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COMOVEMENTS IN EMERGING MARKET BOND RETURNS: AN EMPIRICAL ASSESSMENT

Irina Bunda[♣], *A. Javier Hamann** *and Subir Lall**

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Abstract

The objective of the paper is to empirically assess the comovement of emerging bond returns of the key constituent countries of the EMBI Global benchmark index since their introduction (broadly in 1997) up to the present. We aim at disentangling the respective roles of common external factors and pure contagion in the recent events of market spillovers. The unweighted average of cross country rolling correlation coefficients, adjusted and unadjusted for the presence of common external factors, provides a first assessment of the joint behavior of emerging markets bond returns during the sample period.
We furthermore show that cross country average correlations method may not be useful in summarizing market results if the underlying distribution of bond returns is not unimodal (i.e., if there are underlying groups that exhibit high within-group comovement but not between-group comovement).
Several methods are used on a year-to-year basis in order to identify periods where the "two-tier paradigm" of emerging markets prevails. The analysis of correlation matrixes enables us to identify groups of countries moving together during the recent events in emerging markets. These findings are further refined by performing Principal Component and Cluster Analysis. We provide a method in order to quantify the excess comovement common to all emerging countries as well as the country specific one. Finally, we find evidence of "market tiering" and investor discrimination especially during tranquil times: the first three quarters of 1997, from the third quarter of 1999 to the end of 2000 and from 2003 onwards.
We suggest that regional patterns and credit quality differentiation have an important role to play in the investors' discriminating behavior regarding the emerging bond markets whenever the period is free of strong and unforeseen shocks leading to spillover across countries and markets.

JEL Classification Numbers: F42, G12, G15

Keywords: emerging bond markets, excess comovement, contagion, market segmentation

Authors' E-Mail Addresses: irina.bunda@univ-orleans.fr
ahamann@imf.org
slall@imf.org

[♣] Laboratoire d'Economie d'Orléans, France

[*] International Monetary Fund

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INTRODUCTION

A salient feature of emerging markets over the past decade has been their proneness to volatility spillovers and contagion across countries and markets during crisis episodes. The Tequila crisis of 1994-95, the Asian crisis of 1997, the Russian default and the collapse of LTCM in 1998, the Brazilian peso devaluation at the beginning of 1999, the US High Yield crisis in 2000, the Enron scandal in 2001 and the run-up to the Argentine debt default in late 2002, all were accompanied by the transmission of financial market volatility across borders.

These sharp spikes in volatility are usually captured by increased cross country market correlations in the now vast literature on contagion. One of the main questions we are trying to address in this paper is whether these increases in the emerging markets comovement are attributable to common shocks or to a "pure" contagion phenomenon.

The paper could thus be embedded in the empirical literature on contagion viewed as excess – comovement, that is, the transmission of shocks from one market or country to others, unexplained either by common shocks or fundamental links among the countries.

The first authors to have quantified the excess-comovement as a measure of contagion in mature markets are Pindyck and Rotemberg (1990, 1993). After taking into account common fundamentals, they showed that there is residual comovement across stocks from very different industries and idiosyncratic fundamentals.

By contrast, little is known with regard to emerging markets as far as the residual comovement is concerned. For instance, in the case of the exchange rate variation, Masson (1999a, b, and c) identifies three components, namely: "monsoonal" shocks or common shocks simultaneously affecting all countries, spillovers occurring through trade and economic relations and a residual, the component unexplained by the previous systematic relations and referred to as "contagion".

Baig and Goldfajn (1998) test for evidence of contagion between the financial markets of East Asian countries. In order to account for residual comovement, they control for own country and cross border news (using a set of dummy variables) and other fundamentals and show evidence of cross-border contagion in the currency and equity markets. The dummy variables they use are proxies for the country's own fundamentals but they can be also viewed as source of contagion for other countries. The authors estimate the impact of these dummies on the financial markets through country-by-country regressions. They further analyze the residuals of these regressions to see the extent of cross-border correlations after controlling for fundamentals. Valdes (1997) uses secondary market debt prices as well as country credit ratings and shows that fundamentals are unable to explain the cross- country comovement of creditworthiness in Latin American countries.

Regarding the interpretation of the excess comovement, the literature attributed this residual comovement either to multiple equilibria (sunspots) or to market behavior. Jeanne (1997) and Jeanne and Masson (1997) develop a Markov-switching model in application to the ERM crisis. According to their vision, discontinuities in the shock transmission process are associated to jumps between multiple equilibria in the currency market.

