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Monetary policy and financial market stability: does inflation targeting make a difference?

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Masters in Management: Finance and Investment

Monetary Policy and Financial Market Stability: Does Inflation Targeting Make A Difference?

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Abstract

Since the early 1990s an increasing number of countries are adopting inflation targeting and although it has been lauded as a successful monetary policy regime this paper seeks to determine whether or not inflation targeting is sufficient to bring about financial market stability.

We compare 10 emerging market economies, 6 that have adopted inflation targeting and 4 that have not in order to ascertain whether or not there is a significant difference between these groups of countries based on 2 financial market stability indicators, the first being the volatility of equity markets and the second being currency volatility.

From these results, there is no evidence that inflation targeting has had any impact on the stability of financial markets and in some instances, non-targeters have outperformed targeters in terms of the improvements in stability.

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1. Introduction

1.1 Background

Policy makers have been interested in the link between monetary policy and asset price movements from the 1920's stock market boom and subsequent 1929 crash to the 1980's Japanese asset bubble, both of which were followed by protracted recessions and deflation. (Bordo and Jeanne 2002)

Although inflation targeting, as the name suggests, primarily involves a central bank determining a medium term numerical target for inflation which is then announced publicly (Mishkin 2008) and confirms that price stability, meaning stable inflation, is the primary long-term goal of the central bank, financial stability should also be a goal as stated by Montes (2010).

In his paper, Mishkin (2008) states that "Fiscal stability is a fundamental necessary condition for inflation control, and hence, inflation targeting", he also goes on to mention that for a successful inflation targeting regime; the financial system has to be safe and sound.

The effectiveness of monetary policy in an inflation targeting regime may be limited by the stability in the financial markets. Crises and unexpected shocks may alter inflation expectations and financial markets are possibly going to take guidance from central bank statements about possible changes in monetary policy and the stability thereof (Montes 2010).

Central banks in developed economies have recognized that there may be a need for them to oversee not only price stability but also financial stability more closely even though there may be occasions were the two objectives collide, like if there was to be a bubble in the strength of the exchange rate and high inflation simultaneously (De Gregorio 2010).

The emphasis on financial stability as it relates to inflation targeting is not a new concept and has been understood for quite some time now. Monetary policy should seek to enhance financial market stability as this stability assists in the efficient implementation on monetary policy (Cocris and Nucu 2013).

This notion that central banks have long understood their explicit financial stability objective is also cited by De Gregorio (2010) who goes on to say "it was a secondary issue for many years, as GDP was growing strong and banks and firms displayed sound balance sheets".

Given this, we will seek to research whether inflation targeting as a monetary policy regime that uses short term interest rates as a policy tool has improved financial stability in the economies that have adopted it. Although there has been extensive research done on the effectiveness of inflation targeting on reducing inflation, inflation variability, inflation expectations and inflation variance (Willard 2012) the focus of this research will be on the impact of this monetary policy stance on financial market stability in the following emerging market economies:

- South Africa
- Brazil
- Mexico
- Chile
- South Korea
- Hungary
- India
- Russia
- Pakistan
- Argentina

As stated in the work done by Cocris and Nucu (2013), there is an absence of a widely accepted definition of financial stability or a framework that can be used as a standard measurement and as such we will define financial stability, similar to them, in terms of share prices and changes thereof (using appropriate indices) and the exchange rate as measured by comparing the local currency to the United States dollar.

In the rest of this chapter we will outline why we believe this research is beneficial and to whom, set forth the problem statement and the research questions.

1.2 Significance

With the spotlight being on central bankers, many of whom have recently intervened in the financial markets, especially in the developed economies like the Federal Reserve in the US and the European Central Bank, as well as the uncertainty as it pertains to monetary policy post the Global Financial Crisis we believe that this research will be of benefit to the following:

- Central bankers and policy makers in understanding the role monetary policy in general and inflation targeting specifically have in influencing financial stability.
- Investors, asset managers and financial market practitioners would have a keen interest in how policy could possibly impact the ability of the market to remain

stable and efficient and how they should view inflation targeting when making investment decisions.
- Regulators who seek to ensure that financial markets are stable and function efficiently
- Those involved in academia as this will highlight whether or not inflation targeting has been effective in achieving some of it's' objectives.

1.3 Problem Statement

Given the recent financial market instability we have seen that began in the US as well as other recent stock market crashes and foreign exchange market dislocations it seems that the ever popular monetary policy regime of inflation targeting may not be achieving one of its' objectives, that of financial stability.

If interest rates are unstable, this will result in volatile asset prices as the discount rate fluctuates and this volatility may make it difficult to plan and forecast. This uncertainty could have a negative impact on economic activity which in turn may create further volatility.

Understanding the role monetary policy plays in financial market stability and its' limitations in this regard is imperative. This is because such knowledge could lead to the avoidance of future catastrophic events and provide information to both those who are policy makers and those involved in the financial markets. The consequences of neglecting this are exacerbated by the growing integration of financial markets and globalization.

As mentioned by Stiglitz (2002) capital market liberalization has played a critical role in the increased frequency and depth of financial crises.

1.4 Research Questions

- Has inflation targeting improved financial market stability as it relates to changes in stock market prices?
- Have foreign exchange markets stabilized in the wake of inflation targeting?
- Can monetary policy be used to bring about financial market stability and inflation targeting simultaneously?
- Given that inflation targeting relies on the use of interest rates as an instrument, to what extent does it foster an environment where asset prices are stable based on a stable discount factor?

The remainder of this paper will cover the literature review followed by an explanation of the data and methodology used. Then an evaluation of the results and a conclusion.

2. Literature Review

2.1 Inflation Targeting

Many papers have been written about inflation targeting since it was adopted by New Zealand and then Chile in 1990 which were followed by Canada in 1991 and the United Kingdom in 1992 creating a lot of public and academic debate (Neumann and Von Hagen 2002)

It is widely accepted that the term 'inflation targeting' refers to more than just targeting the rate of inflation. It involves the setting of a numerical target range for inflation, using monetary policy, in the form of interest rate adjustments, to achieve the target, an independent central bank being tasked with operating this policy instrument and the inflation rate being the primary objective (Arestis and Sawyer 2003)

Proponents of this monetary policy regime have argued that the price stability brought about by inflation targeting brings about improved economic performance (Fry) and that policy making under this regime is coherent and transparent with increased accountability and greater attention to long-run effects (Bernanke and Mishkin 1997)

Others have said that inflation targeting has, in industrialized economies, "played a significant role in anchoring long-run inflation expectations" (Levin, Natalucci et al. 2004) while Arestis and Sawyer (2003) state that it improves communication between policy makers on the one hand and business, markets and the public on the other hand.

Inflation targeting has also been associated with overall economic performance based on the fact that levels and volatility of inflation as well as interest rates have declined after countries adopt it and output volatility also seems to have improved (Mishkin and Schmidt-Hebbel 2007). Walsh (2014) also makes the point by saying that inflation volatility is costly and thus price stability is close to optimal and it is the best way to conduct monetary policy.

Moreover, inflation targeting seems attractive because policy makers can set and achieve an inflation target without jeopardizing the achievement of any level of real activity which is independently set of the inflation targeting (Lima and Setterfield 2008)

Even in emerging markets, where often fiscal and financial reforms may not yet be in place, inflation targeting has been a successful monetary policy strategy because it can aid these reforms which explains why the list of emerging markets adopting it has increased in recent times (Mishkin 2008)

Even though inflation targeting has received many accolades for its' superiority as a monetary policy Neumann and von Hagen (2002) noted that there is a lack of empirical evidence that can be drawn upon in support of inflation targeting and they go on further to state that levels of inflation have been reduced everywhere, even in those places that are not targeting inflation.

This sentiment is echoed by research done by Mishkin and Schmidt-Hebbel (2007) where it is noted that "inflation targeting does not yield inflation below the levels attained by industrial countries that have adopted other monetary regimes", they also go on to make the point that although inflation targeting has led to decreased levels of inflation, interest rate as well as decreased output volatility this was a trend in the 1990's and inflation targeters are not unique to non-targeters in this regard.

In his paper *Does Inflation Targeting Matter? A Reassessment,* Willard(2012) states that "based on the evidence thus far, there is at best only weak evidence that inflation targeting contributed to the reduction in inflation experienced in developed countries in the 1990s."

A recurring criticisms for inflation targeting is that in todays' world of liberal financial markets it cannot cope with the potential asset price and debt bubbles that can be caused as a result of financial innovation and this is exacerbated by the fact that central banks seem to pay little attention to rapidly rising asset prices but feel compelled to act during a downturn. This may, in part, be due to the wealth effect which is hypothesized to lead to consumer expenditure in that if asset price values are increasing and consumers feel wealthier they are more inclined to spend. (Arestis and Sawyer 2003)

It is clear that there is much debate about the success and relevance of inflation targeting as a monetary policy regime in both industrial and developing economies and this seems set to continue especially in the aftermath of the global financial crisis.

2.2 Financial Market Stability

The difficulty in defining financial stability is that there does not seem to be a widely accepted definition and more often than not research points to financial instability instead (Issing 2003)

Akram, Bardsen et al (2007) also state that there is no consensus on the operational definition of financial stability and they define it with a focus on banks. Their definition looks at the probability of default in banks, firms and households as well as the profitability of banks.

There also does not seem to be a generally accepted analytical framework for financial stability as there is for other disciplines like economic systems and this could be due to the fact that this type of analysis is still relatively new compared to the analysis of other systems such as macroeconomic stability as an example (Schinasi 2004)

Schinasi (2004) does however attempt to define financial stability based on the financial systems ability to:

i. Facilitate allocation of economic resources efficiently and effectively execute other economic processes like wealth accumulation and economic growth
ii. Adequately asses, price, allocate and ultimately manage financial risks
iii. Withstand external shocks and internal imbalances in order to perform these functions mainly through self-correcting mechanisms.

2.3 Monetary Policy and Financial Market Stability

In the aftermath of the global financial crises, debate is rife about the responsibility that monetary policy has to keep financial markets stable with countries like Canada and Australia incorporating financial stability into their monetary policy regimes and traditional non-targeters like the US and Japan adopting numerical inflation objectives to assist them in their search for a recovery – although neither the Federal Reserve nor the Bank of Japan have declared themselves inflation targeters.(Lavigne, Mendes et al. 2012)

The importance of employing monetary policy to bring about financial stability is becoming increasingly prevalent in a world with increasing financial integration. A case in point is with Sweden who have created a Financial Stability Council whose main responsibility will be to “asses financial stability, manage crises and publish its positions and assessments.” (Svensson 2014)

Price stability, or inflation targeting, is seen by some to be sufficient to bring about financial market stability, as the two seem to “mutually reinforce each other in the long run” (Issing 2003).

However, it has been argued that monetary policy and financial stability are separate and distinct policies with different instruments and objectives and one should not be used to bring about the other as both will then suffer and it will be more difficult to hold policymakers accountable to each of them (Svensson).

This notion of monetary and price stability being separate policies with different instruments is consistent with Tinbergen’s effective assignment principle which states that one should have as many instruments as objectives and that instruments must be

assigned to those objectives they can best impact. Thus if central banks are to achieve both monetary and price stability, they would require more than one policy instrument to do so. (Smets 2013)

Issing (2003) goes on to say that history shows that many banking crises often occur during recessions that follow periods of high inflation and thus there is no trade-off between monetary and financial stability however, he also says that financial imbalances can occur in an environment of stable prices like in the US during the 1920s and 1990s as well as Japan during the late 1980s. Thus low inflation is not a sufficient condition for financial stability.

