FINANCIAL VOLATILITY AND DERIVATIVES PRODUCTS: A BIDIRECTIONAL RELATIONSHIP

Claudiu Tiberiu ALBULESCU
Politehnica University of Timişoara
Timisoara, Romania
claudiu.albulescu@ct.upt.ro

Daniel GOYEAU
University of Poitiers
Poitiers, France
daniel.goyeau@univ-poitiers.fr

Abstract

This paper studies the dynamics of the relationship between the volume of transactions with derivative products and prices volatility of their underlying asset. This relation was widely approached, but mainly from the perspective of the impact of derivative products on the volatility of their underlying assets. The fact that hedging as well as speculative operations with derivative products are based on the price volatility of their underlying asset leaves a priori room to the idea according to which the volume of activity related to derivative products has to follow in a unidirectional manner the price volatility of the underlying assets. However, more recently, the possibility of a bidirectional relationship was put forward, supported by a certain markets imperfection and by an informational asymmetry between the traders. We look into this causality relationship considering the equity index products (futures and options) and the stock exchange markets which are members of the Euronext.liffe, except for the Lisbon. We compute a VAR and we perform causality tests in the sense of Granger. In general, it seems difficult to formulate a firm conclusion on the informational content of the derivative markets and on the object (hedging or speculation) of the dominant operations, in the context in which the causality relationships which occur differ considerably between one product and another and between one country and another.

Keywords: financial volatility, derivative products, VAR, Granger causality, Euronext.liffe
JEL classification: G12, G15, C22

1. INTRODUCTION

The consequences of an excessive financial volatility are well recognized. Financial volatility is generally associated with the incertitude related to the future financial flows and to the discount rate [BIS, 2006] and there are multiple factors which influence it. Financial volatility first results from the real volatility (of the GDP), but other factors such as the economic and financial liberalization [see Milles, 2002], the architecture of the markets, the distribution of assets owned by investors, the costs of the transaction, the financial innovations, …. were put forward.

As Antoniou and Holmes [1995] observe, the worries related to the impact of contracts futures upon the spot markets manifested since the very first transactions with futures on the Chicago Board of Trade, in 1865. Analyses focused on the responsibility of speculators in amplifying the volatility and they highlight the fact that an increase of the volatility is undesirable. The impact of the derivative products introduction on the volatility of the underlying assets was largely scrutinized after the Asian crisis and it still stands for a subject of interest nowadays, in the context of the present worldwide crisis.

From the empirical point of view, the influence of derivative products on the volatility of the underlying assets was approached in two different manners. The first approach compares financial volatility before and after the introduction of derivative products (in particular the futures contracts). The second approach, more recent, investigates the impact of derivatives on the behaviour of the underlying assets, including on their volatility. This latter approach reaches two different sets of results [Bandivadekar and Ghosh, 2003]. The first one alleges that the introduction of derivative products will lead to an increase of the volatility on the spot markets, thus destabilizing these markets [Figlewski, 1981; Stein, 1987]. The second set of results, unlike the first one, supports the idea that the introduction of derivative products contributed to reducing the volatility [Powers, 1970; Schwarz and Laatsch, 1991]. Nevertheless, most of the researches promote contradictory arguments in respect of the effects of derivative products on the price volatility of the underlying assets [Dennisa and Sim, 1999]. We have to note that most of the studies capture the impact of the introduction of futures and options on the stock price volatility. However, few researches [Zapatero, 1998] look to other financial assets, such as for example the interest rate.

The fact that both hedging and speculative operations with derivative products are based on the price volatility of their underlying asset a priori leaves room to the idea according to which the volume of activity related to derivative products has to follow in a unidirectional manner the price volatility of the underlying assets. Therefore, if a more powerful assets volatility is anticipated, risk managers inchoate hedging operations while speculators take or strengthen their position by means of derivative products.

At the same time, this unidirectional connection, from the price volatility of the underlying assets towards the volume of transactions with derivative products, suppose the existence of perfect markets with homogeneous information, being also required that the volume of transactions does not provide information to the operators in respect of the future volatility of the underlying assets. Nevertheless, if there are traders better informed than others and if they are not capable of exactly anticipating the price volatility, the causality from the price volatility of the underlying assets towards the volume of transactions with derivative products is no longer necessarily a unidirectional relation. Practically, so far as the derivative products provide lower transaction costs and higher leverage effects, the traders who are better informed are susceptible of being more attracted by the derivative products than by their underlying assets. In this case, if the better informed traders lead the markets, the volume of transactions with derivative products has to forego the price volatility of the underlying assets.

