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31 December 2008

Online at https://mpra.ub.uni-muenchen.de/12448/
MPRA Paper No. 12448, posted 01 Jan 2009 13:04 UTC

THE VOLATILITY OF THE EUROPEAN CAPITAL MARKETS DURING THE CURRENT FINANCIAL CRISIS: WHAT ARE SAYING THE EMPIRICAL EVIDENCES?

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Key terms: volatility, financial crisis, Quandt-Andrews test, FTSE 100, DAX, CAC 40

Abstract

The uncertainty about the market' evolutions are one striking characteristic of the financial crisis. The objective of this paper is to find some evidences for the pre/ crisis periods actual shifting in volatility for some major European markets. The methodology is based on two particular measures of volatility and in structural changes tests. The main output consists in the thesis that "volatility matters" for an extended financial crisis explanation.

1. Introduction

"The current economic disaster is the result of the combination of negligence, hubris, and wrong economic theory. For decades, an economic and monetary policy has been practiced based on the illusion of, "It doesn't matter." At first it was, "Deficits don't matter." From that, the policy of "it doesn't matter" got extended to money creation, the credit expansion, the stock-market bubble, and the housing boom. Now, we're being told that buying financial junk by the central bank to beef up banks and brokerages also doesn't matter" ([Mueller, 2008]). The financial crisis is one of the most complex economic processes with a large and time-changing number of particular features. Among them the market' prices volatility and the associated uncertainty about their future dynamic is one with a critical importance for explaining the crisis initiation and transmission mechanism. The objective of this paper is to find some evidences for the pre/ crisis periods actual shifting in volatility for some major European markets. Section 1 provides a brief theoretical framework to describe the linkage between the volatility and the market traders' decisions to structure their portfolios. In Section 2 is analysed the markets volatility' evolution for 2006-2008 focusing on "structural breaking points".

Finally some conclusions are dropped down and some further research directions are indicated.

2. Theoretical framework

The market operators' decisions to structure their portfolios are influenced by a complex set of factors both "objectives" as well as "subjective". Among them, volatility is a critical one affecting current and future decisions of the traders. Formally, the *decisional index* (DI) could be written as:

$$DI_t = DI_t\left(\sum_{i=1}^{N} c_{it}, \sum_{i=1}^{L} M_{it}, \sum_{i=1}^{V} Y_{it}, \sum_{i=1}^{N} \eta_{it}, \sum_{i=1}^{N} R_{it}, (*)\right) \qquad (1)$$

where c are the current transactional costs of each $i = 1..N$ financial assets incorporated in the structures of individual portfolios, M are the financial resources allocated for placement of such assets, Y are the incomes from labour and capital obtained in the current period and thesaurised in the past ones, η are the financial assets' return, R the corresponding risks and $(*)$ denotes the anticipated levels of the mentioned variables. The prices and the returns anticipatory mechanisms could be reflected as:

$$P^*_t = \sum_{i=1}^{t-1} \alpha_t P_{t-i} + \beta_t INFO_t \qquad (2)$$

where $INFO$ is an *informational index* which captures the current available information incorporated in the anticipatory mechanisms.

The anticipation mechanism is described in a *bounded rationally framework*: if information is incompletely, non-uniform distributed and costly, then this mechanism will incorporate both past and current viable information.

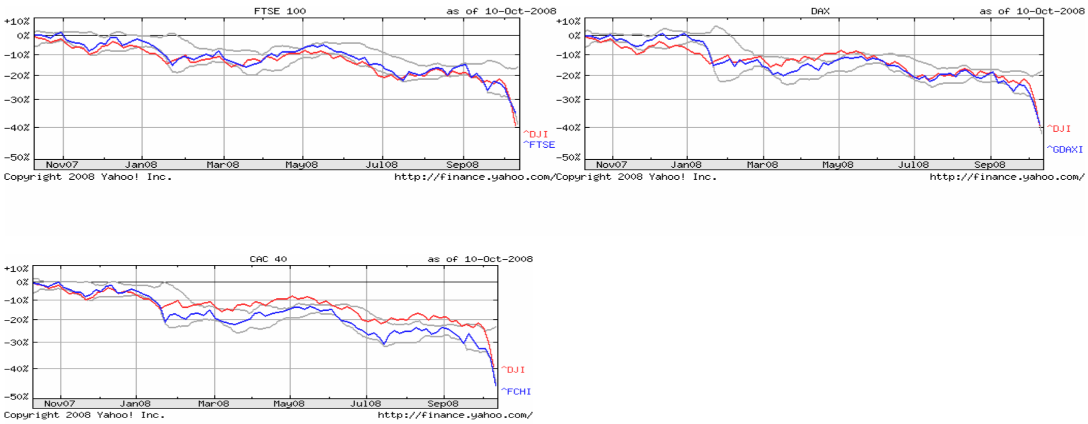
The key point for our argumentation is that both parameters α, β as well as the $INFO$ index depend on the current and past prices volatility:

$$\begin{aligned} \alpha_t &= \alpha_t\left(\sigma^2_{\substack{t-j \\ j=1\ldots k}}\right) \\ \beta_t &= \beta_t\left(\sigma^2_{\substack{t-j \\ j=1\ldots k}}\right) \\ INFO_t &= \sigma^2_t \end{aligned} \qquad (3)$$

