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STUDY OF THE INFLUENCE OF DERIVATIVE STRATEGIES ON THE RISK OF BRAZILIAN COMPANIES

O ESTUDO DA INFLUÊNCIA DA ESTRATÉGIA DE DERIVATIVOS NO RISCO DAS COMPANHIAS BRASILEIRAS

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ABSTRACT

This work aims at investigating the influence of hedge approaches on corporate risk by applying an empirical research on derivative strategies by publicly traded Brazilian companies and the association with their risk levels. Many previous studies did not analyze the effects of specific attributes of both derivative strategies and various financial instruments adopted by companies to mitigate their risk. In this paper, these features were considered and, splitting derivative strategies such as currencies and interest rates, the results indicate that the influence of the strategies on the risk is significant. When the total amount of derivatives contracted by firms was deployed in strategies and products, an association between risk and derivative strategies was significant, which may be explained by the peculiarities of foreign currency and interest rates embedded in various financial instruments. This result is consistent with the macroeconomic environment in which Brazilian companies are inserted in view of the frequent exposure to currency risk and interest rate volatility.

Keywords: financial derivatives, corporate risk, Brazilian companies, hedging alternatives, panel data analysis, derivative strategies, risk effects.

RESUMO

Este trabalho tem como objetivo investigar a influência das abordagens de hedge no risco corporativo, aplicando uma pesquisa empírica sobre estratégias de derivativos por empresas brasileiras de capital aberto e a associação com seus níveis de risco. Muitos estudos anteriores não analisaram os efeitos de atributos específicos de estratégias de derivativos e os vários instrumentos financeiros adotados pelas empresas para mitigar seu risco. Neste artigo, essas características foram consideradas e, ao separar estratégias de hedge tais como moedas e taxas de juros, os resultados indicam que a influência dessas estratégias sobre o risco é significativa. Quando o montante total de derivativos contratados pelas empresas foi segregado em modalidades e produtos, uma associação entre estratégias de risco e derivativos foi significativa, o que pode ser explicado pelas peculiaridades de moeda estrangeira e taxas de juros embutidas

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em diversos instrumentos financeiros. Esse resultado é consistente com o ambiente macroeconômico no qual as empresas brasileiras estão inseridas, em vista da exposição frequente ao risco cambial e à volatilidade da taxa de juros.

Palavras chave: derivativos financeiros, risco corporativo, companhias brasileiras, alternativas de hedge, análise de dados em painel, estratégia de derivativos, efeitos de risco.

INTRODUCTION

This research empirically investigates whether the use of different derivative strategies by Brazilian firms increases or reduces their financial risks. Risk management may be related to volatility of returns in the sense that its reduction is considered hedge and its increase is called speculation (Szado, 2011; Lins *et al.*, 2011). Several studies (Junior, 2012; Coutinho *et al.*, 2012; Keffala, 2015) have been performed both in Brazil and abroad focusing the investigation on financial risks vis-à-vis the use of derivatives. The motivation for these types of studies comes primarily from constant debates about the derivative markets and examples of recent crises, fraud and significant financial losses worldwide.

One of these studies focused in the United States market, from which Hentschel and Kothari's (2001) sample of 425 large companies revealed no association between the volatility of a firm's stock prices and the size of the firm's derivative positions. Their findings showed, however, that these effects are currently small for most firms, even for those with large derivative exposures.

Despite the existence of various approaches and results derived from the analysis of many scholars (Saito and Schiozer, 2004; 2007; Lopes *et al.*, 2013; Rossi, 2013; Novaes and Oliveira, 2005), the present research has as main objective to study the influence of derivative strategies on the risk of Brazilian companies with empirical evidence that ensures robustness of the conclusions herein obtained in order to shed light on an emerging economy like Brazil. The relevance of this study lies on recent events in the global financial market, in which major crisis and turbulences were directly or indirectly originated from the derivative markets (Dodd, 2002; Pagliari, 2012). Few exceptions may be considered, such as natural disasters that struck Japan in March 2011 causing a significant blow to the Japanese economy unrelated to the financial market. In this context, the present work aims to contribute deepening studies in order to identify if there is an impact on risk considering the use of different strategies of derivatives by Brazilian publicly traded firms.

Huian (2010) agrees that one of the causes of these recent events is the misuse of exotic and complex financial derivatives. Due to the wide perception of the strong connection between crisis and certain types of derivatives, the accounting standards for such instruments have been under heightened scrutiny. By requiring the record of financial assets at fair value, companies were urged to write off certain assets related to illiquid financial instruments destroying value and raising fears of banks to lend money. Considering that the derivative market is responsible for so many factors that impact the global macroeconomic scenario (Goldin and Vogel, 2010; Sornette and Woodard, 2010), this work is valuable in the sense that it studies whether firms incur additional risks by using different derivatives strategy or instruments.

The derivative market has become one of the most important pillars of business for financial institutions that adopt, as a master plan, strengthening trading desks and sophisticated professionalization of its executives. Aiming to monetize high investments in information systems and teams to act in complex derivative transactions, banks in general suggest various strategies to operate in this market which performance is divided into financial derivatives (related to interest rate, currencies, stocks and indexes) and non-financial derivatives (cattle, calves, soybeans, sugar, alcohol, corn and coffee).

The intense dynamics of the derivatives market spreads into corporate environments in such a way that firms seek mechanisms of protection and hedge as they become aware of their risk exposure. It is observed that companies often allocate significant financial and intellectual resources to financial risks management and, because this is not a trivial task, they rely on banks' support in order to structure their operations. Farhi and Borghi (2009) emphasize the role of banks as counterparty of these transactions, particularly with regards to asymmetric contractual issues which are capable of questioning in court by firms.

The strong commitment to generating shareholder value drives business growth together with market expansion and, as a natural consequence of these movements, firms face operational and financial risks' increase. The combination of these two dimensions which are the impressiveness of the derivatives market and shareholder pressure for value generation pushes firms to transact in the market, thus becoming major players in derivatives (Giacalone and Wargo, 2009; Aggarwal and Simkins, 2004).

Brigham e Ehrhardt (2006) states that the most important aspect of risk management involves derivative securities. Derivatives can and should be used to protect against certain

risks, but the leverage inherent in derivatives contracts make them potentially dangerous instruments. Moreover, Chief Financial Officers; Chief Executive Officers and Board Members should be reasonably informed about their companies' derivatives contracts, thus establishing policies towards their use as well as instructing auditing procedures to ensure that policies are actually enforced.