The important question here is whether or not central bankers should consider financial stability when making monetary policy decisions and to what extent should they be held accountable for it? (Woodford 2013)

This is amplified by the fact that accommodative monetary policies not only ease financial conditions but they could result in financial vulnerabilities which may include maturity and liquidity transformation in the financial system, compressed risk premiums and excessive leverage and these vulnerabilities could lead to a higher probability of financial crises. (Adrian and Liang 2014)

It is clear that monetary policy and financial stability are interrelated and depend on one another. The balance sheets of economic agents are impacted by monetary policy decisions as these decisions affect asset prices but for monetary policy decisions to be transmitted in the economy a sound and stable financial system is required. (Hrnčíř 2012)

2.3.1 Long Term Interest Rates

The link between monetary policy and financial stability can be seen in the fact that the policy instrument used to implement inflation targeting is the short-term interest rate. The choice of using short term interest rates as the policy tool is based on the assumption that the real effects of the monetary policy take place through interest rates and asset prices as well as the fact that all interest rates and asset prices are linked through arbitrage. This implies that long rates are given by the weighted average of future short rates and asset price values were based on the present discounted value of payments on the asset thus one only needs to change current short rates and this would feed through to long rates and asset prices (Blanchard, Mauro et al. 2010)

So when monetary policy is loosened investors who are looking for an income yield may rebalance their portfolios and invest in longer term bonds so as to maintain their

income. This will boost long term bond prices and result in reduced term premiums given the inverse relationship between bond prices and yields. (Adrian and Liang 2014)

2.3.2 Asset Prices

The Organization for Economic Co-operation and Development (OECD) released a report which was titled “Monetary Policy in a Changing Financial Environment”. In it they comment on the new, and important, considerations for policy makers. This includes the fact that between 1985 and 1998 the value of the total outstanding debt and equity has increased from 150% to 250% of the GDP’s of the largest OECD economies. They go on to say that monetary policy does play an important role in financial stability because through policy decisions borrowing costs for firms and households as well as the value of asset prices change which influences behavior through their impact on the balance sheets. The report also states the greater integration of global capital markets will amplify the sensitivity of asset prices to interest rate movements and monetary policy

The difficulty for central bankers is how to deflate a price bubble when it begins to form by increasing interest rates but without causing the entire economy to collapse. (Gudmundsson, Tovar et al. 2010) Added to this is the complexity of actually knowing whether or not a bubble is forming and how to react to it and due to this central banks have generally looked to minimize the collateral damage post the bubble bursting than trying to prevent it. (Montes 2010)

Former Chairman of the Fed, Alan Greenspan, was also of the view that monetary policy could only really deal with the aftermaths of an asset price bubble but could not prevent it. Others have argued that a central bank would achieve superior performance by reacting not only to inflation targeting and the output gap but also to asset prices. (Bean 2003)

Montes (2010) argues that asset price movements are important for economic forecasts which are necessary for inflation forecasting and targeting so central banks cannot ignore the formation of bubbles, instead they must monitor and supervise financial markets to avoid new bubbles which could lead to crises.

This line of thinking is shared by the conventional view which states that central banks should continue with their flexible inflation targeting objectives and only concern themselves with financial imbalances in asset and credit markets to the extent that they affect inflation forecasting. (Akram, Bardsen et al.2007)

But on the contrary there is the adjustment oriented view which advocates for monetary policy tightening even if near term inflation seems under control if there are signs of

asset price and credit booms which may eventually threaten financial stability. This could lead to a trade-off between price and financial stability and it is suggested that it may be necessary for financial stability to take the forefront for a short time if serious imbalances develop. (Hrnčíř 2012)

In their paper, Adrian and Liang (2014) make the point that not only should central bankers consider financial stability in their decision making, but that they can be the cause of the instability because although accommodative policies can lead to stronger economic growth they can also lead to incentives for risk taking. This is because it leads to a compressed risk premium and this may lead financial market participant to search for yield as many investors have fixed nominal return requirements and asset managers may have their compensation tied to a return above a certain nominal return. Looser monetary policy also makes it easier for market participants to take on additional leverage which in turn will affect asset prices and may lead to a bubble.

However, it is not clear whether increasing interest rates to curb sharp asset price increases would be sufficient to bring about financial stability because the increase in rates may need to be so large that it brings about an undesired decline in inflation and possibly unemployment. Not only this, but in an inflation targeting environment, interest rate movements that are not in line with the underlying inflation expectations may cause the central bank to lose credibility and result financial instability. (De Gregorio 2010)

2.3.3 Foreign Exchange

In emerging markets, especially those with high levels of foreign debt, there is greater concern with exchange rate fluctuations because often a sharp depreciation of the local currency can lead to a rise in inflation due to the pass-through from higher imports and a larger demand for exports. This situation can lead to financial crisis especially for small open economies with dollarized foreign debt – examples of this include the currency crises in Chile in 1982, Mexico in 1994, East Asia in 1997, Ecuador in 1999, Turkey in 2000 and Argentina in 2001 (Mishkin 2008). Thus, Blanchard, Mauro et al (2010) state that in small, open economies the central banks must accept that part of their objective is exchange rate stability.

However, there is no evidence that a sharp rise in interest rates will sustainably stop a currency from depreciating further because as interest rates increase so does the cost of debt and this may lead to an increase in the probability of default and bankruptcy by highly indebted firms and households which would make that country less attractive to invest in. (Stiglitz 2002)

De Gregorio (2010) argues that although exchange rates are an important consideration for central banks they should not become an official objective as this would affect the ability to meet the inflation target as it would weaken the capacity to control interest rates. The point here is that intervention in the foreign exchange markets must be in line with the inflation targeting mandate of the central bank.

“Empirical analysis shows that an inflation targeting strategy under a free or managed floating exchange rate is suitable for promoting financial stability” (Cocris and Nucu 2013).

3. Methodology and Research Design

Since the aim of this research paper is to determine whether or not inflation targeting results in stability in the financial markets we will be comparing the volatility in specific financial market indicators in countries with an inflation targeting regime relative to those without one.

Firstly, to measure financial stability we will look at the volatility as it relates to equity markets and foreign exchange markets. With the equity markets we will look at the total market indices whereas with the foreign exchange markets we will look at volatility against the US dollar.

Using equity markets as an example, we will first calculate the quarterly volatility on the index for 20 quarters prior to the adoption of inflation targeting and 20 quarters thereafter. This will be compared with 40 quarters of data for non-targeters to see if the volatility of returns is greater firstly before the inflation targeting period and secondly within non-targeters relative to targeters post inflation targeting.

By doing so we hope to see if there is a significant difference between targeters and non-targeters and if the transmission mechanism of inflation is greater in any of the financial stability indicators.

A similar process will be used for foreign exchange markets where we will measure the volatility of the domestic currency to the US dollar on a quarterly basis.

The analysis will be done by looking at quarterly data for 10 countries (6 of them inflation targeters and the other 4 are non-inflation targeters) as can be seen in Appendix B.

As financial integration has grown the expectation is to see volatility potentially increasing as cross border flows increase thus by comparing the volatility of targeters and non-targeters we will be able to see if the volatility is more pronounced in any of the groups' overtime.

3.1 Definitions

Before the formula is specified and the rationale for its use explained, the following parameters and observations are explained:

- **Financial market stability**: Defined in terms of share price and exchange rate volatility, which is similar to the definition put forward by Cocris and Nucu (2013).
- **Volatility**: Measure the risk of price movements for a security calculated from the standard deviation of day-to-day logarithmic historical price changes. It is a 90-

day price volatility which equals the annualized standard deviation of the relative price change for the 90 most recent trading day's closing price, expressed as a percentage (Bloomberg)

- **Equity index**: The relevant, traded equity market index for each of the countries we will be looking at which is used as a proxy for stock markets
- **Currency**: the official currency of each country and will be used as a proxy for foreign exchange markets

3.2 Formulae and Methodology

The regression formula used is akin to the one used by Ball and Sheridan (2004) in their analysis of the impact of inflation on economic performance but with a few modification to cater for the fact that the main interest in this research is financial stability in emerging markets.

The regression formula they used was:

$$\boldsymbol{X_{POST} - X_{PRE} = \partial_0 + \partial_1 D + X_{PRE} + \epsilon} \qquad (1)$$

X is the financial stability indicator in question and "pre" and "post" refer to whether the measurement is from before or after inflation targeting had been adopted for targeters. D is a dummy variable equal to 1 for all countries that are in fact inflation targeters and the coefficient $\boldsymbol{\partial_1}$ is meant to measure the effect of targeting on **X**.

Slight modifications have been made as this study, unlike theirs, is not focused on the impact of inflation targeting on inflation and output growth but rather analyzing the impact of inflation targeting on financial market stability.

Thus the final regression that will be run is:

$$\boldsymbol{X_{POST} - X_{PRE} = \partial_0 + \partial_1 D + \partial_2 X_{PRE} + \partial_3 US_{CHANGE} + \partial_4 OIL_{CHANGE} + \partial_5 GOLD_{CHANGE} + \epsilon} \quad (2)$$

Where:

- $\boldsymbol{X_{POST}}$ is the volatility of the financial stability indicator after inflation targeting
- $\boldsymbol{X_{PRE}}$ is the volatility of the financial stability indicator before inflation targeting
- $\boldsymbol{D}$ is the dummy variable equal to one if the country is an inflation targeter.
- $\boldsymbol{US_{CHANGE}}$ is the 'post – pre' (change) in the corresponding US variable volatility
- $\boldsymbol{OIL_{CHANGE}}$ is the change in volatility of the oil price
- $\boldsymbol{GOLD_{CHANGE}}$ is the change in volatility of the price of gold

The aim is to determine whether or not inflation targeting has had a significant impact on the financial market stability on a selected group of emerging market economies.

The process that will be followed is one where we will measure the average volatility for the financial stability indicator (for example an equity index) for the inflation targeting countries before they adopted inflation and then calculate the average for the period after targeting was adopted.

The average for the same periods for the non-inflation targeters will be calculated and compared to ascertain whether or not there is a significant difference between this group of countries and the inflation targeting countries

The dates for the pre and post inflation targeting period are tabled in Appendix B.

The first regression to be run is the following:

$$X_{POST} - X_{PRE} = \partial_0 + \partial_1 D + \epsilon \qquad (3)$$

∂_1 in the regression is meant to measure the effect of targeting on variable **X** however, given that financial stability in emerging market economies is the focus there are other external factors which may have an impact.

This list of 'other variables' is not exhaustive but includes volatility in the US. This is included because all currency are generally quoted against the US dollar so the US is already included in the currency regression however for stock market indexes and long term interest rates we specifically included the change in volatility for the US as it has been known to have an impact on emerging markets.

Secondly, similar to Ball and Sheridan (2004), we included the initial value of variable **X** to the regression to avoid the problem of mean regression. That is that if a country had relatively higher volatility in the pre-targeting period it may improve by a greater degree in the post targeting. Adding the initial value controls for the problem of regressing to the mean such that if the dummy coefficient is significant it would imply that inflation targeting affects a countries change in performance taking into account their initial performance.

Therefore, the next regression run is the following:

$$X_{POST} - X_{PRE} = \partial_0 + \partial_1 D + \partial_2 X_{PRE} + \epsilon \qquad (4)$$

Lastly, both the change in volatility of the price of oil as well as the change in volatility of the gold price have been included. The reason for this is because many emerging

markets rely on natural resources, both from an import and an export perspective and the volatility of these two resources could have an impact on the results and thus we include them in the regression to isolate them in an attempt to measure the impact they have on variable **X.**

Thus the final regression formula that was run is formula number (2) which is restated below:

$$X_{POST} - X_{PRE} = \partial_0 + \partial_1 D + \partial_2 X_{PRE} + \partial_3 US_{CHANGE} + \partial_4 OIL_{CHANGE} + \partial_5 GOLD_{CHANGE} + \epsilon$$

All these additional variables are added to the regression to avoid having the coefficient on the dummy variable being incorrectly significant and thus producing a spurious conclusion.

The regression is run over relatively short periods of time and this is owing to the fact that reliable financial market data in emerging markets has only recently become available.

4. Analysis and Results

4.1 Data Sources

The quarterly data used in running the regressions is in Appendix C and full data is graphed in Appendix E and it was sourced from Bloomberg.

The definitions for each market index as well as currency and long term interest rate data have also been sourced from Bloomberg and can be found in Appendix D.

The information on when each country adopted inflation targeting as well as the conditions preceding this adoption are in Appendix A.

4.2 Equity Volatility

The average change in volatility for inflation targets between pre and post inflation targeting periods was -8.23% (based on data in Appendix C) and that for non-targeters was -10.01%. Thus, at first glance, the volatility in non-targeters decreased by a greater degree.

