Volatility behaviour of BRIC capital markets in the 2008 international financial crisis

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Brazil, Russia, India and China (BRIC) are pointed as the most probable countries to enter the select group of industrialised countries, also appearing among the world’s twelve largest economies. The main objective of the present study is to assess whether the capital market behaviour of the BRIC’s emerging countries in the 2008 international crisis had already been equivalent to that of industrialised countries (USA, Japan, United Kingdom, and Germany). Three univariate approaches were applied for modelling the market volatilities (GARCH, EGARCH and TARCH). The results showed similar behaviours between both market groups regarding the presence of persistent effects of shocks on volatility, volatility asymmetry, and delayed volatility reaction to market changes. The BRIC’s markets showed less persistence to volatility shocks, less asymmetry, and faster reactions of volatility to market changes.

Key words: Volatility, BRIC, emerging markets, GARCH models, financial crisis.

INTRODUCTION

International financial crises are revealing. Within the context of a large-scale crisis, the behaviour of both emerging and industrialised markets is distinct. There are aspects clearly showing the maturity level of markets and economies of the affected countries.

Propagation of a crisis occurs through the naturally existing linkage among the countries’ markets. This linkage occurs in various fronts, either by means of external trade, international private investments or even sovereign capital flows. Under normal conditions, transactions between countries occur around what one considers to be a balance platform, which is dynamic and consists of economic variables related to exchange parities, interest rate levels, inflation, foreign currency reserves, production, consumption, income, among others. Under crisis conditions, however, value and parity references are lost, governments become protectionist, and capital flows occur for preserving and honouring positions only, curiously seeming to be more aligned as if there was a greater integration of the investors’ behaviour around the world.

Under global balance conditions, it is notorious the difference in the financial market characteristics between emerging countries and those with mature and stable economies. When hit by a global financial crisis, however, the financial markets face some common effects such as increase in volatility, capital flight of variable income

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assets, rise in interest rates with increased risk, and reduction of investments in view of the uncertainties. Governments tend to take preventive measures in order to avoid economic recession symptoms while adopting limiting policies for inflationary movements and oscillations in the exchange relationship with the world’s main currencies.

With regard to the capital markets, some aspects are widely known about such differences between emerging and industrialised economies, especially in the scientific milieu. Bekaert and Harvey (1997) have appropriately demonstrated that there are four aspects differentiating the behaviour of asset returns in the emerging capital markets compared to industrialised economies, namely: higher mean returns; low return correlation; higher predictability of the behaviour of returns from asset variations; and greater volatility.

This latter aspect, the greater volatility in the emerging capital markets, has important implications for two crucial factors in any economy: capital cost and option value of waiting to invest. Both effects jeopardise the economic development. The former burdens the ventures, making most of them unviable, whereas the latter delays investment decisions.

Under the conditions imposed by an international financial crisis, the volatility of all markets tends to increase and, curiously, the behaviours of volatility and returns among the markets tend to show a greater similarity. In fact, the markets seem to exhibit higher levels of interdependence and contagious effects.

There are many studies exploring these phenomena. Among them, one can cite the study by Bekaert and Harvey (1997) investigating the reasons which make volatility different between emerging countries, the study by Alper et al. (2009) assessing the predictability of the market volatility behaviour in ten emerging countries by comparing them to industrialised economies in the context of the 2008 crisis, and the study by Chukwuogor and Feridun (2007) analysing the volatility behaviour of fifteen countries, both emerging and industrialised ones, during the crisis which affected Asia and Russia, including the Internet bubble.

Understanding the volatility behaviour of the capital markets is important because it is directly related to capital costs, investment decisions, and leverage levels from investors and companies. These three elements (that is; capital cost, investments, and leverage) have an impact on the development of any economy. Studies on the behaviour of volatility and returns of financial assets in emerging and industrialised markets have indicated the following findings: emerging markets are more volatile than industrialised ones; there are differences between the volatility behaviours of emerging markets, which decrease in the periods of international financial crisis; there is a low return correlation between the assets of emerging and industrialised markets; there is an asymmetric relationship between returns and volatility at highs and lows, which is a phenomenon usually seen in emerging markets during international financial crises; the phenomenon of interdependence between emerging and industrialised markets is significantly increased during global financial crises; contagious effects between financial markets are more likely to occur from industrialised countries towards the emerging ones.

