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VOLATILITY AND STOCK MARKET DIRECTION: A STUDY ON EMERGING MARKETS

Edith Bellini*
Department of Financial Economic and Operations Management, University of Seville, Spain
Avda. Ramón y Cajal 1, Seville, 41.108.
E-mail: ebellini@us

Antonio de la Torre-Gallegos
Department of Financial Economic and Operations Management, University of Seville, Spain
Avda. Ramón y Cajal 1, Seville.
E-mail: atorre@us.es

ABSTRACT

Volatility indices, such VIX, can be used for determining stock market direction. In this paper, we analyze the relationship between changes in the VIX direction and changes in the turning point of S&P 500 and the MSCI Latin-America Emerging Market index, in order to see whether they anticipate the changes. Also, the volatility of emerging markets measured by standard deviation and their relationship with the stock market movements within this market are calculated, since the greater the value of the volatility, the greater the likelihood of a rise or fall. In order to locate the turning point and the upward and downward phases of the cycles, empirical methods are applied and are characterized by using a set of decision rules that reflect the practical experience gained by analysts. Our conclusions include: Turning points, or peaks and troughs, in the VIX are coincident with peaks and troughs in the opposite direction for the S&P 500 index and in emerging markets.

Keywords: *Stock Market, Emerging Market, Options, Volatility, Forecasting, Market Movements.*

1. INTRODUCTION

Volatility indices, such the Chicago Board Options Exchange (CBOE) Volatility Index (VIX), can be used for determining stock market direction. Since it was introduced, in 1993, it quickly became the benchmark for stock market volatility. It is widely followed and has been cited in hundreds of papers and articles in financial publications. The CBOE volatility index (VIX) was last modified in September 2003.

In addition, traders can gauge volatility trends using two other relatively new indices: the Nasdaq 100 volatility index (VXN) and the Nasdaq QQQ volatility index (QQV). In order to make sense of all these volatility indices, let's take a look at what they represent and what makes each one unique. These volatility indices are called the "investor fear gauge" because they are based on real-time option prices, which reflect investors' consensus view of future expected stock market volatility. During periods of financial stress, which are often accompanied by steep market declines, option prices (and volatility indices) tend to rise. So it is usually the case that the greater the fear, the higher the volatility index level. As investors fears subside, option prices tend to decline, which in turn causes indices to decline. It is important to note, however, that past performance does not necessarily indicate future results.

In this paper, we analyze how the VIX is constructed and examine its history. Secondly the relation between the VIX and the turning point of S&P 500, the international index of reference, which has great influence on emerging markets is also studied. The relationship between changes in the VIX direction and changes in emerging markets are then analyzed in order to see if they anticipate the changes. Finally, we calculate the volatility of emerging markets measured by standard deviation and beta coefficient and their relationship with

* Edith Bellini. Facultad de Ciencias Económicas y Empresariales. Avda. Ramón y Cajal 1, Sevilla, España, 41.108.

the stock market movements within this market, since the greater the value of the volatility, the greater the likelihood of a rise or fall.

Various methodologies can be employed to identify the turning points and to determine the duration of the contraction period associated to a market crash, and these can also be applied to forecast the economic cycles. The methodologies can be grouped into empirical or non-parametric methods and methods based on non-linear statistical models such as Threshold autoregressions and Markov-switching vector autoregression (Abad and Cristóbal Quilis, 2000). In this paper, empirical methods are applied, and are characterized by using a set of decision rules that reflect the practical experience gained by analysts. The most famous is the Bry-Bosch method, based on the methodology of the National Bureau of Economic Research (NBER), and used for the detection of business cycles and, therefore, periods of economic crisis.