In general, the sense of the causality between the volume of transactions with derivative products and the price volatility of the underlying assets would depend on the level of markets perfection of the as well as on the nature of the operations (hedging or speculation) which prevail on the derivatives markets. The distinction between the hedging and the speculative operations is not well-marked. Nevertheless, we may consider that the speculative operations prevail in case the growth of the derivative products volume amplifies the volatility of the underlying assets, and, the reverse situation, that the hedging operations are more frequent if the increase of the derivative products volume results in a drop of the volatility.

The analysis of this double causality between the volume of transactions with derivative products and the financial volatility is of recent interest in literature. Most of the researches interrogate the role played by derivatives in amplifying financial volatility and they make use of daily of intra-daily data. An exception in this respect is the paper developed by Jeanneau and Micu [2003] which shows, based on monthly data, that a high volatility on the financial markets entails an augmentation of the transactions on the derivative products markets. More recently, Sarwar [2005] and Buhr et al. [2010] have tested the double potential causality between volume of transactions on options and the volatility of the S&P 500 index, respectively that of the ASX 200 index.

In this paper, we intend to analyse the dynamics of the causality relationship between the volume of transactions with equity index products (futures and options) and the prices volatility of their underlying asset, on the financial markets members of the Euronext.liffe. We have eliminated from the calculations the transactions performed on the Lisbon stock exchange, because of the limited number of data available for the analysed period and of the strong volatility registered with number of traded contracts. The index volatility is estimated based on the historic volatility, measured by means of the standard deviation of the stock market index returns, calculated for a rolling window of twelve months, and on the conditional volatility, computed based on a GARCH(1,1) model.

Our analysis distinguishes from the previous literature and mainly from the researches of Sarwar (2005) and Buhr et al. (2010), in respect of two main aspects. On the one hand, our paper proceeds to an analysis of the relationship stability, concurrently scrutinizing the markets of several countries, the United Kingdom, France, Netherlands and Belgium. On the other hand, it simultaneously considers the contracts futures and options. It is possible to meet causality differences in as far as the contracts options are the only financial products allowing to bet directly on the price volatility of the underlying assets.

The rest of the paper is structured as follows. A first section proposes a review of the literature on the relationship financial volatility – derivative products. The second part describes the data and the applied methodologies and it briefs the results of the econometrical estimations. Finally, the last section summarizes the main findings.

2. REVIEW OF THE LITERATURE

The literature approaching the topic of the connection between financial volatility and derivative products was for a long time developed in one single direction and its endeavour was to emphasize the impact of derivative products on the price volatility of the underlying assets. From the theoretical point of view, there are two main antagonizing approaches.

The first approach supports the idea that the transactions with derivative products lead to an increase of the volatility on the spot markets. The derivatives markets, through the leverage effect they provide, attract the investors, situation which is susceptible to generate an augmentation of the volatility on the spot markets. Moreover, the liquidity existing on this latter market directs towards the derivative products and this liquidity reduction might amplify the volatility on the spot markets.

The other approach considers that the introduction of derivatives diminishes the price volatility of the underlying assets. Thus, several arguments are put forward to support this theory. Skinner [1989] alleges that there are certain conditions to be met in respect of the underlying asset in order for a contract with these products to be listed. These selection criteria give confidence to the investors who expect a reduction of the volatility of the assets returns after the introduction of derivatives. Other voices argue that the derivative products markets, due to their complexity, generally draw in better informed investors. Fedenia and Grammatikos [1992] also reckon that the bid-ask spreads on the stock market can diminish after the introduction of derivative contracts on these stocks and, if so, the volatility of the stock market would decrease.

From the empirical point of view, the outcomes are very contradictory [Charupat, 2006]. They are influenced by the market type, assets type, volatility calculation method and selected periods. We have to note that most of the papers analyze the impact of the introduction of equity index futures on the volatility of the underlying assets. Amongst these researches, there are some showing that the introduction of derivatives amplified the volatility of the underlying assets (see for example the researches of Robinson [1994] on the FTSE 100 index, of Reyes (1996) on the CAC 40 index, of Antoniou et al. [1998] on DAX 100 and Swiss MI indices and those of Antoniou and Holmes [1995] on the FTSE 100 index). Few studies illustrate, from the empirical perspective that the intensification of derivatives transactions leads to a lessening of the underlying assets volatility. Using an EGARCH model, Kasman and Kasman [2008] reach the conclusion that the futures introduction lowers the conditional volatility of the ISE 30 index. Nevertheless, a considerable number of papers either do not find a significant effect in this respect [Edwards, 1988; Darrat and Rahman, 1995] or underline only a reduced effect [Dennisa and Sim, 1999; Jeanneau and Micu, 2003].