As for the market-based interpretation of contagion to which our paper is related, there are mainly three strands of literature. According to the first one, contagion can be captured by shifts in market investors' perceptions and attitudes towards risk (Kumar and Persaud (2001)). The second strand of the literature considers that contagion is the result of herding behavior of investors (Lakonishok, Shleifer and Vishny (1992), Christie and Huang (1995) Kim and Wei (1999a), Choe, Kho and Stulz (1999)). Finally, according to the last view, contagion is the result of "wake up calls" by investors (Goldstein (1998), Baig and Goldfajn (1999), Kaminsky and Schmukler (1999)).

The present paper represents an empirical investigation of the comovement of emerging bond returns of the key constituent countries of the EMBI Global benchmark index over the period 1997 -2005.

Our aim is to assess the respective part of common external factors and market behavior in explaining comovements in emerging markets bond returns.

Generally, comovements in emerging bond markets can be captured by the rolling average correlation of bond returns. These returns may be driven by a wide range of underlying factors: external or internal to the asset class or to the issuing country. Therefore we expect that the eventual market comovement be explained by heterogeneous factors.

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We can roughly divide these factors in two categories, namely:
-common external factors characterizing developed countries (in particular the US);
-factors other than the common external ones, accounting for the residual comovement of emerging markets. These factors can be attributed to the international investors' behavior who shift between asset classes and markets according to their anticipations and attitude towards risk.
In order to disentangle the respective roles of common external factors and market based transmission channel in the recent events of market spillovers we use average correlations of each country returns with the rest of the EMBI global sample, adjusted and unadjusted for the presence of common external factors (US-TB, US-HY and SPX Index returns). The correlation coefficients of residuals thus become a measure of "excess comovement" in emerging bond markets and we ascertain whether the major episodes of market turmoil are accompanied by significant increase of the adjusted correlations. In other words, we address and and try to answer the question whether *the data support the popularly held view that increases in correlations render emerging market bonds more likely to a generalized sell off in case of a single event in a given country.*

However, global average correlations may prove to be inefficient in assessing market comovements in presence of market segmentation. We use several methods on an exogenous year-to-year basis in order to highlight major trends in investors' behavior and attitudes towards risk in emerging countries. The question which then arises is whehther *global investors are treating emerging market sovereign bonds indiscriminately or is there evidence of increased market tiering.*
The analysis of correlation matrixes of adjusted returns enables us to identify groups of countries moving together during the recent events in emerging markets. These findings are further refined by performing Factor analysis methods for each calendar year of the sample period. In doing so, we aim at identifying groups of countries that exhibit high within-group comovement but not between-group comovement. Even if the group composition may change over the year, the periods where the two groups are orthogonal (that is the between group rolling average is nearly zero) may be viewed as periods of increased investors discrimination regarding emerging bond markets.
We furthermore inquire on the underlying factors of eventual market fragmentation and check whether the groups can be explained by regional aspects, credit rating, index weight, number of crises experienced recently.

Our paper is organized as follows. The first part is dedicated to the average correlation analysis, adjusted and unadjusted for the presence of common external factors. The first section presents the methodological aspects while the second one summarizes the main results of this approach. In the second part of the paper we put into question the sample average correlation-based method and look for the presence of groups within the eighteen emerging bond markets returns of our sample. The motivations and the methodological aspects of sample tiering are presented in Section 3 whereas Section 4 exposes our main results. The last section concludes.

I) AVERAGE CORRELATIONS: ADJUSTED AND UNADJUSTED

1. CONCEPTUAL ISSUES AND DATA

We use daily and five-day returns for 18 out of 33 emerging countries initially included in the JP EMBI Global[1i] according to the data availability over the period starting on the 3rd of March 1997 and ending on the 28th of February 2005. Data were obtained from Bloomberg. The selected countries (Argentina, Brazil, Bulgaria, Colombia, Croatia, Ecuador, Malaysia, Mexico, Morocco, Panama, Peru, Philippines, Poland, Russia, South Africa, South Korea, Turkey and Venezuela) accounted for 92,4% of the Index in 1997 and for 87,51% at present[2].

[1] The J.P. Morgan Emerging Markets Bond Index Global (EMBI Global) tracks total returns for US-dollar denominated debt instruments issued by emerging markets sovereign and quasi-sovereign entities (Brady Bonds, Loans, Eurobonds, etc). Currently covers 189 instruments and 31 countries. For further methodological details see the end Notes (**i**) and JPMorgan Methodology Brief "*Introducing the JP Morgan Emerging Bond Index Global*", 1999.
[2] See end Note (**i**) for changes in country index weights during the sample period.

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The adjustment for the presence of common external factors was performed using daily and five-day returns[3] computed from the bond index value of total return[ii], according to the following relations:

$$R_{t/t-i} = ln(I_t / I_{t-i}) \qquad i = 1 \text{ or } 5 \tag{1}$$

where

I_t represents the closing cumulative total return index level on day *t* and I_{t-i} the last total index return on the previous and respectively on the last fifth trading day;

R_t denotes the (*log*) net rate of return between dates *t*-1 and *t*, and respectively *t*-5 and *t*;

t is the trade date (according to the New York bond and holiday calendar and after harmonization with available trade dates for the independent variables).

