of the variation in systematic risk.

Subsequently, there were several other studies that are represented in the two tables below. Several of these studies did not find a significant relationship or found that many of the coefficients were not significantly different from zero, as in the studies by Breen and Lerner (1973), Elgers (1980), Gonedes (1973), Lev (1974), and St-Pierre and Bahri (2006).

Other studies indicate the existence of a relationship between the accounting variables and β_C and β_M. This relationship was observed in the studies by Ball and Brown (1969), Beaver et al. (1970), Hamada (1971), Pettit and Westerfield (1972), Rosenberg and Mckibben (1973), Lev and Kunitzky (1974), Beaver and Manegold (1975), Thompson (1976), Bowman (1979), Hill and Stone (1980), Mandelker and Rhee (1984), Ismail and Kim (1989), Karels and Sackley (1993), Ball et al. (1993), Laveren et al. (1997), Dechow (1994), Almisher and Kish (2000), Brimble and Hodgson (2007), Ecker et al. (2009), and Nekrasov and Shroff (2009). The table below shows a brief summary of the results found by a number of these studies.

Table 1 *Previous studies in the international context*

Authors	Result
Ball and Brown (1969)	The three types of profit studied explain 35% to 40% of the variation in systematic risk.
Beaver et al. (1970)	The variability of the profits, the average payout, the accounting beta, and the indebtedness together explain 23% to 44% of the market beta.
Hamada (1971)	The author concluded that there is an influence of the financial leveraging of the firms on systematic risk and shows, via mathematical expression, that it is possible to estimate this effect. The study concludes by proposing the calculation of the company's beta based on the market beta multiplied by the indebtedness and divided by the company's market value.
Pettit and Westerfield (1972)	The authors found a high degree of correlation between the beta of the cash flows and the market betas.
Gonedes (1973)	The author found a statistically significant relationship between the estimations of systematic risk based on market data and the estimations based on accounting data only in situations in which the accounting estimations were adjusted by the market values.
Rosenberg and Mckibben (1973)	The authors built a model with accounting variables and the historic beta, which explained 38% of the market variance.
Breen and Lerner (1973)	The result of the research displayed a relatively low R^2 value (which varied from 6% to 54%) and the majority of the coefficients found were not significantly different from zero.
Lev (1974)	The author's results showed little explanatory power and observed that there are other variables that explain the variation of risk beyond operational leverage.
Lev and Kunitzky (1974)	The results of the applied test demonstrated that there is a statistically significant association between the stability of the series on the company's operational information and the company's risk, or rather, the total risk (R^2 of 47%) or the systematic risk (R^2 of 65%).
Beaver and Manegold (1975)	Approximately 20% of the variance of the market beta is explained by the accounting betas. The accounting profit divided by the market value of each share was what displayed the greatest power of explanation.
Thompson (1976)	The author's model indicated correlation with variations in profits, dividends, and the multiple of earnings with macroeconomic fluctuations in the model's formula. The study found that models that used the covariance (accounting betas) in their formula were empirically better in explaining differences in the systematic risk.
Bowman (1979)	The author concluded that there is a theoretical relationship between the systematic risk, the firm's leverage, and the accounting beta. With regard to the other variables, no relationship was found with the market risk.
Hill and Stone (1980)	The authors asserted that changes in the debt structure and in the operational risk are important determinants of the alteration in the market betas from one period to another.
Elgers (1980)	The author found notably little relationship between the market beta and the accounting figures; however, the author concluded by defending the use of the measurements in a joint or complementary manner.
Mandelker and Rhee (1984)	The authors found positive and statistically significant associations between a company's two forms of leverage and the market betas of the shares and a trade-off between the two degrees of leverage.
Ismail and Kim (1989)	The authors found a significant relationship between net profit, EBIT, EBITDA, and operational risk and the systematic risk calculated by the market beta, with a stronger association for the total portfolio (panel data).
Karels and Sackley (1993)	The authors found an association between 30% and 60%, depending on the adopted market index.
Ball et al. (1993)	The results indicated that accounting earnings may be a proxy for market risk as it is positively associated with changes in risk.
Laveren et al. (1997)	The authors' results indicate that accounting variables may estimate leveraged and non-leveraged market betas.
Dechow (1994)	The authors' results showed that the explanatory power of accounting profit over the measurement intervals is strongly associated with the asset return.
Almisher and Kish (2000)	The study concentrated on examining the relationship between the market variables and the accounting variables in a company's initial public offering (IPO). The study's results confirmed that the accounting betas are associated with market betas in the first quarters after the IPO.
St-Pierre and Bahri (2006)	The result shows that the accounting beta (of the return on equity) does not constitute an overall measure of risk, perhaps explaining only the financial risk and not the operational, technological, and legal risks. No relationship was exhibited with the market beta.
Brimble and Hodgson (2007)	The results show a strong association between operational variables and growth variables and the accounting variables, which appears to be constant over time.
Ecker et al. (2009)	The study found that the two measurements have similar explanatory power for the real returns of the assets, yet the accounting variables displayed greater explanatory power for the cost of capital inherent to companies in environments with low amounts of information.
Nekrasov and Shroff (2009)	The result showed that the proposed model with accounting betas captured trends of a reduction and growth in share prices.