The results from running the regression are as follows:

Dependent Variable: POST-PRE
Method: Least Squares
Date: 03/30/15 Time: 22:02
Sample: 1 10
Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.100080	0.045677	-2.191037	0.0598
DUMMY	0.017778	0.058969	0.301476	0.7707

R-squared	0.011233	Mean dependent var	-0.089414
Adjusted R-squared	-0.112363	S.D. dependent var	0.086617
S.E. of regression	0.091354	Akaike info criterion	-1.771291
Sum squared resid	0.066765	Schwarz criterion	-1.710774
Log likelihood	10.85645	Hannan-Quinn criter.	-1.837678
F-statistic	0.090888	Durbin-Watson stat	2.908230
Prob(F-statistic)	0.770740		

The results from the first regression (Equation 3) shows that there does not seem to be significance in the dummy variable which represents inflation targeting. The coefficient on the dummy variable is 0.017 which implies that volatility in inflation targeters fell 0.017 points more than in non-targeters.

Next, to avoid mean regression we add the initial value to the regression:

Dependent Variable: POST-PRE
Method: Least Squares
Date: 03/30/15 Time: 22:16
Sample: 1 10
Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.135070	0.033013	4.091438	0.0046
DUMMY	-0.014200	0.020115	-0.705912	0.5031
PRE	-0.658433	0.081950	-8.034529	0.0001

R-squared	0.903270	Mean dependent var	-0.089414
Adjusted R-squared	0.875633	S.D. dependent var	0.086617
S.E. of regression	0.030546	Akaike info criterion	-3.895828
Sum squared resid	0.006531	Schwarz criterion	-3.805052
Log likelihood	22.47914	Hannan-Quinn criter.	-3.995408
F-statistic	32.68328	Durbin-Watson stat	1.673233
Prob(F-statistic)	0.000281		

By adding the initial value, both the R-squared and the Adjusted R-squared increase significantly from 0.011 and -0.112 to 0.903 and 0.875 respectively. This significant increase shows just how much of the variation in volatility is explained by the initial volatility, this can be seen in the fact that the coefficient on the initial value is -0.658 which is significant.

Lastly, given that these are emerging market economies which are often susceptible to movements in commodities prices as well as changes in the US, we add these variable to see the impact that they have:

Dependent Variable: POST-PRE
Method: Least Squares
Date: 03/30/15 Time: 22:26
Sample: 1 10
Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.315473	0.196065	1.609024	0.1829
DUMMY	-0.072412	0.062574	-1.157217	0.3116
PRE	-0.664695	0.105733	-6.286527	0.0033
USPOST-USPRE	-0.120511	1.674550	-0.071966	0.9461
OILPOST-OILPRE	1.246137	2.104324	0.592179	0.5856
GOLDPOST-GOLDPR...	-2.899206	3.076003	-0.942524	0.3993

R-squared	0.923304	Mean dependent var	-0.089414
Adjusted R-squared	0.827434	S.D. dependent var	0.086617
S.E. of regression	0.035982	Akaike info criterion	-3.527901
Sum squared resid	0.005179	Schwarz criterion	-3.346350
Log likelihood	23.63950	Hannan-Quinn criter.	-3.727062
F-statistic	9.630804	Durbin-Watson stat	1.589582
Prob(F-statistic)	0.023790		

When the other independent variable are added, namely the change in volatility of the US stock exchange index, oil and gold the R-squared increases but more importantly the Adjusted R-squared decreases which may imply that there is no value to the model in adding these other variables. Also, it is important to note that given the Durbin-Watson stat being at 1.589 there is a chance of the existence of autocorrelation.

From the above it seems that when it comes to the equity markets the change in volatility is largely due to the initial value that it is due to the impact of inflation targeting. Changes in volatility in the US as well as in commodity prices are more significant than that of inflation targeting as they explain more of the changes in the dependent variable.

4.3 Foreign Exchange Volatility

Dependent Variable: POST-PRE
Method: Least Squares
Date: 03/30/15 Time: 23:18
Sample: 1 10
Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.030300	0.037717	-0.803343	0.4450
DUMMY	0.041266	0.048692	0.847490	0.4214

R-squared	0.082383	Mean dependent var	-0.005540
Adjusted R-squared	-0.032319	S.D. dependent var	0.074244
S.E. of regression	0.075434	Akaike info criterion	-2.154260
Sum squared resid	0.045522	Schwarz criterion	-2.093743
Log likelihood	12.77130	Hannan-Quinn criter.	-2.220647
F-statistic	0.718239	Durbin-Watson stat	2.112668
Prob(F-statistic)	0.421352		

From these initial results based on Equation 3 there is no evidence that inflation targeting improves the change in volatility between targeters and non-targeters. Moreover, when one looks at Appendix C there is no clearly distinction in the change in volatility of targeters and non-targeters.

The next regression we run is based on Equation 4 and the results are as follows:

Dependent Variable: POST-PRE
Method: Least Squares
Date: 03/30/15 Time: 23:21
Sample: 1 10
Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.080337	0.025678	3.128576	0.0166
DUMMY	0.082205	0.022975	3.578008	0.0090
PRE	-1.487331	0.259753	-5.725947	0.0007

R-squared	0.838555	Mean dependent var	-0.005540
Adjusted R-squared	0.792428	S.D. dependent var	0.074244
S.E. of regression	0.033826	Akaike info criterion	-3.691877
Sum squared resid	0.008009	Schwarz criterion	-3.601101
Log likelihood	21.45938	Hannan-Quinn criter.	-3.791458
F-statistic	18.17924	Durbin-Watson stat	1.281505
Prob(F-statistic)	0.001691		

Once again, the addition of the initial value (PRE) is significant and increased the Adjusted R-squared from -0.032 to 0.792. This again shows the impact of mean reversion and just how much the starting point remain significant.

However, given that the Durbin-Watson stat is 1.28, it implies the presence of autocorrelation which means although the coefficient estimates are unbiased they could be inefficient and the incorrect inferences would be made.

Lastly, to control for the impact of the change in volatility of commodities we have modified Equation 2 to exclude changes in the US as this is implied in the exchange rate (all currency volatility is measured against the US dollar), this modification results in the next regression equation:

$$X_{POST} - X_{PRE} = \partial_0 + \partial_1 D + \partial_2 X_{PRE} + \partial_3 OIL_{CHANGE} + \partial_4 GOLD_{CHANGE} + \epsilon \qquad (5)$$

Dependent Variable: POST-PRE
Method: Least Squares
Date: 03/30/15 Time: 23:25
Sample: 1 10
Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.262434	0.199408	1.316063	0.2453
DUMMY	0.036444	0.062266	0.585299	0.5838
PRE	-1.606997	0.302663	-5.309529	0.0032
OILPOST-OILPRE	0.920239	1.164244	0.790417	0.4651
GOLDPOST-GOLDPR...	-2.911158	3.121733	-0.932546	0.3939

R-squared	0.866701	Mean dependent var	-0.005540
Adjusted R-squared	0.760062	S.D. dependent var	0.074244
S.E. of regression	0.036367	Akaike info criterion	-3.483447
Sum squared resid	0.006613	Schwarz criterion	-3.332154
Log likelihood	22.41723	Hannan-Quinn criter.	-3.649415
F-statistic	8.127432	Durbin-Watson stat	1.743513
Prob(F-statistic)	0.020544		

By incorporating all the previously discussed variables from Equation 5 we see the significance of these commodities in explaining the dependent variable but once again the Adjusted R-squared has decreased slightly.

5. Conclusion

No support for the notion that the monetary policy regime of inflation targeting leads to an improvement in financial markets stability was found.

Bean (2003) found that flexible inflation targeting is enough because financial instability and asset price misalignments must be factored into the future growth of inflation and thus, for a central bank to achieve its' goals optimally it will take these into account.

However, inflation targeters do not seem to have fared any differently from non-targeters as volatility in these markets has not improved, in both equity and currency markets, by a greater degree than in those markets where inflation targeting has not been adopted.

The notion that you cannot use one instrument to achieve more than one goal seems true and if central banks wish to improve financial market stability and, in future, smooth out the cycle of booms and busts another policy instrument will be required as inflation targeting with the use of short term interest rates has not proven to be efficient in this regard.

Further research on this topic is required as the quality and frequency of data from more emerging markets becomes available but central banks around the world must clearly understand what inflation targeting can and cannot achieve and make sound decisions with this knowledge.

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Appendix A

Country	Inflation Targeting Adoption
South Africa	In the 1990, South Africa went through a process financial liberalization and other structural developments. Explicit monetary growth targets became less and less useful due to the changing relationship between growth in monetary supply, output and prices. M3 growth guidelines along with informal targets for inflation started in 1998 and a formal inflation targeting framework was adopted in 2000.
Brazil	In Brazil, pre-1994, inflation had reached 2000% and the *real* plan was introduced which succesfully brought inflation down to 1.5% by 1998. However, Brazil still had a lack of fiscal reforms and due to this the *real* was the victim of speculative attacks which resulted in a collapse in January 1999. the central bank then sharply increased interest rates to curve further depreciation of the currency and noted the need for a nominal anchor which resulted in inflation targeting being adopted in June 1999.
Mexico	The Mexican *peso* was floated in December 1994 and after a few years of trying to maintain a monetary target regime the central bank realisedthe level of unreliability between the monetary base and inflation. As a result the Bank of Mexico gradually introduced inflation targeting as it needed a nominal anchor to guide inflation expectations and this was finally adopted in 1999.
Chile	After gaining independence in 1990 Chile faced significant inflationary pressures following the expansionary policies of 1989 and the oil price spike related to the first gulf war. After attempting two unsuccesful exchange rate-based stabilization programs and with monetary aggregates too difficult to control, inflation targeting seemed like the only option. In 1991 Chile formally adopted inflation targeting
South Korea	South Korea was the first country to succesfully adopted inflation targeting in East Asia during 1998. Before this, the country had monetary aggregates as a target but this proved to be unstable following the rapid structural changes in the financial markets during the 1990s. Following the financial crisi in 1997 which forced Korea to abandon its' exchange rate peg inflation targeting becamethe only viable alternative in providing a nominal anchor.
Hungary	The move to inflation targeting in Hungary has been gradual and steady over time. In need of a stable nominal anchor, the country first progressively widened the exchange rate band until it officially adopted inflation targeting in 2001.

Source: Levin, Natalucci et al. (2004)

Appendix B

Inflation Targeters	Pre-Inflation Targeting Period	Post-Inflation Targeting Period
South Africa	31-Mar-95 to 31-Dec-99	31-Mar-00 to 31-Dec-04
Brazil	30-Jun-94 to 31-Mar-99	30-Jun-99 to 31-Mar-04
Mexico	30-Jun-94 to 31-Mar-99	30-Jun-99 to 31-Mar-04
Chile	30-Sep-94 to 30-Jun-99	30-Sep-99 to 30-Jun-04
South Korea	30-Sep-96 to 30-Jun-01	30-Sep-01 to 30-Jun-06
Hungary	30-Jun-97 to 30-Mar-02	30-Jun-02 to 30-Mar-07

Inflation targeting start dates based on paper by Levin, Natalucci et al. (2004)

Non-Inflation Targeters	Pre-Period	Post Period
India	30-Jun-94 to 30-Mar-02	30-Jun-02 to 30-Mar-07
Russia	30-Jun-94 to 30-Mar-02	30-Jun-02 to 30-Mar-07
Pakistan	30-Jun-94 to 30-Mar-02	30-Jun-02 to 30-Mar-07
Argentina	30-Jun-94 to 30-Mar-02	30-Jun-02 to 30-Mar-07

Independent Variables	Pre-Period	Post Period
US	30-Jun-94 to 30-Mar-02	30-Jun-02 to 30-Mar-07
Oil	30-Jun-94 to 30-Mar-02	30-Jun-02 to 30-Mar-07
Gold	30-Jun-94 to 30-Mar-02	30-Jun-02 to 30-Mar-07

Pre and post periods set to coincide with those of inflation targeters.