2. THE CONSTRUCTION OF THE VIX AND HISTORICAL DEVELOPMENT

The VIX measures market expectation of near-term volatility conveyed by stock index option prices. The original VIX[†] was constructed using the implied volatilities of eight different OEX option series so that, at any given time, it represented the implied volatility of a hypothetical "at-the-money" OEX option with exactly 30 days to expiration. The new VIX still measures the market's expectation of 30-day volatility, but in a way that conforms to the latest thinking and research among industry practitioners. The New VIX is based on the S&P 500 index option prices and incorporates information from the volatility "skew" by using a wider range of strike prices rather than just "at-the-money" series. The S&P 500 is the primary U.S. stock market benchmark, and the reference point for the performance of many stock funds, with over $800 billion in indexed assets. In addition, the S&P 500 underlies the most active stock index derivatives, and it is the domestic index tracked by volatility and variance swaps. Furthermore, the new VIX is not calculated from the Black Scholes option pricing model; the calculation is independent of any model. The new VIX uses a newly developed formula to derive expected volatility by averaging the weighted prices of "out-of-the-money" puts and calls. This simple and powerful derivation is based on theoretical results that have spurred the growth of a new market where risk managers and hedge funds can trade volatility, and market makers can hedge volatility trades with listed options.

The generalized formula used in the new VIX calculation is:

$$\sigma^2 = \frac{2}{T}\sum_i \frac{\Delta K_i}{K_i^2} e^{RT} Q(K_i) - \frac{1}{T}\left[\frac{F}{k_0} - 1\right]^2$$

Where:

σ	is VIX/100 => VIX = $\sigma \cdot 100$
T	Time to expiration
F	Forward index level derived from index option prices
K_i	Strike price of i^{th} out-of-the-money option; a call if K_i>F and a put if K_i<F
ΔK_i	Interval between strike prices; half the distance between the strikes on either side of K_i:

$$\Delta K_i = \frac{\Delta K_{i+1} - \Delta K_{i-1}}{2}$$

(Note: K for the lowest strike is simply the difference between the lowest strike and the next highest strike. Likewise, K for the highest strike is the difference between the highest strike and the next lowest strike.)

[†] CBOE will continue to calculate and maintain the original VIX based on the S&P 100 (OEX) index option prices without interruption. However, the ticker symbol will change. Real-time OEX volatility values will continue to be disseminated under the new ticker symbol "VXO".

K_0 First strike below the forward index level, F
R Risk-free interest rate to expiration
$Q(K_i)$ The midpoint of the bid-ask spread for each option with strike Ki.

As a result of the changes being made to the VIX methodology, the new VIX value is different t the original VIX (VXO), although this difference should be small. As shown in the chart below (VIX and VXO for each month during the period January 1986 through December 2010), the new VIX behaves very much like the original in that it tends to increase during stock market declines and decrease when the market advances.
One of the most interesting features of VIX, shown in Figure 1, is that the monthly high level of VIX has had periodic peaks and troughs during times of financial turmoil and investor fear. As markets recover and investors' fears subside, VIX levels tend to drop. For this reason it has been called the "investor fear gauge".

Figure 1

For example, in Figure 1, VIX/VXO reached its record levels at the time of the Market Crash in October 1987 and at the time of Financial Crisis in 2010. The jump in October 1989 was the "mini-crash" resulting from the UAL restructuring failure. The jump in mid-1990 occurred when Iraq invaded Kuwait; and the jump in early 1991 corresponds to UN forces attacking Iraq. VIX reached its record level, 59.89, on Oct-08, at the time of the Financial Crisis in 2008.

More S&P 500 stock index options are traded daily than any other instrument, and hence the index truly is a cross-section of investor sentiment. A low VIX, a range of 18 to 22, indicates that traders have become uninterested in the market and generally indicates a sell-off. The value of VIX increases as the market goes down and decreases when the market moves in an upward direction. A rising stock market is viewed as less risky and a declining stock market more risky. The higher the perceived risk in stocks, the higher the implied volatility and the more expensive the associated options, especially puts. Hence, implied volatility is not about the size of the price swings, but rather the implied risk associated with the stock market. When the market declines, the demand for puts usually increases. Increased demand means higher put prices and higher implied volatilities.

For contrarians, comparing VIX action with that of the market can yield good clues on future direction or duration of a move. The further VIX increases in value, the more panic there is in the market. The further VIX decreases in value, the more complacency there is in the market. As a measure of complacency and panic, VIX is often used as a contrarian indicator. Prolonged and/or extremely low VIX readings indicate a high degree of complacency and are generally regarded as bearish. Some contrarians view readings below 20 as excessively bearish. Conversely, prolonged and/or extremely high VIX readings indicate a high degree of anxiety or even panic among options traders, and are regarded as bullish. High VIX readings usually occur after an extended or sharp decline when sentiment is still reasonably bearish. Some contrarians view readings above 40 as bullish.