The literature review for the execution of this study also found several studies in the national context. The table below shows a brief summary of the results found by several of these studies and demonstrates that there is still no consensus in the academic literature on the relationship between accounting information and systematic risk, which justifies the present study.

Table 2 *Previous studies in the Brazilian context*

Authors	Results Found
Mendonça Neto and Bruni (2004)	The authors analyzed 54 companies that participate in Bovespa with quarterly information from 03/31/1995 to 12/31/2003. The results found show that the association, the market, and the accounting variables are not significant and do not allow for the conclusion that the studied variables explain the return on shares.
Oda (2004)	The author analyzed 93 companies that had shares traded on BM&FBOVESPA, during the period from 1995 to 2003, and the results indicated that the degree of financial leverage and the capital structure displayed positive and statistically significant correlations with the market betas, while the growth of the asset and the payment rate of dividends showed negative associations, which were also significant. Strong evidence was found that the accounting indicators may be used to improve the prediction of market betas, especially when used alongside historical betas.
Gusmão and Cherobim (2001)	The authors studied 37 companies on Bovespa that emitted an ADR between December 31, 1994 and December 31, 2007. The results show that the correlation is not significant and do not allow for the conclusion that the accounting beta is valid as a substitution for the market beta and as a measurement of the systematic risk.
Santos and Silva (2009)	The study was performed in just three banks (Banco do Brasil, Bradesco, and Banco do Nordeste do Brasil) during the period from 1999 to 2008. It was found, with regard to the studied variables, that there was no correlation, overall, with what the theory predicts.
Minardi et al. (2007)	The results demonstrated that the more that is exported, the lower the market beta. In addition, the greater the financial leverage, the size of the asset, and the variability of the current liquidity, then the greater the CAPM Beta will be. These studies, despite not making a direct association between the variation of the results and systematic risk, demonstrated that the latter is related to the characteristics of the company as expressed in its accounting information.
Fernandez (2005)	The sample consisted of shares from the 50 most liquid publicly traded companies on the BM&FBOVESPA (BOVESPA). The statistical evidence indicated low indices of correlation, but the inference test showed that there was a statistically significant relationship between the accounting beta and the systematic risk.
Ilha et al. (2009)	The study analyzed a sample of 83 companies traded on the BOVESPA between the periods from 1996 and 2007, with the results indicating that there is a significant correlation between the betas, depending on the specification of the accounting variables. The accounting beta obtained from the net profit was that which displayed the most marked association with the market beta, reaching a coefficient of 42%.

3 METHODOLOGICAL ASPECTS

The objective of this research is to identify whether the β_C of a company is related to systematic risk, calculated via the β_M, for the shares traded on the BM&FBOVESPA. To accomplish this objective, the following hypothesis were tested, shown in their null form, and tested at a confidence level of α = 95%:

$H_{0,1}$: There is an association between the β_C of a company and the β_M of its shares.

$H_{0,2}$: The β_C of a company may explain the β_M of its shares.

