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SPECULATION-HEDGING ACTIVITY IN FUTURES MARKETS, RELATION WITH VOLATILITY AND CAUSE EFFECTS.

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Abstract:

This dissertation will analyse the relation between speculation-hedging activity, measured using Lucia and Pardo's (2010) ratio, and price volatility, calculated in a intraday and interday perspective, and its cause effects, in Futures Contracts. The study will use regression analyses and Granger Causality tests in S&P 500, Nikkei and DAX futures daily data from 2000 to 2015. The conclusions will give more insights about the future contracts demand activity, as the methodology explore the contractual perspective of the contracts instead of the trading perspective as the past literature, complementing in that way the conclusions obtained in Carchano et al. (2011).

Esta dissertação irá analisar a relação entre a atividade de especulação e cobertura de risco, medida através do rácio de Lucia e Pardo (2010), e a volatilidade no preço, calculada numa perspetiva intradiária e interdiária, e os seus efeitos de causalidade, nos contratos de Futuros. O estudo irá utilizar regressões e testes de causalidade de Granger nos dados diários de 2000 a 2015 dos contratos de futuro de S&P 500. Nikkei e DAX. As conclusões darão mais detalhes sobre o tipo de atividade presente nos contratos de futuro, uma vez que a metodologia explora uma perspetiva contractual ao invés da perspetiva de compra e venda como na literatura antecedente, complementando assim as conclusões obtidas por Carchano et al. (2011).

Keywords: Speculation, Hedging, Volume, Open Interests.

JEL classification: D84, G14.

Index:

1) Introduction:

It is usually accepted that the demand for hedging is the main and most important reason for the existence of futures contracts. Although speculation is a requirement for the efficient growth of the futures market, due to its capacity to facilitate hedging operations, it is important to state what is the main purpose of futures market in light of the criticism and doubts of the efficiency of these market and the effects that they can have in the spot underlying market. A higher knowledge will lead to a more efficient and transparent market as it can avoid unnecessary regulation or improve its mechanisms.

Investors can find in futures market the possibility of hedging, transferring their undesired risk, and speculating, if they are looking for profit in price fluctuations. In both situations price uncertainty must exist to make them viable. When hedging, the investor looks to cancel the risk associated to price movements and when speculating he looks to take that risk in his own advantage. In that way, volume and price volatility in futures market are usually correlated and a lot of research was done in this field. To build a proxy to capture the speculation-hedging demand it has to be focused on two variables, the open interests, which is more capable to evaluate the real quantity of positions of a contract that are currently in the market, and the volume, a measure of the quantity of contracts that are traded between investors. As hedgers tend to hold their positions during a long period of time due to the need to hedge the risk, the open interest are more related to hedging demand. On other hand the volume is more related to speculative activity, due to the nature of speculators to do intraday trading and to hold a contract during a shortest time. This lead to Lucia and Pardo's (2010) Ratio that measures daily contracting activity.

Later literature found strong contemporaneous relation between volume and volatility in futures contracts (Karpoff 1987) and, under the classification of Commodity Futures Trading Commission, hedging demand is more related to volatility than speculative demand (Pan et al. 2003), Hedgers dominates the futures market (Ciner 2006) and hedging activity adds volatility to a trading day (Carchano et al. 2011).

What moves the investors' beliefs to hedge and speculate? Are the futures contracts used with the right purposes? The aim of this dissertation is to understand the relation between speculation-hedging activity, using the absolute values of Lucia and Pardo's (2010) Ratio, and price volatility and their causal relations in futures market. This study will improve the knowledge about the dynamics of the proposed speculation-hedging proxy and what determines its behaviour complementing Carchano et al. (2011), with a different methodology that consider two different types of volatility. The optical change from trading (volume-price relation) to contracting activity (speculation-hedging activity-price relation) is what distinguish this study from previous literature. The use of the Lucia and Pardo's (2010) ratio also distinguish from later studies that usually analysed the speculation-hedging activity under the classification of CFTC. Through regression analyses and causality tests, the conclusions will help to increase the knowledge about investors' reactions and give some insights about the speculation-hedging activity in futures market and its relation with price. As a doubtful and regulated market, the information is important to the decision making of the market participants. The regulation is active in the market, and their policies have serious impact in its development. The increase and dissemination of the technology in financial markets, and the importance of these markets in the world economy, led to constant alterations that will need always a constant evaluation of problems benefits, and, in that way, constant analysis to support the regulation.

For the empirical test, the selected futures contracts will be E-mini S&P 500, S&P 500 Futures, DAX Futures and Nikkei Futures. The daily data is obtained in Bloomberg database. Regression analysis and Granger causality tests will be used to study the variables selected to capture the speculation-hedging activity and price relation.

The first section of this dissertation will go through the related literature, exploring the derivative securities and market participants, and the concepts of price-volume relationship and speculation-hedging activity. The following sections will show and give insights about the used Data and the Empirical Methodology, with an explanation of the expectations for the results. After that, the dissertation will explore the statistical results obtained, starting with an analysis of the Descriptive statistics of the raw data, going through the Regressions' results, comparing them from the contracting and trading perspective, and finally the outcome gave by the Granger Causality Tests. The last section concern the conclusions of the study.

2) Literature review:

2.1) Derivative securities

The trading of derivatives securities appear in the 1970's as a solution to the dramatically increase of price uncertainty, due to deregulation. The success and growth of these contracts led to an increase of the variety of derivatives, with exchange and over-the counter markets offering forwards, futures, swaps, options and other contracts in a wide range of markets.

Peck (1985) examines the economic benefits of derivatives, with leverage, less transfer costs, transfer of risk, information dissemination and price discovery being the key factors. Fleming et al. (1995) also mention the attractiveness of derivatives for speculation purposes and forecast, providing even more information to the market price, influencing the underlying commodity price, due to arbitrage, and leading it more closely to their true value. The impacts of this in economy contributes to a more efficient allocation of resources in the economy.

However, there is a common public opinion that derivatives destabilize the underlying markets, which is also the argument for the creation of regulation to control derivatives markets. In addition, as discussed by Flemming et al. (1995) there is a tendency to point speculation as the main reason for some crashes in markets and consequent crisis in economy. A good example is that during the Gulf Crisis of 1990-91, there was the proposal of shutting down derivatives markets for a "cooling-off period", according to the United States Senate (1991). To support this position of detraction of futures markets, some consulting reports and studies have related speculative activity to price fluctuations in energy markets, mainly petroleum.

As explained by Weiner (2002), there is three main claims that speculative behaviour influences negatively futures markets. The first one, it drives away prices from fundamental value, usually referred as a "bubble" in the modern finance literature. Second, speculators manipulate the market, influencing the flows with their decision making. And third, speculators support their decisions in technical analysis and watching market tendencies ("herding"), and usually they do not have information about the business and are not aware of market fundamentals.

2.2) Market participants

The financial theory defines three types of traders that can be identified in derivatives markets: hedgers, speculators and arbitrageurs (Hull 2015).

Hedgers use derivatives looking to reduce their risk from potential futures movements in the market. On other hand, speculators use them with the expectation to capitalize the future movements of the market. Keynes (1936) describes that speculation is characterized as an economic activity where speculators ambition potential profit in the short term, and in that way they form expectations to anticipate the market behaviour, contributing to the liquidity of the futures market. Smith (1776) considered that the economic agents, especially speculators are important to increase liquidity in the market and helped to give stability to the prices. The last type of trader are arbitrageurs, and they look to take a risk free profit by using two or more instruments.

There is a need in those who work in finance or related fields to understand derivatives and how they work, and due to the importance in the current economy, even regulation has to understand clearly its variables. This is the main reason that leads to study empirically and theoretically derivatives markets more closely. One of the approaches, and closely the same that motivated this dissertation, is the price-volume relationship in future markets.