Appendix C

Equity Indexes			
Country	**Pre Period**	**Post Period**	**Change in Volatility**
South Africa	17,53%	18,80%	1,28%
Brazil	48,04%	30,92%	-17,12%
Mexico	28,64%	24,16%	-4,48%
Chile	21,10%	14,85%	-6,25%
South Korea	37,67%	25,61%	-12,06%
Hungary	32,17%	21,43%	-10,74%
Oil	35,00%	32,38%	-2,62%
Gold	11,47%	16,59%	5,12%
US	16,48%	14,02%	-2,46%
India	26,26%	20,36%	-5,90%
Russia	57,87%	30,04%	-27,83%
Pakistan	22,04%	22,82%	0,78%
Argentina	36,69%	29,60%	-7,08%

Currencies			
Country	**Pre Period**	**Post Period**	**Change in Volatility**
South Africa	8,81%	16,79%	7,98%
Brazil	5,89%	15,49%	9,60%
Mexico	16,09%	8,20%	-7,88%
Chile	5,53%	8,31%	2,78%
South Korea	15,42%	6,69%	-8,72%
Hungary	9,42%	12,24%	2,83%
Oil	35,00%	32,38%	-2,62%
Gold	11,47%	16,59%	5,12%
India	3,56%	3,17%	-0,39%
Russia	12,83%	2,70%	-10,13%
Pakistan	9,80%	2,47%	-7,33%
Argentina	3,56%	9,29%	5,73%

Appendix D

Equity Index	Definition
FTSE/JSE Africa All Share Index	Market capitalization-weighted index which includes up to 99% of the total pre free-float market capitalization of all listed companies on the Johannes Stock Exchange
Ibovespa Brasil Sao Paulo Stock Exchange Index	The gross total return index weighted by market value to the free float and is comprised of the most liquid stocks traded on the Sao Paulo Stock Exchange
Mexican Stock Exchange IPC Index	It is the capitalization weighted index of the leading stocks traded on the Mexican Stock Exchange
Santiago Stock Exchange IPSA Index	It is a total return index that is composed of the 40 stocks with the highest average annual trading volume in the Santiago Stock Exchange
Korea Stock Exchange KOSPI Index	Capitalization-weighted index of all common shares on the Korean Stock exchanges
Budapest Stock Exchange Index	Capitalization-weighted index adjusted for free float and tracks the performance of large, actively traded shares on the Budapest Stock Exchange
Dow Jones Industrial Average	Price-weighted average of 30 blue-chip stocks that are generally leaders in their industry.
S&P BSE SENSEX Index	It is a cap-weighted index and the members are selected on the basis of liquidity, depth and industry representation.
MICEX Index	Cap-weighted composite index calculated based on prices of the 50 most liquid Russian stocks of the largest and dynamically developing Russian issuers presented on the Moscow Exchange
Karachi All Share Index	Market capitalization weighted index comprising all listed stocks on the Karachi Stock Exchange
Buenos Aires Stock Exchange Merval Index	A basket weighted index, the Argentina Merval Index is the market value of a stock portfolio selected according to participation in the Buenos Aires Stock Exchange

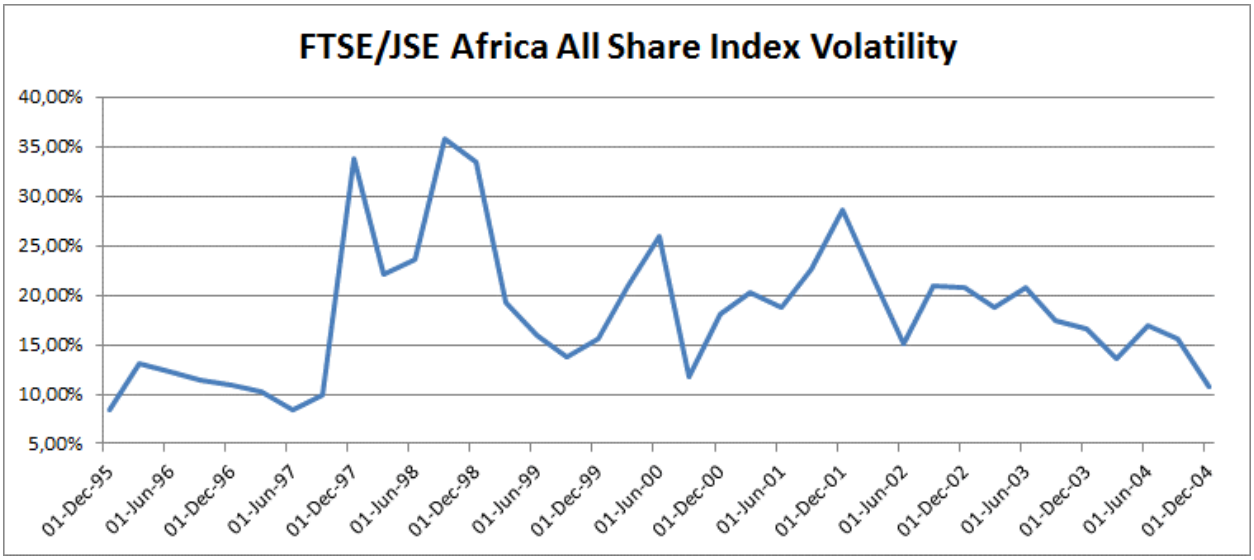
Currency	Definition
ZAR	South African Rand
BRL	Brazilian Real
MXN	Mexican Peso
CLP	Chilean Peso
KRW	South Korean Won
HUF	Hungarian Forint
INR	Indian Rupee
RUB	Russian Ruble
PKR	Pakistani Rupee
ARS	Argentine Peso

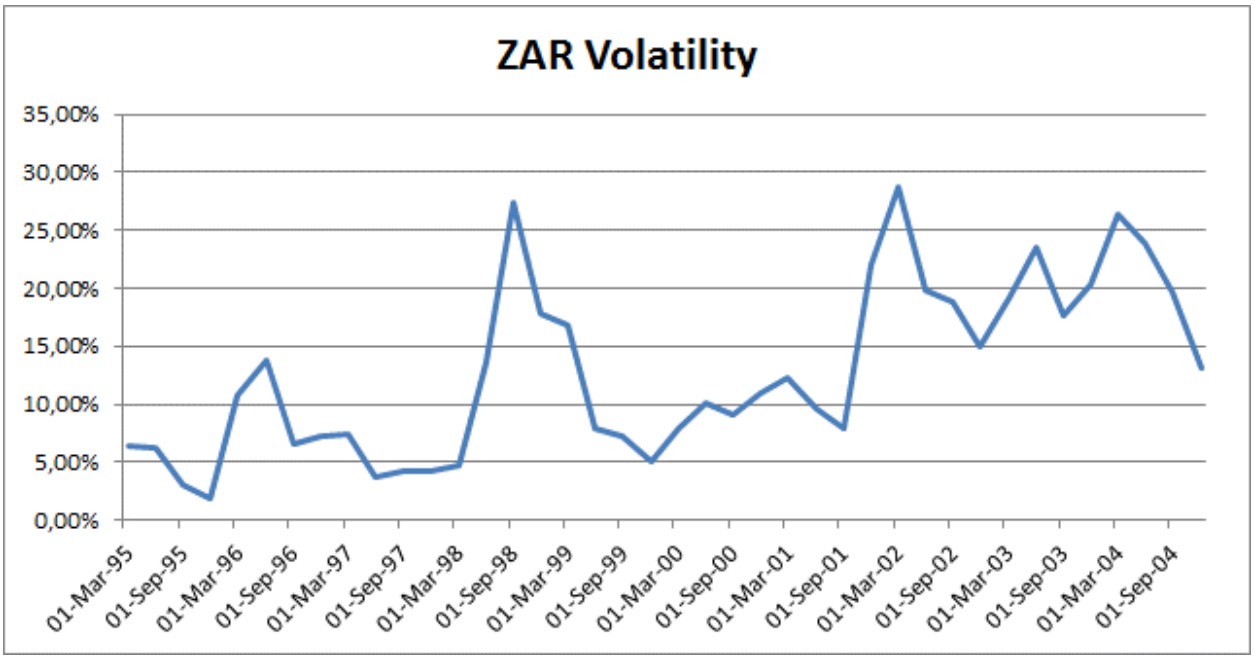
Source: Bloomberg

Appendix E

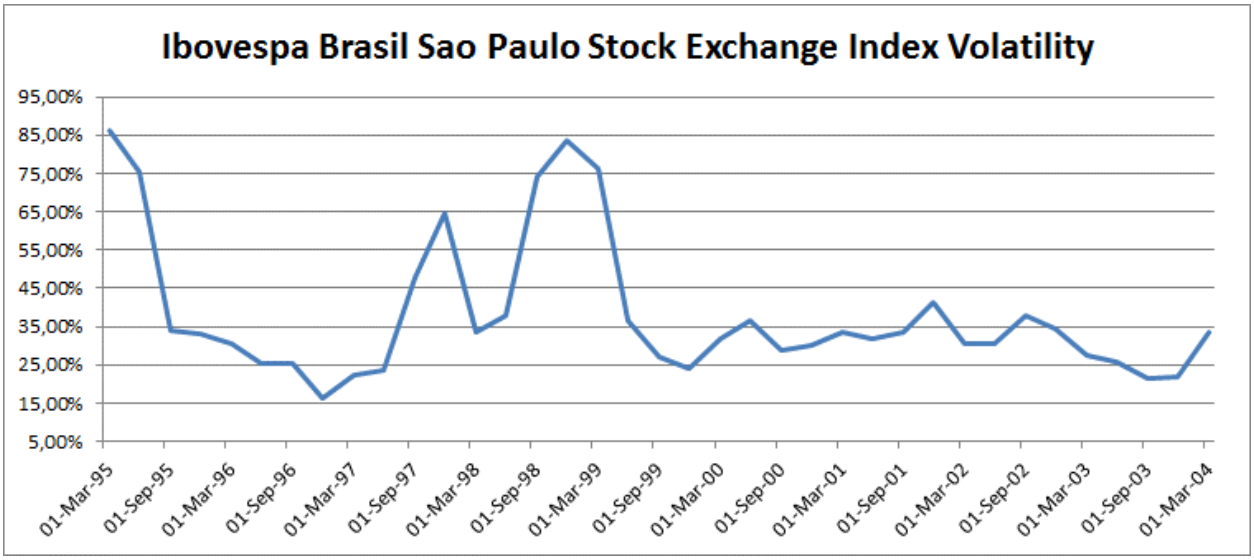
All data from Bloomberg

South Africa





Brazil


Ibovespa Brasil Sao Paulo Stock Exchange Index Volatility
95,00%
85,00%
75,00%
65,00%
55,00%
45,00%
35,00%
25,00%
15,00%
5,00%
01-Mar-95
01-Sep-95
01-Mar-96
01-Sep-96
01-Mar-97
01-Sep-97
01-Mar-98
01-Sep-98
01-Mar-99
01-Sep-99
01-Mar-00
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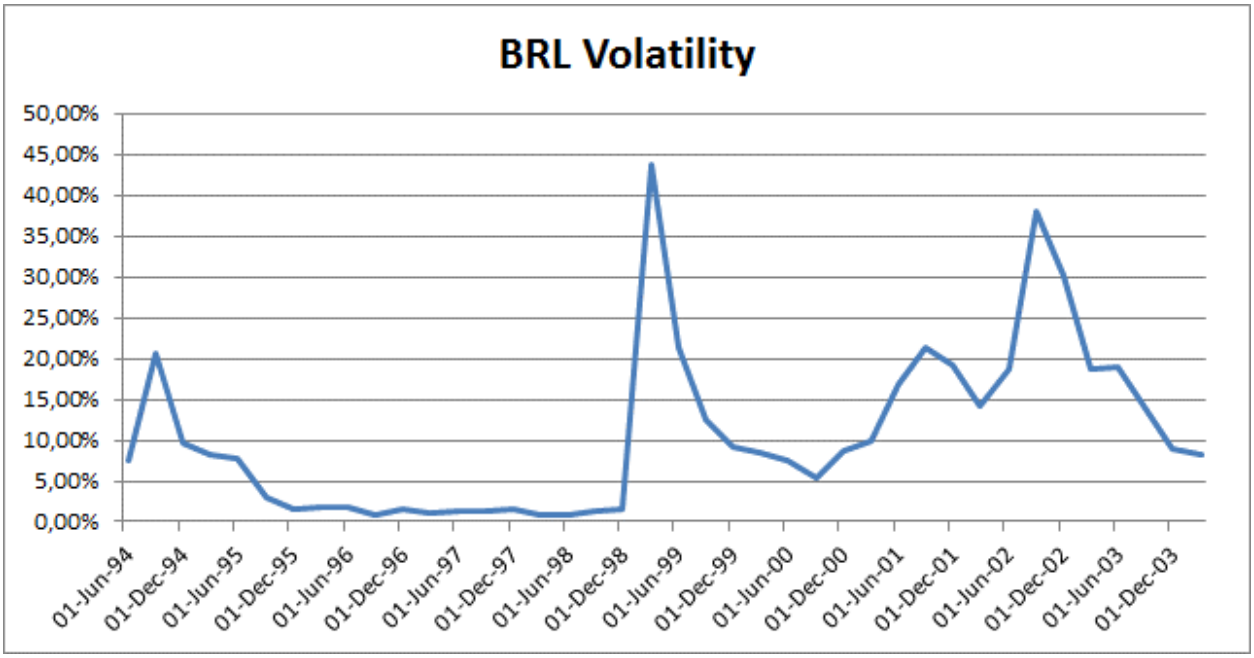
01-Sep-03
01-Mar-04