Conflicting signals between VIX and the market can also yield sentiment clues for the short term. Overly bullish sentiment or complacency is regarded as bearish by contrarians. On the other hand, overly bearish sentiment or panic is regarded as bullish. If the market declines sharply and the VIX remains unchanged or decreases in value (towards complacency), it could indicate that the decline has further to go. Contrarians might take the view that there is still not enough bearishness or panic in the market to warrant a trough. If the market advances sharply and VIX increases in value (towards panic), it could indicate that the advance has further to go. Contrarians might take the view that there is not enough bullishness or complacency to warrant a peak.

3. Relation between the VIX and the turning points of S&P 500

To see the relation between the VIX and the turning points of S&P 500, it is necessary to first identify the turning point in both indices.

Various methodologies are employed to identify the turning points and to determine bull a bear periods, and can also be applied to forecast economic cycles. The methodologies can be grouped into empirical (or non-

parametric) methods and methods based on non-linear statistical models such as Threshold autoregression and Markov-switching vector autoregression (Abad and Cristóbal Quilis, 2000).

In this paper, empirical methods are applied, and are characterized by using a set of decision rules that reflect the practical experience gained by analysts. The most famous is the Bry-Bosch method, based on the methodology of the National Bureau of Economic Research (NBER), and used for the detection of business cycles and, therefore, peaks and troughs in periods of economic crisis.

Since the purpose of this paper is to analyze the contraction period "bear markets" and "bull periods", this method would be unnecessarily complex, and therefore, for this research, a more simplified method will be applied, whereby the stages in which there have been declines in stock indices from a maximum to a minimum over 15% will be identified and associated. This method is known as "maximum drawdown" or "maximum loss".

Applying this filter to the series of S&P 500 Index, (see Figure 2), the change in prices that has an upward trend and then suddenly plunges can be detected: this can be associated with the beginning of a crisis phase.

As shown on the graph, the crises started in March 1998 (Asian Crisis); February 2000 (Crisis of Technology Companies); and May 2007 (forerunner of the Financial Crisis). As expected, these dates correspond with the start time of both the stock market crises and economic crises, which are widely discussed and analyzed in the financial literature.

Figure 2

At the bottom of the same figure, the VIX indicator is represented. The figure shows, with up arrows and down arrows, that some turning points (peaks and troughs) in the VIX are coincident with peaks and troughs in the opposite direction for the S&P 500 index. In October 1998, for example, the VIX spiked upward and the S&P 500 spiked downward. Similar effects are also seen in 2002 and 2008.

At other times, however, there can be a run-up in stock prices as well as volatility. In January 1999, the VIX was rising (i.e., investors were becoming more nervous) while the level of the S&P 500 index was rising. However, at other times, there can be a run-up in stock prices with little movement in volatility. See, for example, June and July of 1997, and December 1999.

It can be observed from the four up arrows that volatility was extremely low and anticipates an entry into a bearish trend. In the same way, it can be observed from the three down arrows, that the volatility was extremely high and an entry into a bull trend was anticipated.

From Figure 2, it can be seen that an interesting aspect of VIX is that, historically, it tends to move in the opposite direction to its underlying index, and that changes in the VIX are related to stock market returns. The fact that the VIX has peaks and troughs during periods of market turmoil is the reason why it has become known as the "investor fear gauge." Naturally, it is also common for such fears to be reflected in stock prices. This stands to reason. If expected market volatility increases, investors demand higher rates of return on stocks, and hence stock prices fall. The relation is not perfect, however.

Nevertheless, it is worth bearing in mind the sudden drop in volatility readings ever since the start of the market uptrend back in the year 2003 which has made the volatility troughs much more difficult to detect. This narrowing of the range of the VIX could invert in the near future, thus signaling the start of a stock market downtrend.

Many users view the VIX as a contrary indicator. High VIX values such as 40 (likely to be reached when the stock market is very low) can represent irrational fear and can indicate that the market may be getting ready to return to an upward trend. Low VIX values of less than 13 (likely to be reached when the market is very high)

can represent complacency and can indicate the market may be at risk of peaking and is due for some profit-taking.