According to Darós and Borba (2005), the pricing of derivatives requires an extremely advanced quantitative instrumental that seems to escape the domain of most financial market professionals and accountants in particular. Therefore, the difficulty in understanding the mechanisms for pricing of derivatives may lead to misinterpretation. It is clear the effort of companies to adopt efficient risk management, especially when faced with the most recent examples of significant losses in the derivatives market, such as Sadia and Aracruz, which went bankrupt in Brazil due to wrong derivative strategies. However, several and complex factors hinder the full domain of financial risks knowledge, thus raising questions about a particular strategy adopted by a firm.

Shareholders are deeply interested in the financial risk management policy of the organization since the inadequate practice of derivative instruments generates loss of value. Risk is a direct function of the derivative positions assumed by the organization and its accounting record is a valuable source of information concerning market valuation. Selecting the correct derivative instrument to be used in every circumstance is vital to the financial success of all operations contracted by the company. One cannot, due to the extreme market volatility, accurately estimates what will be the gain or loss on certain derivative transaction at a future date (Ball, 2006; Barth *et al*., 2001).

Hentschel and Kothari (2001) empirically investigate whether the systematic use of derivatives by firms increases or reduces their risk levels. The basis of the study was 425 large U.S. companies whose data on derivative transactions were taken from the notes of their balance sheets by searching for keywords that indicate activity in this market. The results indicate that there is no strong economic or statistical relationship between the use of derivatives and stock returns volatility. The authors showed that the determination of the tests have much relevance not only to counteract the current idea that firms use derivatives to speculate, thus putting at risk the shareholder wealth, as well as, the concern of regulatory agencies in their considerations of the derivatives market regulation and transparency towards the disclosure of contracted positions.

In this context, the present work presents the study of large companies in the Brazilian market which, being characterized by harshest conditions, present distinct results. Only listed companies with shares traded on the B3[4] formed the sample of this research. This procedure is appropriate because of the mandatory disclosure of financial reports which represent the main source of corporate data about derivatives. In addition, unlisted companies provide no disclosure on the risk policy of derivatives.

In this sense, our study aimed, at first, to investigate whether the results obtained by Hentschel and Kothari (2001) may also be applied to Brazilian market. Subsequently, sought to understand if, unlike the authors that found no evidence for increased risk by using derivatives, the Brazilian market could have different results considering the particularities of Brazilian companies and the market in which they operate, thus trying to explore the level of inherent risk.

Complementing previous authors that also explored derivative usage by Brazilian firms, our study investigates the main publicly traded companies instead of only considering the respondent companies under a survey (Saito and Schiozer, 2004; 2007). Additionally, different from Lopes *et al.* (2013) that analyzed the operations that were exclusively contracted with a single bank, our study considered the derivative transactions disclosed by all companies in their financial statements. Instead of Rossi (2013), that explored the occurrence of a significant time variation in the use of derivatives by companies, our concern was towards exposure to currency or interest rates risks, as well as which instruments were used by companies (swaps, futures, options and forwards). Finally, we considered a timeframe of 2008 to 2013 as opposed to Novaes and Oliveira (2005) who constructed an original database consisting of 23,767 foreign exchange swap contracts outstanding, however related only to 2002.

The results of the present study may be useful to the academic environment, since it complements previously published works on the subject updating and presenting evidence as to whether or not the transactions undertaken by companies in the derivatives market increase their risks. Additionally, it is considered as a source of inspiration for future researches that seek to broaden this scope including other variables and factors not addressed, as well as updating with more recent data.

LITERATURE REVIEW

GLOBAL MARKET AND THE USE OF DERIVATIVES BY FIRMS

Lien and Zhang (2008) express that there is a consensus that derivatives are rarely the cause of a financial crisis, but they could amplify the negative effects of the crisis and accelerate contagion. Derivative market contributes to the development of the financial infrastructure of a country by means of connecting cash markets, hedgers and speculators.

[4] B3 is a company in Brazil that manages the organized securities and derivatives markets, providing registration, clearing and settlement services. It acts as central counterparty, guaranteeing financial liquidity for the trades executed in its environments.

It has grown rapidly in emerging economies since the 1990s, especially those that have been removing capital controls and developed its own market of underlying securities. The growing use of derivatives offers alternatives for efficient risk management and facilitates capital flows to emerging economies, thus creating conditions for increased risk of the economic system and expansion of negative effects during episodes of financial crisis. Financial derivatives are important for hedging and risk management, as they facilitate the money exchange in the international market. However, they generate more unpredictable crisis dynamics and provide a transmission channel of contagion, evidencing that financial derivatives may play both positive and negative roles.

Indeed, derivatives markets are the tools that enable efficient management and control of risks, according to Ineichen (2001). The heterogeneity of market participants (end users, banks, hedge funds, etc.) ensures a high degree of efficiency to the market. Derivatives are often associated with speculation. In any market, speculation, here defined as a bet on a change in price occasionally, is important. In a liquid market, there has to be a participant who believes one can buy low and sell high, i.e. the benefit of price changes from time to time. It is speculation that enables efficient transfer of risk, liquidity and increases the probability of executing a transaction.

In theory, companies can manage their risk exposure by other means rather than derivatives. Some companies, for example, consider having a natural hedge from incomes in foreign currency that may eventually compensate the fluctuations in their international debts. Corporate bonds may also function as hedge to the risk of interest rate. According to Antoniou *et al.* (2009), managers are able to immunize the firm value against changes in interest rates, to some extent, combining the sensitivity of its assets and liabilities to interest rate risk through active risk management of the interest rate market. Thus, if the company employed other forms of hedging derivatives will, then, be performing a trade-off between the costs of an alternative mechanism for hedging and the cost of contracting derivatives. In this sense, Bartram *et al.* (2009) showed that derivative usage is determined internally together other financial and operating decisions within the company in an intuitive way, but not related to specific theories for why firms hedge. For example, derivative usage helps persuade the level and maturity of debt, dividend policy, holdings of liquid assets, and international operating hedging. Recent studies show, however, that most companies do not systematically cover their risk exposure. Most companies adopt hedging strategies oriented and profit-based forecasts and adjust in proportion to market fluctuation. In other words, they monitor market, according to Antoniou *et al.* (2009).

Due to controversy over the full understanding and use of derivatives, companies in general, apply pre defined policy-based risk management and supported in committees. Rarely the decision to contract derivative is taken unilaterally determined by a company executive. Usually, a collegial decision that requires extensive internal debate about the current market conditions vis-à-vis the level of exposure to the financial risks of the company takes place. Representing the highest executive level in the company, the CEO becomes responsible for the company's derivatives program and therefore ultimately for the gains and/or losses of the company at the end of each year (Bigley and Wiersema, 2002). Thus, it is clear the importance of the stimulus packages linked to results as motivation to create value in organizations, according to Supanvanij and Strauss (2010) who state that the compensation of the CEO's long-term encourages them to act in best interest of the shareholders (maximizing the price of the firm) and do hedge.