Although several studies have corroborated these findings on capital markets elsewhere (mainly those published over the past 30 years, as econometric and statistical techniques had been improved and markets highly integrated by important technological advances), changes in the world’s economic, financial, and political scenarios have been very significant.

By focusing on the BRIC countries, especially Brazil, the issues motivating the elaboration of the present study have been raised by the confrontation between the known capital market characteristics of emerging and industrialised countries, with the BRIC countries in the threshold of becoming developed. These issues are the following: a) If the emerging markets are more volatile than the industrialised ones, are the BRIC markets less volatile today, with volatility closer to that of industrialised countries? b) If there is an asymmetric relationship between returns and volatility at highs and lows, which is noticeable in emerging markets during international financial crises, did this phenomenon occur in the last global crisis in 2008 at levels different from those seen in industrialised markets?

Therefore, the objective of the present study was to assess whether the capital market behaviour of four emerging countries (BRIC) had already been equivalent to that of industrialised economies during the last global financial crisis (US sub-prime crisis in 2008).

Technically, this work can bring contributions and innovations to the field based on the following points: a) this is a current study, as the phenomena being analysed refer to the period comprising the last great international financial crisis in 2008; b) this is the first study focusing on the issue whether BRIC countries could be considered already developed in terms of capital market behaviour; and c) this is a timely study, as BRIC countries have recently entered the select group of G-20 not only because of their GNP but also because the finance ministers and central bank chairmen of the major hit countries announced, on the 25th September 2009, that the G-20 would be the new Permanent Council for International Economic Co-operation, replacing that formed by the G-8 representatives.

LITERATURE REVIEW

Asymmetry of returns and volatilities

The studies investigating the asymmetry in the behaviour
of returns and volatilities in the stock markets of many countries have shown that it appears in three forms: a) as an effect of the price variation on volatility; b) as a reversion phenomenon depending on the prices of assets; and c) as a variation of return correlation of different assets or market indexes. These three aspects of the asymmetry are especially detected in periods of domestic or global financial crisis.

The first manifestation of asymmetry is the most robust and studied of the three forms. Volatility increases more after negative shocks on the market (that is; when prices and returns fall) than after positive shocks of the same intensity.

Studies on the stock market of several countries have shown that when a negative impact (bad news, crises) hits the assets of a given market, the returns fall and volatility increases. On the other hand, when positive impacts (good news, optimism) occur, returns tend to rise and volatility tends to decrease. However, for an impact of same intensity (positive or negative), the negative effects are greater for both returns and volatility. That is, with the market falling, returns fall more rapidly and volatility increases more than when the market is at high. In addition, several studies showed that the correlation between stock markets of different countries also has an asymmetrical behaviour. In periods of falling prices (ex: financial stress, crises), the correlation between markets seems to be higher than that in periods of rising prices. Since the seminal publications by Black (1976) and Christie (1982), other studies on the negative asymmetric relationship between returns and volatilities have been conducted over the past decades, such as Schwert (1989); Campbell and Hentschell (1992); Glosten et al. (1993); Shields (1997); Bekar et al. (2000); Chiang and Doong (2001); Daouk (2001); Venetis and Peel (2005); Shamsuddin (2008), Badhani (2009) and Chang (2009). However, as stated by Daouk (2001; p.2), “volatility is still a puzzle”.

Daouk (2001) has pointed to the existence of four arguments, or models, which try to explain the asymmetry between returns and volatility. The first argument is based on studies by Black (1976) and Christie (1982). Black hypothesised that financial leverage for companies might explain, at least partially, such a relationship. For the same author, when a company becomes more leveraged, the value of its net worth tends to fall, and vice-versa.