4. RELATION BETWEEN CHANGES IN THE VIX AND STOCK MARKET DIRECTION IN EMERGING MARKETS

Now that the relationship between turning points of the VIX and the S&P500 has been studied, we can explore whether there is also a relationship between turning points in emerging markets, as measured from the EM MSCI Index (MSCI Latin-America Emerging Market Index) and the VIX.
Since, over recent years, there has been major correlation between the S&P 500 and emerging markets, as can be observed in Figure 3.

Figure 3

Figure 4 shows the turning points in emerging markets, as measured from the EM MSCI Index (MSCI Latin-America Emerging Market Index) and the VIX.

Figure 4

From Figure 4, the beginnings of the last three major crises can be seen to correspond to low VIX points, as marked on the chart with red arrows, while the ends of the bearish phases in the index, the minimums, correspond to areas of high values of the VIX, above 40. This data can help managers make market timing strategies.

5. VOLATILITY OF EMERGING MARKETS MEASURED BY STANDARD DEVIATION

Standard Deviation is a statistical measure of volatility and can be used to predict the turning points in the financial markets and emerging markets.

High Standard Deviation values occur when the data item being analyzed (e.g., an emerging market index) is changing dramatically. Similarly, low Standard Deviation values occur when the stock markets are stable.

Over recent years, many analysts have felt that major troughs are accompanied with high volatility as investors struggle with the fear. Major peaks are assumed to be calmer as investors have a lower expectation of profits.

Standard Deviation is derived by: calculating an n-period simple moving average of the monthly yield; summing the squares of the difference between the yield and its moving average over each of the preceding n time periods; dividing this sum by n; and then calculating the square root of this result.

$$\sigma = \sqrt{\frac{\sum_{j=1}^{n} \left(\text{Yield}_j - \quad (\text{n} - \text{period SMA Yield})\right)^2}{\text{n}}}$$

Where:
SMA = Simple Moving Average
n= number of time periods

Figure 5 shows how Peaks correspond to low monthly volatility, around 10%, while Troughs correspond to higher monthly volatility, above 30%.

Figure 5

This data can help managers create market timing strategies in emerging markets.

6. CONCLUSION

Stock Market Volatility can be used for the identification of stock market direction. Since the VIX is constructed from the implied volatilities of S&P 100 index options, it is, by definition, a measure of expected stock market risk. The descriptor "investor" arises from the fact that investors set the level of the VIX, albeit indirectly. Investor demands for S&P 100 call and put options set prices, and these prices, in turn, are used to imply the level of the VIX.

Over its fourteen-year history, VIX has acted reliably as a fear gauge. High levels of VIX are coincident with high degrees of market turmoil, whether the turmoil is attributable to stock market decline, the threat of war, unexpected change in interest rates, or a number of other newsworthy events.

The higher the VIX, the greater the fear. High readings of VIX usually occur after a market sell-off and indicate that a long-term position should be taken. Low readings usually occur after a rally and imply a short-term position.

Turning points, or peaks and troughs, in the VIX are coincident with peaks and troughs in the opposite direction for the S&P 500 index and in emerging markets. This data can help managers create market timing strategies.