$H_{0,3}$: The β_C of a company may predict the β_M of its shares.

$H_{0,4}$: The β_C of a company may improve the prediction of the β_M of its shares.

Next, the variables used in the research are described along with the statistical model and the study sample.

3.1 Variables Used in the Research.

As the dependent variable, the systematic risk of the share of a company was used and calculated by means of its β_M. Based on previous studies, the present research opted to not limit itself to only one proxy for the β_M but to present and work with six possible types of proxy for β_M. The purpose was to recover and verify previous research that used different proxies and therefore reached incomparable results.

Before introducing these proxies and their calculations, it is important to highlight the formula for the calculation of the return on a share:

$$R_{it_i} = LN \frac{(P_{it})}{(P_{it-1})},$$

where the return on a security in period t is calculated by the natural logarithm, and its current price is calculated by the price from a previous period. The β_M values used in this study were as follows: β_M: calculated by means of a regression between the returns of the company and the average market portfolio returns. To obtain the β_M of the company's shares, the following equation was used:

$$R_{it} = a + \beta_i (R_{mt}) + e,$$

where (βi), a linear regression was performed between the series of the rates of return of the company's share R_{it} as the dependent variable and the series of the rates of return from the market index (iR_{mt}) as an independent variable, R_{mt} (Bildersee, 1975; Hill & Stone, 1980; Ismail & Kim, 1989; Mandelker & Rhee, 1984; Thompson, 1976).

To accomplish the research objective, fourteen accounting variables were selected as possible explanatory variables of the risk determined by the market. All of these variables are derived from the theory, and several of them have already been tested in previous research, as per the following table:

Table 3 *Independent variables of the research*

Independent Variables	Justification
1. Net Income (NI)	In the literature review, it is the most commonly found variable that explains market risk, as in the initial studies by Ball and Brown (1969), Beaver et al. (1970), and Gonedes (1973).
2. EBIT	Earnings before interest and taxes (EBIT) represents a measurement of the most operational result without interference from financial expenses and taxes (Pettit & Westerfield, 1972).
3. EBT	Earnings before taxes,also called EBT, was the third variable of profitability, which represents the result after all expenditures, but before income taxes (Rosenberg & Mckibben, 1973).
4. Revenue (REV)	In addition to having a meaning for the market in its nominal form, revenue is a rather common element in several indicators of unemployment and is present in several previous studies on its association with risk β_m: Beaver and Manegold (1975), Lev (1974) and Lev and Kunitzky (1974).
5. Size (S)	Beaver et al. (1970, p. 662) asserted that "there is a large belief that larger companies have less risk than smaller ones" and, as evidence, indicate the Dun's Review by Dun and Bradstreet, the studies by Horrigan (1966), and those by Hickman (1958) (Bowman, 1979; Ilha et al., 2009; Thompson, 1976).
6. Growth (G)	It is believed that companies with high growth may display greater β_m values, as calculated by means of the logarithms of the rates from the total assets, revenues, and profits, as per Beaver et al. (1970).
7. Market to Book (MB)	According to Brimble and Hodgson (2007), the greater the M/B, the greater the expectations of the company's power to generate wealth. Due to the trade-off between risk and return, it is assumed that there is a relationship in which companies with a high market-to-book ratio will have larger β_m values.
8. Debt Burden (DB)	Insofar as the dividends increase, the earnings of the shareholders become more volatile. Therefore, indebtedness may be used as a measurement of the risk created by the company's capital structure.
9. Indebtness (IND)	The second most commonly studied accounting variable with regard to systematic risk is indebtedness (Bildersee, 1975; Elgers, 1980; Hamada, 1971; Hill & Stone, 1980; Mandelker & Rhee, 1984).
10. Liquidity (LIQ)	Beaver et al. (1970, p. 662) argued that liquid assets have a less volatile return than non-current assets.
11. Net Working Capital (NWC)	The greater the net working capital, the greater the amount of the company's own resources and the resources of third parties that are invested in short-term operations over the long term, which means financial slack for operations and contributes to a reduction in the company's risk.
12. Interest Coverage (INTCOV)	The greater this variable is, the greater a company's ability to pay will be in relation to its dividends, which contributes to a reduction in risk.
13. Degree of Operating Leverage (DOL)	Defined as EBIT/Net Earnings (Weston & Brigham, 2000, p. 352). This shows the fixed costs that increase companies' risk.
14. Degree of Financial Leverage (DFL)	The company represents the intensity with which a variation in its operational result (EBIT) affects its net profit (NP), defined as (Weston & Brigham, 2000, p. 678): NP/EBIT.