Regulators also have an important function in derivatives markets. Regulation is important to control the believed systematic risk of the markets and protect investors and the economy from the financial problems that the markets can create. There is a wide variety of possible interventions from regulation, since trading restrictions to increase of taxes, or simply shutting down markets. However, the causes that support the intervention are not always clear, as shown by Weiner (2002), for the reason that in any derivative market the total open interest must sum zero, as every long position must be completed with a short position, which means that there is a conflict of perspectives and intentions, motivated by market information that is the key to influence the decision making. There is also the possibility that excess of regulation can impose limits to the development and innovation of financial markets.

2.3) Price-Volume relationship

Within financial and derivatives markets, this study will focus on the futures market. The need to understand better the futures markets and its possible impacts in financial markets motivated many efforts to study it closely. The price-volume relationship has been studied and analysed several times during the last years, with the variables being important to understand the behaviour of investors and their interaction with the market.

Theoretical models that are underlying to this two variables behaviour were built as a basis to start the works and simplify the reality. The most know theoretical frameworks are the Mixture of Distribution Hypothesis (MDH), where both variables have a joint dependence on a common directory event or variable, and the Sequential Arrival of Information (SAI), which differs in the possibility of forecast due to sequential relation between the variables.

Clark (1973) and Epps & Epps (1976) were the first to introduce MDH and more recently Andersen (1996) refined it, and many empirical studies supported the theory, finding evidences for a strong contemporaneous relation between price and volatility. Clark (1973) used cotton futures to test the relation, Cornell (1981) analysed 17 commodities, Tauchen & Pitts (1983) based their study in Treasury Bills Futures Market, Grammatikos & Saunders (1986) took 5 Foreign Currencies Futures data, Garcia et al. (1986) also studied commodities future data with improved Rutledge (1979) methodology and Bhar & Malliaris (1998) focused also in 5 currencies futures. These are some of the most known empirical works in futures market to study the price-volume relation. Karpoff (1987) made a survey for the later studies of this thematic in futures and spot markets, presenting close results to support the MDH and discussing issues related to it.

The methodology was improved and refined along the years, with recent data and from different contracts, but variables were closely the same. In futures market, usually the volume is the number of contract trading, with some assumptions due to price limits and trend, and the volatility was estimated using the absolute or squared price change of the same future contract.

Copeland (1976) introduced the SAI, and results from studies have reached different conclusions. Not all supported the theory, usually tested using Granger causality tests. The test can conclude if a variable can cause another, and that can confirm the sequential information effect (Hiemstra & Jones 1994). With the improvement of techniques and the introduction of GARCH, some like Najand & Yung (1991), Kocagil & Shachmurove (1998) and Mougoué & Aggarwal (2011) empirical work supported this theory. Accordingly to some literature (Kocagil & Shachmurove, 1998) the absence of causality are more frequent in high volume markets, meaning that efficiency, defined by Fama, increases with trading activity.

Some other literature focused on the determinants of volume, including in regressions more variables besides price volatility. Martell & Wolf (1987) and Malliaris & Urrutia (1991) concluded that the price variance is the variable with higher relation, but the explanatory power increased with the introduction of more variables in the models.

Other research focused in the impact of Futures trading in spot volatility, due to the criticism that they could destabilize the equity market. It was mainly agreed that the introduction of futures market lead to more information freely distributed (Grossman 1977) and increased the depth and efficiency of the underlying market (Bessembinder & Seguin 1992; Lafuente-Luengo 2009; Antoniou & Holmes 1995; Lee et al. 2012).

2.4) Speculation-Hedging activity and Price relationship

Chen et al. (1995) developed a model to analyse the behaviour of Open Interests (OI) in S&P 500 Futures. As then defended by Chang et al. (2000), to measure market participation, OI is a better proxy than volume when the aim is to capture the impact of trading intentions. OI represents the number of contracts outstanding, ignoring in that way the activity promoted by day traders and scalpers that is captured with volume. For instance, OI can detect more efficiently the aggregate demand, which will enable to measure the level of hedging activity. Chen et al.'s Model used implied variance from S&P options and concluded that the OI increases as the underlying volatility increases. These relations support that the trading demand in futures markets for hedging purposes increases as the risk increases in the underlying market.

Chang et al. (2000) examined the relation between volatility and the demand for hedging using S&P 500 stock index futures contracts. They tracked the daily OI of contracts for hedging and for speculation using the Commodity Futures Trading Commission (CFTC) records. The CFTC classifies traders as large or small if they exceed a minimum number of contracts, and if they are large, their position is classified as commercial, when taken to hedge specific risk, and non-commercial, when taken for reasons other than hedging. In that way the data can be classified as large hedger, large speculators and small traders. The daily price volatility was estimated in two ways. The first one using Parkinson (1980) estimator and the second through a GARCH model, both using prices of futures contracts and divided into expected and unexpected volatility. Pan et al. (2003) extended this research using recent data, improved models and more volatility estimates. A implied volatility using S&P 500 Index Futures Options, a conditional volatility estimate calculated from S&P 500 Index returns (GARCH model), and the CBOE's Volatility Index (VIX) were used. The empirical research concluded that hedgers and spot volatility estimate has a positive relation, and speculators are moved by risk premium. The research also focused on a speculation index (Working 1960), that supported Peck's (1981) findings to be negatively related with volatility, and hedging pressure (De Roon et al. 2000) where was found that volatility has an explanatory power.

However, the CFTC classification is not widely accepted. Peck (1982) highlighted the limitations of the data and the possibility to bias the information. In that way it is important to define alternatives to measure market activity. Lucia and Pardo (2010) criticise and analyse two possibilities of ratios and propose one that serves as a proxy of hedging-speculative demand using volume and open interest data. The use of ratios using variables related to the volume of a contract was introduced in Rutledge (1979) and Garcia et al.'s (1986) works. Carchano et al. (2011) analysed the influence of trading activity and contracting activity in index future volatility (intraday Garman-Klass-type). They used Lucia and Pardo's (2010) ratio to measure contracting activity and noted the importance of studying separately the closing and opening of contracts, as they can lead to different interpretations. The used regression to investigate the relationship could capture the persistence of volatility shocks, the flows of entering trades and cancelling trades and also the Relative Net Number of Open Positions (RNOP), the proxy suggested by Lucia and Pardo (2010). Despite being stated that there is no general conclusions for the different futures contract (S&P500, Nikkei and DAX), the main conclusions of the study was that hedgers add volatility to the trading day, in contrast to speculators that have no influence.

Ciner (2006) examines a different approach to analyse the motivations behind futures trading activities. The LMSW model is used (Llorente et al. 2002) to track who dominates the market of crude oil, heating oil and unleaded gasoline. The model works under the assumption that when hedging (speculation) is the primary motive, high volume days will be followed by price reversals (continuation). This theory is closely in line with Wang's (2003) findings, using CFTC's classification, where speculators (hedgers) activity are positively (negatively) correlated with subsequent abnormal returns. Ciner (2006) concluded that hedgers dominates the market, as well as Ederington & Lee (2002), using CFTC's classification.

Brunetti & Büyükşahin (2009) highlight the different types of speculative traders, and the importance to understand if Noise Traders, the ones who makes irrational decisions, or the behaviour of herding led to price variations or inflation. They conclude that the market of commodities was not destabilized by this type of investment behaviour.

Speculation-hedging activity in futures markets, relation with volatility and cause effects.

3) Data

The selected data for the empirical study will be stock index futures contracts, namely E-mini S&P 500 (ES1), S&P 500 futures (SP1), DAX Futures (GX1) and Nikkei Futures (NK1), and their respective underlying stock index (Table 1). The database is obtained from Bloomberg continuous series, in a daily frequency from the 1st of January 2000 to the 31st of December 2015, except for Nikkei futures where the available data starts in the 18th of September 2007.

Table 1 – Analysed contracts
This table summarize the characteristics of the four analysed contracts in this study

Contract	Type	Exchange	Underlying asset
E-mini S&P 500	Index Future	CME	S&P 500 stock index
S&P 500 futures	Index Future	CME	S&P 500 stock index
DAX Futures	Index Future	Eurex	DAX stock index
Nikkei 225 Future Contract	Index Future	SGX, OSE, CME	Nikkei 225 stock index

For each contract it was obtained the daily aggregated Open Interests, the daily aggregated Volume and the daily Open, Close, Higher and Lower price. For each underlying asset it was obtained the daily Open and Close price.