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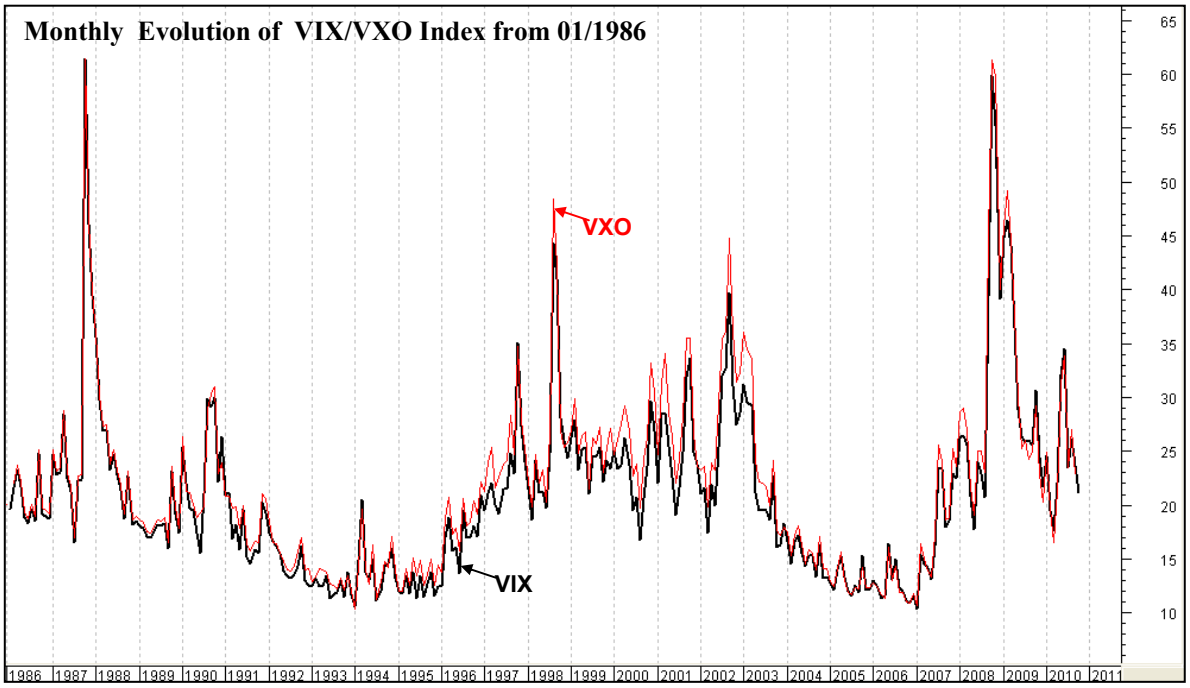