For each of the fourteen variables shown in the table above, 36 versions were stipulated and calculated as accounting betas, the mean, and the standard deviation. Each one of these was also taken in its nominal form, first difference, percentage variation, and standardized by the total assets, net worth, or market value.

To satisfy the objective of "verifying whether the β_C of a company has a relationship with its systematic risk, calculated via the β_M, for the shares traded on BM&FBOVESPA," the level of association between β_C and β_M was analyzed first. The second step was to select the variables that obtained the greatest β_M association and to analyze whether these variables might explain the β_M by means of the panel data tool.

3.2 Panel Data Models.

Also known as combined data, time series combinations, and cross-section data, longitudinal data, historical event analysis, or cross-cutting analysis, panel data correspond to the joint use of the cross-section and time series methodologies, known as pooling, which have the goal of providing the researcher with greater flexibility to model differences between individual behaviors (Gujarati, 2006). Greene (1997) demonstrates that in general terms, a generic approach for this methodology may be shown by means of a linear regression, as follows:

$$Y_{it} = \alpha + \beta X_{it} + e_{it}$$

where Y_{it} is the dependent variable of the *i-th* individual cross-section at time *t*; α is the individual intercept of each individual cross-section; β is the vector of coefficients of the independent variables; X_{it} is a vector with *k* independent variables for the *i-th* individual cross-section at time *t*; e_{it} is a random error term.

The differentiated intercept for each of the individuals allows the researcher greater flexibility to model the differences in behavior that may exist among the individuals. This individual effect is given in the above equation by the term $\alpha 1$ ($= \alpha + \mu 1$), which is constant over time *t* and specific for each individual. For cases in which α is the same for all companies, the ordinary least squares method provides efficient and consistent estimations to estimate α and β. If the individual effect is different among the companies, the specification of the panel data shows two alternative hypotheses to model the heterogeneous behavior of those who belong to the unit: the fixed effects model and the random effects model (Ferreira, 2006).

3.3 Study Sample.

The sample consisted of 687 stocks, and there was more than one share from the same company among these. The second step was then to select one share per company that had the greatest traded volume on the stock exchange in 2009. Next, the number of companies in the sample was reduced to 384. The next step was to exclude companies from the financial sector and select data from between the period of 1995 and 2009. Companies that did not have financial statements and stock market information since 1995 were excluded. Finally, companies that existed in 1995 but ceased to exist or trade their stocks on the BM&FBOVESPA in 2009 (due to bankruptcy, delisting, or acquisitions by other companies) were excluded. Therefore, the sample had a total of 97 companies from 15 economic sectors.

4 ANALYSIS OF THE RESULTS

First, correlations were established among the 36 versions of each of the fourteen variables with regard to the six possible β_M. It was then observed whether the coefficient of correlation represented a relevant value, thereby accepting or rejecting the first research hypothesis.

The $\beta_M$values were calculated by means of the quarterly returns that occurred between the first quarter of 1995 and the third quarter of 2009. According to the formulas above, six $\beta_M$values were generated for the period for each company. The same approach was employed with the β_C values, also calculated using the company's quarterly data and the means of the companies in the sample between the first quarter of 1995 and the third quarter of 2009, which led to a β_C for the company for each version of the variable. Finally, quarterly data were also considered between the first quarter of 1995 and the third quarter of 2009 to obtain a mean and a standard deviation for the company for each version of the studied variable.

The coefficient of correlation was considered to be relevant when greater than 0.25. Thus, if the coefficient of correlation between the β_C and β_M is above 0.25, an association was considered to exist for the two variables, therefore accepting the first research hypothesis that there is an association between the accounting variables and systematic risk.