In order to deal with missing data in some limited cases of market closure among the emerging countries in the EMBI global, we computed the inferred price between the last trading day and the opening day[iii]. Finally, we retained 2005 returns computed on a five-day basis.

As far as the three US market indicators are concerned (TB, SPX and HY Indexes), we use the daily closing prices provided by Bloomberg and compute the daily and respectively five days returns according to the relation *(1)* previously mentioned.

Initially there were 2015 trading dates for EMBI global, 2028 for SPX_Index and 2088 for both US_HY and US_ TB Index. After harmonization, we retained 2010 trading dates. Data for non-Asian countries were lagged by one day in order to adjust for the time difference between Asian and non Asian markets.

In order to measure the emerging bond markets comovement and the transmission of shocks from one country/region to another we adopt an approach based on correlations of bond returns after controlling for common external factors. These factors will affect emerging countries differently according to their macroeconomic characteristics (trade links, international financing requirements, degree of integration in the world economy).

More precisely, the bond returns (daily or computed on a 5-day basis-corresponding to a holding period for international investors) are adjusted for the presence of common external factors by performing rolling linear regressions of individual countries returns against the US Treasury returns (JPM US_TB5-7Y), the comprehensive US Stock Market Index (SPX_Index[iv]) and a total return index of the US High Yield market (JOAO). The rolling regressions were performed over a 60-day window in order to separate the impact of external and respectively idiosyncratic factors of emerging markets comovement. Pairwise correlations are then estimated based on unadjusted and adjusted 5-day returns over the same 60-day window.

By hypothesis, the external factors as endogenous variables, cannot explain any variation in the underlying residuals. Therefore, the residuals could be viewed as adjusted returns which are free from the influence of external common factors. Furthermore, the rolling canonical pairwise correlation of the regression residuals will capture the excess comovement of bond returns beyond common external factors/shocks.

The estimated model can be written as following (for two countries *i, j =1* to 18, *i≠j*) :

For a given 60-day window :

$$R_{i,t} = \beta_{i,0} + \beta_{i,1} \cdot R_{US_TB,t} + \beta_{i2} \cdot R_{SPX_Index,t} + \beta_{i,3} \cdot R_{US_HY,t} + \varepsilon_{i,t} \tag{2}$$

$$R_{j,t} = \beta_{j,0} + \beta_{j,1} \cdot R_{US_TB,t} + \beta_{j,2} \cdot R_{SPX_Index,t} + \beta_{j,3} \cdot R_{US_HY,t} + \varepsilon_{j,t} \tag{3}$$

and the correlation coefficient of residuals thus become a measure of the co movement in bond returns after removing the influence of common external shocks.

$$\rho_{ij} = \rho(\varepsilon_i, \varepsilon_j) = \frac{(\varepsilon_i' \cdot \varepsilon_j)}{(\varepsilon_i' \cdot \varepsilon_i)^{1/2} \cdot (\varepsilon_j' \cdot \varepsilon_j)^{1/2}} \tag{4}$$

The essence of the adjustment is then equivalent to a partial correlation between countries returns controlling for the effect of common factors[v].

The first question that naturally arises is why focusing on only these three common factors? Trends in emerging debt markets are closely tied to developments in mature markets of industrial countries and in particular in the US. Therefore, in our analysis, we focus on what appeared to us to be the three major

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[3] We obtained more significant results whenever returns are computed over a holding period of five trading days as they are less affected by the autocorrelation of day by day returns. Therefore we present only the results using 5-day returns.