Figure 1

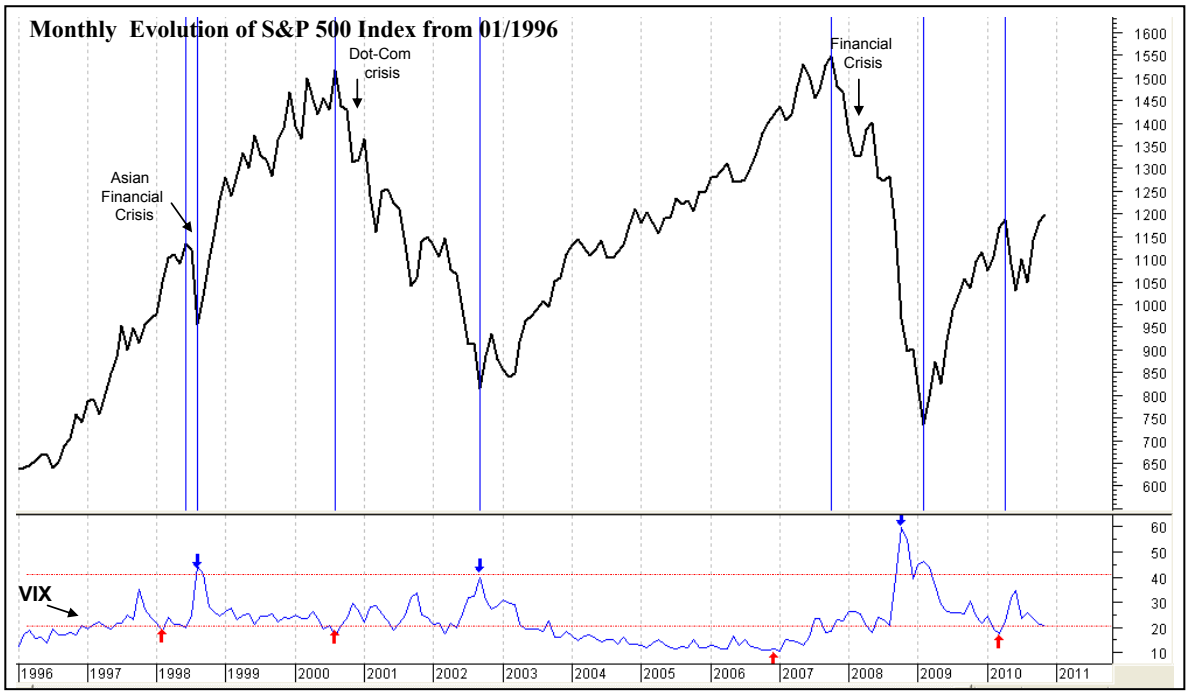

Figure 2

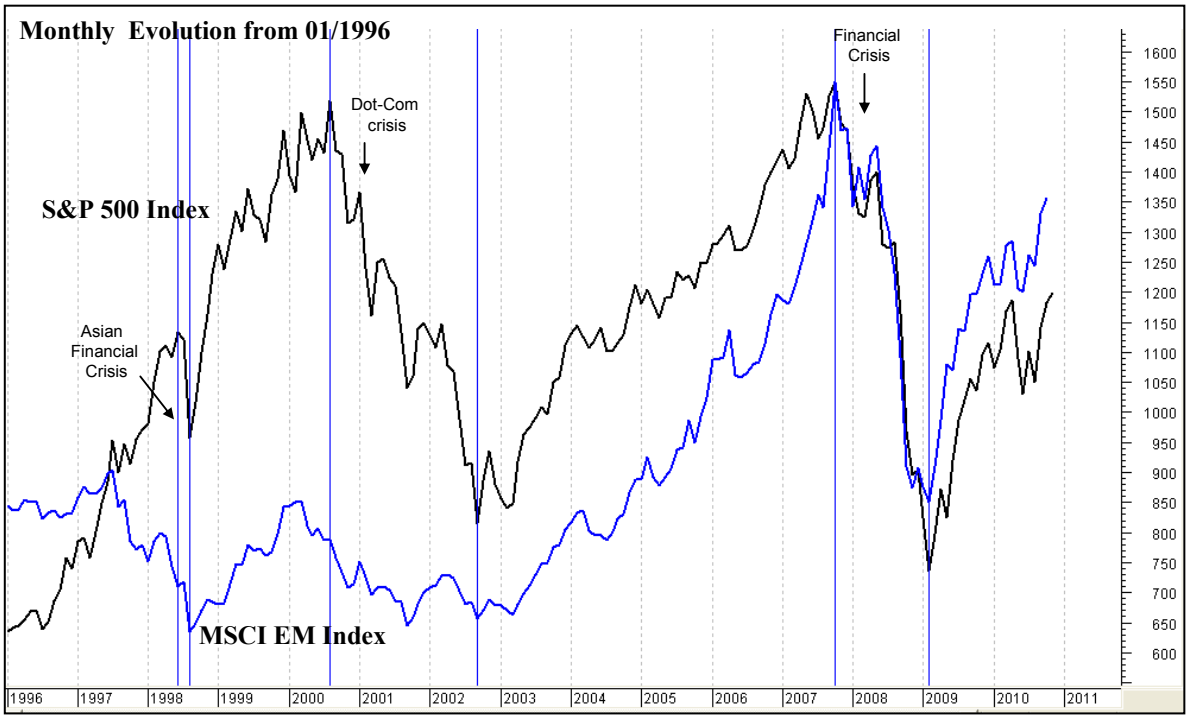

Figure 3

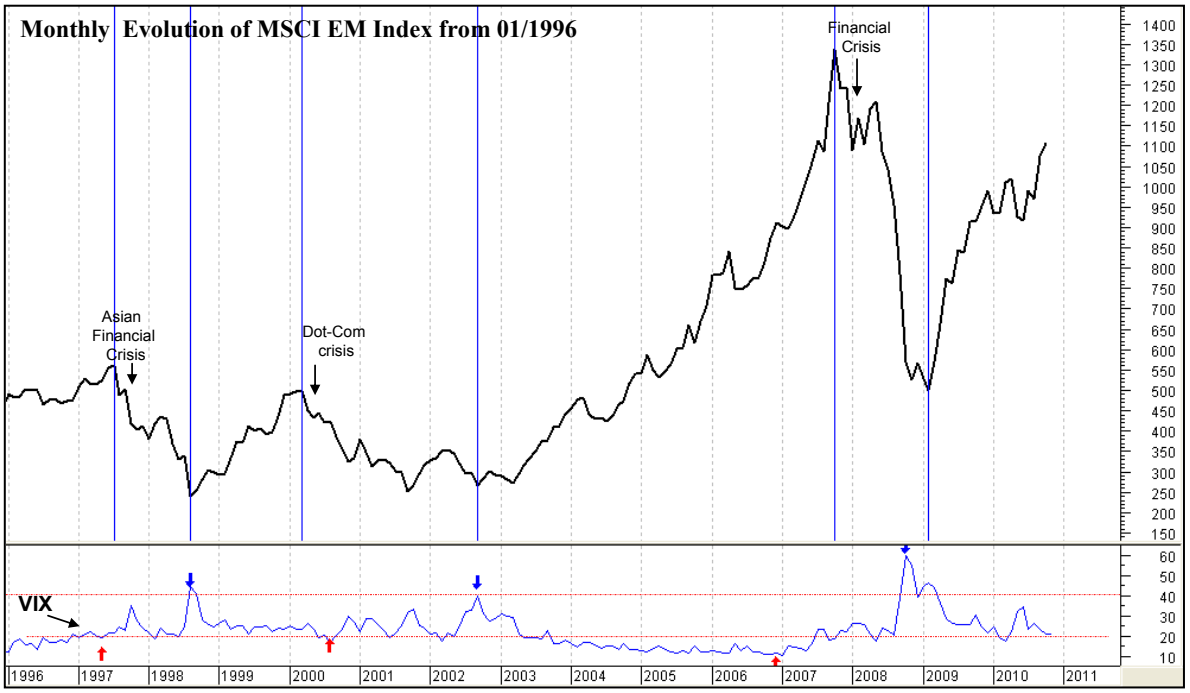