Any increase in the market volatility will induce a shift in the mentioned parameters and as a consequence a "reformulation" of the current decisions to structure the individual portfolio. In the conditions of an increased uncertainty specific for the financial crisis this will be concretised in frequent changes in the portfolios' structures as an expression of an instable $\frac{\beta}{\alpha}$ ratio and also in shorter time period of anticipation formation process. In other words, the traders will put a greater relative importance on current available information and will reduce the period for which they formulate prices and returns expectations. Of course, one could argue that a more accurate interpretation of this thesis consists in the idea that the „rush of panik" will make that $\alpha \rightarrow 0$ and the *bid/ask* book for the market will be significant disiquilibrated leading to a higher observated volatility of prices .

3. Methodology

Friday, 10 October 2008, the *FTSEurofirst 300* index of top European shares lost 7.6 percent to finish at 851.23 points - its lowest close since July 2, 2003. This tendency was common for all the major European capital markets which tumbled to their lowest close in more than five years:



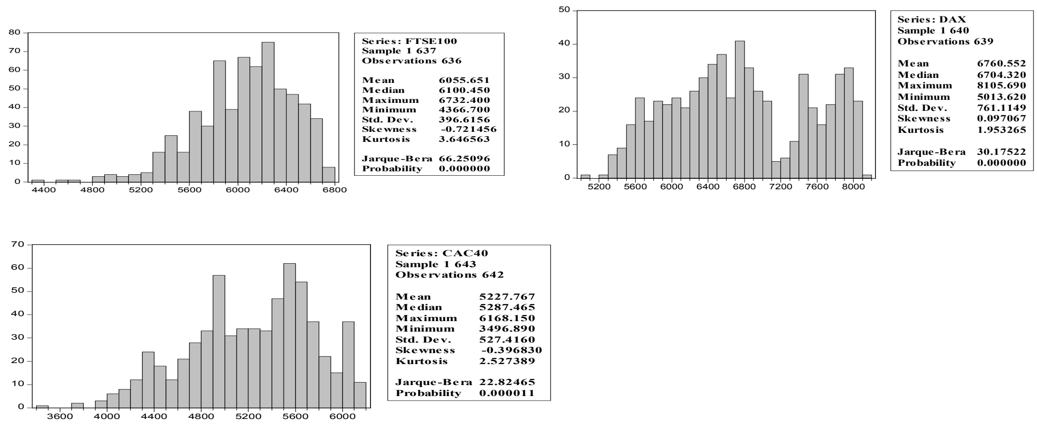
Graphic 1: Recent evolutions of the major European indexes (versus US Dow Jones index)

Such an evolution is characteristic for a "financial crisis" which for the capital market reaction could be described at a minimal level by:

- An "auto-sustainable" downward trend for the market prices;
- A tendency for increase in the market *intrinsic* volatility as an expression of the unbalanced *bid/ask* ratio due to the increase of uncertainty in the transactional environment;

- A possible increase of the autochthonous market indexes co-integration with the regional ones as in the case of Asian financial crisis (see for instance [Choudhry and Lin,2004];[Wan Mansor and Marlinda,2007]) due to the *contagion effect*;
- Frequent changes in the market indexes' distribution under the impact of an increased *informational asymmetry*;
- A shift in the market structures and mechanisms as well as an increased "institutional fragility".

Some of these characteristics are currently captured by the general statistics for the most important European indexes. For instance, taking into account an analysis period between 4/3/2006-10/9/2008 for the **FTSE 100, DAX** and **CAC 40** (daily values of the *Close* prices, non-seasonally adjusted) the histograms looks like follows (all the data are obtained from [http://finance.yahoo.com, 2008] :



Graphic 2: The general statistical characteristics of the FTSE 100, DAX and CAC 40 indexes

These histograms suggest that:

- The distribution of the indexes is a non-normal one with important *fat-tails effects*;
- There is an important level of volatility (measured for instance by the *variance coefficient*- the ratio between the standard deviation and the mean) greater for DAX and lower for FTSE 100;
- There could be a relevant shifting in the indexes distribution during the observation period.