These contradictory results are mainly influenced by the retained volatility concept. The first papers on this subject measure the non-conditional variance while other studies estimate the conditional variance, depending on its past values. Recent researches use the ARCH (Autoregressive Conditional Heteroskedasticity), GARCH (Generalized ARCH) or TGARCH (Threshold GARCH) models, which take into account the heteroskedasticity of assets returns.

Practically, in order to measure the volatility, it is necessary to make a distinction between long-range volatility (months, years) and the short-range volatility (hours, days). If the long term volatility is influenced in particular by the economic fundamentals and institutional changes, on short-range, the volatility is generated by the pressure and turmoil ascertained in respect of the transaction process, as well as by the noises. An important accent has lately fallen on this latter type of volatility which depends on its past values.

Daly [2008] depicts an exhaustive presentation of the financial volatility calculation techniques and makes a distinction between statistic methods and time-varying measures of volatility. A common measure of stock market volatility is the standard deviation of returns. For example, Cushman [1983] makes use of a rolling window of four observations to measure the standard deviation of the exchange rate, as a proxy for the exchange rate volatility.

These measures of volatility are referred to as time invariants measures. However, the variance of stock returns is widely acknowledged to be time-varying and, consequently, the usefulness and efficiency of time invariant measures have been questioned. This resulted into increasing attempts to develop time-varying methods to calculate the volatility (volatility depends on its past values). The best known models reaching this purpose are ARCH model (developed by Engle [1982]) and GARCH model which represents an extension of the ARCH model into a generalized one (developed by Bollerslev [1986]). GARCH is an intuitive model to predict volatility.

Another concept of volatility is now often used, more specifically the implied volatility. This type of volatility is identified using a model of Black and Scholes based on observed stock prices and its stands for a measure of volatility anticipated by the market. Thus, Jeanneau and Micu [2003] use the actual volatility, measured by means of the annualized standard deviation of the assets price change, and the implied volatility.

In our paper, we do not retain the delineation between fundamental volatility and transitory noise volatility. Actually, in so far as our analysis is aimed at investigating the causality between the volume of transactions with derivative products and the price volatility of their underlying asset, it seems difficult to explain why the operators' hedging or speculative attitudes on the markets would differ, depending on the type of observed or predicted volatility (either fundamental or noise volatility). At the same time, we leave aside, as most of the recent researches do, the implied volatility. Practically, in so much as it depends on the in-the-money, at-the-money and out-of-the-money nature of the options (volatility smile), the relation between the volume of transactions with derivatives and the volatility of the underlying assets is susceptible of being distorted by the evolution of the type of exchanged options (in-the-money, at-the-money and out-of-the-money). Besides, the results of Buhr et al. [2010] show that, on the Australian market, the activity of call options near-the-money and in-the-money has a significant predictive ability for the price volatility of underlying assets, while the market activity of call options out-of the-money only has a poor or even no predictive ability. At the same time, because we retain the aggregate volume of contracts options traded on each of the markets, it seems delicate to retain the concept of implied volatility to perform our analysis.

Therefore, in order to approximate the spot markets volatility, we retain two concepts of volatility: historic volatility and conditional volatility. Thus, the GARCH type model is used to define the short term volatility, generated by market conditions and by noises, while the classical statistic methods can be applied to measure the long term volatility. In this context, we resort to the standard deviation of equity index returns for a rolling window of twelve months (data available in the Yahoo.finances database) to measure the historic financial volatility, using at the same time a GARCH(1,1) model to calculate the conditional volatility equity index returns.

Aiming at emphasizing the biunivocal relationship which can occur between financial volatility and volume of transactions with derivative products, we estimate a VAR. High assets price volatility can entail an increase of the volume of transactions with derivative products and, inversely, an intensification of derivatives transactions can result into an increase of price volatility of the underlying assets. To test this double causality, the Granger method is retained. Thus, if the index volatility has a Granger causality effect on the volume of derivatives, this leaves room to think that the hedging operations prevail on the derivatives markets. In exchange, if the volume of derivative products has a Granger causality effect on the indexes volatility, then the speculative operations prevail.

3. EMPIRICAL ANALYSIS

We first present the data, then we proceed to the methodology and then we conclude with the results.