The effect of some variables on risk management is more complex than usually considered, and according to Aretz and Bartram (2010), a detailed understanding of the underlying structural parameters is required to capture these effects properly in empirical analyzes. It is also important to note that existing theories describe the reasons for corporate hedging in general, while the empirical tests often focus only on a single dimension of risk management, *i.e.*, the use of financial derivatives, to explain the use of hedge by the company. Moreover, it is difficult to assess the extent to which firms use hedging given the complex combination of different channels such as diversified hedging profiles of payment, time horizons, and so on, as well as changes in exposures along the time. Consistent with the notion that hedging increases the transparency and predictability of cash flows of the companies resulting in fewer distortions in stock prices, Lin, Pantzalis and Park (2010) showed that the use of derivative by companies is negatively associated with stock price distortions. Thus, data collected during the period 1992-1996 showed that companies using a wide variety of types of derivative contracts have stock prices less distorted. Therefore, companies that make extensive use of derivatives, contract a diversity of products and adopt sophisticated hedging policies, have their best stock prices received by the market.

The importance of investigating the use of derivatives in emerging economies such as Brazil lies in the dynamics of these markets on global scenario. According to Aysun and Guldi (2011), the study of emerging markets is critical for two reasons: first, these countries have been recently pursuing more active monetary policy and more flexible foreign currency regimes. Thus, understanding how companies deal with the volatility of the foreign currency is important for assessing risks to financial stability. However, financial markets operate in a global structure and in order to be effective, Dixon and Bhandari (1997) suggest that regulations should have the strength to be globally practicable. The starting point for making this possible would be: better harmonization of international accounting, financial disclosures (or increased transparency) and trading practices. It is important that supervisors and regulators become an internationally recognized body to monitor

transactions in the international capital markets. The new international body should have the authority to determine its accounting and financial disclosures, define transactions and set appropriate standards to regulate any form of derivatives trading (Detomasi, 2002).

NATURE OF DERIVATE INSTRUMENTS AND THEIR IMPACTS

According to Galdi and Guerra (2009), the so-called derivatives have characteristics that distinguish them from other financial instruments, which are : (i) the high leverage due to its ability to generate large losses, (ii) the high speed of transactions on behalf of the advancement of current technology, thus enabling the execution of operations in a matter of seconds on electronic terminals, and (iii) the enormous complexity of product structures making necessary its proper understanding by the organization.

Many studies claim that risk management can reduce the probability of bankruptcy and financial distress costs, mitigate the asset substitution problem and reduce information asymmetry. In this context, Yi, Lin and Chen (2008) examined if the use of derivatives affects the credit rating of debt issuers, the borrowing costs measured by the yield spread, market reactions to the issue of securities and investment banking fees. The research supports the fact that risk management is beneficial to the business activity in many respects , however, the cost of debt do not seem to fall into that list of benefits .

In the Brazilian market, the demand for derivatives have been growing particularly with regards to protection against significant foreign currency changes, such as depreciation of 45% of the real exchange rate from 2011 to 2014, as reported by Serrano and Summa (2015).

Thus, it is important to note that exposure to foreign exchange risk has always been a constant concern in the treasury departments of companies. Other risks are equally important, such as interest rate, inflation degree and GDP growth fluctuations. However, due to high currency volatility caused by various situational factors, it is somewhat difficult for financial managers to predict, by themselves, the future behavior of the Real against other currencies, which leads them to the exchange rates being negotiated under contracts of currency future markets. The impact on cash flows and corporate results are significant if no protective measure is adopted. Companies are in constant search of derivative instruments that allow them the best coverage for degrading and stress scenarios.

Lopes *et al.* (2013) studied dynamics of currency derivatives usage by Brazilian non-financial firms, using a unique database of over-the-counter operations contracted between these companies and a large international bank between 2003-2008 and 2009-2011. The results found no evidence of speculation, reinforcing, thus, the idea that massive losses caused by currency derivatives in late 2008 worked as a wake-up call for managers, boards, investors and regulators, who started monitoring derivatives operations more closely.

The currency risk is an inherent aspect of international trade. Fortunately, there are a variety of derivative instruments that can be used to hedge these risks, including forward contracts, futures contracts, options interest rate and currency swaps. However, familiarity with these tools, while necessary, is not sufficient according to Kawaller (2008). Managing these risks requires coordination across the enterprise, otherwise the risk mitigation efforts of a subsidiary or related parties may end up exacerbating the exposure of the consolidated entity. Korn (2010) adds that corporate risk management with derivative products has become increasingly important in recent decades and, for many companies, is now an integral part of their corporate policy.

In fact, being part of the company's corporate policy appears that the use of derivative acts on a number of dimensions of the organization and can bring different consequences. Importantly, the use of derivatives is not limited just to cover financial exposures and yes, is connected to a number of attributes that result in the overall performance of the company. According to Fehle (1999), existing theories of corporate hedging are typically based on the notion that companies do global economic hedge exposure to a particular variable. However, it is difficult for many companies to assess the overall economic exposure, because it covers not only the cash flows of the transaction that are directly exposed to this variable, but also the indirect effects of the market to which they are subject. Market dynamics and global financial crises have significant impacts on the finances of an organization. Thus, the company's treasury team monitors itself, for example, the company's exposure to currencies, interest rates and commodity prices regarding contracts it holds and its possible effects on future cash flows.

DERIVATIVES AND RISK MANAGEMENT

Hull (2013) warns that derivatives are very versatile instruments, since they can be used for hedging, speculation or arbitrage. It is this very versatility that can cause problems. Sometimes traders who have a mandate to hedge risks or follow an arbitrage strategy become (consciously or unconsciously) speculators and the results can be disastrous.

In emerging markets, where regulation is weaker, complicated financial products can become tools of institutions to obtain more profits. Furthermore, the complex design of the product increases the information asymmetry between shareholders and corporate managers, which accentuates the problem of agency, according to Ding and Li (2009) who studied the market in China. This requires highest standards of corporate governance, since the complex pricing and manipulation may increase the costs of supervision. According to

the authors, the government hardly interferes with the design of derivative financial instruments, as it assumes that the parties to the transaction can understand the structure and risks of derivatives. Thus, the transaction is market behaviour without government involvement. In this circumstance, the innovations of derivatives may deviate from the fundamental economic principles.

Currently in the markets, there are more reflections about risk. According to Ojo (2010), in many countries, although the formalization of the regulatory and supervisory process has been growing, its focus has been directing more to risks instead of rules and statutes, including also the management responsibilities. Thus, the author suggests a method of regulation that is done internally in companies with respect to risk management and control strategies. As a result, the supervision would not be limited to only observe the performance of companies with respect to regulatory standards, but crucially, assess and monitor the awareness of managers about the risks created by their business and internal control.