BRL Volatility
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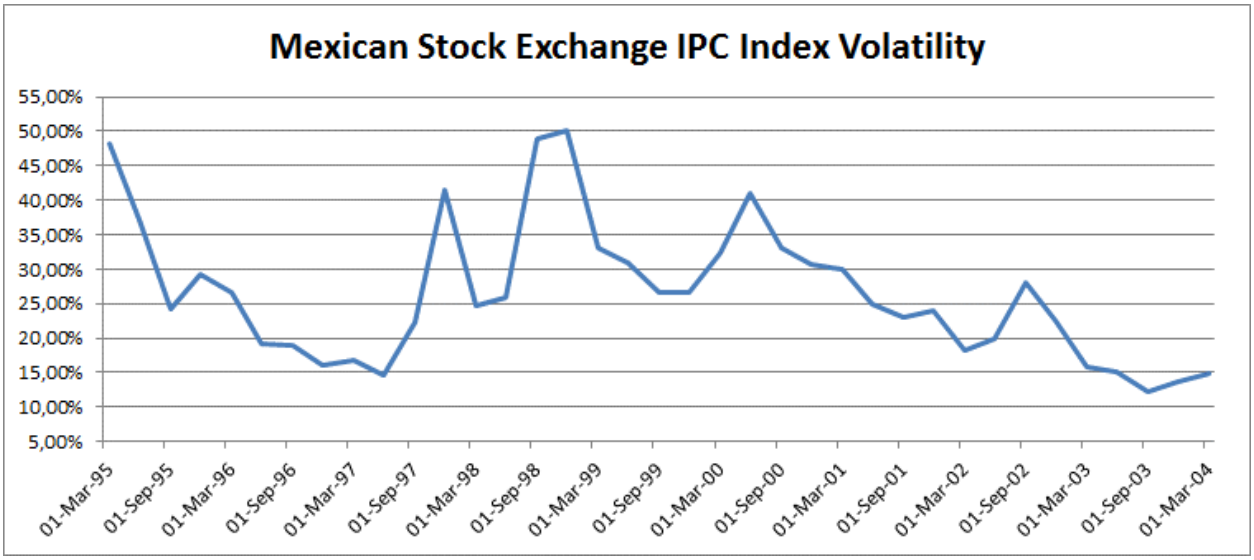
45,00%
40,00%
35,00%
30,00%
25,00%
20,00%
15,00%
10,00%
5,00%
0,00%
01-Jun-94
01-Dec-94
01-Jun-95
01-Dec-95
01-Jun-96
01-Dec-96
01-Jun-97
01-Dec-97
01-Jun-98
01-Dec-98
01-Jun-99
01-Dec-99
01-Jun-00
01-Dec-00
01-Jun-01
01-Dec-01
01-Jun-02
01-Dec-02
01-Jun-03
01-Dec-03

Mexico


Mexican Stock Exchange IPC Index Volatility
55,00%
50,00%
45,00%
40,00%
35,00%
30,00%
25,00%
20,00%
15,00%
10,00%
5,00%
01-Mar-95
01-Sep-95
01-Mar-96
01-Sep-96
01-Mar-97
01-Sep-97
01-Mar-98
01-Sep-98
01-Mar-99
01-Sep-99
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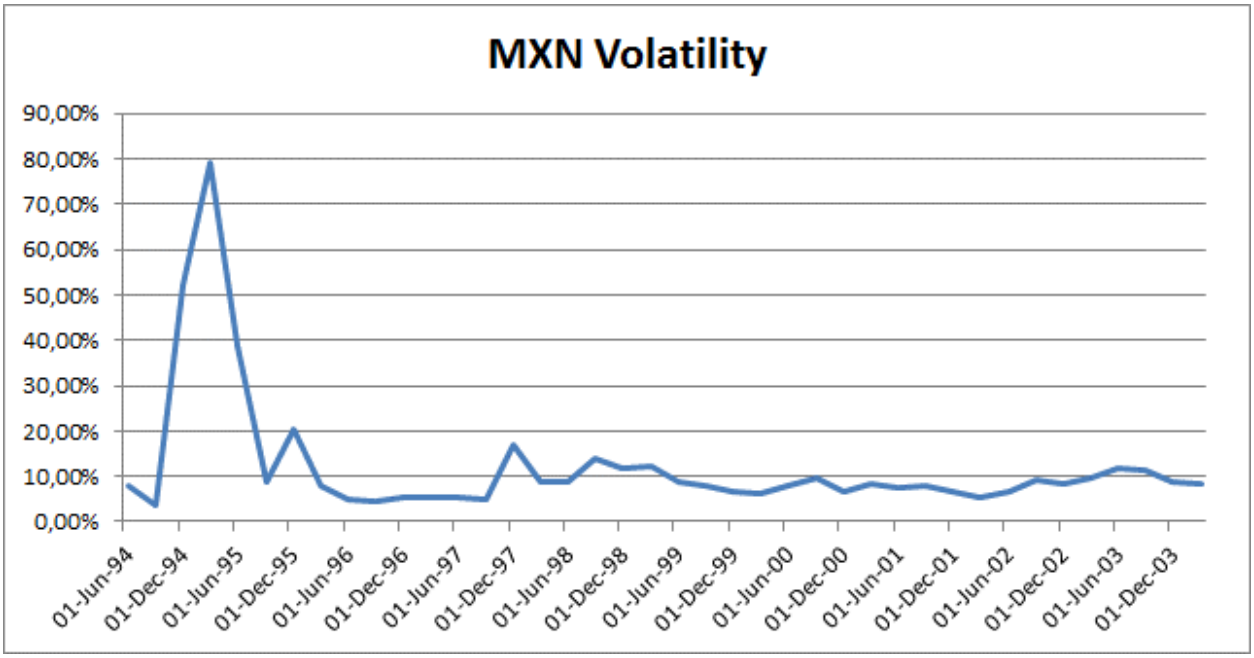
01-Sep-03
01-Mar-04


MXN Volatility
90,00%
80,00%
70,00%
60,00%
50,00%
40,00%
30,00%
20,00%
10,00%
0,00%
01-Jun-94
01-Dec-94
01-Jun-95
01-Dec-95
01-Jun-96
01-Dec-96
01-Jun-97
01-Dec-97
01-Jun-98
01-Dec-98
01-Jun-99
01-Dec-99
01-Jun-00
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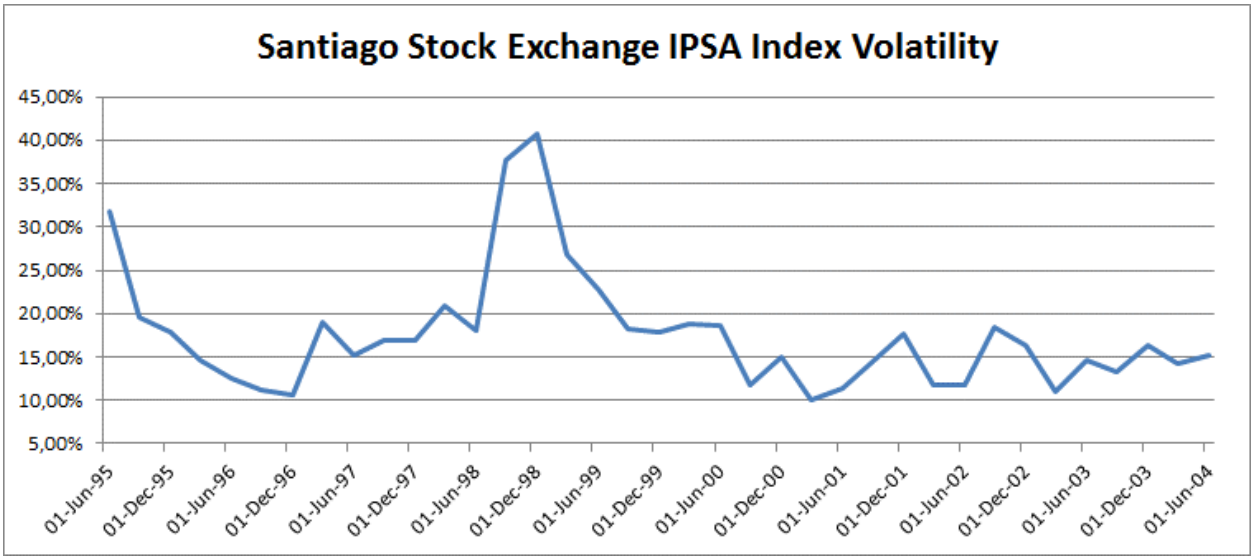
01-Jun-01
01-Dec-01
01-Jun-02
01-Dec-02
01-Jun-03
01-Dec-03

Chile


Santiago Stock Exchange IPSA Index Volatility
45,00%
40,00%
35,00%
30,00%
25,00%
20,00%
15,00%
10,00%
5,00%
01-Jun-95
01-Dec-95
01-Jun-96
01-Dec-96
01-Jun-97
01-Dec-97
01-Jun-98
01-Dec-98
01-Jun-99
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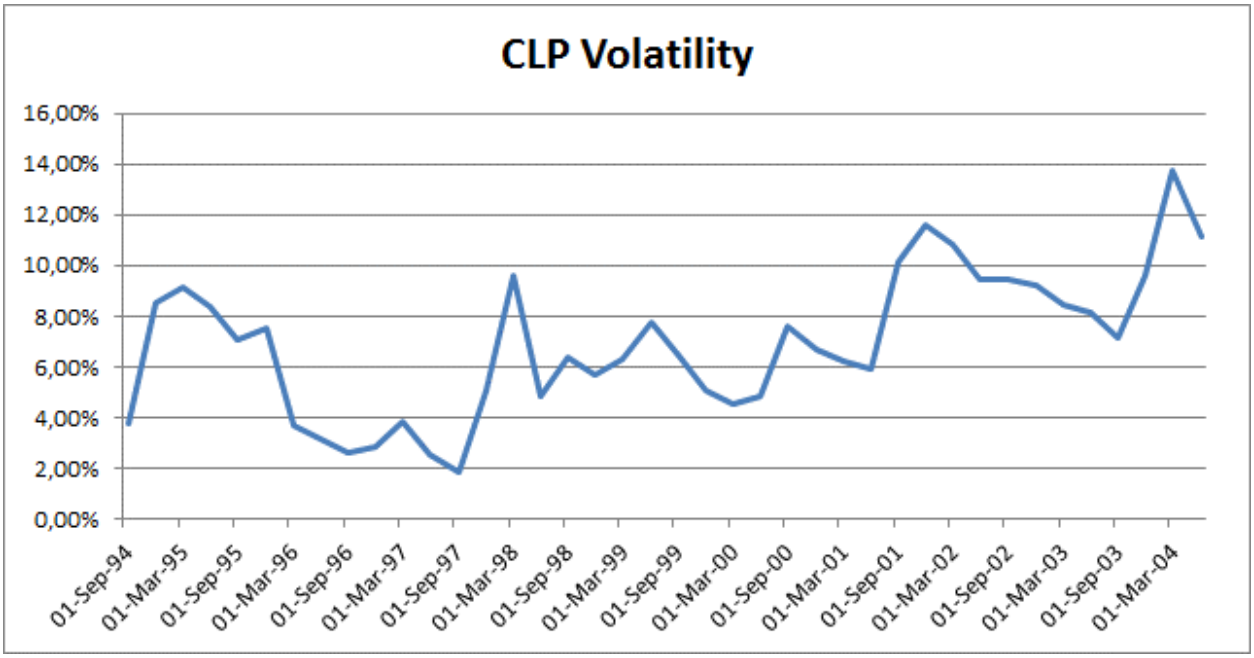
01-Jun-04