Schwert (1989) and Glosten et al. (1993) have addressed the second explanation for the phenomenon of asymmetry. According to them, the stock return volatility of a company would be probably related to the expected future cash flow volatility. If there is an increased expectance among investors regarding the cash flow to be generated, the value of the company tends to fall and consequently perceived risk and volatility tend to be high.

The third argument is associated with the risk premium. The hypothesis is that an increase in the volatility of unexpected returns will also provoke increase in the future expected volatility, meaning a higher perceived risk and demands for higher premiums. This idea is also called volatility feedback. The studies conducted by Pindyck (1984) and French et al. (1987) were pioneers in investigating such an argument. If this argument is valid, then the variation in the volatility of future expected returns is the factor promoting changes in stock prices, reducing them as a way of compensating for the high risks assumed. The idea of feedback volatility intrinsically depends on the existence of a great volume of information available to a high number of investors, a sine qua non condition for the assessment of future volatility and significant price movement.

The fourth argument explaining the asymmetry is associated with the investors’ position during the periods of financial crises. When such a crisis occurs, asset prices fall heavily and quickly. In this new pessimistic context, investors change their behaviour as they negotiate under stressful conditions, thus increasing the market volatility. This idea has been more explored in the recent years by researchers elsewhere.

Verma and Verma (2005) have also identified four possible origins for asymmetries between behaviours of returns and volatilities in the international markets. The first one would be related to differences in expected returns between the investors in view of potential impacts or changes in the international stock markets. If, for example, a small decrease occurs in the US stock market – which is an international reference, the other markets may be even more affected, mainly the emerging economies, by the fear or “disappointment” among the investors. Through this reasoning, the psychological effect on investors resulting from the changes in American market is more important for the asymmetry magnitude than the intensity of the change itself. Odier and Solnik (1993) and Erb et al. (1994) are among the first authors studying such a phenomenon.

The second possible origin of these asymmetries would be the use of investment strategies based on incomplete, irrelevant and/or distorted information. Foreign investors, in the absence of full specific information about a given market, could be led to assume biased positions as a result of the effect of irrational and/or subjective decisions. A typical example of such behaviour occurs with emerging markets. In fact, many foreign investors tend to see emerging markets indistinctly if they are unable to obtain full specific information about a given market and its assets, mainly in financial stressful conditions. Studies by Harvey (1995) and Aitken (1996) have explored this issue.

The third possible origin of asymmetries between returns and volatilities would involve the existence of an unidentified risk component embedded in the prices of international stock markets. Because the relationship
between any risk component and stock returns are not linear, a priced unidentified risk component can result in volatility imbalance in markets experiencing highs and lows. Studies by Pettengil et al. (1995) and Fletcher (2000) were pioneers in investigating this behavioural feature between risk and returns in stock markets.

With regard to both latter arguments on asymmetry origin, the one based on mistaken strategies due to lack of precise information and the one based on the existence of an unidentified risk component, there is a very interesting joint explanation or variant investigated by several researchers. According to Grossman (1988), Gennaioli and Leland (1990), Jacklin et al. (1992), Romer (1993), Berry and Howe (1994), and Johnson and Westberg (2004), among others, the majority of investors are neither well informed nor sufficiently so. This fact creates conditions to change the opinions on the fair value of each asset as new information is taken into account by each investor. When the market is hit by some type of impact, either positive or negative, it is natural to expect investors to re-evaluate their positions, with part of them probably making negotiations to adjust their investment portfolios. As the business volume grows, information which had not been regarded or propagated is then perceived and incorporated into the prices. This process can provoke rapid and acute changes in prices, which particularly occur in situations of crisis with generalised decrease in negotiated assets. Here, is a probable origin for the asymmetry between returns and volatilities.