In this context, companies are susceptible to the implementation of the derivative transactions by finance managers in the treasuries that have perceptions of different scenarios and own motivations when interacting with financial institutions. Although aware that strategic decisions regarding the use of derivatives are taken by the top members of the organization, managers employ their particular criteria in identifying and recruiting these transactions in the market. The benefits of risk management are not identified by either the executive or the counsellors. There are several indicators that demonstrate increased activity of risk management in the Brazilian business environment, on the other hand, there are no studies that seek to identify whether this practice adds value to the companies, nor if it is an unilateral decision of the executives.

DATA AND VARIABLE CONSTRUCTION

DATA AND SAMPLE SELECTION

This work was based on the study of Ludger Hentschel and S. P. Kothari published in the Journal of Financial and Quantitative Analysis in 2001, called "Are Corporations Reducing or Taking Risks with Derivatives?", and applied to the reality of the Brazilian market through research on the use of derivatives by public companies in the period from 2008 to 2013, in reason of being the subsequent period of 2008 global financial crisis. In order to contribute to this issue, this paper studies the impacts of risk arising from the use of derivatives by non-financial companies publicly traded in the Brazilian Exchange Market (BM&FBovespa).

Similarly to Schiozer and Saito (2009), financial institutions were also excluded because it is often difficult to distinguish between the use of derivatives for trading purposes and those used for Asset Liability Management. The survey for the current study examined the notes of Standardized Financial Statements of the companies, proving the use of derivatives by identifying strategies that were adopted in face of exposure to currency or interest rates risks, as well as which instruments (swaps, futures, options and forwards) were in force during the period 2008-2013. The notional amounts are arranged in notes denominated "Derivative Financial Instruments". Thus, the amount of derivative contracted by companies was obtained by reading the individual set of notes that companies publish together with their annual reports. In addition to segregating the necessary information by nature of risk and instruments used in the derivatives, it was also observed the consistency of these data compared to previous years.

The present study presents a data base composed by 516 firm-years totaling 86 companies that had public traded shares during the full period of 2008 up to 2013. The selection of publicly traded companies was based on the representativeness of each company in the market evidenced by its inclusion in at least 2 (two) market performance indexes considered as measure for return analysis. Since a stock index gives the investor a benchmark to evaluate the performance of an asset or portfolio of assets, the present research considered the 4 (four) indexes with higher relevance for the Brazilian market.

The Bovespa Index is the most important indicator of average stock prices in the Brazilian market. The IBrX – Brazil Index is a price index that measures the return on a theoretical portfolio composed by 100 stocks selected among BM&FBOVESPA's most actively traded in terms of number of trades and enterprise value. IBrX is particularly important as it is based on market value and not liquidity. The Large Cap Index Mid (MLCX) is not yet widely used, but with the development of ETFs/Ishares in Brazil, alternative indexes can gain more relevance. The Large Cap Mid aims to measure the performance of companies listed on the Stock Exchange measured by the return on a portfolio composed of the largest market capitalization companies. The component stocks are selected for their liquidity and are weighted in the portfolio at market value of the shares available for trading. The companies, which together represent 85% of the total market value of the Stock Exchange, are eligible to participate in the MLCX index. And, finally, IGC – Share Index with Differentiated Corporate Governance which comprises companies that adhere to practices of Corporate Governance.

In order to complement the survey data by composing the financial reporting framework, other items were considered and collected from Bloomberg: (i) book value of assets, (ii) equity market value, (iii) the notional value of derivatives divided by the market value of assets. The market value of assets is obtained from the sum of the equity market value and book value of liabilities, (iv) leverage is the book value of liabilities divided by the equity market value (leverage ratio), (v) Book-to- Market ratio, obtained by dividing the Total Assets by Equity Market Value, (vi) the standard deviation of returns , σ is measured in percentage points and is calculated from daily returns and,

(vii) the standardized standard deviation of the returns , σ/σ m is the normalized standard deviation measured by the daily standard deviation of the Bovespa index in the year.

VARIABLE CONSTRUCTION

Starting from the premise that the use of derivatives is to take the financial risk factor for the companies, this study aimed, first, to investigate whether the results obtained by Hentschel and Kothari (2001) is applied to the Brazilian market. Subsequently sought to investigate if, unlike the authors that found no evidence for increased risk by using derivatives, the Brazilian market could have different results considering the characteristics of Brazilian companies and the market in which they operate. Notably, the derivative transactions have two main objectives: hedging and reduction of financial costs. Thus, the study of derivative strategies adopted by companies to either exchange or interest rate protection should be fundamental to understand the level of inherent risk.

Initially, in order to develop the research steps, the present study used the same model of Hentschel and Kothari (2001) to check whether the results would be similar. Then, subsequently this study adopted its own criteria to analyze the effects of the influence of derivative strategies on the risk of Brazilian companies. The new criteria is divided into categories (exchange rate and interest rate risks) according to strategy, product and the instrument.

Chart 1 presents the basic structure models: (i) regression of the standard deviations of stock returns only in relation to the derivatives position; (ii) regression of the standard deviation of stock returns including, besides the derivative position, the value of the equity market, the degree of leverage and book-to-market ratio (B / M) and (iii) regression of same variables in the model (ii), but excluding derivatives.

To this end, Hentschel and Kothari (2001) present Equation [1]:

$$\sigma_{i,t} = y_0 + y1_{i,t} + y2_{i,t} + y3_{i,t} + y4_{i,t} \quad [1]$$

Where: σ is the standard returns deviation of daily prices for firm *i* in year *t*; *y1* is derivatives/market value of assets for firm *i* in year *t*; *y2* is ln market value of Equity for firm *i* in year t; *y3 is* Leverage for firm *i* in year *t*; *y4* is book-to-market ratio for firm *i* in year *t*.

The steps outlined in Chart 1 were employed interrelating data/variables obtained from public companies of Brazilian market from 2008 to 2013. The main objective of the model estimation process was to identify the impact on risk of Brazilian companies arising from the use of derivatives and their specificities. The amount of derivatives contracted by each firm was segregated into: strategies, products and instruments. After performing the calculations, it was understood that the statistical tools used were appropriate and the results were useful in interpreting the model and completion of this work.

METHODOLOGY AND EMPIRICAL RESULTS

The method of analysis with panel data or longitudinal data is characterized by having observations on the spatial dimension and the temporal dimension. Each explanatory variable varies over time for one or more units of cross section. Section units may be countries, companies, individuals, among others, as well as, according to Wooldrigde (2002) the increasingly popular use of panel data is the ability to test the rationality in economic models of behavior of individuals, families, businesses and regions.

As the estimation of panel models are subject to heterogeneity across individuals (different structure between countries, companies and different preferences and behaviors among consumers), its estimation requires the appropriateness of the type of effect shown by the data set. In this sense, among the advantages of this distinction and use, Baltagi (2005) notes: the consideration of the heterogeneity of the units; less co linearity amongst variables; more degrees of freedom; identification and best measurement of non-observed effects.