CLP Volatility
16,00%
14,00%
12,00%
10,00%
8,00%
6,00%
4,00%
2,00%
0,00%
01-Sep-94
01-Mar-95
01-Sep-95
01-Mar-96
01-Sep-96
01-Mar-97
01-Sep-97
01-Mar-98
01-Sep-98
01-Mar-99
01-Sep-99
01-Mar-00
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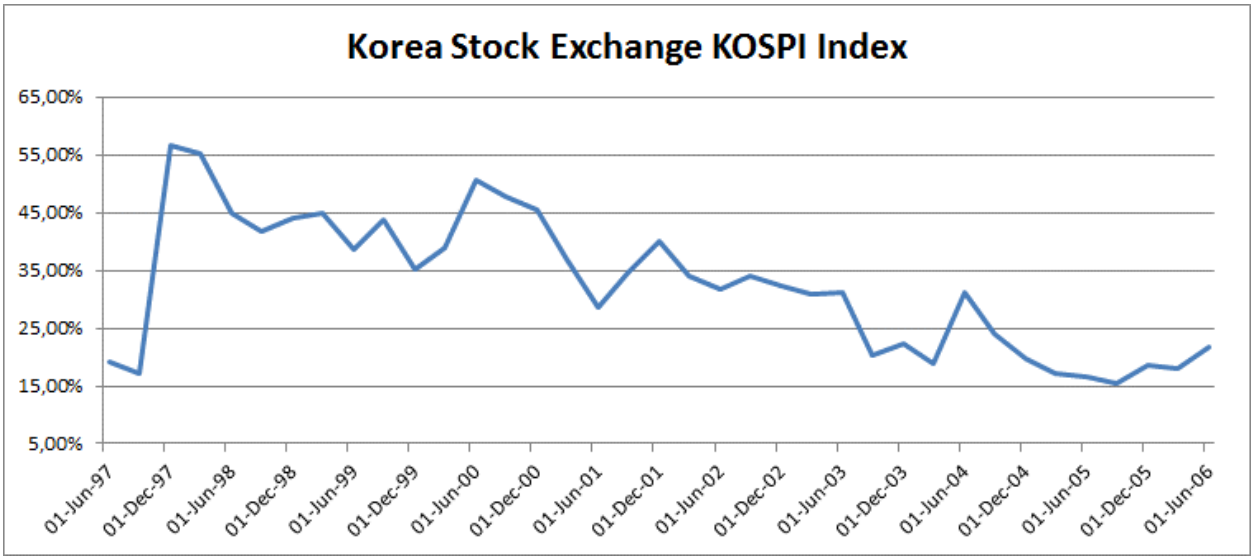
01-Sep-02
01-Mar-03
01-Sep-03
01-Mar-04

South Korea


Korea Stock Exchange KOSPI Index
65,00%
55,00%
45,00%
35,00%
25,00%
15,00%
5,00%
01-Jun-97
01-Dec-97
01-Jun-98
01-Dec-98
01-Jun-99
01-Dec-99
01-Jun-00
01-Dec-00
01-Jun-01
01-Dec-01
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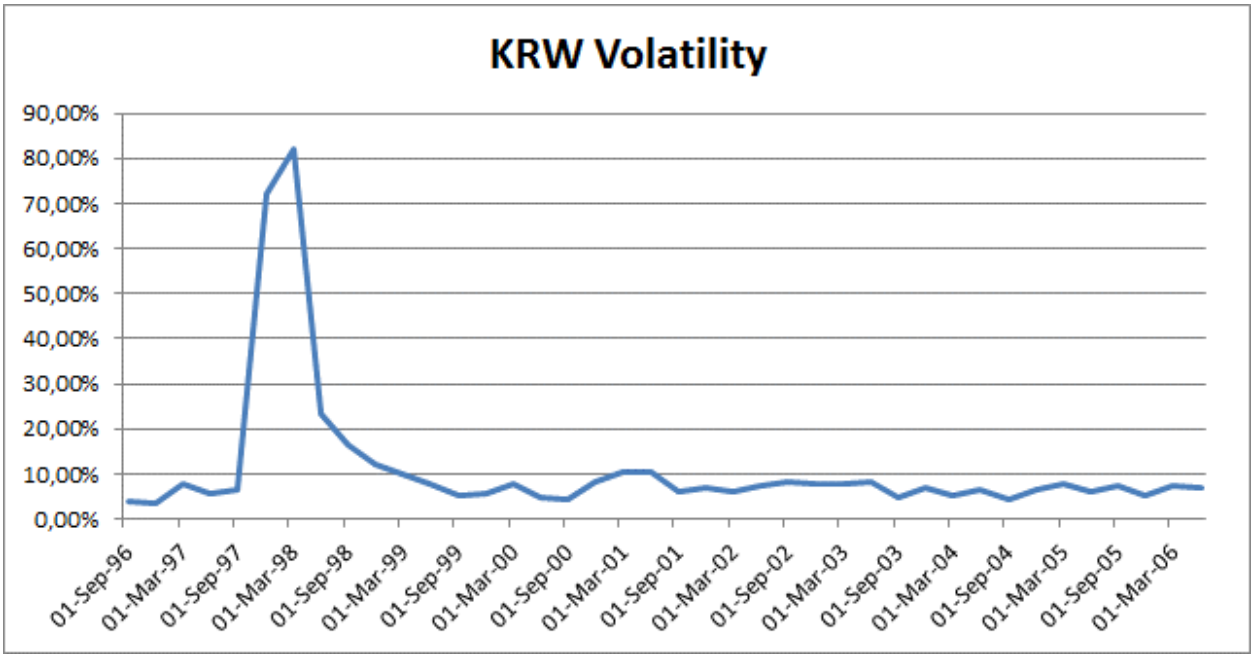
01-Jun-06


KRW Volatility
90,00%
80,00%
70,00%
60,00%
50,00%
40,00%
30,00%
20,00%
10,00%
0,00%
01-Sep-96
01-Mar-97
01-Sep-97
01-Mar-98
01-Sep-98
01-Mar-99
01-Sep-99
01-Mar-00
01-Sep-00
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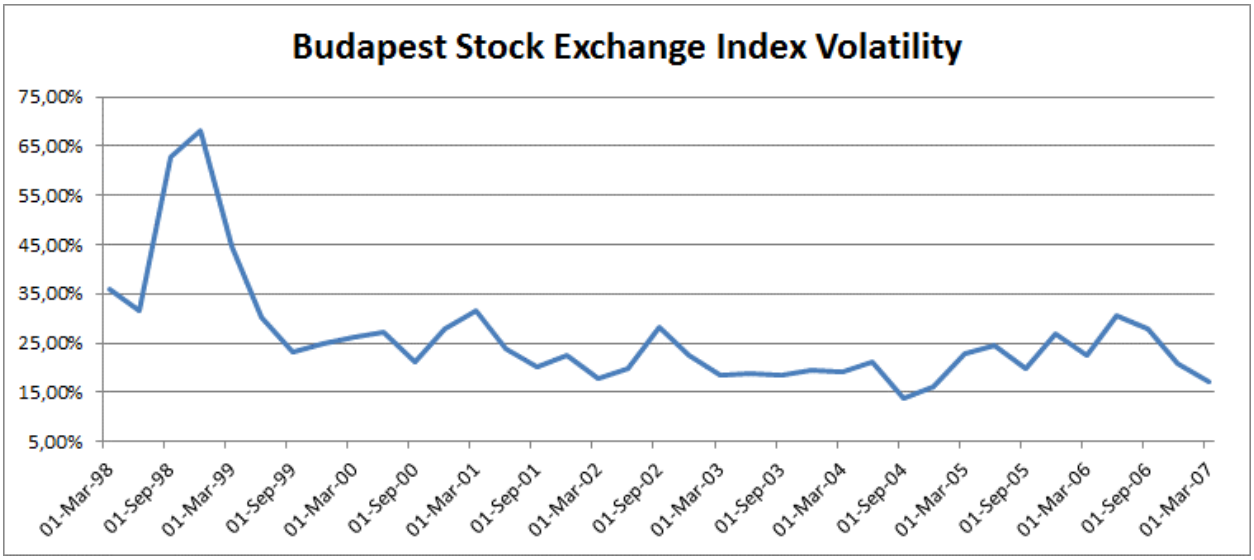
01-Mar-06

Hungary


Budapest Stock Exchange Index Volatility
75,00%
65,00%
55,00%
45,00%
35,00%
25,00%
15,00%
5,00%
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01-Sep-98
01-Mar-99
01-Sep-99
01-Mar-00
01-Sep-00
01-Mar-01
01-Sep-01
01-Mar-02
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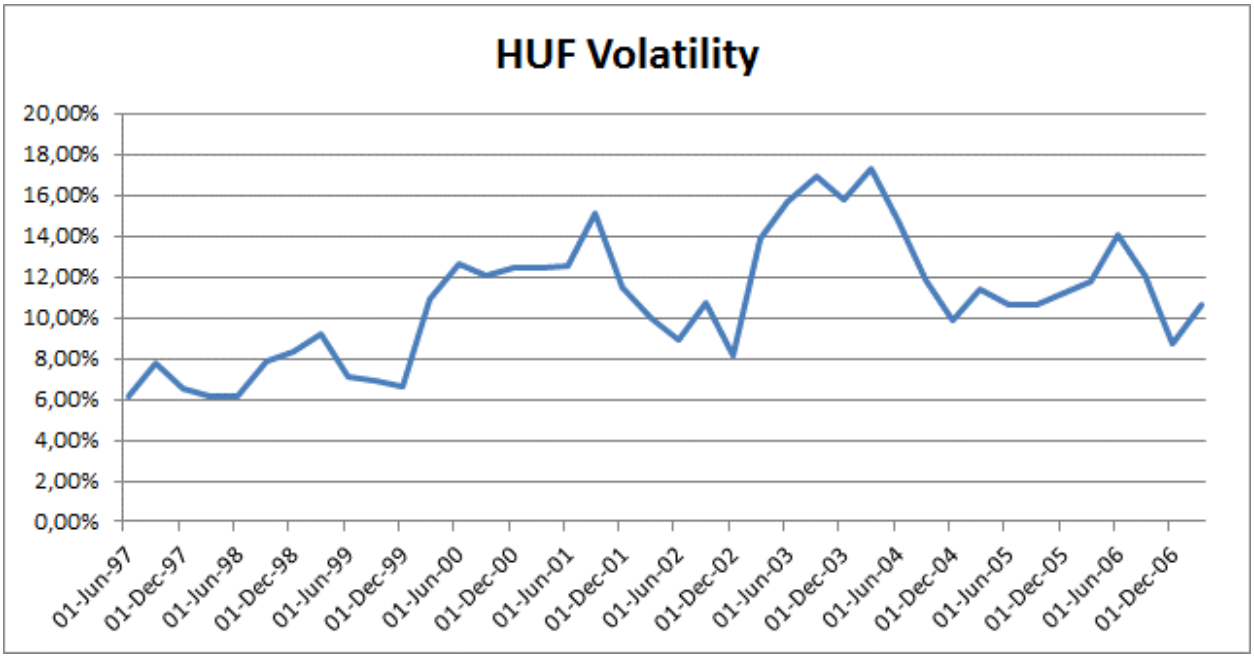
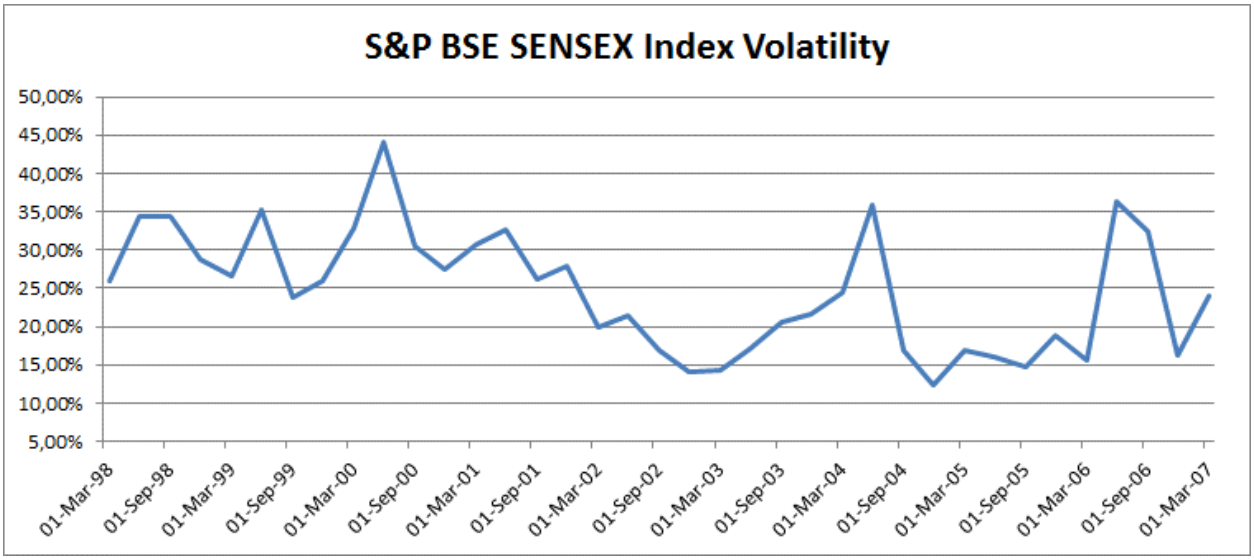
01-Sep-06
01-Mar-07