The fourth and last possible explanation for such asymmetries, according to Verma and Verma (2005), is related to the manifestation of investors, which is psychologically based. In general, they react more to falls than to rises in the market prices. Even though the average investor has more difficulty in booking the loss, but being in a rush to make gains, both pessimism and panic diffuse much faster than optimism. In fact, markets fall much faster than rise. The irrational behaviour caused by fear and aversion to risk is different from the self-conflicting behaviour seen during those periods when markets are at high, even considering the irrationalities generated by greed. Asymmetry would come from this behavioural imbalance. Studies by Hong and Stein (1999) and Gervais and Odean (2001) are important references on this issue.

In sum, some interesting considerations can be highlighted regarding studies on the phenomenon of asymmetry of returns and volatilities. They are the following: a) the phenomenon of asymmetry is particularly detected in periods of domestic or international financial crisis; b) The literature points out at least eight arguments to explain the occurrence of asymmetry, which is based on technical aspects such as company leverage as well as behavioural financial issues; c) the volatility increases more after negative (that is; when prices and returns fall) than positive shocks of the same intensity; d) the emerging markets are more volatile than the industrialised ones; e) The investors react faster and more intensively to negative than positive impacts; f) Unexpected news can affect prices in short and very short term, whereas bad news have a greater impact on prices during negative than positive phases; g) price reaction to the news tends to last more during positive (prices tending to rise) than negative (prices tending to fall) phases; h) volatility of returns tends to increase during negative phases.

**METHODOLOGY**

**Data source and treatment**

Data used in the present study are the historical series of market stock indexes of eight countries (Table 1). The series are formed by daily closing prices covering a 5-year period from 2006 to 2010, totalling 1,301 observations for each one of the eight indexes. This period of time involves the global financial crisis occurring in 2008, including two years before and two years after. Data are secondary, being generated and organised by stock markets and divulged by several information agents elsewhere, such as Bloomberg, Económica, Reuters, Yahoo Finance, among others.

<table>
<thead>
<tr>
<th>Country Index</th>
<th>Country Index</th>
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<tbody>
<tr>
<td>USA S&amp;P 500</td>
<td>Brazil Ibovespa</td>
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<tr>
<td>Japan Nikkei 225</td>
<td>Russia RTSI</td>
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<tr>
<td>UK FTSE 100</td>
<td>India BSE Sensex</td>
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<td>Germany DAX 30</td>
<td>China SSE 180</td>
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Table 1. Countries and equity index analyzed.

Countries whose markets were analysed are divided into two groups: one formed by major industrialised economies (USA, Japan, United Kingdom, and Germany) and other formed by the main emerging economies (Brazil, Russia, India and China), which comprise the so-called BRIC block.

The historical series of stock market indexes were converted into historical series of logarithmic returns.

**Data analysis**

Analysis of the behaviour of returns and their volatilities, which had been obtained from the stock market indexes selected for the present study, was performed based on the ARIMA (p,d,q) and GARCH (p,q) model families. The former was used for returns and the latter for volatilities. The first procedures regarding the data involved statistical descriptive analysis of the series and characteristics of their distributions, stationary and non-stationary behaviours, and linearity.

With regard to the series of financial returns, the random component (also called prediction error term, residue, or innovation) of ARIMA model (p,d,q) adjusted for each series is expected to have mean zero, with no correlation between a given observation and past observations. Although error terms are not correlated, they are not independent either. This fact enables a GARCH model (p, q) to reproduce its generating mechanism.

After obtaining the series characteristics, the next step was to estimate the ARIMA models (p,q,d) by using auto-correlation
function (ACF) and partial auto-correlation function (PACF) of each series. These functions offer an indication of the number of lags p and q of the models by assessing the occurrence of serial auto-correlation.

After estimating the ARIMA models \((p,d,q)\), ACF and PACF were obtained for the resulting series of quadratic residues. One procedure needed for this step is to perform a test in order to detect the presence of heteroscedasticity in the series of residues. Ljung-Box-Pierce test and Q-test were used for doing so. ACF and PACF, which were applied to quadratic residues, provide an indication of the number of lags p and q in the GARCH model \((p,q)\) suitable for estimating the volatility.