Next, all of the variables that displayed coefficients of correlation above 25%, either with a positive sign or with a negative sign, were included in the panel data model. The β_C and β_M were calculated based on four previous quarters, between the first quarter of 1995 and the third quarter of 2009. The results of this first model of panel data with fixed effects, as per the tests by Chow and Hausmann, are shown below.

Table 4 *Relationship between accounting betas and the market beta -1995- 2009*

Dependent Variable: BMT Sample: 1 56 Included observations: 56 Cross-sections included: 97 Total pool (balanced) observations: 5432					
Variable	**Coefficient**	**Prob.**	**Variable**	**Coefficient**	**Prob.**
C	0.723102	0.0000	L	-0.005159	0.0438
CWC	0.001055	0.7066	OLTA	-0.000603	0.8059
CNI	0.007183	0.0179	NWC	0.006661	0.3136
CMTB	0.014688	0.0001	NWCTA	-0.011728	0.1025
INTCOV	-0.001931	0.5527	NWCE	0.000832	0.8159
DB	0.002811	0.3092	EBT	0.002897	0.3047
DBTA	0.001898	0.5979	EBTTA	-0.006060	0.2800
DBE	0.010063	0.0927	LIQ	-0.003519	0.6423
EBITTA	0.006717	0.1200	NI	-0.009069	0.0044
EBITMV	0.016261	0.0067	NITA	-0.002391	0.5200
IND	0.001927	0.8055	NIMV	0.014426	0.1441
INDTA	0.005225	0.2879	RTA	0.013495	0.3889
INDE	-0.020769	0.0025	RE	-0.001128	0.8800
FL	-0.001135	0.6001	REMV	-0.008761	0.5279
Effects Specification Cross-section fixed (dummy variables)					
R-squared	0.083165		Mean dependent var		0.748605
Adjusted R-squared	0.061920		S.D. dependent var		1,47706
S.E. of regression	1.430.596		Akaike info criterion		3,57662
Sum squared resid	10863.38		Schwarz criterion		3,72729
Log likelihood	-9.590.106		F-statistic		3,91451
Durbin-Watson stat	0.863956		Prob (F-statistic)		0.000000

Based on Table 4, it can be noted that the equation from the set of β_C is significant (F value 0.000000) and explains 6% of the β_M (R^2 of 0.0619), which may be considered a low power of explanation. The following variables were considered to be statistically significant: net profit, EBIT/Total Assets, percentage growth of the indicator of earnings per share, percentage growth of the indicator of market to book, third party capital over the net worth, and the degree of interest coverage.

To verify the robustness of the results, an attempt was made to analyze a smaller period of five years, more specifically, the period between the fourth quarter of 2004 and the third quarter of 2009. The results of the analysis confirmed the statistical significance of the model, (F_{value} 0.000000), in which the explanatory power increased to 27% of the market beta (R^2 of 0.2777).

Next, using the stepwise model, only the accounting betas that were significant and tested in a panel were selected. It is worth noting that the normality and the heteroscedasticity of the residuals were tested. The residuals displayed a trend of normality and heteroscedasticity. Thus, the panel was corrected based on White cross-section standard errors and covariance, which transformed the residuals into homoscedastic values. The results of this model are shown in the table below.

Table 5 *Relationship between the accounting betas and the market beta – 2004 – 2009*

Dependent Variable: BMT
Sample: 36 56
Included observations: 21
Cross-sections included: 97
Total pool (balanced) observations: 2037
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.602285	0.040171	1,499309	0.0000
CMTB	0.153876	0.035352	4,352647	0.0000
INDE	-0.024337	0.006241	-3,8997	0.0001
FL	0.008922	0.002520	3,540837	0.0004
OL	-0.007085	0.002136	-3,316422	0.0009
EBTTA	-0.078770	0.014410	-5,466418	0.0000
LIQ	0.145631	0.040404	3,604362	0.0003

R-squared	0.308324	Mean dependent var	0.750799
Adjusted R-squared	0.271845	S.D. dependent var	1,139072
S.E. of regression	0.971993	Akaike info criterion	2,830305
Sum squared resid	182.718,00	Schwarz criterion	3,114439
Log likelihood	-277.966	Hannan-Quinn criter.	2,934536
F-statistic	845.203	Durbin-Watson stat	1,114372
Prob (F-statistic)	0.000000		

It can be noted that the results indicate an increase in the relevance of the accounting information in the last five years compared to the complete fifteen-year period. This finding may imply that with the evolution of the Brazilian capital market that has taken place over the past three decades, accounting information had the greatest relevance to the perception of company risk.