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benchmarks of the US markets because they are the most likely to induce fluctuations in emerging markets returns.
In the first place, we take into account the US Treasury Bill returns for a maturity compatible with that of bonds included in the EMBI Global. The interest rates on Treasury Bills are virtually risk free rates and are commonly accepted as reflecting the general level of interest rates in the US economy. Studies on the international capital movements show that emerging markets bond returns are significantly affected by variations in the US interest rates[4].
The US_TB is characterized by lower risk of variation than emerging market bonds or US_High Yields and also by a lower return. During market rallies, whenever the emerging market prospects are encouraging, investors dump low yielding risk free TBs and buy emerging debt securities which offer a higher return. Their higher liquidity and the lower market risk come at the price of lower rates of return than debt or equity securities. Conversely, the global investors may shift to TBs in times of stress, whenever they have a perception of increased risk and are uncertain as to the economic prospects in emerging countries.
In the second place, we took into account the SPX_Index - the composite index of US stock market as a proxy for the stock market portfolio. Unlike other stock market indexes (e.g. Dow Jones Industrial Average) which track the value of a portfolio with one share of each stock, the SPX_ Index reflects the value of a portfolio that holds shares in each firm in proportion to the number of outstanding shares. The behavior of the SPX_ Index is thus similar to that of the entire US stock market.
The link between stock returns and those of emerging market bonds could be interpreted as a proxy for the global investors shift between competing asset classes. The investor behavior towards stocks depends on the growth perspectives of the concerned country (higher rates of investment, productivity growth, etc). Therefore, investors tend to prefer equities whenever the economy is doing well and shift to buy safer assets whenever the situation deteriorates.
Finally, we take into account the performance of the high yield sector in the US with the aim of capturing the global investors' behavior regarding two competing asset classes of similar risk. The selected JOAO Index is characterized by an average rating comparable to that of emerging markets (BB and B rated). Therefore the two indexes (HY Index and EMBI global) roughly reflect the same degree of risk. The sign and the importance of the HY coefficients in the regression of each emerging country returns against the three common external factors is an indication of an eventual investors shift between local and emerging market securities of similar risk.
Nonetheless, the relationship between HY returns and emerging market debt returns is not straightforward. On the one hand, if there are concerns about the ability of corporate/sovereign issuers to service or to roll-over their debt in the HY/emerging market bond markets, we could expect global investors (in particular cross-over investors) to shift to the alternative market more attractive in terms of risk-return.
On the other hand, troubles in the US_HY sector often reverberate through the emerging markets and sell offs in the first market trigger similar sell offs in the latter over the last years. Troubles in the HY sector (as it was the case during the US_HY crisis in the last quarter of 2000) could be associated by global investors with an increase in the overall risk of the portfolio. In this case, investors tend to reduce the exposure in similar securities in terms of risk (in particular, the emerging market bonds).

2. DESCRIPTION OF RESULTS

2.1. Analysis of beta coefficients in initial regressions

The beta coefficients as the sensitivity of bond market to changes in US_TB, SPX_Index or US_HY measure the variation induced in bond returns by a one percent variation of the exogenous variables. In terms of prices, the beta coefficients measure the growth rate of the emerging market bond price relative to the growth rate of the return on the external factors.
Let us summarize the most important findings of our regressions.

[4] e.g. Calvo and Reinhart (1996) show that increase in US interest rates, other things equal, are associated with capital outflows from Latin America, in the aftermath of the Mexican crisis of 1994/95.

US_TB coefficients

The evolution of bond returns sensitivities to changes in the US_TB returns as illustrated in Annex 1 is a good indicator of changes in market behavior through the period under consideration.
The US_ TB is characterized by lower risk of variation than EM bonds or US_ High Yields and also by a lower return. During market rallies, whenever the emerging market prospects are encouraging, investors dump low yielding risk free TB and buy emerging debt securities which offer a higher return. Their higher liquidity and the lower market risk come at the price of lower rates of return than debt or equity securities.
Conversely, the global investors may shift to TB in times of stress, whenever they have a perception of increased risk and are uncertain as to the economic prospects in emerging countries.
A positive link between the returns of these two assets would indicate an indiscriminate attitude regarding fixed-income securities and possible shifts between asset classes (e.g. between stocks and bonds).
Therefore, the US_ TB link to emerging debt market may be viewed as a proxy for shifts in market beliefs and if this is the case, we would expect a negative link between yields of US_ TB and those of emerging bond markets.
At the beginning of the period, until the Thai bath devaluation of July 1997, the emerging markets showed positive sensitivity of returns in response to changes in US_TB returns, which indicates investors' indiscriminate attitude regarding fixed-income securities and possible shifts between asset classes (e.g. between stocks and bonds).
Starting with the Asian crisis, the positive link between TB and emerging markets returns is broken. The first important drought took place around November 1997, followed by a peak of the same magnitude. During this period and until the end of 1999, Malaysia and the Philippines stand out as having the most volatile sensitivity in the sample.
The next decoupling of emerging markets returns from the US_TB returns took place during the Russia default and LTCM crisis of September 1998. All emerging countries in the sample show particularly high negative sensitivity. However, Russia stands out with a coefficient of -23, Brazil, Ecuador, Malaysia and Venezuela with sensitivities to changes in the US_TB returns inferior to -10. The negative link between emerging market and US_TB returns suggests that investors substitute emerging market bonds to risk free zero coupon bonds according to their attitude towards risk.
The Brazilian peso devaluation at the beginning of 1999 induced another significant drop in emerging market bond returns regarding the US_TB returns in the case of Brazil, Argentina, Ecuador[5] and Russia (with a coefficient inferior to -8) and to a lesser extent Colombia, Croatia, Mexico, Morocco, Peru and Venezuela (coefficients inferior to -2). No significant impact on Bulgaria, Malaysia, Korea, the Philippines, Poland and Turkey is noticed.
The Argentinean sell-off of March 2000 seems to have little impact on the sensitivities of emerging markets relative to the US_TB returns.
The Nasdaq turbulence in the third quarter of 2000 induced a wave of positive sensitivity with the US_TB returns. Rises in US_TB returns were accompanied by simultaneous rises in emerging market returns in the case of Argentina, Colombia, Ecuador, Mexico, Panama, Peru Philippines, Russia, South Africa and Venezuela. Countries like Ecuador and Croatia exhibited negative sensitivity during this period and for the rest of countries in the sample the impulse is not significant.
Starting with the beginning of 2001 and until towards the end of 2003, the variations in the US_TB returns seem to have little impact on country returns in the case of Bulgaria, Croatia, Malaysia, Morocco, Panama, Philippines, Poland, Russia, South Africa, Korea, Mexico and Venezuela. Conversely, the other countries coefficients are characterized by large fluctuations over the whole period.
Throughout 2003, the mix of stimulative monetary policies and strengthening emerging market fundamentals contributed to a strong rally in asset prices and to a compression of credit spreads on bond markets. The perspective of lower returns on US Treasury Bonds led investors to shift to more attractive emerging debt securities within the same class of fixed income assets. Higher demand for emerging market debt induced a rise in prices and therefore higher returns. In presence of low interest rates in the US, US _TB prices were high and investors, in their fight for performance, preferred other more yielding assets like emerging debt bonds or (high yield) corporate bonds.