However, the estimation of parameters for ARIMA (moving average) and GARCH (conditional variance) models frequently face convergence problems. ACF and PACF are tools capable of minimising such a problem by detecting a simpler and consistent model for description of serial data. For financial assets, these functions usually reveal that on return series data are not correlated while quadratic errors present correlation, that is, the series variance can be shaped by a GARCH process.

The estimated ARIMA and GARCH models have been validated by analysing the residue series with Ljung-Box-Pierce test and Q-test. These tests show whether the residues in the modelled series follow an i.i.d. (identically and independently distributed) process, whether distribution respects a normal (Gaussian) distribution, and whether they exhibit any serial correlation or any volatility conglomeration. If such conditions are met, then it means that the model is consistent.

### RESULTS AND DISCUSSION

Tables 2 and 3 show the GARCH model coefficients estimated for industrialised and BRIC markets, respectively.
### Table 3. Coefficients of GARCH models - bric markets.

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<tr>
<th></th>
<th>BRAZIL</th>
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<td>GARCH</td>
<td>TARCH</td>
<td>EGARCH</td>
<td>GARCH</td>
<td>TARCH</td>
<td>EGARCH</td>
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<tr>
<td>( \omega )</td>
<td>6.48E-06</td>
<td>9.78E-06</td>
<td>-0.420672</td>
<td>3.74E-06</td>
<td>7.04E-06</td>
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<td>( \alpha_1 )</td>
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<td>-0.047034</td>
<td>0.152288</td>
<td>0.051521</td>
<td>0.055211</td>
<td>0.180939</td>
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<tr>
<td>( \alpha_2 )</td>
<td>-</td>
<td>0.061803</td>
<td>-</td>
<td>-</td>
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<tr>
<td>( \beta_1 )</td>
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<td>0.879836</td>
<td>0.962398</td>
<td>1.970208</td>
<td>0.882069</td>
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<tr>
<td>( \beta_2 )</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-1.553377</td>
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<td>-</td>
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<tr>
<td>( \beta_3 )</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.525955</td>
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<tr>
<td>( \beta_4 )</td>
<td>-</td>
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<td>-</td>
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<td>-</td>
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<tr>
<td>( \gamma_1 )</td>
<td>-</td>
<td>0.160715</td>
<td>-0.146592</td>
<td>-</td>
<td>0.109790</td>
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<tr>
<td>( \gamma_2 )</td>
<td>-</td>
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<td>D</td>
<td>t-Student</td>
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<td>GED</td>
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<td>AIC</td>
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<td>EGARCH</td>
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<td>( \omega )</td>
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<td>( \alpha_2 )</td>
<td>-</td>
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<tr>
<td>( \beta_1 )</td>
<td>0.875978</td>
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<td>-</td>
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<td>-0.742872</td>
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<td>-</td>
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<tr>
<td>( \beta_3 )</td>
<td>-</td>
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<tr>
<td>( \beta_4 )</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>( \gamma_1 )</td>
<td>-</td>
<td>0.093220</td>
<td>-0.136250</td>
<td>-</td>
<td>0.109256</td>
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<tr>
<td>( \gamma_2 )</td>
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<tr>
<td>D</td>
<td>GED</td>
<td>Normal</td>
<td>GED</td>
<td>Normal</td>
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<td>t-Student</td>
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<td>-5.420365</td>
<td>-5.503079</td>
<td>-4.989221</td>
<td>-4.991985</td>
<td>-5.066434</td>
</tr>
</tbody>
</table>

The coefficients are relative to the three models presented as follows.