Such suggestions lead an interesting question: does the financial crisis induce an increased volatility on the market? Or, more accurate: are there significant differences between pre/crisis periods in the volatility dynamic?

The objective of this section is to describe a possible analytical framework of the volatility analysis in order to deduce some (at least partially) answers to this question.

In order to estimate the *intrinsic volatility* two *proxies* are involved:

1. **A volatility measure based on "High-Low" difference** $\left(I_{H-L}\right)$ defined as:

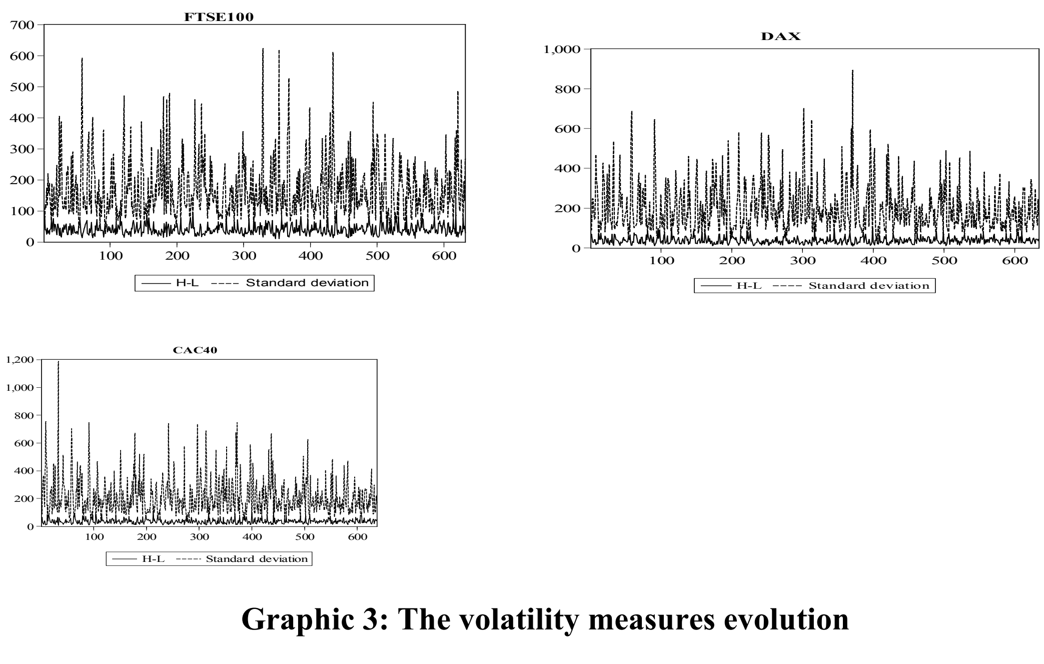
$$I_{tH-L} = \frac{\left(H_t - L_t\right)}{\left(\max\limits_{i\in[t-k\ t]}\left(H_i\right) - \min\limits_{i\in[t-k\ t]}\left(L_i\right)\right)} * 100 \qquad (4)$$

with k exogenous selected.

2. **A volatility measure based on standard deviation** $\left(I_{\sigma^2}\right)$ **computed as:**

$$I_{t\sigma^2} = \frac{\sigma^2{}_{tX}}{\sigma^2{}_{C_i}\limits_{i=[t-k\ t]}} * 100 \qquad (5)$$

where $\sigma^2{}_X$ is the standard deviation of the $X_t = \left\lfloor O_t\ H_t\ L_t\ C_t \right\rfloor$ vector formed by the *Open, High, Low, Close* current prices and $\sigma^2{}_C$ is the standard deviation of the *Close* prices over a $\left[t-k\ t\right]$ observation period.



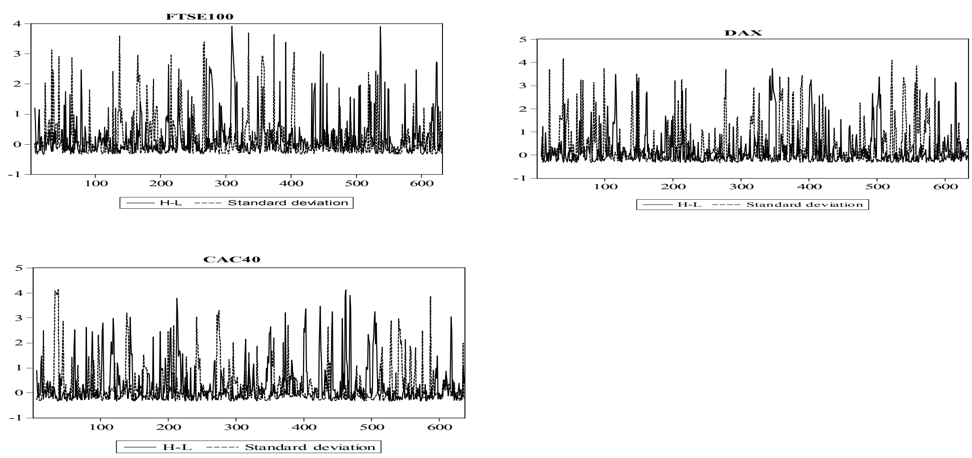
Graphic 3: The volatility measures evolution