[5] Particularly volatile during this period

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At the beginning of 2004 anticipations of a less accommodative monetary stance come out. Investors became more cautious and started to adjust their portfolios to the prospect of an increase in US interest rates moving up in the credit quality spectrum and reducing the duration of their portfolios. When effective, in June 2004, the measure induced a peak in sensitivities with the US_TB returns especially in Latin American countries (Brazil, Colombia, Ecuador, Mexico, Panama, Peru and Venezuela). That means that the fall in US_TB returns induced losses of greater magnitude in most vulnerable emerging markets.
However, from the last quarter of 2004 onwards the US_TB fluctuations seem to have no significant impact on emerging market returns.

SPX_Index coefficients

Emerging bond sensitivities to changes in equity market returns could be viewed as a proxy for the global portfolio relocations between bonds and equity. Annex 2 shows that over the period under consideration, the impulses from the stock market had a lower impact on all countries (with the exception of Russia in 1998-1999) than those from US_TB and US_HY markets.
The SPX_Index returns reached a low on 27th of October 1997, 7 days after the Hong Kong stock market collapse. Positive coefficients in the rolling regressions covering this period reflect that returns on emerging market bonds also decreased more or less proportionally.
Another event which intensified the link between the two markets was the Russian default in July 1998 and the LTCM crisis at the end of September 1998. During this period equity returns were negative almost all the time, with an important through at the end of August (in the aftermath of Russian default) and another in October 1998 (in the aftermath of the LTCM collapse). Negative coefficients during this period reflect an opposite movement of bond and equity returns. The sharp decrease in the SPX_Index was accompanied by a rise of emerging bond market returns. Prices and yields moving in different directions could be an indication of investors shift between markets, in this case, from the stock market to the emerging bond market. This is due to the underlying drop in the SPX_Index returns.
As the events in Russia directly affected the emerging sovereign debt market, the sign of coefficients could indicate if the similar drop in other emerging market bond returns is due to contagion from Russia or to external factors. Furthermore it could give information on investors' behavior and portfolio rebalancing between bonds and equities. In the aftermath of the Russian devaluation we notice that sensitivities of all countries with the SPX_Index started to decline and approached zero which means that the evolution in emerging market returns were less explained by external factors during this period. In the case in which returns on emerging market bonds are lower than those on equities, there is a part for spillovers from Russia in explaining market comovement. We can notice that during this period the drop in emerging market bonds returns took place before the drop in SPX_Index returns (with the exception of Croatia) which means that it was a consequence of events in Russia affecting all emerging markets.
The next fall in SPX_Index returns in October seems to modify the link between the two markets as almost all countries suffered a drop in their sensitivities with the equity market. In the aftermath of the LTCM crisis, the equity returns dropped sharply in October 1998. A negative coefficient for all the emerging countries in the sample suggests that the emerging bond market was unaffected by this event and returns moved in the opposite direction.
In the aftermath of the Brazilian peso devaluation of January 1999, the link between the two markets became positive and reached a peak in March 1999. However, the coefficients were strictly superior to unity only in the case of Russia meaning that the decrease in emerging market returns couldn't be entirely explained by external factors and that the market also had a role to play in returns comovement.
The main events at the end of 2001 (Enron collapse) and in 2002 (mainly the Argentinean default) induced a peak in sensitivities in Argentina, Brazil, Ecuador, Peru, Philippines and Turkey. The bursting of the technology, media and telecom (TMT) bubble and an widespread equity price declines in mature markets was accompanied by a heightened perception of risk and an indiscriminate attitude towards high-risk assets. Investors rebalanced their portfolios away from equity and low grade bonds towards higher quality assets (e.g. Treasury Bills).