HUF Volatility
20,00%
18,00%
16,00%
14,00%
12,00%
10,00%
8,00%
6,00%
4,00%
2,00%
0,00%
01-Jun-97
01-Dec-97
01-Jun-98
01-Dec-98
01-Jun-99
01-Dec-99
01-Jun-00
01-Dec-00
01-Jun-01
01-Dec-01
01-Jun-02
01-Dec-02
01-Jun-03
01-Dec-03
01-Jun-04
01-Dec-04
01-Jun-05
01-Dec-05
01-Jun-06
01-Dec-06

India


S&P BSE SENSEX Index Volatility
50,00%
45,00%
40,00%
35,00%
30,00%
25,00%
20,00%
15,00%
10,00%
5,00%
01-Mar-98
01-Sep-98
01-Mar-99
01-Sep-99
01-Mar-00
01-Sep-00
01-Mar-01
01-Sep-01
01-Mar-02
01-Sep-02
01-Mar-03
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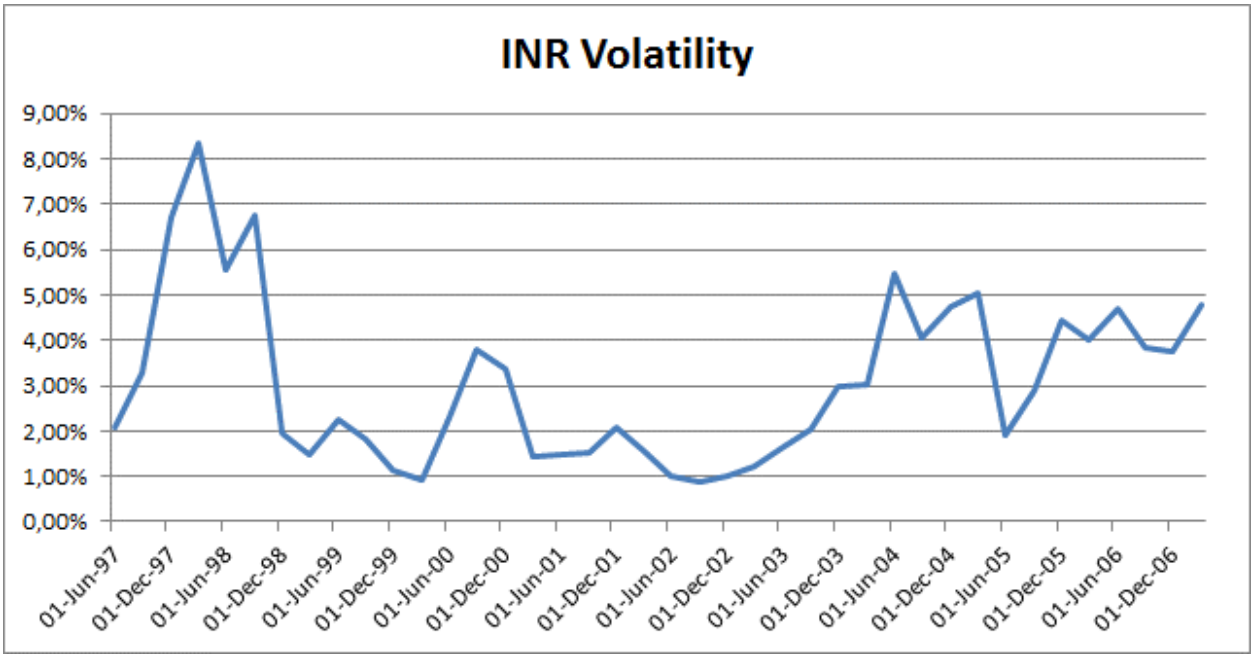
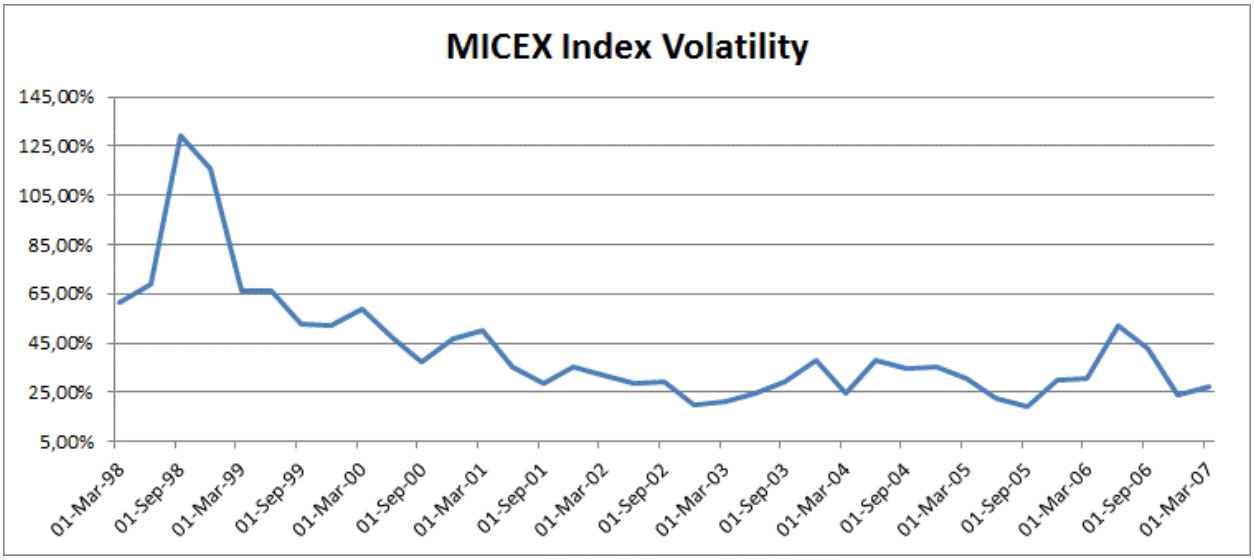
01-Sep-05
01-Mar-06
01-Sep-06
01-Mar-07


INR Volatility
9,00%
8,00%
7,00%
6,00%
5,00%
4,00%
3,00%
2,00%
1,00%
0,00%
01-Jun-97
01-Dec-97
01-Jun-98
01-Dec-98
01-Jun-99
01-Dec-99
01-Jun-00
01-Dec-00
01-Jun-01
01-Dec-01
01-Jun-02
01-Dec-02
01-Jun-03
01-Dec-03
01-Jun-04
01-Dec-04
01-Jun-05
01-Dec-05
01-Jun-06
01-Dec-06

Russia


MICEX Index Volatility
145,00%
125,00%
105,00%
85,00%
65,00%
45,00%
25,00%
5,00%
01-Mar-98
01-Sep-98
01-Mar-99
01-Sep-99
01-Mar-00
01-Sep-00
01-Mar-01
01-Sep-01
01-Mar-02
01-Sep-02
01-Mar-03
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01-Mar-04
01-Sep-04
01-Mar-05
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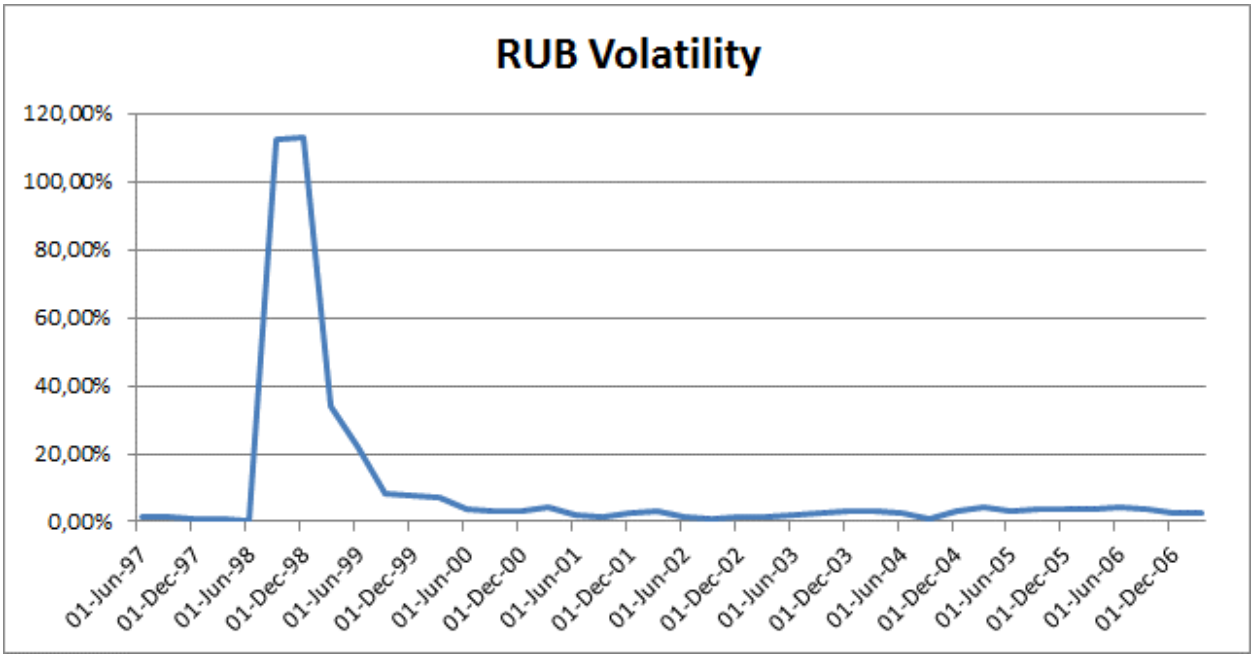
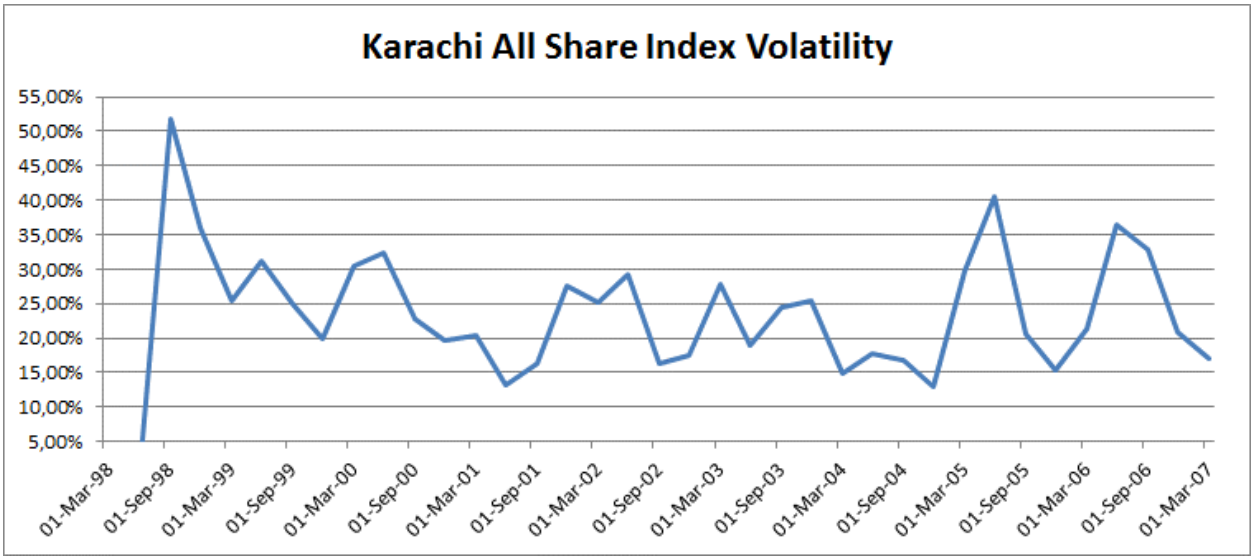
01-Mar-06
01-Sep-06
01-Mar-07