S&P 500 futures and E-mini S&P 500 are traded in Chicago Mercantile Exchange (CME), one of the most diverse derivatives marketplace, sharing the same underlying asset, the S&P 500 stock index, with the contract unit being $250 and $50 times it respectively, being traded in the March quarterly cycle. Two years is what separates the S&P 500 futures first trading date and last trading date, a day before settlement. Although in E-mini S&P 500 it is 1 year and 3 months, with the last trading date matching the settlement date. Due to the lower size and the exclusivity of being fully electronic, the E-mini S&P 500 have the advantages of having a more liquid market, due to a greater affordability for individual investors and continuous trading hours.

DAX Futures are traded in the Eurex exchange market, the largest European futures and options market, and its underlying asset is the DAX stock index, a stock market index consisting of the 30 major German companies trading on the Frankfurt Stock Exchange. The contract value is 25€, with a standard duration of 9 months in the three nearest quarterly months of the March, June, September and December cycle. The last trading day is the final settlement day, which is the third Friday of each maturity month, or the next trading day if it is not a trading day.

The Nikkei 225 Future Contract is the future contract of the stock market index for the Tokyo Stock Exchange, composed by a number of Japanese companies. The Future Contract is traded at Singapore Exchange (SGX), Osaka Securities Exchange (OSE) and CME. In this last market it is traded in Yen and Dollar. The Future has quarterly contract months, for the months of March, June, September and December. The last trading day is the business day preceding the second Friday of each contract month. The value of each contract unit is ¥10,000.

4) Empirical methodology

This study will test the relation between price volatility and the Speculation-Hedging activity (aforementioned also as SHA) (1) in futures markets, calculated with the absolute values of Lucia and Pardo's (2010) ratio:

$$SHA_t = \left|\frac{\Delta OI_t}{V_t}\right| \tag{1}$$

where OI_t is the open interests and V_t the volume of occurred transactions of a contract on day t. The relation between the two variables is the Lucia and Pardo's (2010) ratio on day t.

The values of the ratio range between -1 and 1, as the maximum change in Open Interest is bounded to the volume. When it presents extreme values, it means that, in that day, the volume transacted corresponded to the number of closed or opened positions, if -1 or 1, respectively. A positive (negative) number will indicate more (less) number of opened positions than liquidated positions. When the ratio assumes the values of -1 or 1, it means that all the parties involved in the transactions, liquidated or took new positions in the contract analysed. The closer to zero the ratio is, the more intraday transactions occurred in that day. With absolute values of Lucia and Pardo's ratio, defined in this study as SHA, the differentiation of opening and closing of contracts is ignored and will range between 0 and 1. Values close to 0 indicates that the volume of trading contracts was very few related with the opening or closing of positions, and values close to 1, the volume of trading contracts was mainly due to the opening or closing of positions in that contract. Under the assumption that hedgers tend to maintain their positions for more than one day, and hedgers tend to trade within a day, the SHA can be interpreted as being more related to speculation activity when close to 0 and more related to hedging activity when close to 1. The SHA allows to evaluate the contracting activity of a contract, which permits to analyse the demand in a contracting perspective.

The objective is to understand how the speculation-hedging activity is related to different types of volatility. The hedging activity should be the main purpose of the futures markets, and increase with volatility of the underlying market (Chen et al. 2005). To understand its behaviour a regression analysis will be used to capture the impact of intraday and interday volatility, and see if it is in line with previous studies. In the literature, this approach is a change from a trading perspective (where only volume matters) to a contracting perspective (where volume and open interest have influence). To evidence the differences, both perspectives will be analysed and compared. Causality tests will be used to understand the impact of how the change of perspective can influence the implied relations and find different, or more conclusive, evidences than later works. Both tests will support the mixed distribution hypothesis and the sequential arrival of information theories, respectively, that leads to the understanding of the relation between the price and volume or speculation-hedging activity of contracts.

The obtained data is divided and analysed in two data series, one from 2000 to 2015 and another from 2008 to 2015, due to the importance of the year of 2008 in the financial markets.

The relation between SHA and price variation will be tested with an Ordinary Least Squares (OLS) linear regression analysis that will be used to obtain the coefficients of the following model:

$$\log\left(\frac{SHA_t}{SHA_{t-1}}\right) = \alpha + \beta_1 \log\left(\frac{\sigma_{et}}{\sigma_{et-1}}\right) + \beta_2 \log\left(\frac{\sigma_{at}}{\sigma_{at-1}}\right) + \mathcal{E}, \qquad (2)$$

where SHA_t represents the Speculation-Hedging activity on day t, the constant α can be interpreted as the normal speculation-hedging activity, the variable σ_{et} represents the interday volatility on day t, and σ_{at} measures the intraday volatility on day t and $\mathcal{E}$ the errors.

Due to some cases of inconsistency on the data obtained, the unrealistic values of the SHA, i.e. outside logical limits, and the 400th outliers or 200th outliers of the data from 2000 to 2015 or 2008 to 2015 respectively (roughly 10%) will drop the final data.

Relatively to the constant, as Ciner (2006) and Ederignton and Lee (2002) stated, hedgers dominates the market. To be in line with these findings, the constant should have a value slightly higher than 0.

The variable σ_{et} represents the interday volatility on day t and it will be calculated using the Exponentially Weighted of the historical price returns of the underlying market. The interday volatility should capture the volatility of the analysed securities from information between days. Its calculation is based in the Close-to-close method using weight for the previous jumps to keep the historical presence. The reason that makes an investor to demand hedging is a commitment in spot or forward markets that involves risk exposure (Lucia and Pardo 2010). With an increase in volatility that risk may increase and in that way investors will look to hedge it. It is expected that hedging activity dominates when there is high interday volatility, as it was supported by Chen et al. (2005). The β_1 value is expected to have a positive signal. Assuming a statistical significance, this means that when there is a high interday volatility, investors also look to hedge their positions, meaning a value of SHA closer to 1.

The variable σ_{at} represents the intraday volatility, and it will be calculated using the estimator created by Parkinson (1980), ${\sigma_{Pat}}_t$ (3), and Rogers-Satchell (1991), ${\sigma_{RSat}}_t$ (4). The intraday volatility captures the price variation within a day. The first volatility estimator was introduced by Parkinson in 1980, and is calculated using the high and low prices of the contract. The Rogers-Satchell approach, a variation introduced in the early 1990s, is a more powerful estimator as it includes opening and closing prices in the calculation. These estimators assume continuous trading, ignoring potential movements outside the trading hours and then underestimating the volatility. It is usually accepted that the Rogers-Satchell estimator is more efficient than the Parkinson estimator, although some studies have shown that the Parkinson estimator is the best measure for empirical data.

$$Volatility_{Parkinson} = {\sigma_{Pat}}_t = \sqrt{\frac{1}{4N\ln(2)}\sum_{t=1}^{N}\left(\ln\left(\frac{H_t}{L_t}\right)\right)} \tag{3}$$

$$Volatility_{Rogers-Satchell} = {\sigma_{RSat}}_t = \sqrt{\frac{1}{N}\sum_{t=1}^{N}\ln\left(\frac{H_t}{C_t}\right)\ln\left(\frac{H_t}{O_t}\right) + \ln\left(\frac{L_t}{C_t}\right)\ln\left(\frac{L_t}{O_t}\right)}, \tag{4}$$

where it is used for N days the open (O_t), close (C_t), high (H_t) and low (L_t) prices of the contract on day t.

In this study, the Parkinson estimator is calculated using a 1 day sample and the Rogers-Satchell estimator is calculated using a 5 day sample, in order to have two different in efficiency estimators to cover some differences and allow to increase the range of possible conclusions.