**GARCH**

\[
\sigma_t^2 = \omega + \alpha_1 \sigma_{t-1}^2 + \alpha_2 \sigma_{t-2}^2 + \beta_1 \sigma_{t-1}^2 + \beta_2 \sigma_{t-2}^2 + \beta_3 \sigma_{t-3}^2 + \beta_4 \sigma_{t-4}^2
\]

**TARCH**

\[
\sigma_t^2 = \omega + \alpha_1 \sigma_{t-1}^2 + \alpha_2 \sigma_{t-2}^2 + \beta_1 \sigma_{t-1}^2 + \beta_2 \sigma_{t-2}^2 + \beta_3 \sigma_{t-3}^2 + \beta_4 \sigma_{t-4}^2 + \gamma_1 \sigma_{t-1}^2 - \gamma_2 \sigma_{t-2}^2
\]

**EGARCH**

\[
\ln(\sigma_t^2) = \omega + \alpha_1 \frac{\sigma_{t-1}^2}{\sigma_{t-1}} + \alpha_2 \frac{\sigma_{t-2}^2}{\sigma_{t-2}} + \beta_1 \ln(\sigma_{t-1}^2) + \gamma_1 \sigma_{t-1}^2 + \gamma_2 \sigma_{t-2}^2
\]

The first important aspect in the coefficient analysis is that all of them (all models for all markets) have resulted in statistically significant values of 5% (set as reference).

In the GARCH and TARCH models, all values for constant \( \omega \) resulted in numbers very close to zero (\( 10^{-5} \) order) as well as in negative numbers for EGARCH models.
(which was already expected as the model uses variance logs).

The values of lag coefficients $\beta$ indicate that shocks on conditional variance are persistent, that is, they cause an effect which takes a long time to dissipate. It is common that financial series with daily periodicity have persistence coefficients above 0.8. The results showed that coefficients $\beta$ seem to meet this expectancy in all models for all markets, resulting in values greater than 0.8. Table 4 shows this in particular.

The values of coefficients $\alpha$ (from error term) show the intensity of reaction of volatility to market movements. If the coefficient is high, it means that reactions are intense. Markets with high coefficients $\alpha$ and low coefficients $\beta$ are those in which volatility changes rapidly and intensively, but with effects dissipating rapidly. On the other hand, markets with low coefficients $\alpha$ and high coefficients $\beta$ are those in which volatility reacts less intensively, but with effects lasting longer. It is common that financial series with daily periodicity have coefficients $\alpha$ below 0.2. In fact, all values of coefficients $\alpha$ met this expectancy, as shown in Table 5.

In GARCH models, the sum of coefficients $\alpha$ and $\beta$ should be smaller than the unit if the return processes are stationary. The GARCH models estimated for all markets meet this condition. However, as shown in Table 6, the sum of coefficients $\alpha$ and $\beta$ for seven of the eight markets is around 0.99. The exception was the Brazilian market (0.984278). This close proximity to unit may indicate that market volatility predictions do not follow the reversion patterns at the long-term average level of volatility. This result suggests that an integrated GARCH model can be tested to better shape the series or that asymmetric GARCH models should be used, which was the option adopted here.

The coefficients $\gamma$ of TARCH and EGARCH models detect the effect of asymmetry on market volatility clusters. Such an asymmetry occurs because, in general, volatility increases more when asset prices fall as compared to when they rise. The conventional GARCH models (symmetric) are not able to differentiate unexpected returns between positive and negative, thus justifying the use of asymmetric GARCH models (TARCH and EGARCH) in the present study.

All values of coefficients $\gamma$ of TARCH models were found to be positive and significantly different from zero (Table 7), except for the Chinese market. This indicates the presence of volatility asymmetry in seven of the eight markets. In addition, all values of coefficients $\gamma$ of
EGARCH models were negative and significantly different from zero, indicating that negative shocks on market volatility have a more acute effect compared to that of positive ones. Again, the Chinese market exhibited a value of coefficient $\gamma$ very close to zero despite being statistically significant.

When observed as a whole (Table 8), the values of coefficients $\alpha$, $\beta$ and $\gamma$, obtained as simple means for the groups of industrialised and BRIC markets, reveal some interesting aspects. Coefficient $\alpha$ (error term), which shows the intensity of reaction of volatility to market movements, tends to be small in the group of industrialised markets although such values were found to be small in both groups. In addition, this coefficient is negative for all industrialised markets when their volatilities are modelled by TARCH. By using the same model, coefficients $\alpha$ for all BRIC markets were found to be positive. This result suggests that volatility in industrialised markets is contrarily affected (positive/negative) compared to variance innovations occurring in immediate past periods, whereas for BRIC markets such an effect is of the same magnitude.