RUB Volatility
120,00%
100,00%
80,00%
60,00%
40,00%
20,00%
0,00%
01-Jun-97
01-Dec-97
01-Jun-98
01-Dec-98
01-Jun-99
01-Dec-99
01-Jun-00
01-Dec-00
01-Jun-01
01-Dec-01
01-Jun-02
01-Dec-02
01-Jun-03
01-Dec-03
01-Jun-04
01-Dec-04
01-Jun-05
01-Dec-05
01-Jun-06
01-Dec-06

Pakistan


Karachi All Share Index Volatility
55,00%
50,00%
45,00%
40,00%
35,00%
30,00%
25,00%
20,00%
15,00%
10,00%
5,00%
01-Mar-98
01-Sep-98
01-Mar-99
01-Sep-99
01-Mar-00
01-Sep-00
01-Mar-01
01-Sep-01
01-Mar-02
01-Sep-02
01-Mar-03
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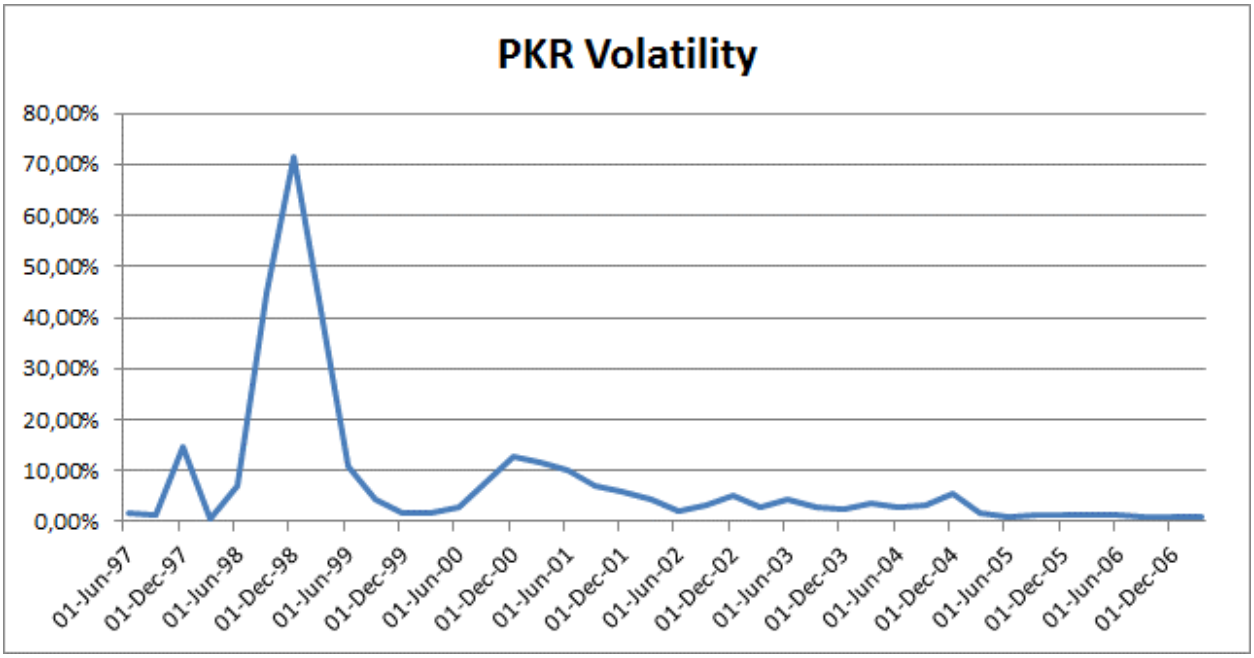
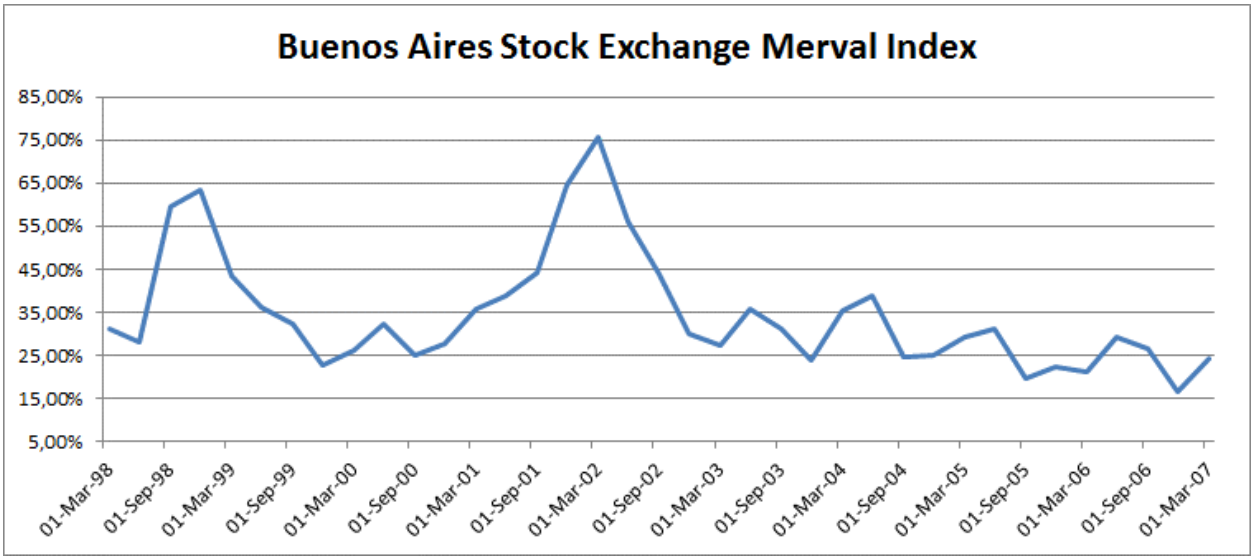
01-Mar-06
01-Sep-06
01-Mar-07


PKR Volatility
80,00%
70,00%
60,00%
50,00%
40,00%
30,00%
20,00%
10,00%
0,00%
01-Jun-97
01-Dec-97
01-Jun-98
01-Dec-98
01-Jun-99
01-Dec-99
01-Jun-00
01-Dec-00
01-Jun-01
01-Dec-01
01-Jun-02
01-Dec-02
01-Jun-03
01-Dec-03
01-Jun-04
01-Dec-04
01-Jun-05
01-Dec-05
01-Jun-06
01-Dec-06

Argentina


Buenos Aires Stock Exchange Merval Index
85,00%
75,00%
65,00%
55,00%
45,00%
35,00%
25,00%
15,00%
5,00%
01-Mar-98
01-Sep-98
01-Mar-99
01-Sep-99
01-Mar-00
01-Sep-00
01-Mar-01
01-Sep-01
01-Mar-02
01-Sep-02
01-Mar-03
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01-Mar-04
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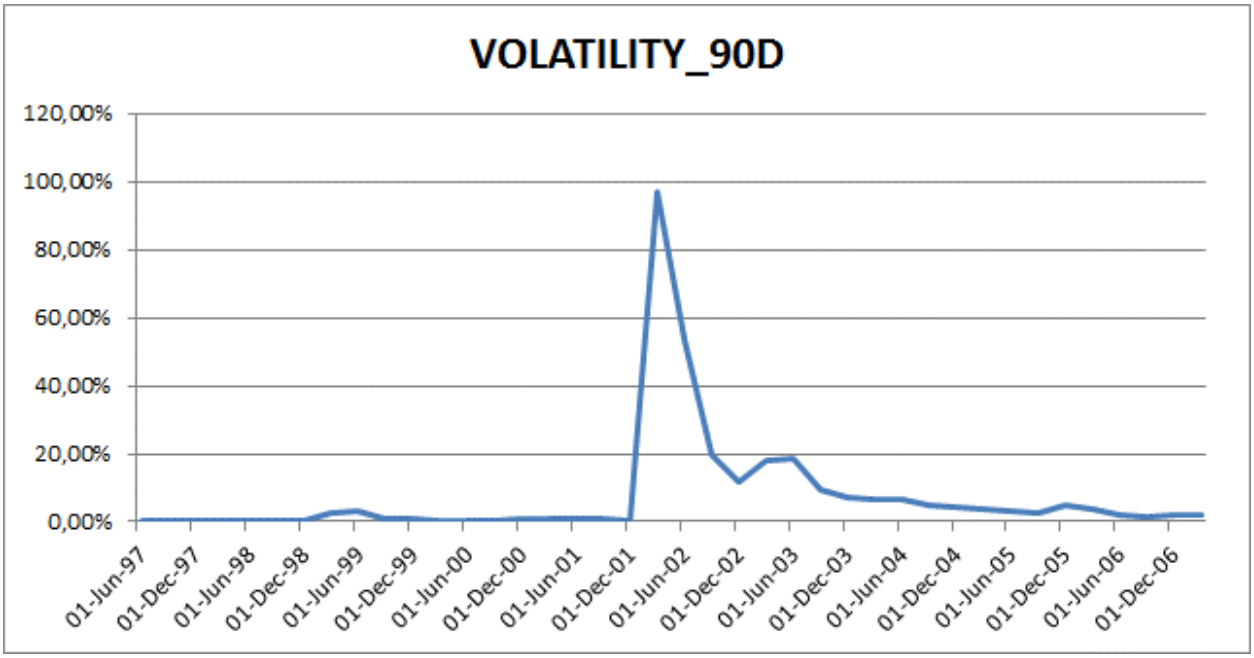
01-Mar-05
01-Sep-05
01-Mar-06
01-Sep-06
01-Mar-07


VOLATILITY_90D
120,00%
100,00%
80,00%
60,00%
40,00%
20,00%
0,00%
01-Jun-97
01-Dec-97
01-Jun-98
01-Dec-98
01-Jun-99
01-Dec-99
01-Jun-00
01-Dec-00
01-Jun-01
01-Dec-01
01-Jun-02
01-Dec-02
01-Jun-03
01-Dec-03
01-Jun-04
01-Dec-04
01-Jun-05
01-Dec-05
01-Jun-06
01-Dec-06