The estimation of the data can be done through three main models: Pooled data, the fixed effects model and random effects model. In the OLS model for pooled data, estimation is done assuming that the parameters are common to all individuals. In the fixed effects models, the estimation assumes that the heterogeneity of individuals is captured in the constant part, which means, it is different for every individual. In the random effects model, the estimation is done by introducing heterogeneity of individuals in the error term, that is, it is different for each individual, and captured as a non-observable random parameter.

To identify and choose the most suitable estimation method for the data set, some tests such as Chow, Breusch-

Chart 1. *Comparison with Hentschel and Khotari's Model.*

	Hentschel and Khotari´s Model		Proposed Model
Standard deviations of Stock Returns (σ)	Derivatives	Model 1	Foreign currency and Interest rate strategies
	Other Variables (+) Derivatives	Model 2	Other Variables (+) Foreign currency and Interest rate strategies
	Other Variables (-) Derivatives	Model 3	Other Variables (-) Foreign Currency and Interest rate strategies

Pagan and Hausman (Wooldrigde, 2002; Baltagi, 2005; Greene, 2012) were performed. The Chow test (or test F) verifies the hypothesis of homogeneity in steady, so one can decide for estimation model by fixed effects or pooled. The Breusch-Pagan test verifies that the hypothesis of unit-specific error variance is null, which is decided by the estimation of random effects or pooled. Since the Hausman test checks whether the GLS estimates are consistent, this case is decided by the estimation of random effects or fixed effects.

Table 1 shows the results of tests for the proposed nine models. In Chow (F test) was possible to reject the model with common constant. Models with fixed effects, in this case, were statistically more appropriate. In Pagan Breusch-test, the null hypothesis error variance was rejected, i.e. with non-zero variance, the random effects model proves more appropriate. Finally, the Hausman investigates the hypothesis that the random method estimates are consistent. Only in Kotari_1 model, it was not possible to reject the hypothesis of consistency in the estimation of random effects; in other models, such hypothesis can be rejected.

The results are conclusive to accept that the vast majority of models proposed follows an estimation by fixed effects. These results are corroborated by the proposition that there are reasons to believe that the individual effects are correlated with the explanatory variables, and thus the fixed effects method is more appropriate, as pointed by Gujarati and Porter (2011).

In this study, it is understood that the different sizes, segments and capital structures of firms may cause heteroscedasticity, *i.e.*, the error variance is not constant. To test the occurrence of heterocedasticity, the Wald statistic was calculated for heterocedasticity on the regression residuals panel fixed effects (Wooldrigde, 2002; Baltagi, 2005). According to data from the Table 2, it was possible to reject the null hypothesis of the Wald test, *i.e.*, reject the hypothesis that the units in question have the same error variance.

According to Wooldridge (2002), the correction of heterocedasticity is necessary because, although the OLS model is non-biased, it no longer is the estimator with minimum variance among all non-linear biased estimators. After verifying the nature of heteroscedasticity (positive), the correction adopted checks in estimating the models by weighted least squares (WLS) (Wooldrigde, 2002; Greene, 2012)[5]. The weighted term lies in the fact that the coefficient minimizes the weighted sum of squared residuals, where each squared residual is weighted by the variance. The idea is that observations with higher error variance receive less weight.

Using a database of Brazilian companies, the model of Hentschel and Kothari (2001) was applied, obtaining as results of the regressions the values presented in Table 3.

The "Model Kotari_1" presents the regression results between the standard deviations of returns of stocks and derivatives position normalized by the market value of assets. Considering only derivatives, it is not possible to measure the predictive power of the coefficient of determination R2, because, being a random-effects model the variance is weighted and such coefficient loses applicability. In statistical terms, it presents the coefficient of the derivative position normalized by the market value of the assets of 0.0014 and p-value of

Table 1. *Tests of the Effects: Pooled, Fixed and Random.*

Models	F Test: *Pooled* x Fixed			Breusch Pagan Test: *Pooled* x Random			Hausman Test: Random x Fixed		
	F	p-value	Effect	X^2	p-value	Effect	X^2	p-value	Effect
Kotari_1	2,205	1,30E-07	Fixed	34,385	4,50E-09	Random	1,804	0,179	Random
Kotari_2	2,183	2,00E-07	Fixed	29,937	4,50E-08	Random	11,853	0,018	Fixed
Kotari_3	2,192	1,70E-07	Fixed	30,834	2,80E-08	Random	10,494	0,015	Fixed
Strategy_1	2,073	1,20E-06	Fixed	25,299	4,90E-07	Random	12,847	0,002	Fixed
Strategy_2	1,978	5,50E-06	Fixed	18,525	1,70E-05	Random	30,786	0	Fixed
Product_1	2,236	8,10E-08	Fixed	32,603	1,10E-08	Random	12,381	0,015	Fixed
Product_2	2,103	7,60E-07	Fixed	22,874	1,70E-06	Random	32,13	0	Fixed
Instrument_1	2,148	3,60E-07	Fixed	26,331	2,90E-07	Random	24,764	0,001	Fixed
Instrument_2	1,995	4,40E-06	Fixed	16,217	5,60E-05	Random	57,432	0	Fixed

[5] The use of the WLS estimator adjusts heteroskedasticity and Serial correlation (Batalgi and Griffi, 1988; Batalgi, 2008) in panel data estimates. In order to reinforce the obtained results the tests of heteroscedasticity and serial correlation were made for all models, according to Wooldridge (2002) and Drukker (2003). As expected, both problems were detected. Following Driscoll and Kraay (1998) we implemented two more types of estimates to confirm the results. Using Stata software, robust standard error estimates were made per cluster and the approach suggested by Driscoll and Kraay (1998). In Driscoll and Kraay (1998) the error structure is assumed to be heterocedastic, autocorrelated until some delay and possibly correlated between the groups. The results of the tests and the estimates are given in Appendices A and B. The results of the estimations by these two additional methods are in agreement with the results previously found. Signals, magnitudes and significance of the coefficients have undergone minor changes.

0.0004, *i.e.*, significant in explaining the standard deviations of the shares of the companies under review.

By adding the variables market value of equity, leverage and book-to-market ratio to the previous model, "Model Kotari_2", the explanatory power of the regression, the fixed effects model in this case, recorded 15.19%. Furthermore, the coefficient of the derivative position normalized by the market value of the assets remained significant, 0.0013 and p-value of 0.012. Among the other variables, only leverage was significant.

The results of the "Model Kotari_3" consider all other variables except derivatives. The coefficient of determination (R2) practically remained, 15.20%, and the leverage variable remained significant.