It is expected to have a negative relation with contracting activity, i.e. a negative β_2, assuming that high intraday volatility creates more conditions for speculative investors, assuming their preference for daily trading. The value of the proxy is then expected to assume lower values, close to 0, in a scenario of high intraday volatility.

However, it is also expected to have some differences on the results accordingly to the future contract analysed, namely contracts with high trading volume. The liquidity of a market can enhance to more efficiency (Kocagil and Sachmurove 1998). However, that liquidity will match easily different beliefs, creating conditions to either speculation or hedging, and the SHA may not capture properly the activity.

To compare with the trading perspective the following regression, similar to (2), will be analysed:

$$\log\left(\frac{V_t}{V_{t-1}}\right) = \alpha + \beta_1 \log\left(\frac{\sigma_{et}}{\sigma_{et-1}}\right) + \beta_2 \log\left(\frac{\sigma_{at}}{\sigma_{at-1}}\right) + \mathcal{E}, \tag{5}$$

where the dependent variable V_t represents the Volume of a contract on day t.

The main objective is to state if the conclusions holds the same or not, supporting or not the importance of changing to a contracting perspective.

Granger Methodology will be used to identify if the variables have causality relation. The used variables will be the same as the one presented in the regression analysis. A Granger causality states that X Granger causes Y, meaning that X past values can improve the forecasts of the present value of Y, in a statistical sense. The Granger causality tests are essentially important to support the existence of a sequential arrival of information. It is important to note if there is causality effects between SHA and volatility to track the information provided by the market. Later literature studied this possibility under the trading perspective and did not get consensual conclusions, as for example the ambiguous conclusions of Bessembinder and Seguin (1993) and Chen et al. (1995). With the change to a contracting perspective, the methodology may polish some of those issues. The conclusions can also support some evidences that contracts with low volume reveal more causality effects and then they are less efficient, to be in line with Kocagil and Sachmurove (1998).

5) Descriptive statistics

The descriptive statistics of the raw data obtained from contracts that will be analysed, allow us to better understand the context of the information that will be produced. Recapitulating, it was obtained data from four index future contracts, SP1, ES1, GX1 and NK1, where the first two share the same underlying asset. The data is divided in two data series, one from 2000 and 2015 and another from 2008 and 2015.

Looking for the descriptive statistics of the volume of the contracts (Table 2) and open interest (Table 3), it is easy to conclude that the ES1 is the most liquid contract, having, in the data from 2008 to 2015, a mean daily volume of 2.052 thousands and a mean daily open interests of 2.834 thousands.

Table 2 – Descriptive statistics: Variable Volume

This table reports general descriptive statistics as Mean, Standard-Deviation and Range of the raw daily volume data of the four analysed contracts in the two data series, from 2000 to 2015 and 2008 to 2015

Volume - Data from 2000 to 2015

	SP1	*ES1*	*GX1*
Mean	51.753,72	1.371.084,37	130.409,74
Standard-Error	797,38	15.510,70	1.108,68
Median	36.851,50	1.221.059,50	120.523,50
Standard-deviation	50.543,86	984.410,03	70.329,20
Sample Variance	2.554.681.988	969.063.116.443	4.946.195.751
Kurtosis	4,95	1,17	6,34
Asymmetry	1,99	0,91	1,72
Range	460.020	6.914.463	668.267
Minimum	160	12197	8.759
Maximum	460.180	6.926.660	677.026
Sum	207.946.461	5.522.727.861	524.768.805
Count	4.018	4.028	4.024

Volume - Data from 2008 to 2015

	SP1	*ES1*	*GX1*	*NK1*
Mean	28.676,65	2.051.924,59	148.320,21	83.796,05
Standard-Error	811,28	18.272,20	1.430,38	1.004,14
Median	15.777,50	1.907.556,00	137.643,00	74.095,00
Standard-deviation	36.390,19	820.826,77	64.176,26	44.352,79
Sample Variance	1.324.246.064,90	673.756.594.339,85	4.118.592.821,27	1.967.170.058,62
Kurtosis	12,30	3,09	8,11	12,90
Asymmetry	3,17	1,22	2,01	2,62
Range	298.110	6.830.558	650.544	497.794
Minimum	160	96.102	26.482	16.136
Maximum	298.270	6.926.660	677.026	513.930
Sum	57.697.427	4.140.783.832	298.568.587	163.486.086
Count	2.012	2.018	2.013	1.951

Table 3 – Descriptive statistics: Variable Open Interests

This table reports general descriptive statistics as Mean, Standard-Deviation and Range of the raw daily Open Interests of the four analysed contracts in the two data series, from 2000 to 2015 and 2008 to 2015

Open Interests - Data from 2000 to 2015

	SP1	*ES1*	*GX1*
Mean	443.808,62	1.800.425,93	213.858,24
Standard-Error	3.044,18	18.341,20	1.085,39
Median	488.907,50	2.182.143,00	192.038,00
Standard-deviation	193.251,71	1.164.196,69	68.868,99
Sample Variance	37.346.225.241	1.355.353.934.977	4.742.937.744
Kurtosis	-1,30	-1,48	1,77
Asymmetry	-0,30	-0,25	1,36
Range	739.753	411.0346	441.883
Minimum	80.043	13.007	110.486
Maximum	819.796	4.123.353	552.369
Sum	1.788.548.733	7.253.916.075	860.993.263
Count	4.030	4.029	4.026

Open Interests - Data from 2008 to 2015

	SP1	*ES1*	*GX1*	*NK1*
Mean	300.368,31	2.834.276,09	178.941,68	405.511,55
Standard-Error	3.471,03	7.488,89	737,43	1.569,61
Median	269.255,00	2.813.462,00	170.916,00	397.650,00
Standard-deviation	156.003,27	336.500,64	33.094,21	69.471,79
Sample Variance	24.337.019.774	113.232.681.492	1.095.226.422	4.826.329.691
Kurtosis	-0,34	0,91	0,88	2,39
Asymmetry	0,77	0,38	1,00	1,05
Range	689.334	2.355.348	209.675	511.807
Minimum	80.043	1.768.005	117.200	259.519
Maximum	769.377	4.123.353	326.875	771.326
Sum	606.743.983	5.722.403.418	360.388.540	794.397.117
Count	2.020	2.019	2.014	1.959

For the ES1 index future, the mean of the variables Volume and Open Interest increases in the most recent years, as oppose to the SP1 index future, which shares the same underlying asset, where the mean of the variables decreased. This phenomenon is possibly related to the characteristics of the E-mini contracts, that suits better the modern trading behaviours and preferences of investors. Nowadays, the technology of information has a growing importance in the financial markets.

The GX1 index contract, when comparing the two different data series, presents an increase in the mean of daily volume, and a decrease in the mean of daily open interests.

The descriptive statistics of SHA (Table 4) shows that the ES1 contract has the lower mean for that variable in both data series, followed by the GX1 contract and NK1 contract. This states that usually there is more speculation activity in the ES1 than the others, a justification for the higher liquidity as speculators bring it as defended by Smith (1776). The SP1 contract is the one with the highest mean. This order is the opposite of the one stated in the Volume descriptive statistic (Table 2). It is also important to note that the ES1 contract is the one with the lower amplitude of values, followed by GX1 contract, NK1 contract and finally SP1 contract. When comparing the contracts that share the same underlying asset, we state that the ES1 contract decreases its amplitude of values when changing the data series from the data between 2000 and 2015 to the data between 2008 and 2015, and the SP1 contract increases its amplitude of values. This relation is probably related to the increase in the liquidity of the ES1 contract and the decrease in the liquidity of the SP1 contract, showing evidence that the increase in liquidity brings stability to the SHA.

