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Anticipating Turbulent Periods in Latin American Emerging Markets
The Mexican Crisis of 1994

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Abstract

Some Latin American markets have been seriously affected by the episodes of financial crises during the last 15 years. One way of dealing with crises is to find mechanisms and policies that may be implemented in order to prevent or face this type of episodes. However, one could also try to characterize and anticipate periods of turbulence in emerging capital markets through historical technical analysis. In this work one does the later by studying the multifractal properties of three Latin American emerging markets facing the Mexican crisis of 1994: Argentina, Brazil and Peru. The analysis of returns is made trough its singularity spectrum during the period 1989-2000. By using a crisis-switching indicator with an empirical threshold, one shows that sudden changes in one version of the sequence of Holder exponents preceded turbulent periods with about sixty days of anticipation.

Keywords: Financial crisis, multifractal analysis.

3.2. Crisis-Switching Indicator

One alternative to analyze the variation of the former multifractal characterization consists on estimating the singularity spectrum performing a rolling window in a time interval $[t_0, t_1]$. In this sense, one would obtain a series of $F_\alpha^{[j,j+w]}$ sets computed in subintervals: $[j, j+w]$, $j \in [t_0, t_1 - w]$. The minimum value for each set can be computed as

$$\underline{\alpha}_j = \min\left\{F_\alpha^{[j,j+w]}\right\}, \quad (9)$$

Considering a rolling window $[j, j+w]$ such that there is a unique $\underline{\alpha}_t$ for each time t and a trajectory $\underline{\alpha}$ is constructed for minimum values only. A smooth version of the previous $\underline{\alpha}$ is achieved by means of a moving average estimator $\underline{\bar{\alpha}}_t$. This leads to an error function of

$$\xi_t = \underline{\alpha}_t - \underline{\bar{\alpha}}_t \quad (10)$$

Which is bounded defined as the local maximum (upper bound $\xi^u{}_t$) and local minimum (lower bound $\xi^l{}_t$) of previous errors, defining a set of crossing times constructed by the union $\psi = \psi^u \cup \psi^l$ with

$$\begin{aligned} \psi^u &= \left\{t : \underline{\alpha}_t \geq \xi^u{}_t\right\}, \\ \psi^l &= \left\{t : \underline{\alpha}_t \leq \xi^l{}_t\right\} \end{aligned} \quad (11)$$

Where ψ recovers all periods that cross the bands.

Now let $\psi(m)$ be the m-th element of ψ, and M be the number of crossing times. Then crossing lines are defined as the set of pairs

$$L^{ll} = \left\{(\psi(m), \psi(m+n)) : \psi(m) \in \psi^u, \psi(m+n) \in \psi^l\right\}, \text{ and} \quad (12)$$

$$L^{uu} = \left\{(\psi(m), \psi(m+n)) : \psi(m) \in \psi^l, \psi(m+n) \in \psi^u\right\} \quad (13)$$

With $0 < m \leq M; m+n \leq M$ such that each element in the first set (L^{ll}) is called a down-crossing line if $n = 1$, and a pendular movement of a down crossing line if $n > 1$. A similar reasoning applies for the second set (L^{uu}), where each element is an up-crossing line if $n = 1$, and a pendular movement of an up crossing line if $n > 1$. Figure 2 shows an example of how crossing lines may actually look like.

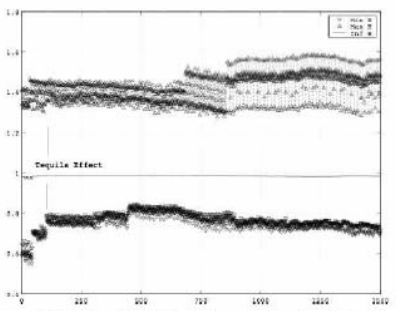

Figure 3: MERVAL multifractal Paths (a). The graphic shows the evolution of the maximum (Max H), minimum (Min H), and information (Inf H) Hölder exponents deduced in MLA. The jump in Min H around observation 170 represents the tequila crisis.