To Hentschel and Kothari (2001), clearly, derivatives can be used to manage risk and volatility, however, in the sample used, a typical company does not seem to achieve great changes in risk through derivatives, at least when compared to companies with size and similar leverage.

Although with large dollar amounts of derivative positions, Hentschel and Kothari (2001) show, however, that these positions are small relative to the size of the company. In light of these relatively small positions, it is not surprising that the derivatives do not have large effects on the volatility of companies.

To Hentschel and Kothari (2001), although it is not possible to detect an economically significant relationship between volatility and derivatives, the firms can be successful in covering flows of short-term cash derivatives. While the flows of short-term cash represent a small fraction of the value of the company is likely to express a limited fraction of the volatility of the company. Additionally, any reduction in volatility short term cash flow will have a modest impact on the overall volatility of the company.

In the case of the analyzed Brazilian companies, the data presented in Table 4 do not corroborate the results obtained by Hentschel and Khotari (2001), noting that when considering only derivatives or these and other variables, there was a significance of these variables in explaining the risk of stocks.

In order to deepen and refine the relationships, the present study aimed to analyze the effect of the strategies, derivatives products and derivative instruments. To do so, it first took place the unfolding of derivative strategies into foreign exchange and interest rates. Secondly, it was considered an offshoot of derivative products and, finally, into instruments to study the effects of such segregations.

Table 4 presents the regression results between the standard deviation of stock returns and position in derivatives spun off in exchange and interest strategy. In "Model Strategy_1", it can be seen the strategy variables that appeared significant despite the low explanatory power, with R2 6.6%.

By adding other variables, market value of equity, leverage and book-to-market ratio to derivatives dismembered into strategies, it is seen in the "Model Strategy_2" the explanatory power of the regression high to 18.38%. The significance of variables foreign currency strategy and interest rate strategy is maintained, as well as to the leverage variable.

In the next step, the strategy variables were split into products, as it can be seen on Table 5. In "Model Product_1", the following items were analyzed: swaps, futures, options

Table 2. *Wald test of independent distribution for heterocedasticity.*

Wald Test	Statistic Test	p-value	Distribution
Model Kotari_1	-	-	-
Model Kotari_2	3,11E+03	0	heteroscedastic
Model Kotari_3	2740,49	0	heteroscedastic
Model_Strategy_1	1804,95	0	heteroscedastic
Model_Strategy_2	13554,8	0	heteroscedastic
Model_Instrument_1	4724,78	0	heteroscedastic
Model_Instrument_2	30054,9	0	heteroscedastic
Model_Product_1	6329,71	0	heteroscedastic
Model_Product_2	4410,73	0	heteroscedastic

Table 3. *Derivatives and Volatility of Stock Returns.*

Variables	Model Kothari_1 (random)			Model Kothari_2 (WLS)			Model Kothari_3 (WLS)		
	Coefficient	*p-value*		*Coefficient*	*p-value*		*Coefficient*	*p-value*	
const	2,50732	<0,00001	***	1,99976	<0,00001	***	1,97422	<0,00001	***
derivatives/market value of assets	0,00140215	0,0004	***	0,00132466	0,01283	**			
ln(market value of Equity)				0,0174149	0,28523		0,0220719	0,1535	
Leverage				0,497115	<0,00001	***	0,522466	<0,00001	***
book-to-market ratio				-0,0482357	0,26002		-0,0350125	0,45398	
R-square				0,151914			0,152036		

Table 4. *Derivative Strategies and Volatility of Stock Returns.*

Variables	Model Kotari_1 (random)			Model_Strategy_1 (WLS)			Model_Strategy_2 (WLS)		
	Coefficient	*p-value*		*Coefficient*	*p-value*		*Coefficient*	*p-value*	
const	2,50732	<0,00001	***				1,95204	<0,00001	***
derivatives/market value of assets	0,001402	0,0004	***						
ln(market value of Equity)							0,0244241	0,12952	
Leverage							0,511086	<0,00001	***
book-to-market ratio							-0,0543872	0,22024	
foreign currency strategy				0,00415052	<0,00001	***	0,0035173	<0,00001	***
interest rate strategy				-0,00556943	0,00441	***	-0,00833278	0,00002	***
R-square				0,066898			0,183842		

Table 5. *Derivative Products and Volatility of the Stock Returns.*

Variables	Model Kotari_1 (random)			Model_Strategy_1 (WLS)			Model_Strategy_2 (WLS)		
	Coefficient	*p-value*		*Coefficient*	*p-value*		*Coefficient*	*p-value*	
const	2,50732	<0,00001	***	2,28207	<0,00001	***	1,9648	<0,00001	***
derivatives/market value of assets	0,0014022	0,0004	***						
ln(market value of Equity)							0,0113206	0,48226	
Leverage							0,54196	<0,00001	***
book-to-market ratio							-0,0469664	0,30531	
product: swap				0,00586501	<0,00001	***	0,00427546	<0,00001	***
product: futures				-0,00128675	0,69611		-0,0066655	0,02763	**
product: options				0,0100716	0,19241		0,0109094	0,09914	*
product: forward				0,00155242	0,17339		0,00145552	0,16388	
R-square				0,088289			0,198672		

and forwards. In this model, the explanatory power was low, with 8.8% coefficient R2. Regarding the significance of the variables, just swap was significant, i.e., it has relevant information about the standard deviations of the shares.

After adding the market value of equity, leverage and book-to-market ratio to the model with the products, "Model Product_2", the explanatory power of the regression is high to 19.86%. The product swap variable retained its significance and product variables of options and futures have become significant. Accompanying the other models presented, the leverage variable continued to show significance.

Lastly, the segregation of the strategies was performed using instruments available in the market. Instrument is defined as the notional amount split into foreign currency swaps, interest rate swaps, foreign currency futures, interest rate futures, foreign currency options, interest rate options and foreign currency forwards.

Table 6 presents the regression results between the standard deviations of returns of stocks and derivative instruments segregated. In "Model Instrument_1", it was analyzed only if the instruments bring the model relevant information on the dependent variable, in this case, only the interest rate swaps and interest rate options were not significant. The explanatory power of this model was registered in 12,64%.

By adding the market value of equity, leverage and book-to-market ratio to the model with the segregated instruments, "Model_Instrument_2", the explanatory power of the regression is increased to 23,08%. Like the other models, the leverage variable retained its significance and among those instruments, remained significant the following variables: foreign currency swaps, interest rate futures, foreign currency options and foreign currency forwards.