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US_HY coefficients

Annex 3 illustrates the evolution of bond returns sensitivities to US_HY return variations.
The US corporate high yield bonds are often viewed by global investors as competing asset class to emerging market bonds. This is due to the higher risk (and returns) associated to the high yield sector compared to TB or US investment-grade bonds, making them similar in some way to the emerging market bonds. Over the period under consideration the US_ HY sector experienced downgrading and massive sell offs which had an impact on the emerging bond markets as well.
At the beginning of the sample period the returns on emerging markets bonds displayed broadly positive and low sensitivities.
The first drop in coefficients occurred during the Asian crisis, in the aftermath of the Hong-Kong stock exchange collapse. During this period, emerging market returns proved to be far more volatile than returns on HY. They fell dramatically in early October and this movement seemed unrelated to the evolution of HY returns (which increase and decrease slightly) with the exception of Colombian returns which remains positively correlated with HY returns. After this date sensitivities became significantly positive and reached an important peak at the beginning of 1998 in almost all the countries in the sample which indicates that an increase/decrease in HY returns induced an upward/downward movement in emerging markets. This situation could thus reflect a generalized sell-off (in the case of a simultaneous drop in both markets) when a sudden increase in the overall risk of the investors' portfolio leads them to dump risky assets and to increase the part of safe assets. The simultaneous increase in returns could be the result of investors' reallocation between different classes of assets (from stocks to fixed-income securities).
We can notice a new important drop in sensitivities (especially for Russia and Ecuador) taking place in the run-up to the Russian default of May 1998 and indicating an opposite movement of the two markets.
Starting with this date coefficients began to rise and became positive in July 1998 which reflects the simultaneous drop in emerging markets and HY returns. After an insignificant drop in October 1998, sensitivities rose again to reach a peak in the aftermath of the LTCM crisis, in November 1998. This is an all time high (over our sample period) for most countries (the most sensitive are Bulgaria, Ecuador, Russia, Peru and Venezuela). Returns on emerging countries were low below zero and far more volatile than the returns on corporate bonds.
After this date sensitivities started to decline in such a way that at the time of the Brazilian peso devaluation in January 1998, returns on emerging market bonds became negative whereas HY returns kept fluctuating within a small interval. This is an indication that the two markets evolved in opposite directions as a result of investors shift within the same class of risk, between emerging markets and local corporate bond market.
During the first months of 1999 emerging markets sensitivities became almost zero indicating a decoupling of the two markets. Another significant peak is reached in mid 1999, when both returns on emerging markets increased.
In the run up to the Argentinean sell off of January 2000 coefficients became highly positive for Brazil, Bulgaria, Russia and Venezuela which puts into light a simultaneous upward movement in HY and emerging markets returns. In the wake of the Argentinean sell-off, coefficients on HY returns declined for the majority of the countries in the sample to insignificantly positive levels or significantly negative levels in the case of Colombia, Croatia, Russia, Venezuela. As for Peru and Philippines, they reached a drought in sensitivities later, in November 2000.
A new rise in coefficients was recorded in the second semester of 2000, during the HY crisis especially in Colombia, Malaysia, Morocco, Panama, Peru, the Philippines, Poland, Russia and Venezuela.
During 2001 coefficients remained at levels close to zero which suggests that the impact of HY returns becomes less and less important. The exception is Argentina, with extremely volatile sensitivities during the whole sample period.
In the wake of the Turkey devaluation we notice a drop in coefficients although they remained at an insignificant level. It is worth noticing that during this period emerging market returns dropped dramatically whereas HY returns fluctuate closely to zero suggesting a weak association between emerging and HY markets.
Over the last part of the sample period there are generally no more extreme variations in returns. The exceptions are the Philippines with sensitivities rising to significant levels in 2003, Colombia, Ecuador Brazil and Venezuela whose sensitivities increase significantly over the last two years and finally, Turkey,

the most volatile, displaying positive sensitivities during the whole sample period. Since the beginning of 2005 the only country displaying negative sensitivities is Ecuador and Venezuela, country rated as underinvestment grade. This could indicate that investors shifted within the same class of risk, between those emerging markets bonds and local corporate bond market.
As a general remark, let us say that, starting roughly with the last quarter of 2001, the emerging countries sensitivities to the evolutions on the HY sector are far less volatile than they were at the beginning of the sample period (which comforts the results of decreasing correlation between emerging market returns and the three external factors at the end of the sample period).