Even though lag coefficients $\beta$, which indicate persistent shocks on conditional variance, are high in all markets, GARCH and TARCH models had higher values for industrialised markets than for BRIC emerging ones. This result shows that impacts on industrialised markets took longer to dissipate.

Seven of the eight markets analysed, except China, have clearly presented the effect of volatility asymmetry in which negative shocks on market volatility had a more intense effect than that of positive shocks. Nevertheless, the values of coefficient $\gamma$ of TARCH and EGARCH models are higher (in module) for industrialised markets, thus revealing a greater effect of asymmetry on their volatility behaviour. Interestingly, the values of coefficient $\gamma$ for the Brazilian market (0.16 and -0.14) were shown to be similar, on average, to those for industrialised markets, suggesting a behaviour closer to that of the latter, at least regarding this aspect.

### Table 8. $\alpha$, $\beta$ e $\gamma$ coefficients.

<table>
<thead>
<tr>
<th>Coefficient model</th>
<th>Developed markets</th>
<th>BRIC markets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>Standard deviation</td>
</tr>
<tr>
<td>$\alpha$ GARCH</td>
<td>0.059448</td>
<td>0.040144</td>
</tr>
<tr>
<td>TARCH -0.021690</td>
<td>0.025099</td>
<td>0.030735</td>
</tr>
<tr>
<td>EGARCH 0.127037</td>
<td>0.014233</td>
<td>0.172162</td>
</tr>
<tr>
<td>$\beta$ GARCH</td>
<td>0.935694</td>
<td>0.041798</td>
</tr>
<tr>
<td>TARCH 0.937434</td>
<td>0.028724</td>
<td>0.915435</td>
</tr>
<tr>
<td>EGARCH 0.975352</td>
<td>0.007621</td>
<td>0.979896</td>
</tr>
<tr>
<td>$\gamma$ TARCH</td>
<td>0.168672</td>
<td>0.040390</td>
</tr>
<tr>
<td>EGARCH -0.144850</td>
<td>0.010528</td>
<td>-0.094130</td>
</tr>
</tbody>
</table>

**Conclusion**

A new pattern of behavior of capital markets of the BRIC countries, closer to that have the most developed economies in the world, can mean significant changes in destinations of foreign capital flows, in the attitude of international investors, the cost of capital for these countries and their businesses, leverage levels prevailing in these economies, the composition of investment portfolios in investment volumes, finally, in crucial respects to the consolidation of a new map of the distribution of wealth, economic stability profile, and vectors of development, growth and technological advancement in the world. To show the behavior of capital markets of the BRIC countries is already similar, or closer, the behavior of developed markets, this study examined the period surrounding the international financial crisis of 2008, two important aspects: it is during crises the differences and similarities between emerging and developed markets, are lighter, and because the crisis is recent (some experts even believe that she has finished) and coincided with the historical event and innovative invitation to the BRIC countries to make up the select group called G20 and the new Council Permanent International Economic Cooperation (replacing the council formed by representatives of the G8), not only reached the level of GDP, but the importance of their economies.

The results showed that the BRIC markets, over that period, had higher volatility (higher levels of risk) that the developed markets. This finding is consistent with virtually all the studies that evaluated this aspect of the
emerging markets, especially the studies of Shin (2005), Singh et al. (2008) and Park (2010). The group of BRIC markets have also shown similar behaviours compared to those of the group of industrialised markets regarding presence of persistent effects of shocks on volatility, presence of volatility asymmetry, and slower reaction of volatility to market variations. However, there are visible differences in the intensity of each one of these phenomena. The BRIC markets showed less persistence to volatility shocks, less asymmetry, and faster volatility reactions to market variations. The general conclusion is that the capital markets of the BRIC countries still do not behave like those of developed markets.

Conflict of Interests

The author(s) have not declared any conflict of interests.

REFERENCES

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