The results indicate that the influence of the strategies on the risk is significant. The data collected was similar when

Table 6. *Derivative Instruments and Volatility of the Stock Returns.*

Variables	Model Kotari_1 (random)			Model_Instrument_1 (WLS)			Model_Instrument_2 (WLS)		
	Coefficient	*p-value*		*Coefficient*	*p-value*		*Coefficient*	*p-value*	
const	2,50732	<0,00001	***	2,27676	<0,00001	***	1,9532	<0,00001	***
derivatives/market value of assets	0,001402	0,0004	***						
ln(market value of Equity)							0,01163	0,46891	
Leverage							0,55317	<0,00001	***
book-to-market ratio							-0,06284	0,17887	
Instrument: foreign currency swaps				0,0076307	<0,00001	***	0,0062996	<0,00001	***
Instrument: interest rate swaps				-0,0007459	0,72298		-0,0024593	0,20839	
Instrument: foreign currency futures				0,0070165	0,08045	*	0,0024198	0,53138	
Instrument: interest rate futures				-0,01019	0,0457	**	-0,0175	0,00028	***
Instrument: foreign currency options				0,023168	0,02706	**	0,021609	0,01475	**
Instrument: interest rate options				-0,011056	0,51437		-0,009379	0,57817	
Instrument: foreign currency forwards				0,0042478	0,00985	***	0,0048329	0,00206	***
R-square				0,126451			0,230838		

considering the total derivatives, but when the total was broken down into strategies, products and instruments, a significant association between the risk and the strategies of derivatives was obtained. Essentially, this significance may be explained by the existing strategies in foreign currency and interest rate on various financial products.

CONCLUSIONS

According to Lien and Zhang (2008), financial derivative markets have helped support the flow of capital to emerging market economies. There is a consensus that derivatives are rarely the cause of the crisis, but they can amplify their negative effects and accelerate contagion. The reasons for the negative effects are associated with the leveraged nature of derivatives, opaque reports on transactions and insufficient risk management or unsophisticated risk controls, as well as weak prudential supervision.

As pointed by Rossi (2011), companies in emerging countries face greater foreign currency exposure and interest rates volatility than those of developed countries, thus making the risk management fundamentally more important for these companies.

However, increasing the size of the derivatives market requires that controls have to be constantly updated and even though there is ample widespread use of derivatives for risk management systems, not all companies are immune to misuse of derivatives according to Bezzina and Grima (2012).

Ineichen (2001) believes that risk awareness and management will increase in the future: the only certain input for long-term investors is uncertainty itself. Risk management can prove to be the best approach to dealing with uncertainty than trying to guess the future. Given these assumptions, the author hopes that the use of instruments by the risk manager (derivatives) can expand, the process of demystification of the derivatives market may continue, the liquidity in derivatives markets will increase, and there will be even greater product customization in risk management and corporate finance.

Our findings indicate the need to consider a break in the analysis, thus taking into account the different ways companies contract derivatives in the market. When we broke down, we did get significant results. This has many managerial implications in the sense that companies shall rely on managers that have very specific and capable skills in order to be able to interpret all possible derivative alternatives available, given that our study showed that there are risks when considering the different strategies adopted by companies, as seen in the notes of their balance sheets.

Among the various financial risks to which Brazilian companies are constantly exposed, it is considered as indicative of the results of this study that the derivatives risk is one of the biggest worries for financial managers. In addition to the ineffective macroeconomic policies, the dubiousness of the messages issued by the monetary authorities of the Brazilian federal, government significantly hamper mapping a strategy of derivatives by companies.

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APPENDIX A

Tests for serial correlation and heteroscedasticity.

```
. xtserial $ylist $xilist
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
  F( 1,    84) =  825,037
       Prob > F =    0,0000
```

```
. xtserial $ylist $xiilist
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
  F( 1,    83) =  128,206
       Prob > F =    0,0000
```

```
. xtserial $ylist $xiiilist
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
  F( 1,    83) =  119,287
       Prob > F =    0,0000
```

```
. xtserial $ylist $xivlist
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
  F( 1,    84) =  805,061
       Prob > F =    0,0000
```

```
. xtserial $ylist $xvlist
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
  F( 1,    83) =  113,192
       Prob > F =    0,0000
```

```
. xtserial $ylist $xvilist
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
  F( 1,    84) =  727,132
       Prob > F =    0,0000
```

```
. xtserial $ylist $xviilist
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
  F( 1,    83) =  160,146
       Prob > F =    0,0000
```

```
. xtserial $ylist $xviiilist
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
  F( 1,    84) =  746,538
       Prob > F =    0,0000
```

```
. xtserial $ylist $xixlist
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
  F( 1,    83) =  158,073
       Prob > F =    0,0000
```

Figure A-1. *Tests for serial correlation according to Wooldridge (2002) and Drukker (2003).*

Note: the models from *i* to *ix* correspond: i = Model Kotari 1; ii = Model Kotari 2; iii = Model Kotari 3; iv = Model Modelo_Strategy_1 (WLS); v = Model_Strategy_2 (WLS); vi = Model_Product_1; vii = Model_Product_2; viii = Model_Instrument_1 (WLS); ix = Model_Instrument_2 (WLS).

```
. lrtest i . , df(85)
Likelihood-ratio test
> LR chi2(85)
>          =  250,08
(Assumption: . nested in i)
> Prob > chi2 =    0,0000
```

```
. lrtest ii . , df(85)
Likelihood-ratio test
> LR chi2(85)
>          =  297,99
(Assumption: . nested in ii)
> Prob > chi2 =    0,0000
```

```
. lrtest iii . , df(85)
Likelihood-ratio test
> LR chi2(85)
>          =  295,09
(Assumption: . nested in iii)
> Prob > chi2 =    0,0000
```

```
. lrtest iv . , df(85)
Likelihood-ratio test
> LR chi2(85)
>          =  239,69
(Assumption: . nested in iv)
> Prob > chi2 =    0,0000
```

```
. lrtest v . , df(85)
Likelihood-ratio test
> LR chi2(85)
>          =  279,26
(Assumption: . nested in v)
> Prob > chi2 =    0,0000
```

```
. lrtest vi . , df(85)
Likelihood-ratio test
> LR chi2(85)
>          =  300,77
(Assumption: . nested in vi)
> Prob > chi2 =    0,0000
```

```
. lrtest vii . , df(85)
Likelihood-ratio test
> LR chi2(85)
>          =  282,77
(Assumption: . nested in vii)
> Prob > chi2 =    0,0000
```

```
. lrtest viii] . , df(85)
Likelihood-ratio test
> LR chi2(85)
>          =  272,43
(Assumption: . nested in viii)
> Prob > chi2 =    0,0000
```

```
. lrtest ix . , df(85)
Likelihood-ratio test
> LR chi2(85)
>          =  258,11
(Assumption: . nested in ix)
> Prob > chi2 =    0,0000
```

Figure A-2. *Tests for heteroskedasticity according to Wooldridge (2002) and Drukker (2003).*

Note: The models from *i* to *ix* correspond: i = Model Kotari 1; ii = Model Kotari 2; iii = Model Kotari 3; iv = Model Modelo_Strategy_1 (WLS); v = Model_Strategy_2 (WLS); vi = Model_Product_1; vii = Model_Product_2; viii = Model_Instrument_1 (WLS); ix = Model_Instrument_2 (WLS).