It could be observed from the general statistic property of the volatility' measures that for FTSE100 index there is a tendency of an increasing volatility in the last part of the observation period. Correlatively, for the DAX and CAC40 indexes the global "peaks" in volatility appears earlier in July-August 2008. Also it should be mentioned the fact that the evolution is not uniform with relatively clearly sub-periods with different statistic characteristic. This conclusion could be also derived by studying the changes in the volatility measures distribution using for instance an aggregate indicator such as:

$$ID_t = \frac{\left(\underset{j=t-k...t}{skew}\left(Volatility_j\right)\right)^2 + \left(\underset{j=t-k...t}{kurt}\left(Volatility_j\right) - 3\right)^2}{9} \qquad (6)$$

where $skew, kurt$ are a measure of asymmetry of the distribution of the series around its mean (the Skewness of a symmetric distribution, such as the normal distribution, is zero, positive Skewness means that the distribution has a *long right tail* and negative Skewness implies that the distribution has a *long left tail*) and respectively a measure of the "peakedness" or "flatness" of the distribution of the series (the Kurtosis of the normal distribution is 3;if the kurtosis exceeds 3, the distribution is "peaked" – *leptokurtic*- relative to the normal and if the Kurtosis is less than 3, the distribution is "flat" –*platykurtic*- relative to the normal one).

For the two involved measure of the volatility the distribution was evolved like:



Graphic 4: The shifts in the volatility' distribution

In order to develop a more detailed analysis it is useful to check for "structural points" area in order to identify more accurate the sub-periods with individual evolution of the volatility pattern.

As a first step, the behaviour of the indexes is described inside as framework of an *ARMA* equation:

$$y_t = \alpha_1 y_{t-1} + \alpha_2 MA_{6_t} \tag{7}$$

where

$$MA_{6_t} = \frac{1}{6} \sum_{k=t-6}^{t} y_k \tag{8}$$

For estimating the probability of "structural breaking points" the equation parameters stability over the observation sample is analyzed by involving a specific test.

The *Quandt-Andrews Breakpoint Test* tests for one or more unknown structural breakpoints in the sample for a specified equation. The idea behind the *Quandt-Andrews test* is that a single *Chow Breakpoint Test* is performed at every observation between two observations, τ_1 and τ_2. The k test statistics from those *Chow* tests are then summarized into one test statistic for a test against the null hypothesis of no breakpoints between τ_1 and τ_2 .

The distribution of these test statistics is non-standard. Andrews (1993) developed their "true distribution", and Hansen (1997) provided approximate asymptotic *p*-values. The distribution of these statistics becomes degenerate as τ_1 approaches the beginning of the equation sample, or τ_2 approaches the end of the equation sample. To compensate for this behaviour, it is generally suggested that the ends of the equation sample not be included in the testing procedure (for instance, a standard level for this "trimming" is 15%, where there are excluded the first and last 7.5% of the observations). Furthermore such a level (symmetric for the beginning and the end of data sample) is considered for the trimming and the Hansen *p*-values are taking into account.

Testing for the sample data, the results suggest that the null of no structural changes could be rejected for all indexes for both measures of volatility. Also overall they tend to designate July-August 2007 and January 2008 as major structural changes areas. Of course, such results should be taken into account with prudence due to the relative sensitivity of the *Quandt-Andrews Breakpoint Test* to the level of "trimming". But this output could be considered consistent with the general context of financial crisis evolution.

4. Conclusions and further research

The empirical evidences from the previous section could enlighten (despite the limited number of markets and observation) the fact that current financial crisis was generate a "structural change" in the markets volatility pattern. Of course, such a conclusion is to general and does not put in evidence the "transmission mechanism". For a more detailed analysis is it minimally necessary: (1) to develop a conceptual framework of the market operators' decisional stance which leads to a higher volatility in crisis periods; (2) to explain the "contagion" mechanisms; (3) to estimate the impact of the different volatility states on market portfolios structures. Despite these limitations, we are arguing that such analysis could better clarify the particular conditions of the financial Dark Ages.

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