3.1. The data

There are two main approaches to measure the derivative products related activity [Jeanneau and Micu, 2003]. The first possibility considers their turnover (or volume), and it refers to the number of contracts traded in a specific period. The other approach is the open interest, which advert to the total number of ongoing contracts. Taking into consideration that there are few available data on the value of the volume or the fact that this information is of recent nature, we have preferred using an indicator mirroring the number of contracts to measure the derivative products related activity. At the same time, the number of contracts and the total value of the contracts volume are highly correlated in so far as, on the exchange markets, the contracts value is mainly standardized. The analysis considers the number of futures and options equity index contracts. These data are available on Euronext.liffe.

The analysis covers the period 1991.1- 2009.12. This timeframe is large enough and it is characterized by significant evolutions of index returns volatility, which proved high during crisis periods, in particular at the beginning and at the end of the years 2000s, and appeared to reach very low levels between these milestones [BRI, 2006].

3.2. The methodology

There are two main possibilities to study the bidirectional relationship between the derivative products and their underlying assets, both entailing advantages and inconveniences: the vector autoregression (VAR) and the simultaneous equations models (SEM). The VAR was criticized on the one hand by Koch [1993], who argued that the VAR ignored the possibility of contemporaneous interactions and could therefore lead to biased results and to inaccurate conclusions. On the other hand, Chan and Chug [1995] have found that the VAR model can better reveal the underlying process and that SEM could be misleading and yield unreliable inferences.

We resort to the VAR method to assess the relationship between financial volatility and the volume of traded derivative products. All the variables in a VAR are treated symmetrically by including for each variable an equation explaining its evolution based its own lags and the lags of all the other variables in the model. Because there is a priori a biunivocal relationship between the selected variables, we consider this method as the most appropriate.

In order to select the number of lags and the constant, we refer to the information criteria (the likelihood ratio test can be also used to choose the number of lags). Each equation of the VAR enables to deduct an AIC (Aikake) criterion and a SC (Schwartz) criterion and we have calculated a weighted mean of the two (depending on the degrees of freedom) which resulted into a single AIC and SC criterion. Further on, we have retained the VAR which minimized the two information criteria. Then, we have interrogated the stability of the VAR. The estimated VAR is stable if all roots have modules less than one and lie inside the unit circle. If the VAR is not stable, certain results (such as impulse response standard errors) are not valid. In our case, all the VAR retained into the analysis are stable. Finally, we perform a Granger causality test to identify the direction of the causality between financial volatility and the number of negotiated derivatives contracts. We repeat this type of analysis for each category of contracts (futures and options) and for each stock market.

But, before testing our VAR, we have checked the stationarity of the data retained for the analysis (see Table 1). In order to do this, we have applied two types of tests: the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP).

Table no.1 Unit root tests

Null hypothesis-non stationarity	***United Kingdom***		***France***		***Netherlands***		***Belgium***	
(level)	ADF	PP	ADF	PP	ADF	PP	ADF	PP
feip	4.9	-3.4***	-4.5***	-2.9**	0.2	-3.0**	-2.5	-2.8**
oeip	-2.9**	-2.0	-1.4	-2.8*	-0.0	-2.9**	-6.8***	-3.9***
sdir	-2.0	-2.6*	-2.7*	-2.4	-2.3	-2.6*	-2.4	-2.5
cvir	-4.0***	-3.9***	-3.7***	-3.7***	-5.5***	-5.5***	-4.3***	-4.1

(*) (**) and (***) indicate the rejection of the null hypothesis at 10%, 5%, respectively 1% (*t-statistic*)

Note : feip – number of futures equity index products; oeip number of options equity index products; sdir – index returns historic volatility; cvir – index returns conditional volatility.

The stationarity tests are required because the presence of a unit root within the data had very important effects from the statistic point of view. First, the presence of regressors with a unit root within a regression can lead to the situation in which apparently very good regressions are estimated amongst variables which are totally independent one from another. Then, a series stationary in level and a series stationary in first difference show a radically opposed behavior on the long run. A stationary time series tends to reposition itself around its determinist trend after a mean reversion. A series stationary in difference does not return around its trend after a reversion, because the choc also affects the stochastic trend of the series. As we can observe in Table 1, the choice of the VAR is appropriate because the variables are stationary in level according to one test or to the other.

3.3. The results

The results related to the relationship between index returns historic volatility and the number of futures equity index products, are listed in Table 2 below.