APPENDIX B

Additional Estimates (Robustness).

	robusti b/se
derivmktas~t	0,001**
	(0,001)
_cons	2,622***
	(0,077)

	robustii b/se
derivmktas~t	0,001
	(0,001)
lnValmercpat	-0,294***
	(0,061)
lev	0,132
	(0,131)
BM	0,279
	(0,273)
_cons	5,104***
	(0,639)

	robustiii b/se
lnValmercpat	-0,298***
	(0,063)
lev	0,152
	(0,133)
BM	0,309
	(0,259)
_cons	5,146***
	(0,654)

	dris_kraayi b/se
derivmktas~t	0,001***
	(0,000)
_cons	2,622***
	(0,306)

	dris_kraayii b/se
derivmktas~t	0,001**
	(0,000)
lnValmercpat	-0,294***
	(0,043)
lev	0,132**
	(0,053)
BM	0,279
	(0,253)
_cons	5,104***
	(0,687)

	dris_kraay~i b/se
lnValmercpat	-0,298***
	(0,046)
lev	0,152***
	(0,035)
BM	0,309
	(0,247)
_cons	5,146***
	(0,703)

Figure B–1. *Estimates according to Driscoll and Kraay (1998) – corresponding, respectively, to models: Model Kotari_1; Model_ Kotari 2 (WLS); Model_Kotari 3 (WLS).*

	robusti b/se
derivmktas~t	0,001**
	(0,001)
_cons	2,622***
	(0,077)

	robustiv b/se
estcambio	0,003*
	(0,001)
estjuros	-0,004
	(0,003)
_cons	2,635***
	(0,079)

	robustv b/se
lnValmercpat	-0,265***
	(0,055)
lev	0,140
	(0,127)
BM	0,295
	(0,262)
estcambio	0,004**
	(0,002)
estjuros	-0,009**
	(0,004)
_cons	4,828***
	(0,573)

	dris_kraayi b/se
derivmktas~t	0,001***
	(0,000)
_cons	2,622***
	(0,306)

	dris_kraayiv b/se
estcambio	0,003***
	(0,001)
estjuros	-0,004
	(0,003)
_cons	2,635***
	(0,303)

	dris_kraayv b/se
lnValmercpat	-0,265***
	(0,021)
lev	0,140***
	(0,044)
BM	0,295
	(0,263)
estcambio	0,004***
	(0,001)
estjuros	-0,009
	(0,006)
_cons	4,828***
	(0,461)

Figure B–2. *Estimates according to Driscoll and Kraay (1998) – corresponding, respectively, to models: Model Kotari_1; Model_ Strategy 1 (WLS); Model_Strategy 2 (WLS).*

	robusti b/se
derivmktas~t	0,001**
	(0,001)
_cons	2,622***
	(0,077)

	robustvi b/se
estswap	0,003**
	(0,001)
estfuturos	-0,004
	(0,005)
estopcoes	0,002
	(0,004)
estforward	0,002
	(0,002)
_cons	2,589***
	(0,090)

	robustvii b/se
lnValmercpat	-0,288***
	(0,057)
lev	0,171
	(0,128)
BM	0,219
	(0,252)
estswap	0,003**
	(0,001)
estfuturos	-0,021**
	(0,009)
estopcoes	-0,003
	(0,005)
estforward	0,007**
	(0,003)
_cons	5,010***
	(0,587)

	dris_kraayi b/se
derivmktas~t	0,001***
	(0,000)
_cons	2,622***
	(0,306)

	dris_kraayvi b/se
estswap	0,003***
	(0,001)
estfuturos	-0,004
	(0,004)
estopcoes	0,002
	(0,001)
estforward	0,002**
	(0,001)
_cons	2,589***
	(0,286)

	dris_kraay~i b/se
lnValmercpat	-0,288***
	(0,038)
lev	0,171***
	(0,022)
BM	0,219
	(0,235)
estswap	0,003***
	(0,001)
estfuturos	-0,021**
	(0,009)
estopcoes	-0,003
	(0,002)
estforward	0,007***
	(0,003)
_cons	5,010***
	(0,592)

Figure B-3. *Estimates according to Driscoll and Kraay (1998) – corresponding, respectively, to models: Model Kotari_1; Model Product_1; Model Product 2.*

	robusti b/se
derivmktas~t	0,001**
	(0,001)
_cons	2,622***
	(0,077)

	robustviii b/se
prodscambio	0,005***
	(0,001)
prodsjuros	-0,003
	(0,002)
prodfcambio	0,002
	(0,005)
prodfjuros	-0,006
	(0,006)
prodocambio	0,022*
	(0,012)
prodojuros	-0,010**
	(0,005)
prodwcambio	0,003
	(0,002)
_cons	2,581***
	(0,091)

	robustix b/se
lnValmercpat	-0,265***
	(0,056)
lev	0,185
	(0,124)
BM	0,231
	(0,238)
prodscambio	0,005***
	(0,001)
prodsjuros	-0,003
	(0,002)
prodfcambio	0,001
	(0,004)
prodfjuros	-0,040***
	(0,005)
prodocambio	0,020*
	(0,012)
prodojuros	-0,022***
	(0,004)
prodwcambio	0,013***
	(0,002)
_cons	4,725***
	(0,562)

	dris_kraayi b/se
derivmktas~t	0,001***
	(0,000)
_cons	2,622***
	(0,306)

	dris_kraay~i b/se
prodscambio	0,005***
	(0,001)
prodsjuros	-0,003
	(0,002)
prodfcambio	0,002
	(0,003)
prodfjuros	-0,006
	(0,004)
prodocambio	0,022***
	(0,004)
prodojuros	-0,010**
	(0,005)
prodwcambio	0,003**
	(0,001)
_cons	2,581***
	(0,289)

	dris_kraayix b/se
lnValmercpat	-0,265***
	(0,023)
lev	0,185***
	(0,022)
BM	0,231
	(0,249)
prodscambio	0,005***
	(0,001)
prodsjuros	-0,003
	(0,002)
prodfcambio	0,001
	(0,003)
prodfjuros	-0,040***
	(0,005)
prodocambio	0,020***
	(0,005)
prodojuros	-0,022***
	(0,006)
prodwcambio	0,013***
	(0,001)
_cons	4,725***
	(0,409)

Figure B-4. *Estimates according to Driscoll and Kraay (1998) – corresponding, respectively, to models: Model Kotari_1; Model_ Instrument_1 (WLS); Model_Instrument_2 (WLS).*