Figure 4

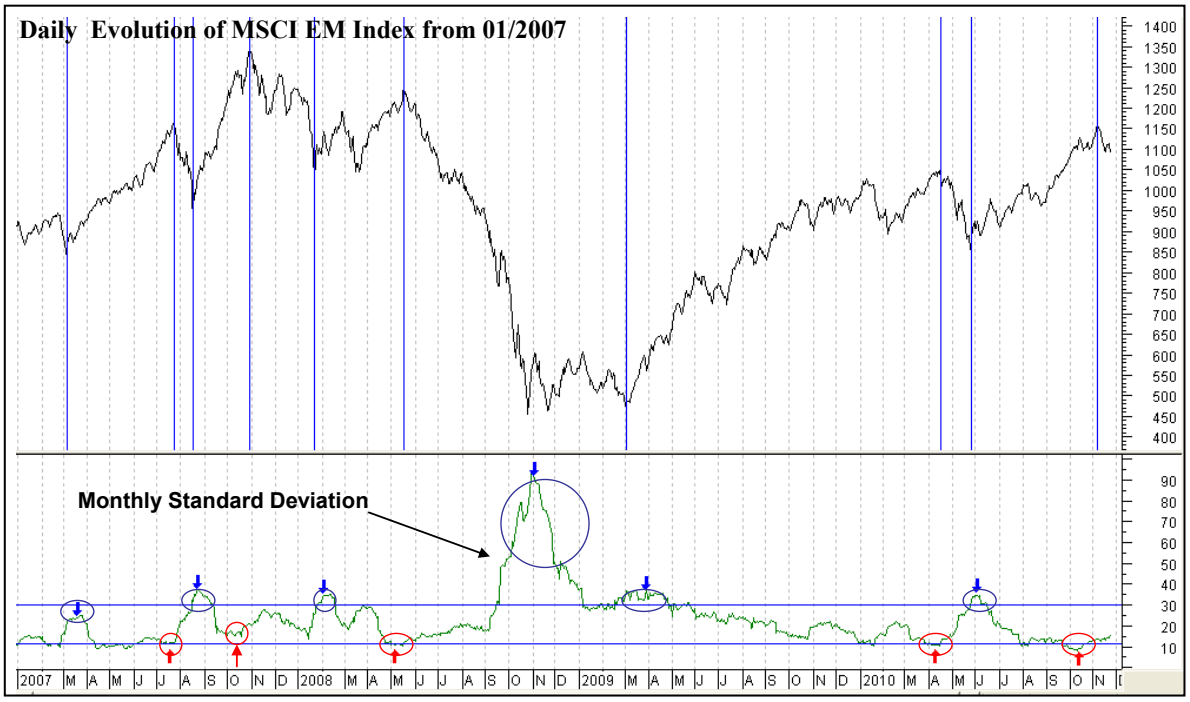
Daily Evolution of MSCI EM Index from 01/2007
Monthly Standard Deviation
2007
2008
2009
2010

Figure 5