4. Empirical Results

In this section local multifractal analysis (LMA) and the crisis switching indicator (CSI) based on it are tested for the stock markets indexes of three Latin American emerging markets: MERVAL (Argentina), IBOVESPA (Brazil) and IGBVL (Peru). Table 1 shows the data considered for each case divided in two periods.

For each one of the three indexes 2600 data points were used. The pre-crisis period took the first 1100 observations, while the crisis period used the next 1500 ones. Log versions of time series and its returns were studied for the crisis period. Typical behavior of financial time series such as volatility clustering and fat tails of return's distribution was found for all three series (see figures 3, 4 and 5). Properties harder to analyze like log normal volatility, absence of returns correlations, and scale variant distribution of returns, were also verified by basic statistics.

Table 1: Periods of analysis

Index	Pre-crisis	Crisis Period
MERVAL	10/19/89 - 04/06/94	04/07/94 - 03/31/00
IBOVESPA	01/02/89 - 07/05/93	07/06/93 - 08/02/99
IGBVL	01/30/87 - 06/27/91	06/28/91 - 07/01/97

Due to the lack of homogeneous time intervals, the Mexican crisis is manifested at different data points according to the selected time series. Table 2 summarizes the most important dates and data points for all indexes. It shows two periods for the contagious beginning, one for MERVAL and IBOVESPA (12/21/04), and other for IGBVL (01/09/95), but clearly one highest peak time in 01/10/95. That is a one day reaction delay for the contagious of Argentinean and Brazilian markets, and a reaction of the Peruvian one almost conditioned to the first two crashes.

Table 2: Most important days of the Mexican crisis

Index	Dates		Data Points		
	Contagious	Peak	Tequila	Contagious	Peak
MERVAL	12/21/94	01/10/95	178	179	192
IBOVESPA	12/21/94	01/10/95	363	364	377
IGBVL	01/09/95	01/10/95	864	878	879

As mentioned in the previous section, even though there is a crossing line pattern before turbulence periods, it is rather difficult to establish a common time delay between the crossing day (the day were the CSI is activated), and the crisis or the climax days. Table 3 summarizes some results concerning CSI estimations.

Table 3: CSI Empirical Results

Index	Crossing Date	Crossing Point
MERVAL	09/05/94	104
IBOVESPA	09/20/94	302
IGBVL	01/03/95	874

So it seems, that for the Mexican crisis of 12/20/94, one could actually anticipate the stock market crashes in Argentina (MERVAL), Brazil (IBOVESPA) and Peru (IGBVL). In the first two cases about three months before it happened, and for the later just a few days in advance. Of course this leads to a very important question about the optimal waiting time for a crisis to happen after the CSI is activated, with a not clear-cut answer. The empirical test of the CSI trough a more extend period where dragon and vodka effects are taking into account suggest that the maximum waiting time one should consider is 95 data points, that is in between three and four months.

5. Concluding Remarks

It has been showed that patterns in the so-called multifractal path of the minimum (H) apparently existed around the Mexican crisis of 1994 in Argentinean (MERVAL), Brazilian (IBOVESPA), and Peruvian (IGBVL) markets. It has also been showed that such patterns are expressed under the form of sudden changes in the H trajectory, and that such changes can be captured in a formal way by means of a crisis-switching indicator with about 60 data points in advance. However, there are many tasks to accomplish before being able to establish the possibility of turbulence anticipation by means of multifractal analysis. For instance, it is not clear why there is not pendular movements in IBOVESPA, when they are present in MERVAL and IGBVL. The same happens for the need of a more profound analysis of the optimal waiting time before a market crash takes effect.

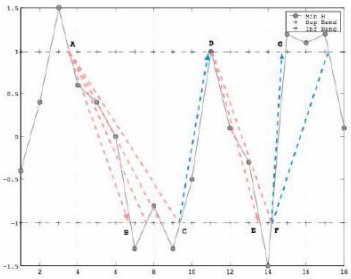

Figure 2: CSI Crossing Lines. Arrows A-B, C-D, D-E and F-G represent up (blue) and down (red) crossing lines. Simple discontinuous lines show pendular movements of a up-crossing line (blue), or pendular movements of a down-crossing line (red). Plus lines represent confidence bands.