Table no. 2 Causality relation between index returns historic volatility (sdir) and number of futures equity index products (feip)

UNITED KINGDOM				
VAR	***sdir***	***feip***	***Granger causality***	***Probability of the null hypothesis*** *(does not cause)*
sdir(-1)	0.991 (*125.4*)	10.14 (*2.379*)	feip does not cause sdir sdir causes feip	(*0.47*) (*0.01*)
sdir (-2)				
feip(-1)	0.001 (*0.709*)	0.850 (*21.18*)		
feip(-2)				
c				
R^2	0.92	0.69		

FRANCE				
VAR	***sdir***	***feip***	***Granger causality***	***Probability of the null hypothesis*** *(does not cause)*
sdir(-1)	1.050 (*0.06*)	-5.151 (*7.86*)	feip causes sdir sdir does not cause feip	(*0.04*) (*0.24*)
sdir (-2)	-0.069 (*0.06*)	6.693 (*7.77*)		
feip(-1)	0.001 (*0.00*)	0.575 (*0.06*)		
feip(-2)	-0.000 (*0.00*)	0.374 (*0.06*)		
c				
R^2	0.92	0.80		
NETHERLANDS				
VAR	***sdir***	***feip***	***Granger causality***	***Probability of the null hypothesis*** *(does not cause)*
sdir(-1)	0.955 (*13.06*)	-10.78 (-*1.60*)	feip does not cause sdir sdir does not cause feip	(*0.13*) (*0.22*)
sdir (-2)	0.001 (*1.405*)	11.38 (*1.704*)		
feip(-1)	0.017 (*0.233*)	0.587 (*8.818*)		
feip(-2)	-0.000 (-*0.91*)	0.402 (*5.984*)		
c				
R^2	0.89	0.88		
BELGIUM				
VAR	***sdir***	***feip***	***Granger causality***	***Probability of the null hypothesis*** *(does not cause)*
sdir(-1)	1.004 (*13.71*)	-0.434 (-*0.52*)	feip causes sdir sdir does not cause feip	(*0.02*) (*0.86*)
sdir (-2)	-0.051 (-*0.72*)	0.385 (*0.477*)		
feip(-1)	0.004 (*0.704*)	0.666 (*9.601*)		
feip(-2)	0.001 (*0.186*)	0.326 (*4.604*)		
c				
R^2	0.90	0.79		

**(...) – t-statistic*

In respect of the index returns historic volatility, two situations can occur. For the United Kingdom, it is the index volatility that determines the increase of the transactions with futures equity index products (the hedging operations prevailing), whereas for France and Belgium, the outcomes indicate an inverse relation – the increase of the traded futures equity index products causes the financial volatility increase. For Netherlands, no relation is indicated.

Except for the United Kingdom, all the VAR retained into the analysis embody two lags. If we look at the lags coefficients (and at the corresponding t-statistic), the interdependence relationship between the two variables appears rather of poor significance. At the same time, the Granger test provides additional information.

The results related to the relationship between index returns conditional volatility and number of futures equity index products is presented in Table 3.

Table no. 3 Causality relation between index returns conditional volatility (cvir) and number of futures equity index products (feip)

UNITED KINGDOM				
VAR	***cvir***	***feip***	***Granger causality***	**Probability of the null hypothesis** *(does not cause)*
cvir(-1)	0.841 (*23.04*)	3.800 (*2.625*)	feip does not cause	(*0.13*)
cvir (-2)			cvir	(*0.01*)
feip(-1)	0.001 (*1.495*)	0.826 (*20.22*)	cvir causes feip	
feip(-2)				
c	2.696 (*3.615*)	-30.48 (*-1.03*)		
R^2	0.74	0.70		
FRANCE				
VAR	***cvir***	***feip***	***Granger causality***	**Probability of the null hypothesis** *(does not cause)*
cvir(-1)	0.965 (*0.06*)	-1.175 (*-1.98*)	feip causes cvir	(*0.00*)
cvir (-2)	-0.025 (*0.06*)	1.470 (*2.530*)	cvir causes feip	(*0.01*)
feip(-1)	0.027 (*0.00*)	0.542 (*8.662*)		
feip(-2)	-0.018 (*0.00*)	0.402 (*6.275*)		
c				
R^2	0.78	0.80		
NETHERLANDS				
VAR	***cvir***	***feip***	***Granger causality***	**Probability of the null hypothesis** *(does not cause)*
cvir(-1)	0.715 (*9.726*)	-0.085 (*-1.03*)	feip causes cvir	(*0.05*)
cvir (-2)	0.043 (*0.587*)	0.074 (*0.892*)	cvir does not cause	(*0.57*)
feip(-1)	0.080 (*1.351*)	0.573 (*8.544*)	feip	
feip(-2)	-0.048 (*-0.80*)	0.421 (*6.197*)		
c				
R^2	0.50	0.88		
BELGIUM				
VAR	***cvir***	***feip***	***Granger causality***	**Probability of the null hypothesis** *(does not cause)*
cvir(-1)	0.752 (*10.27*)	0.016 (*0.478*)	feip causes cvir	(*0.01*)
cvir (-2)	0.086 (*1.199*)	-0.044 (*-1.31*)	cvir does not cause	(*0.21*)
feip(-1)	0.079 (*0.548*)	0.665 (*9.633*)	feip	
feip(-2)	0.041 (*0.281*)	0.341 (*4.846*)		
c				
R^2	0.67	0.79		