Table 4 – Descriptive statistics: Variable SHA

This table reports general descriptive statistics as Mean, Standard-Deviation and Range of the calculated SHA (used in regressions) of the four analysed contracts in the two data series, from 2000 to 2015 and 2008 to 2015

SHA - Data from 2000 to 2015

	SP1 SHA	*ES1 SHA*	*GX1 SHA*
Mean	0.0801	0.0178	0.0303
Standard-Error	0.0013	0.0003	0.0005
Median	0.0515	0.0128	0.0207
Standard-deviation	0.0783	0.0158	0.0292
Sample Variance	0.0061	0.0002	0.0009
Kurtosis	2.3457	2.6655	3.5175
Asymmetry	1.6298	1.6070	1.8216
Range	0.3775	0.0862	0.1585
Minimum	0.0038	0.0011	0.0018
Maximum	0.3813	0.0873	0.1603
Sum	289.99	67.00	113.51
Count	3,620	3,768	3,750

SHA - Data from 2008 to 2015

	SP1 SHA	*ES1 SHA*	*GX1 SHA*	*NK1 SHA*
Mean	0.1215	0.0135	0.0216	0.0637
Standard-Error	0.0024	0.0003	0.0004	0.0014
Median	0.0874	0.0098	0.0158	0.0458
Standard-deviation	0.1036	0.0119	0.0189	0.0589
Sample Variance	0.0107	0.0001	0.0004	0.0035
Kurtosis	1.1297	3.1895	2.4022	3.5220
Asymmetry	1.2826	1.6884	1.5612	1.7896
Range	0.4812	0.0704	0.0970	0.3200
Minimum	0.0067	0.0009	0.0016	0.0042
Maximum	0.4879	0.0713	0.0986	0.3242
Sum	217.94	25.42	40.66	117.12
Count	1,794	1,886	1,886	1,838

6) Regressions

For the conclusions, when running the linear regressions, if the coefficients of the variables presents a p-value lower than 0.05, the selected significance level in this study, the null hypothesis will be rejected, meaning that the coefficient is statistically significant, which support that the variations of the independent variables have contemporaneous relation in the variations of the dependent value. The regressions can only conclude about the relations between variables. To conclude about causality between variables, a Granger test will also be further analysed.

6.1) Contracting Perspective

For the first regression, where we analyse the relation between the percentage variation in the SHA and the percentage variation in the intraday, calculated with the Parkinson's approach, and in the interday volatility using data from 2000 to 2015, the intraday and interday volatility are significant in the ES1 contract, as can be seen in the Table 5. The coefficient of the intraday volatility percentage variation presents a positive value in the ES1 contract and the interday volatility presents a negative value in the ES1 contract. The same regression variables in the data series from 2008 to 2015 holds the same results (Table 5) for the interday volatility in the ES1 contract and also have the intraday volatility percentage variation as statistically significant in the NK1 contract. Although the coefficient for the NK1 contract presents a negative value.

The results show us that, in the ES1 contract, there is a positive variation in the SHA as the intraday volatility in that contract increases and interday volatility decreases. In that way, the coefficient values of the ES1 contract, presents an opposite result from the expectations, as they support that the hedging activity increases when the intraday volatility increases and the interday volatility decreases. In this way, hedging activity increases in days with high variations in prices within a day, and decreases when there is more variation of prices between days.

Table 5 – (2) Regression results: Intraday volatility with Parkinson approach

This table presents the estimated coefficients and their p-value of the regressions on the variables of the contracting perspective (percentage variation of the SHA as dependent variable) the R-squared and Adjusted R-squared, for the 4 analysed contracts in the two analysed data series, from 2000 to 2015 and 2008 to 2015. The intraday volatility is calculated with Parkinson approach.

		Dependent Variables			
Independent Variables		*Var. SHA SP1*	*Var. SHA ES1*	*Var. SHA GX1*	*Var. SHA NK1*
Data Series from 2000 to 2015	Constant	0.00	0.00	0.00	
	p-value	*0.96*	*0.93*	*0.69*	
	Interday Volatility	-0.21	-0.86	0.20	
	p-value	*0.37*	*0.00*	*0.17*	
	Intraday Volatility (Parkinson)	0.01	0.19	-0.05	
	p-value	*0.77*	*0.00*	*0.29*	
	R-Squared	*0.00*	*0.02*	*0.00*	
	Adjusted R-squared	*0.00*	*0.02*	*0.00*	
Data Series from 2008 to 2015	Constant	0.00	0.00	0.00	0.00
	p-value	*0.80*	*1.00*	*0.93*	*0.76*
	Interday Volatility	0.29	-0.82	0.07	-0.56
	p-value	*0.38*	*0.01*	*0.03*	*0.11*
	Intraday Volatility (Parkinson)	-0.03	0.13	-0.06	-0.22
	p-value	*0.63*	*0.06*	*0.33*	*0.00*
	R-Squared	*0.00*	*0.01*	*0.00*	*0.01*
	Adjusted R-squared	*0.00*	*0.01*	*0.00*	*0.01*

In the SP1 the results (Table 5) were not statistically significant. Despite that, in the data series from 2000 to 2015, the signals of the estimated coefficients for the SP1 contract where against the expectations, negative in the variation of the interday volatility and positive in the variation of the intraday volatility. For the same contract in the data series from 2008 to 2015 the coefficients signals were in line with the expectations.

The estimated results, in relation to the percentage variation of the intraday volatility, for the NK1 contract, and in relation to the percentage variation of the interday volatility, for the GX1 contract, in the data series from 2008 to 2015 are in line with the expectations, and statistically significant. This duality in the results may be related to the difference in the liquidity of the contracts.

In the second regression, it was analysed the relation between SHA percentage variation and the intraday volatility, calculated with the Rogers-Satchell approach, and interday volatility percentage variation from 2000 to 2015 and 2008 to 2015. The results are presented in the Table 6.

Table 6 - (2) Regression results: Intraday volatility with Rogers-Satchell approach

This table presents the estimated coefficients and their p-value of the regressions on the variables of the contracting perspective (percentage variation of the SHA as dependent variable) the R-squared and Adjusted R-squared, for the 4 analysed contracts in the two analysed data series, from 2000 to 2015 and 2008 to 2015. The intraday volatility is calculated with Rogers-Satchell approach.

		Dependent Variables			
	Independent Variables	*Var. SHA SP1*	*Var. SHA ES1*	*Var. SHA GX1*	*Var. SHA NK1*
Data Series from 2000 to 2015	Constant	0.00	0.00	0.00	
	p-value	*0.96*	*0.92*	*0.69*	
	Interday Volatility	-0.29	-1.34	0.21	
	p-value	*0.20*	*0.00*	*0.13*	
	Intraday Volatility (Rogers-Satchell)	0.27	0.56	0.14	
	p-value	*0.10*	*0.00*	*0.41*	
	R-Squared	*0.00*	*0.01*	*0.00*	
	Adjusted R-squared	*0.00*	*0.01*	*0.00*	
Data Series from 2008 to 2015	Constant	0.00	0.00	0.00	0.00
	p-value	*0.96*	*0.99*	*0.93*	*0.79*
	Interday Volatility	-1.07	-1.13	0.07	-0.02
	p-value	*0.00*	*0.00*	*0.03*	*0.96*
	Intraday Volatility (Rogers-Satchell)	-0.10	0.25	0.14	-0.42
	p-value	*0.64*	*0.25*	*0.53*	*0.05*
	R-Squared	*0.01*	*0.01*	*0.00*	*0.00*
	Adjusted R-squared	*0.01*	*0.01*	*0.00*	*0.00*

For the second regression, in the longest analysed data period, both independent variables are statistically significant in the ES1 contracts (Table 6). The coefficients present the same signals as in the first regression, which translates in statistical evidence against the expectations of this study.

In the same data series, for the SP1 and GX1 contract, the estimated values are not statistically significant, with only the coefficient of the interday volatility of the GX1 contract being in line with the expectations.

For instance, in the shortest data series there is slightly different results, with statistically significance of the intraday volatility percentage variation only in the NK1 contract and the interday volatility percentage variation in the SP1, ES1 and GX1 contracts. The coefficient for the intraday volatility in the NK1 contract is negative, in line with the expectations, and the coefficient for the interday volatility is positive for the GX1 contract, as expected, and negative for the SP1 and ES1 contracts.