The most important variables were the β_C values for the percentage variation in market to book and the β_C of the financial indicator of liquidity, which displayed coefficients with the greatest magnitude and demonstrated a direct relationship with the β_M. The result for market to book reveals that the greater the variation and the magnitude is between the stock market value and the value recorded in the NW of these stocks, the greater the perception of risk β_M will be. The theory suggests that companies with a large difference between these two values are those with markets that place high expectations of return with regard to the accounting numbers. This fact corroborates the idea that the greater the expected return, the greater the risk.

Curiously, the β_C for liquidity carries the information that greater liquidity is related to greater β_M values. This result appears not to have a theoretical foundation, as it is contrary to what the theory proposes. According to Beaver et al. (1970, p. 662), net assets have a less volatile return than non-current assets.

Meanwhile, the other β_C have rather small coefficients. This phenomenon is observed for the β_C of DFL and the β_C of EBT/Total Assets. Despite small coefficients, the result shows that increases in the DFL explain increases in the β_M. In addition, reductions in profitability may explain an increase in the β_M. The matter still remains that the total β_C for third party capital over net worth and the β_C for the degree of operational leverage exhibit signs that are different than expected. In these cases, the results suggest that the increase in indebtedness would reduce the perception of risk and that the reduction of the DOL would increase the risk.

To test the third research hypothesis, namely, that the accounting betas could anticipate the market betas, the following equation was used:

$$Y_{it} = \alpha + \beta X_{it-4} + C_{it} + U_{it},$$

where Y_{it} is the information on the temporal evolution of the dependent variable for all the individuals of the sample; X_{it-4} is the information on the temporal evolution of the independent variables for all the individuals of the sample on the date of four quarters prior to the period observed for the dependent variable; C_{it} is the fixed effect of time and specific to each individual, or rather, the model will have a

presence of "n" fixed effects (one for each individual in the sample), and U_{it} is the random error of the model.

The results of this model, which also used the stepwise method to select the accounting betas in the fourth quarter of 2004 and the third quarter of 2009, showed that the equation for the set of β_C is statistically significant (F_{value} 0.000000) and explains 14% of the β_M (R^2 of 0.1455).

It is interesting to observe that up to 14% of the β_M for the current period may be explained by the β_C from one year ago. This finding provides evidence that the β_C determined today may influence future β_M values. Among the variables, the β_C for the percentage growth of the market to book indicator remains significant, along with the total β_C of third party capital (Current + Long-term Liabilities), the β_C of the earnings per share, and the β_C of the Debt burden. However, observing the coefficients for each β_C, it is possible to observe rather small values, an observation that makes the practical use of this model unfeasible; the model is shown in Table 6.

Table 6 *Accounting betas and the market beta – 2004 – 2009; anticipation*

Dependent Variable: BMT
Sample: 36 56
Included observations: 21
Cross-sections included: 97
Total pool (balanced) observations: 2037
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.761639	0.010164	7,493595	0.0000
CNI(-4)	0.009922	0.002215	4,480169	0.0000
CMTB(-4)	-0.029669	0.010262	-2,891085	0.0039
DB(-4)	-0.007295	0.002487	-2,933597	0.0034
IND(-4)	0.012456	0.004798	2,596141	0.0095

R-squared	0.187543	Mean dependent var	0.750799
Adjusted R-squared	0.145578	S.D. dependent var	1,139072
S.E. of regression	1.052.901	Akaike info criterion	2,989287
Sum squared resid	2.146.250	Schwarz criterion	3,267903
Log likelihood	-2.943.588	Hannan-Quinn criter.	3,091494
F-statistic	4.468.963	Durbin-Watson stat	1,10614
Prob (F-statistic)	0.000000		