**(…) – t-statistic*

When approximating financial volatility using conditional volatility, a general analogue fact can be ascertained. As for the historic volatility, no causality direction clearly evolves for the entire set of countries. In general, having as starting point the analyzed futures European markets, it seems, on one hand, that the futures derivatives markets are not capable of providing reliable information on the future volatility of the stock markets and, on the other hand, that no type of operation (hedging or speculation) significantly dominates the other.

For the options contracts the situation is different. When approximating the volatility using historic volatility, a causality relationship appears only for the United Kingdom and Belgium. Yet, if in case of the United Kingdom the transactions with options seem to precede the volatility showing thus a more speculative character, for Belgium, the direction of the causality goes in the other sense and the transactions with options mainly result from hedging operations (see Table 4).

Table no. 4 Causality relation between index returns historic volatility (sdir) and number of options equity index products (oeip)

UNITED KINGDOM				
VAR	***sdir***	***oeip***	***Granger causality***	***Probability of the null hypothesis** (does not cause)*
sdir(-1)	1.026 (*13.20*)	-4.671 (*-0.61*)	oeip causes sdir	(*0.04*)
sdir (-2)	-0.086 (*-1.12*)	4.923 (*0.657*)	sdir does not cause	(*0.80*)
oeip(-1)	-0.001 (*-0.62*)	0.596 (*8.080*)	oeip	
oeip(-2)	0.001 (*1.769*)	0.352 (*4.654*)		
c	0.200 (*2.355*)	3.140 (*0.378*)		
R^2	0.93	0.82		
FRANCE				
VAR	***sdir***	***oeip***	***Granger causality***	***Probability of the null hypothesis** (does not cause)*
sdir(-1)	1.079 (*16.26*)	-2.903 (*-0.19*)	oeip does not cause	(*0.84*)
sdir (-2)	-0.084 (*-1.27*)	5.863 (*0.397*)	sdir	(*0.22*)
oeip(-1)	0.000 (*0.515*)	0.608 (*9.636*)	sdir does not cause	
oeip(-2)	-0.000 (*-0.56*)	0.338 (*5.386*)	oeip	
c				
R^2	0.92	0.88		
NETHERLANDS				
VAR	***sdir***	***oeip***	***Granger causality***	***Probability of the null hypothesis** (does not cause)*
sdir(-1)	0.955 (*11.23*)	-25.82 (*-1.27*)	oeip does not cause	(*0.37*)
sdir (-2)	0.016 (*0.197*)	28.32 (*1.405*)	sdir	(*0.34*)
oeip(-1)	0.000 (*0.790*)	0.537 (*7.102*)	sdir does not cause	
oeip(-2)	-0.000 (*-0.35*)	0.443 (*5.818*)	oeip	
c				
R^2	0.87	0.79		
BELGIUM				
VAR	***sdir***	***oeip***	***Granger causality***	***Probability of the null hypothesis** (does not cause)*
sdir(-1)	0.984 (*74.72*)	0.960 (*2.185*)	oeip does not cause	(*0.33*)
sdir (-2)			sdir	(*0.02*)
oeip(-1)	0.001 (*0.959*)	0.867 (*23.65*)	sdir causes oeip	
oeip(-2)				
c				
R^2	0.90	0.64		

** (…) – t-statistic*

When approximating the volatility using conditional volatility, the disparities amongst countries are confirmed. For the United Kingdom, a bidirectional relation occurs. If we refer to France, a single univocal causality relation emerges, from volatility towards the number of options equity index products. However, in all the other situations, no significant causality relation appears (Table 5).