The results show that the volatility percentage variation in the intraday and interday volatility is not a strong explanatory variable for the behaviour of SHA percentage variation. The used models have a poor explanatory value, reaching an adjusted R-square between 0.02 and 0.00, with the ES1 contract always having the highest values in the different approaches. It is important to remind the complexity of the derivatives market as the conclusions of Marten & Wolf (1987) shows, where the explanatory power of their used models increased with more variables.

The different calculations of the intraday volatility and the different periods of the data has some impacts in the results of the analysed regressions. This can be a consequence of the increase in regulation or overview of the financial markets that are more present in the most recent data series. Nevertheless, the regressions calculated with the intraday volatility calculated with the Parkinson approach resulted in higher R-Squares.

Despite some support to conclusions are obtained, as there is evidence that the intraday and interday volatility are slightly related to the speculative and hedge demand, the results, and how the variables interact with each other cannot be translated in clear conclusions, as we cannot confirm neither oppose our expectations. No general conclusions can be supported for the different future contracts, as also stated by Carchano et al. (2011).

The opposite results between the ES1 and the other contracts can be related to the difference of liquidity, and therefore the expected returns for this contract can be influenced by the time that the contract is hold. In that way, the assumptions that speculators close their positions within a day can mislead the analysis of the expectations. In that way, it would be important to analyse if the behaviour of the variables is recurrent in contracts more liquid than the analysed in this study or to include a variable to capture this effect, as for example the risk-premium.

6.2) Trading Perspective

To better understand the contracting perspective and its importance to the study of the type of demand that is present in a certain contract, some comparative regressions will also be analysed. The comparative regressions use the same independent variables as before, the percentage variation of the intraday volatility calculated with the Parkinson or Rogers-Satchell approach, and the percentage variation of the interday volatility calculated with expecting weighted moving average. The difference stands in the dependent variable being the daily percentage variation of the Volume of one contract, which means a change to a trading perspective, as it measure the quantity of trading.

The models were also divided in two different data series, the longest with data from 2000 to 2015, and the shortest with data from 2008 to 2015.

Looking into the results (Table 7) the model using data from 2008 to 2015 has the highest adjusted R-squared and in both scenarios the ES1 contract regression is generally the one with the highest R-squared. The obtained values range between 0.12 and 0.30 using the longest data series, and 0.12 and 0.37 using the shortest data series. It is possible to notice that the results are much higher than the ones obtained in the trading perspective, meaning that the independent variables have more explanatory power for the daily Volume percentage variation of a contract than for the type of demand in that contract, captured by the SHA.

Looking into the significance of the independent variables and their coefficients (Table 7), in the estimations using data from 2000 to 2015, the intraday volatility percentage variation is statistically significant in the three analysed contracts and the coefficients have a positive value. The intraday volatility percentage variation is also statistically significant and have a positive value in the models of the four analysed contracts using data from 2008 to 2015. This means that the increase in the percentage variation of the volume is higher when there is a higher percentage variation of the intraday volatility.

Table 7 - (5) Regression results: Intraday volatility with Parkinson approach

This table presents the estimated coefficients and their p-value of the regressions on the variables of the trading perspective (percentage variation of the Volume as dependent variable) the R-squared and Adjusted R-squared, for the 4 analysed contracts in the two analysed data series, from 2000 to 2015 and 2008 to 2015. The intraday volatility is calculated with Parkinson approach.

		Dependent Variables			
	Independent Variables	*Var. VOL SP1*	*Var. VOL ES1*	*Var. VOL GX1*	*Var. VOL NK1*
Data Series from 2000 to 2015	Constant	0.00	0.00	0.00	
	p-value	*0.88*	*0.86*	*0.98*	
	Interday Volatility	0.08	0.25	0.00	
	p-value	*0.19*	*0.00*	*0.95*	
	Intraday Volatility (Parkinson)	0.26	0.31	0.35	
	p-value	*0.00*	*0.00*	*0.00*	
	R-Squared	*0.12*	*0.30*	*0.30*	
	Adjusted R-squared	*0.12*	*0.30*	*0.30*	
Data Series from 2008 to 2015	Constant	0.00	0.00	0.00	0.00
	p-value	*0.90*	*0.99*	*0.99*	*0.99*
	Interday Volatility	0.06	0.30	0.00	0.26
	p-value	*0.54*	*0.00*	*0.82*	*0.00*
	Intraday Volatility (Parkinson)	0.33	0.36	0.35	0.36
	p-value	*0.00*	*0.00*	*0.00*	*0.00*
	R-Squared	*0.12*	*0.37*	*0.36*	*0.36*
	Adjusted R-squared	*0.12*	*0.37*	*0.36*	*0.36*

The interday volatility is statistically significant only in the ES1 contract in both analysed data series, and in the NK1 contract in the data from 2008 to 2015, always presenting a positive value in the coefficient. In that way, there is statically evidence that the positive variation in the volume are related to positive variations in the intraday volatility.

One conclusion to obtain from the models used to analyse the trading perspective is that the volatilities percentage variation are more related to the daily volume percentage variation of a contract than to the percentage variation of the SHA. This can indicate that there is other variables than the volatility that influence investors' decisions and beliefs and the volatility do not help to clarify traders' intentions without more information about the market, or in other words, to understand and study the contracting perspective. This conclusion can support the importance to understand the positive or negative factors of traders' intentions, mainly the impacts of Noise Traders, as discussed by Brunetti & Büyükşahin (2009).

Looking into the combined results of the regressions, in the ES1 contract, the one which regressions have best explanatory power in the analysed contracts, there is an increase in transactions and an increase in speculative activity when there is an increase in interday volatility. For instance, there is an increase in transactions and an increase in hedging activity when there is an increase in intraday volatility. These results can support that the future markets can answer rapidly to the demand for hedging purposes, and that demand is related to great activity in the contract, meaning that the future markets are important for the financial markets. With the Granger causality tests, we can better understand if the intraday or interday volatility and the volume or the proxy have cause effects that allow us to understand better these relation.

7) Granger Causality

The objective of testing the Granger causality is to find statistically evidence if one variable can help to forecast the future values of another one, and then support the SAI in the volume-volatility relationship and SHA-volatility relationship to obtain evidence of more information about the type of demand present in the volume of a contract. In this test, the p-value of the results will be statistically significant if lower than 0.05, meaning that the tested null hypothesis, that one variable does not Granger causes another, is rejected.

It was analysed the causality relations between the three variables used in equation (2) and (5), both trading and contracting perspective, in the three or four future contracts, if the data was from 2000 to 2015 or 2008 to 2015 respectively. The only difference for the data used in the regression analysis is the assumption of the values of days where the SHA dropped due to the unrealistic values as zero percentage variation, to complete the time series. The use lags where 1, 2, 5, 10, 15, 20 and 30 days, which allow to analyse the impact of past data from one working day to one and a half month of working days.

In the trading perspective, where the results are shown in the Table 8 and Table 9 for the data series from 2000 to 2015 and 2008 and 2015 respectively, there is strong evidence of Granger causality between variables.

Table 8 – P-Value: Granger Causality tests for (5) – Parkinson approach.

This table presents the estimated p-value of the Granger Causality tests between the variables of the trading perspective of the three analysed contracts, at lags 1, 2, 5, 10, 15, 20, 30, with data from 2000 to 2015.