Finally, according to the fourth research hypothesis, an attempt was made to verify whether the accounting beta of a company could improve the prediction of the market beta and its shares. For this, it was first observed how much the dependent variable itself, at time t-1, can explain its behavior at t. The following equation was tested:

$Y_{it} = \alpha + \beta Y_{it-1} + U_{it}$,

Where Y_{it} is the information on the temporal evolution of the dependent variable for all the individuals in the sample; Y_{it-1} is the information on the temporal evolution of the dependent variable for all the individuals of the sample at time t-1; and U_{it} is the random error of the model.

The results showed that the equation to predict β_M is significant (F_{value} 0.000000) and 33% of the β_M (R^2 of 0.3334) may be explained by the data for β_M from one period prior. Next, the accounting betas of the selected variables were added. The result showed that the equation to predict the market betas is statistically significant (F_{value} 0.000000), and the explanatory power of the equation increased to 39% for the market beta (R^2 of 0.3945).

Table 7 *Prediction of the market beta using historical data and accounting betas*

Dependent Variable: BMT
Method: Pooled Least Squares
Sample: 36 56
Included observations: 21
Cross-sections included: 97
Total pool (balanced) observations: 2037
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.265775	0.079913	3,325786	0.0009
BMT(-1)	0.422282	0.120482	3,504935	0.0005
CMTB	0.110323	0.041662	2,648053	0.0082
LIQ	0.110710	0.036064	3,069856	0.0022

R-squared	0.424296	Mean dependent var	0.750799
Adjusted R-squared	0.394560	S.D. dependent var	1,139072
S.E. of regression	0.886312	Akaike info criterion	2,644817
Sum squared resid	1.520.824	Schwarz criterion	2,923434
Log likelihood	-2.592.746	Hannan-Quinn criter.	2,747024
F-statistic	1.426.842	Durbin-Watson stat	1,934904
Prob (F-statistic)	0.000000		

This result corroborates the results of Oda (2004), in which strong evidence was found that the accounting indicators may be used to improve the prediction of β_M, especially when used together with the historical betas.

To summarize, in the empirical evidence shown, the results for the testing of the hypotheses H_1, H_2, H_3, and H_4 agree with previous studies that were performed abroad, which did not find a significant relationship, found low R^2 values, or found many of the coefficients not to be significantly different from zero, as in Breen and Lerner (1973), Elgers (1980), Gonedes (1973), Lev (1974), and St-Pierre and Bahri (2006).

5 FINAL CONSIDERATIONS

The EMH and CAPM incorporated the concept that new relevant information exerts an immediate effect over the price of a security by either altering expectations with regard to the return or by altering expectations with regard to the risk: β_M, market beta. Therefore, the present study was developed to investigate whether a company's accounting betas β_C have a relationship with its systematic risk, as calculated by means of the β_M.

To evaluate the relationship between accounting information and systematic risk, this study used proxies for β_C and β_M. Therefore, it sought to verify whether the β_C have an association with the β_M, whether the β_C can explain the β_M, whether the β_C can anticipate the β_M, and whether the β_C can contribute to predicting the β_M.

To perform this study, 97 companies were selected from 15 economic sectors between the first quarter of 1995 and the third quarter of 2009. For the β_M, six different types of calculation were used. For the β_C variables, fourteen variables were selected, several of which were not used in previous studies, as was the case with working capital and the market to book multiple.

To determine whether there was a relationship between the β_C of a company and the β_M of its stocks, the Pearson Correlation statistical tool was first applied. The results generated in the sample were not very significant for the majority of the variable versions and the β_C and were even nonexistent for the majority of the analyzed relationships. However, the results of the correlation for 27 variables and β_C indicated that although the coefficients of correlation may not be high (approximately 30%), it cannot be denied that there is an association of a certain degree between the β_C and the accounting variables with the β_M. The second step was to select the variables that had a higher correlation to β_M and to analyze whether these can explain, anticipate, and improve the prediction of the β_M by analyzing the panel data.