Table no. 5 Causality relation between index returns conditional volatility (cvir) and number of options equity index products (oeip)

UNITED KINGDOM				
VAR	***cvir***	***oeip***	***Granger causality***	***Probability of the null hypothesis** (does not cause)*
cvir(-1)	0.750 (*9.751*)	-1.827 (*-3.59*)	oeip causes cvir	(*0.00*)
cvir (-2)	0.065 (*0.893*)	1.959 (*4.023*)	cvir causes oeip	(*0.00*)
oeip(-1)	0.035 (*3.358*)	0.560 (*8.058*)		
oeip(-2)	-0.017 (*-1.59*)	0.393 (*5.305*)		
c	2.727 (*3.184*)	1.716 (*0.303*)		
R^2	0.78	0.83		
FRANCE				
VAR	***sdir***	***oeip***	***Granger causality***	***Probability of the null hypothesis** (does not cause)*
cvir(-1)	0.904 (*13.43*)	-1.749 (*-1.57*)	oeip does not cause cvir	(*0.40*)
cvir (-2)	-0.030 (*-0.45*)	2.554 (*2.286*)	cvir causes oeip	(*0.04*)
oeip(-1)	0.005 (*1.331*)	0.600 (*9.576*)		
oeip(-2)	-0.004 (*-1.14*)	0.344 (*5.496*)		
c	3.860 (*3.379*)	-10.75 (*-0.56*)		
R^2	0.77	0.88		
NETHERLANDS				
VAR	***sdir***	***oeip***	***Granger causality***	***Probability of the null hypothesis** (does not cause)*
cvir(-1)	0.718 (*8.424*)	-0.222 (*-0.89*)	oeip does not cause cvir	(*0.15*)
cvir (-2)	0.042 (*0.495*)	0.270 (*1.088*)	cvir does not cause oeip	(*0.54*)
oeip(-1)	0.027 (*1.060*)	0.523 (*6.884*)		
oeip(-2)	-0.014 (*-0.56*)	0.463 (*6.035*)		
c				
R^2	0.48	0.79		
BELGIUM				
VAR	***sdir***	***oeip***	***Granger causality***	***Probability of the null hypothesis** (does not cause)*
cvir(-1)	0.808 (*18.82*)	-0.061 (*-1.00*)	oeip does not cause cvir	(*0.41*)
cvir (-2)				(*0.31*)
oeip(-1)	-0.025 (*-0.82*)	0.802 (*18.26*)	cvir does not cause oeip	
oeip(-2)				
c	7.454 (*2.946*)	11.11 (*3.109*)		
R^2	0.66	0.65		

**(…) – t-statistic*

In general, the outcomes of the econometrical tests based on options transactions confirm the ambiguity of the results. It seems, on one hand, that options equity index products are not capable of providing reliable information on the future volatility of stock market index and, on the other hand, that no type of operation significantly dominates the other. Table 6 provides a synthesis of results.

Table no. 6 Synthesis of results

Causality →	*Volatility*	***futures (hv)***	***futures (cv)***	***options (hv)***	***options (cv)***
United Kingdom	Volume	↲	↲	↥	↲↥
France	Volume	↥	↲↥	—	↲
Netherlands	Volume	—	↥	—	—
Belgium	Volume	↥	↥	↲	—

4. CONCLUSIONS

The literature on the relationship financial volatility – volume of transactions with derivative products is abundant, but, up to a recent date, it showed interest mainly for the impact of derivatives introduction on the underlying assets volatility. Nevertheless, at theoretical level, the sense of the causality is ambiguous and depends on the level of market perfection and on the nature of operations (hedging or speculation) prevailing on the derivatives markets. On one hand, high volatility can be an incentive for investors to cover their positions resorting to derivative products. On the other hand, an increase of the number of traded contracts can generate a more powerful volatility of the underlying assets. In this case, the operations would show a speculative character.

These assumptions have been analyzed on the stock exchange markets members of Euronext.liffe, estimating a VAR model and proceeding to Granger causality tests. The stock exchange index volatility is approximated using the historic volatility, measured by means of the stock exchange index standard deviation calculated for a rolling window of twelve months, and the conditional volatility, predicted based on a GARCH(1,1) model. Unlike previous studies focusing on a single exchange market and on a single derivative product, considering several exchange markets and several derivative products enables to test the stability of identified causalities.

In general, our analysis does not allow removing the theoretical ambiguity in as far as no causality connection, common to the different approached exchange markets, emerges. Thus, it seems on one hand, that equity index European markets are not in condition to provide reliable information on the future volatility of stock exchange markets and, on the other hand, that no type of operation (hedging or speculation) significantly dominates the other.

References

[1] Antoniou, A., Holmes, O., Priestley, R., The effects of stock index futures on stock volatility: An analysis of the asymmetric response of volatility to news, *Journal of Futures Markets*, Vol. 18, 1998, pp. 151-166.

[2] Antoniou, A., Holmes, P., Futures Trading, Information and Spot Price Volatility: Evidence for the FTSE-100 Stock Index Futures Contract Using GARCH, *Journal of Banking & Finance*, Vol. 19, 1995, pp. 117-129.