2.2. Interpretation of the adjusted and unadjusted cross-country average correlations

Analytically, unadjusted correlation higher than the adjusted one[6] implies that the two country returns are correlated in the same way (that is both positively or negatively correlated) with the common external factor.
Conversely, rolling adjusted correlation coefficients higher than the unadjusted ones indicate that a part of the "true" comovement of emerging markets was overshadowed by general trends taking place in mature markets. In the case in which emerging markets are oppositely linked to the common external factors, removing the impact of these common external factors will actually strenghten the linkages between emerging countries bond returns.

Figure 1 below illustrates the evolution of aggregate correlations, adjusted and unadjusted for the presence of common external factors. Aggregate correlations were computed as the average of all 157 pairwise canonical correlations of the 18 countries within the sample over a 60-day rolling window.
As a general feature, we notice that the adjusted and unadjusted rolling average cross correlations have always been positive suggesting a tendency of individual country returns to move together. The large spikes in global average correlations were usually associated with the major episodes of market turmoil suggesting less investor discrimination during sell offs compared with periods of market rallies. This reinforces the "crossover" nature of investors which tend to unwind their open positions in emerging markets during bad times.
At the same time, we highlight a secular decline in both adjusted and unadjusted series over the whole period under consideration. The decline is more marked in the case of the adjusted correlations which are proxies for the comovement specific to emerging markets. Thus, emerging bond returns comovement appears to be less and less specific to emerging markets and mainly driven by events taking place in mature markets, as showed by the widening gap between adjusted and unadjusted average correlations over the last years.

We briefly analyze the evolution of adjusted and unadjusted **aggregate correlations** in connection with the key episodes taking place during the sample period.
The Thai devaluation in July 1997 seems to have little impact on investors' attitude towards emerging markets bonds. Both unadjusted and adjusted average correlations decreased in the run-up to the crisis reaching 0.5 and respectively 0.2 at the time of the crisis.This downward movement lasts till the Hong Kong market crash of October 1997 which marks a reversal in correlations trend. Both the adjusted and unadjusted correlations rise and reach a peak of 0.8 and respectively 0.53 at the end of October. The Hong-Kong crisis could thus be viewed as a clear example of significant increased market comovement after controlling for the common external factors. The residual comovement doubled in the aftermath of the stock market crash and this is due to investors' behavior with regard to the emerging debt instruments indicating a generalized sell-off.
Unlike the previous episodes, in the case of the Russian crisis of August 1998, correlations increased prior to the crisis and continued during the crisis. A possible interpretation would be insufficient investor discrimination in the run-up to the crisis and then "herd behavior" during or after the crisis. In the aftermath of the Russian crisis we notice an important gap between the two average correlations indicating that external factors (in particular the LTCM crisis of September 1998) had a role to play in explaining market comovement.

[6] i.e. the correlation of regression residuals

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Most of the time, adjusted returns are below the unadjusted ones, which indicates that market comovement was partly due to events taking place in mature markets. The most notable exception concerns the period leading to the Brazilian devaluation of January 1999 characterized by adjusted returns higher than the unadjusted ones. Moreover, adjusted returns reach during this period the highest level of the sample period indicating investors concerns about emerging countries specific risk.
In the case of the Argentinean sell off of March 2000, adjusted correlations maintain at a very low level (around 0.3) before and after the crisis. At the same time, unadjusted correlations are particularly high (around 0.6) indicating that the market comovement was due to external factors (e.g. the revision of expectations of the US monetary policy) rather to contagion from Argentina. Similar trends are noticed in the case of the US-HY crisis of October 2000.
The Turkey devaluation of February 2001 seems to have little impact on other emerging markets returns. The last episode of increased market comovement is the Argentinean crisis of July 2001 during which the investors' fears regarding Argentina specific risks spread across emerging markets.
Events taking place after this date (e.g. the Enron scandal in December 2001, Argentinean default at the end of 2002 or US interest rate rise in June 2004) did not trigger generalized disruptive effects on emerging markets. Adjusted correlations display a mean value around zero over the last three years indicating a lack of generalized emerging market comovement. This could be due, on one hand, to the upgrade of some emerging countries of the EMBI global to investment grade (e.g. Mexico, Bulgaria, Croatia) and overall good country fundamentals and, on the other hand, to low interest rates in mature markets which increased the attractiveness of emerging markets bonds.