Data from 2000 to 2015		*1*	*2*	*5*	*10*	*15*	*20*	*30*
Var. Interday volatility Granger causes Var. Volume	*SP1*	0.000	0.000	0.001	0.001	0.002	0.001	0.004
	ES1	0.000	0.000	0.000	0.000	0.000	0.001	0.099
	GX1	0.659	0.439	0.729	0.816	0.117	0.244	0.428
Var. Volume Granger causes Var. Interday volatility	*SP1*	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	ES1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	GX1	0.007	0.000	0.000	0.002	0.005	0.024	0.131
Var. Intraday volatility Granger causes Var. Volume	*SP1*	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	ES1	0.390	0.001	0.000	0.000	0.000	0.001	0.007
	GX1	0.223	0.002	0.000	0.000	0.000	0.000	0.000
Var. Volume Granger causes Var. Intraday volatility	*SP1*	0.823	0.476	0.011	0.122	0.000	0.058	0.062
	ES1	0.015	0.000	0.000	0.000	0.000	0.000	0.000
	GX1	0.058	0.022	0.030	0.017	0.010	0.004	0.003

In the longest data series (Table 8), there is statistical support to reject the null hypothesis of a variable to not Granger cause another, and in that way having potential to forecast it in various scenarios. The null is rejected for the percentage variation of the volume to not Granger cause interday volatility percentage variation in the 3 contracts, in almost every lag, and to not Granger cause intraday volatility percentage variation in the ES1 and GX1 contracts. The percentage variation of the volatilities to not Granger cause the percentage variation of the volume have statistical support to not reject the null only in the GX1 contract, with the interday volatility in every lag.

In the shortest data series (Table 9), the conclusions are similar. The exceptions are the statistical support to not reject the null of the interday volatility percentage variation to Granger cause volume percentage variation in the SP1 contract at lags 1, 2, 5 and 10 and of the volume percentage variation to Granger cause intraday volatility percentage variation in the GX1 contract at lags 1, 2, 5, 10 and 15. There is also statistical evidence to reject the null of every volume and volatilities Granger relations between each other in the NK1 contract in mostly every lag.

Table 9 – P-Value: Granger Causality tests for (5) – Parkinson approach

This table presents the estimated p-value of the Granger Causality tests between the variables of the trading perspective of the four analysed contracts, at lags 1, 2, 5, 10, 15, 20, 30, with data from 2008 to 2015.

Data from 2008 to 2015		1	2	5	10	15	20	30
Var. Interday volatility Granger causes Var. Volume	*SP1*	0.077	0.079	0.126	0.089	0.016	0.004	0.007
	ES1	0.000	0.000	0.000	0.000	0.001	0.005	0.157
	GX1	0.988	0.511	0.639	0.820	0.058	0.135	0.245
	NK1	0.000	0.000	0.000	0.000	0.001	0.066	0.163
Var. Volume Granger causes Var. Interday volatility	*SP1*	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	ES1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	GX1	0.056	0.007	0.005	0.004	0.014	0.048	0.218
	NK1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Var. Intraday volatility Granger causes Var. Volume	*SP1*	0.001	0.000	0.000	0.000	0.000	0.000	0.000
	ES1	0.009	0.000	0.000	0.000	0.000	0.000	0.000
	GX1	0.098	0.000	0.000	0.000	0.000	0.000	0.000
	NK1	0.008	0.000	0.000	0.000	0.000	0.001	0.001
Var. Volume Granger causes Var. Intraday volatility	*SP1*	0.017	0.232	0.043	0.294	0.078	0.117	0.207
	ES1	0.011	0.000	0.000	0.000	0.000	0.000	0.000
	GX1	0.625	0.172	0.165	0.067	0.053	0.041	0.045
	NK1	0.201	0.008	0.000	0.004	0.020	0.020	0.023

Similarly, and as expected, to the relation analysis between variables, the Granger causality test shows different results when changing from a trading perspective to a contracting perspective. The Granger causality tests for the contracting perspective also do not support a general conclusion for the analysed contracts.

In the data series between 2000 and 2015 the results of the test (Table 10) support the rejection of the null in the testing of the SHA percentage variation to Granger cause the interday volatility percentage variation in the ES1 and GX1, at almost every lags.

Table 10 - P-Value: Granger Causality tests for (2) – Parkinson approach

This table presents the estimated p-value of the Granger Causality tests between the variables of the contracting perspective of the three analysed contracts, at lags 1, 2, 5, 10, 15, 20, 30, with data from 2000 to 2015. The intraday volatility is calculated with the Parkinson approach.

Data from 2000 to 2015		1	2	5	10	15	20	30
Var. Interday volatility Granger causes Var. SHA	*SP1*	0.871	0.852	0.550	0.684	0.643	0.551	0.756
	ES1	0.021	0.071	0.166	0.273	0.278	0.547	0.673
	GX1	0.865	0.441	0.134	0.127	0.127	0.171	0.091
Var. SHA Granger causes Var. Interday volatility	*SP1*	0.964	0.500	0.693	0.703	0.511	0.552	0.718
	ES1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	GX1	0.928	0.000	0.000	0.004	0.003	0.005	0.000
Var. Intraday volatility Granger causes Var. SHA	*SP1*	0.501	0.640	0.419	0.488	0.323	0.402	0.252
	ES1	0.820	0.399	0.726	0.643	0.903	0.915	0.831
	GX1	0.296	0.484	0.379	0.716	0.765	0.800	0.665
Var. SHA Granger causes Var. Intraday volatility	*SP1*	0.646	0.457	0.624	0.652	0.816	0.678	0.770
	ES1	0.360	0.455	0.610	0.703	0.819	0.830	0.539
	GX1	0.654	0.680	0.550	0.834	0.490	0.504	0.664

With the change to the data series from 2008 to 2015, the GX1 loses the evidence to reject the null (Table 11), but holds in the ES1. In that way we have evidence that the percentage variation of the SHA Granger causes the interday volatility percentage variation in the ES1 contract in the data series from 2000 to 2015 and 2008 to 2015 and in the GX1 contract in the data series from 2000 to 2015.

Table 11 - P-Value: Granger Causality tests for (2) – Parkinson approach

This table presents the estimated p-value of the Granger Causality tests between the variables of the contracting perspective of the four analysed contracts, at lags 1, 2, 5, 10, 15, 20, 30, with data from 2008 to 2015. The intraday volatility is calculated with the Parkinson approach.

Data from 2008 to 2015		*1*	*2*	*5*	*10*	*15*	*20*	*30*
Var. Interday volatility Granger causes Var. SHA	*SP1*	0.381	0.403	0.654	0.867	0.574	0.355	0.340
	ES1	0.270	0.023	0.129	0.240	0.079	0.149	0.126
	GX1	0.451	0.058	0.061	0.039	0.051	0.091	0.063
	NK1	0.672	0.047	0.422	0.574	0.576	0.644	0.657
Var. SHA Granger causes Var. Interday volatility	*SP1*	0.620	0.803	0.781	0.778	0.543	0.382	0.196
	ES1	0.000	0.000	0.000	0.000	0.002	0.006	0.006
	GX1	0.708	0.927	0.093	0.337	0.633	0.524	0.250
	NK1	0.203	0.003	0.027	0.149	0.338	0.316	0.218
Var. Intraday volatility Granger causes Var. SHA	*SP1*	0.175	0.145	0.326	0.274	0.128	0.312	0.255
	ES1	0.797	0.968	0.997	0.954	0.986	0.988	0.990
	GX1	0.106	0.242	0.227	0.627	0.855	0.744	0.758
	NK1	0.315	0.106	0.246	0.400	0.378	0.356	0.389
Var. SHA Granger causes Var. Intraday volatility	*SP1*	0.386	0.877	0.650	0.484	0.719	0.471	0.044
	ES1	0.968	0.433	0.390	0.311	0.450	0.395	0.165
	GX1	0.593	0.959	0.998	0.892	0.833	0.919	0.779
	NK1	0.028	0.033	0.103	0.482	0.695	0.679	0.893

Changing the approach of the intraday volatility calculation, the results of the Granger test only changes for the causal relations with the changed variable. Despite that, in the tests with both approaches, the majority of the results support that there is no causal relation between the SHA and intraday volatility percentage variation (Table 10, Table 11, Table 12 and Table 13). There is statistical evidence to reject the null hypothesis of the SHA percentage variation to not Granger cause the percentage variation of the intraday volatility in the ES1 contract, at the lags 1 and 2, with the Rogers-Satchell approach with the data from 2000 to 2015 (Table 12) and in the NK1 contract, at lag 5, with the Parkinson approach with the data from 2008 to 2015 (Table 11). There is no evidence of causal relations between the intraday volatility, with Rogers-Satchell approach, and SHA in the data from 2008 to 2015 (Table 13).