[3] Bandivadekar, S., Ghosh, S., Derivatives and Volatility on Indian Stock Markets, *Bank of India Occasional Papers*, Vol. 24/3, 2003, pp. 187-201.

[4] BIS, The Recent Behaviour of Financial Market Volatility, *BIS Paper* 29, 2006.

[5] Bollerslev, T., Generalised Autoregressive Conditional Heteroskedasticity, *Journal of Econometrics*, Vol. 31, 1986, pp. 307-327.

[6] Buhr, K.E., Li, X., Rose, L.C., The Informational Role of Options Trading Volume in the Australian Index Options Markets, *Finance and Corporate Governance Conference*, La Trobe University, Australia, 7-9 April, 2010.
[7] Chan, K., Chug, Y.P., Vector autoregression or simultaneous equations model? The intraday relationship between index arbitrage and market volatility, *Journal of Banking & Finance*, Vol. 19, 1995, pp. 173-179
[8] Charupat, N., The effect of derivative trading on the underlying markets: Evidence from Canadian instalment receipts trading, *International Review of Economics and Finance,* Vol. 15, 2006, pp. 276-293.
[9] Cushman, D.O., The effects of real exchange rate risk on international trade, *Journal of International Economics*, Vol. 15, 1983, pp. 45-63.
[10] Daly, K., Financial volatility: Issues and measuring techniques, *Physica A*, Vol. 387, 2008, pp. 2377-2393.
[11] Darrat, A.F., Rahman, S., Has futures trading activity causes stock price volatility?, *Journal of Futures Markets*, Vol. 15, 1995, pp. 537-557.
[12] Dennisa, S.A., Sim, A.B., Share price volatility with the introduction of individual share futures on the Sydney Futures Exchange, *International Review of Financial Analysis*, Vol. 8, 1999, pp. 153-163.
[13] Edwards, F.R., Futures trading and cash market volatility: Stock index and interest rate futures, *Journal of Futures Markets*, Vol. 8, 1988, pp. 421-439.
[14] Engle, R.F., Autoregressive conditional heteroscedasticity with estimates of the variance of UK inflation, *Econometrica*, Vol. 50, 1982, pp. 987-1008.
[15] Fedenia, M., Grammatikos, T., Options trading and the bid-ask spread of the underlying Stocks, Journal of Business, Vol. 65, 1992, pp. 335-351.
[16] Figlewski, S., Futures Trading and Volatility in the GNMA Market, *Journal of Finance*, Vol. 36, 1981, pp. 445-484.
[17] Jeanneau, S., Micu, M., Volatility and derivatives turnover: a tenuous relationship, *BIS Quarterly Review*, March, 2003, pp. 57-66.
[18] Kasman, A., Kasman, S., The impact of futures trading on volatility of the underlying asset in the Turkish stock market, *Physica A*, Vol. 387, 2008, pp. 2837-2845.
[19] Koch, P.D., Reexamining intraday simultaneity in stock index futures markets, *Journal of anking & Finance*, Vol. 17, 1993, pp. 1191-1205.
[20] Powers, M.J., Does Futures Trading Reduce Price Fluctuations in the Cash Markets?, *American Economic Review*, Vol. 60, 1970, pp. 460-464.
[21] Reyes, M.G., Index futures trading and stock price volatility: Evidence from Denmark and France, *Journal of Economics and Finance*,Vol.20, 1996, pp.81-88.
[22] Robinson, G., The effect of futures trading on cash market volatility: Evidence from the London stock exchange, *Review of Futures Markets*, Vol. 14, 1994, pp. 429-459.
[23] Sarwar, G., The Informational Role of Option Trading Volume in Equity Index Options Markets, *Review of Quantitative Finance and Accounting*, Vol. 24, 2005, pp. 159-176.
[24] Schwarz, T.V., Laatsch, F., Dynamic Efficiency and Price Leadership in Stock Index Cash and Futures Markets, *Journal of Futures Markets*, Vol. 11, 1991, pp. 669-683.
[25] Skinner, D., Options markets and stock return volatility, *Journal of Financial Economics*, Vol. 23, 1989, pp. 61-78.
[26] Stein, J.C., Information Externalities and Welfare Reducing Speculation, *Journal of Political Economy*, Vol. 95, 1987, pp. 1123-1145.
[27] Zapatero, F., Effects of financial innovations on market when beliefs are heterogeneous, *Journal of Economic Dynamics and Control*, Vol. 22, 1989, pp. 597-626.