The main results of the present study are the following:

- Certain accounting variables, β_C, help to explain the systematic risk, β_M, as follows: the percentage variation of the market to book indicator, total third party capital over net worth, earnings before taxes over total assets, the degree of operational leverage, the degree of financial leverage, and the financial indicator of liquidity. The results showed an explanatory power of the variable of 27% (R^2 of 0.27) and also showed that the β_C of a company explains the β_M.

This result confirms the findings by Ball et al. (1993), Ball and Brown (1969), Beaver et al. (1970), Beaver and Manegold (1975), Bildersee (1975), Bowman (1979), Brimble and Hodgson (2007), Dechow (1994), Hill and Stone (1980), Ilha et al. (2009), Mandelker and Rhee (1984), Nekrasov and Shroff (2009), Rosenberg and Mckibben (1973), Pettit and Westerfield (1972), Teixeira and Valle (2008), and Thompson (1976).

- The β_C may also explain in advance the β_M of the company's stocks. Up to 14% (R^2 of 0.14) of the future β_M may be explained by the β_C from previous periods. Among the β_C, there are the following: β_C of the percentage growth of the market to book indicator, the β_C of the total third party capital (current + long-term liabilities), the β_C of earnings per share, and the β_C of the debt burden.
- The β_C improved the prediction of the market beta. First, the explanatory power of the $\beta_M$was regressed to its own historical data lagging by one period, and later the β_C were added to this equation. In the studied companies, the explanatory power went from 33% (R^2 of 0.33) to 40% (R^2 of 0.40) with the inclusion of the β_C for earnings before taxes over total assets, liquidity, and market to book.

The practical contribution of these results is that they may be used by investors and managers in their decision-making processes by observing these accounting variables in addition to the market beta to evaluate a company's risk. The results provide clues that the Brazilian market is affected by market to book, liquidity, EBT, and indebtedness indices and that these indices have a relationship with the market beta.

Finally, it is important to highlight that for the vast majority of the observed β_C, no relationship can be found with the β_M. The empirical evidence on the relationship between the β_C and β_M shows that for the majority of the β_C versions, there was little significance or even nonexistent significance for the majority of the analyzed relationships. Ultimately, the results showed the possibility that certain β_C may explain the market beta for a restricted number of companies in the sample and that certain β_C are composed of components that are similar to the market betas.

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APPENDIX - VARIABLES USED IN TABLES AND THEIR MEANINGS

Variable	Meaning	Occurrence
BMT (-1)	Market Beta	Table 7
C	Constant	Table 4, Table 5, Table 6, Table7
CMTB	Constant of Market to book	Table 4, Table 5, Table6, Table7
CNI	Net Income Constant	Table 4, Table 6
CWC	Constant of Working Capital	Table 4
DB	Debt Burden	Table 4, Table 6
DBE	Debt Burden on Equity	Table 4
DBTA	Debt Burden on Total Assets	Table 4
EBITTA	EBIT on Total Assets	Table 4
EBITVM	EBIT on Market Value	Table 4
EBT	Earnings Before Tax	Table 4
EBTTA	Earnings Before Tax on Total Assets	Table 4, Table 5
FL	Financial Leverage	Table 4, Table 5
IND	Indebtness	Table 4, Table 6
INDE	Indebtness on Equity	Table 4, Table 5
INDTA	Indebtness on Total Assets	Table 4
INTCOV	Interest Coverage	Table 4
LIQ	Liquidity	Table 4, Table 5, Table 7
NI	Net Income	Table 4
NIMV	Net Income on Market Value	Table 4
NITA	Net Income on Total Assets	Table 4
NWC	Net Working Capital	Table 4
NWCE	Net Working Capital on Equity	Table 4
NWCTA	Net Working Capital on Total Assets	Table 4
OL	Operational Leverage	Table 4, Table 5
OLTA	Operational Leverage on Total Assets	Table 4
RE	RevenuesonEquity	Table 4
REMV	Revenueson Market Value	Table 4
RTA	Revenueson Total Assets	Table 4

Note: On the independent variables of the survey see also, in the article, Table 3.