Table 12 - P-Value: Granger Causality tests for (2) – Rogers-Satchell approach

This table presents the estimated p-value of the Granger Causality tests between the intraday volatility, calculated with the Rogers-Satchell approach and the SHA (contracting perspective) of the four analysed contracts, at lags 1, 2, 5, 10, 15, 20, 30, with data from 2000 to 2015.

Data from 2000 to 2015		1	2	5	10	15	20	30
Var. Intraday volatility Granger causes Var. SHA	*SP1*	0.726	0.262	0.673	0.312	0.063	0.186	0.113
	ES1	0.259	0.540	0.121	0.401	0.484	0.608	0.615
	GX1	0.561	0.506	0.617	0.674	0.817	0.913	0.562
Var. SHA Granger causes Var. Intraday volatility	*SP1*	0.409	0.392	0.723	0.707	0.681	0.852	0.951
	ES1	0.234	0.093	0.012	0.095	0.205	0.450	0.281
	GX1	0.523	0.773	0.920	0.967	0.940	0.942	0.961

Table 13 - P-Value: Granger Causality tests for (2) – Rogers-Satchell approach

This table presents the estimated p-value of the Granger Causality tests between the intraday volatility, calculated with the Rogers-Satchell approach and the SHA (contracting perspective) of the four analysed contracts, at lags 1, 2, 5, 10, 15, 20, 30, with data from 2008 to 2015.

Data from 2008 to 2015		1	2	5	10	15	20	30
Var. Intraday volatility Granger causes Var. SHA	*SP1*	0.101	0.281	0.691	0.189	0.427	0.540	0.529
	ES1	0.577	0.566	0.355	0.246	0.172	0.142	0.476
	GX1	0.451	0.130	0.383	0.497	0.439	0.594	0.376
	NK1	0.941	0.258	0.090	0.088	0.136	0.080	0.187
Var. SHA Granger causes Var. Intraday volatility	*SP1*	0.307	0.497	0.655	0.468	0.586	0.748	0.278
	ES1	0.196	0.139	0.496	0.580	0.702	0.511	0.647
	GX1	0.908	0.695	0.711	0.501	0.690	0.565	0.272
	NK1	0.086	0.223	0.263	0.260	0.493	0.319	0.598

When comparing to the trading perspective, the results show less causality between the variables. This can mean that the activity in a contract and the volatility are related and have causal effects, and there is no specification about the type of activity and how it can affect the market. In that way, the question that usually rise about the negative influence of speculators in the market do not have support in this study. The study gives also support to the SAI theory in the price-volume relation, without discrimination in the origin of the volume.

Although, for the ES1 contract, the results give some support that the SHA variation Granger causes interday volatility in the six tested lags, in the different analysed models. We can conclude that in this contract, the SHA helps to forecast the values of the interday volatility. Taking into account the conclusions of the regressions for this contract, there is support that the increase of hedging activity causes a decrease in the interday volatility of the ES1 contract. This means, under the assumptions of this study, that the prices, and consequent volatility, of this future contract are influenced negatively by the demand of traders with hedging purposes, and positively by the demand of traders with speculative purposes. This conclusion, that there is statistical evidence that hedgers can Granger cause effects in volatility, is also stated by Carchano et al. (2010). Despite that the results in this study do not support that they add volatility to a trading day.

This study do not support the conclusion of Kocagil and Sachmurove (1998) that the absence of causality are more frequent in markets with high volume. Although we cannot refute this conclusion, despite the ES1 being the most liquid contract and the one with more causality evidences, as there is only comparison between the ES1 and SP1 contracts.

The obtained results support the importance to look into the data in a contracting perspective, as more information where used in the models, and some conclusion could not be supported in both models. This information should be taken into account when there is assumption that effects of one variable can impact the raw volume of a contract, but do not have specific consequences on the type of demand. The results also should alert for the use of alternative variables to study the speculation-hedging activity and price relationship.

8) Conclusion

The study of the derivative markets and their determinants is a high priority for the recent financial literature. One of the most focused analysis is the relation between the volume and the price of a derivative contract. The relation is essentially divided in two models, the Mixture of Distribution Hypothesis and the Sequential Arrival of Information. The type of demand that contributes for the volume of a derivative contract is having, in recent studies, more importance for the questions and conclusions, leading to models of analyses as the LMSW, studies with CFTC data or the development of proxies like Lucia and Pardo's (2010) one.

This study focused in the speculation-hedging activity, using the Lucia and Pardo's (2010) proxy, and price relation, complementing Carchano et al. (2011), with a different methodology that consider two different types of volatility. The optical change from trading (volume-price relation) to contracting activity (speculation-hedging activity-price relation) is what distinguish this study from later literature.

The SP1, ES1, GX1 and NK1 contracts were analysed in this study, using two different data series, one form 2000 to 2015 and another from 2008 to 2015. It was clear that the ES1 was the most liquid contract, due to the characteristics of the contract. The ES1 contract was also the one with the lower speculation-hedging activity, in the different data series, meaning that speculative activities is more present in this contract than the others analysed. The relation of liquidity and presence of speculators is defended by Smith (1776).

In the regression analysis and Granger causality tests, similarly to the identified by Carchano et. al (2010), no general conclusions can be supported for the relation between speculation-hedging activity and price, as there is not enough or clear evidence, in the contracts analysed, to identify similar results.

Although, the ES1 contract regressions, the ones with the higher explanatory power, shows that the increase in hedging activity are more related to days with increase in intraday volatility, i.e., with higher variation of the price within days, and to days with decrease in interday volatility, i.e., with higher variation of the price between days. These conclusions are against the expectations of this study, and can be related to the characteristics of the ES1 contract and highlight the differences and complexity compared to the others. They can also be an evidence that the market of the contract answers rapidly to the needs of hedgers, supporting their effectiveness or that, speculators can be more stimulated with other variables, like risk premium, that cannot be captured with this study.

Comparting the results of the regressions with the Volume as dependent variable, instead of the Speculation-hedging activity, the explanatory power is higher and there is more statistically significant evidence of relation between the variables, confirming the support to the MDH of the past literature as show in Karpoff (1987). Although, as stated by past literature (Chang et al. 2000), the variable of volume by itself does not give enough information about the investors intentions that origins the volume.

The Granger Causality tests are essential to understand de Sequential Arrival of Information, as it supports or not that the variables analysed helps to forecast the future values. The results shows more causality evidence in the trading perspective than in the contracting perspective. The SP1, ES1, GX1, NK1 contract shows high evidence of causality between the variables in the trading perspective.

In the contracting perspective, the Granger Causality tests supports less evidence to not reject the null hypotheses in the determined level of significance a p-value of 0.05. There is more evidence of causality in the ES1 contract, as opposite to the conclusions of Kocagil and Sachmurove (1998) that there is less evidence of causality in the most liquid contracts. The results support that in the ES1 contract the variation in the SHA helps to forecast the interday volatility. There is not significant differences between the tested lags, neither with the used data series. However it is important to consider the evolution of technology, regulation and development of the market in the analyses, as certainly they influence the behaviour of variables.

Despite being not possible to draw general conclusions, as Carchano et al. (2010), there is statistical evidence to support that, in the ES1 contract, the increase in speculation activity in a future, bring volatility to the future underlying asset, and the increase in hedging activity have the opposite relation. The conclusion, that there is statistical evidence that speculation-hedging activity can Granger cause effects in volatility, is also stated by Carchano et al. (2010).

The relation of the speculation-hedging activity with the price or volatility in future markets may not be the better aspect to take into account to understand the investors intentions and what motivates them. As oppose to the trading perspective, with the volume-price relation, where the conclusions can be interpreted as the fundamentals of the demand and supply law, the contracting perspective should involve in future studies the presence of other variables or effects than the analysed in this study.

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