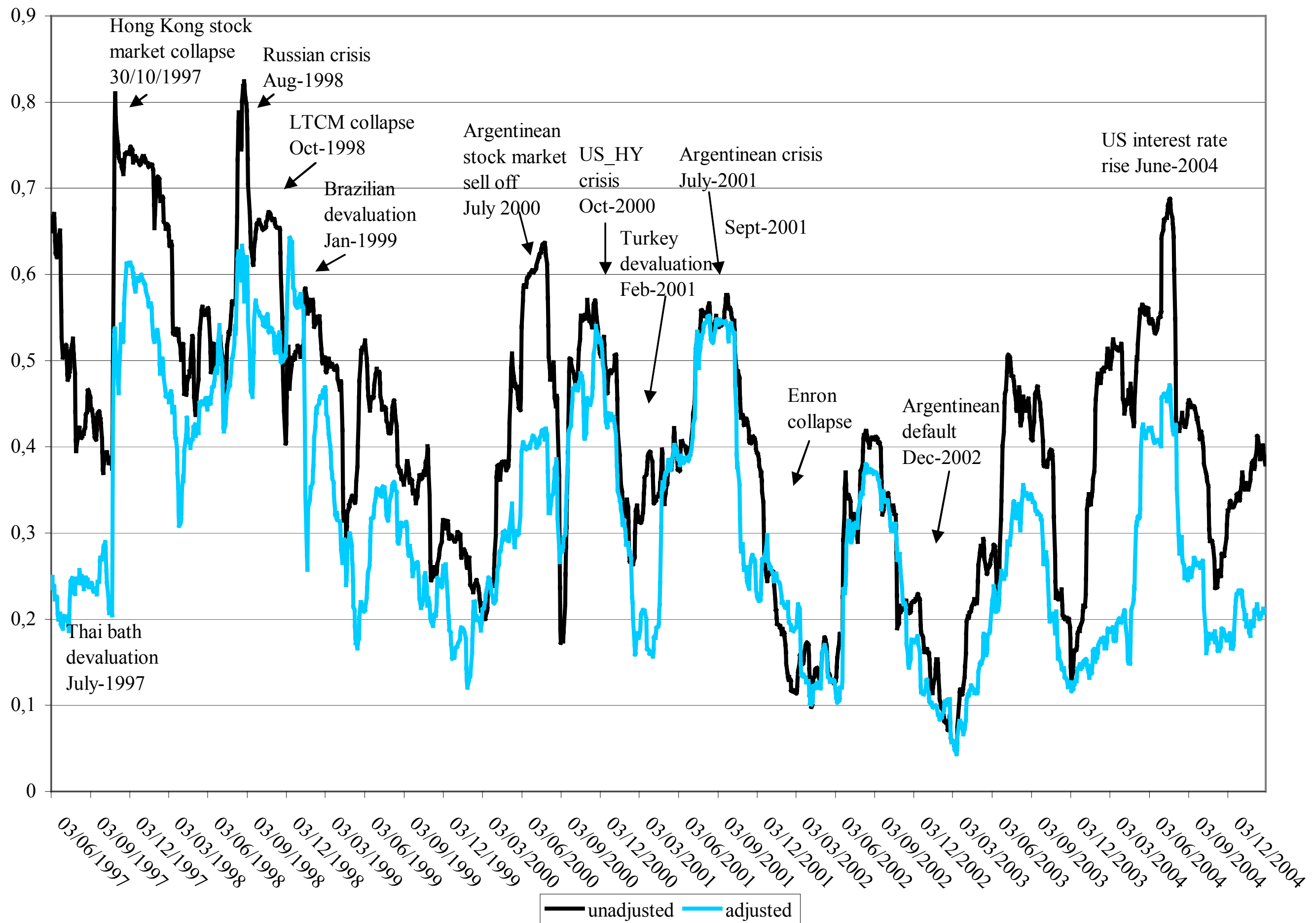

Figure 1: Adjusted and unadjusted rolling average correlations

Although the linkages of emerging market returns with the external factors are particularly strong during periods of market turmoil, the emerging markets "excess" comovement is decreasing over time in such a way that in 2005 it reaches the low levels existing before the Asian crisis.

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II) ARE AVERAGE CORRELATIONS A GOOD SUMMARY INDICATOR?

Average correlations may not be useful in summarizing market results if the underlying distribution of bond returns is not unimodal (i.e. if there are underlying groups that exhibit high within-group comovement but not between-group comovement). Therefore there is a need to look for some evidence of market tiering in order to better assess the excess comovement of emerging bond returns.

3. LOOKING FOR GROUPS : METHODOLOGY

The choice of the calendar year as a time unit for performing Principal Component and Cluster Analysis was motivated by the fact that any transitory movement in correlation coefficients or in the underlying groups tends to disappear with the increase in time period.
The simple observation of pairwise correlation coefficients[vi] allowed us to distinguish the presence of groups of countries in our sample but the clusters composition needs further refinement in order to reflect the complexity of the simultaneous movements within each group. Therefore we use different types of Factor Analysis methods (Principal Components and Cluster Analysis) in order to identify homogenous groups in our sample.

3.1. Principal components analysis

In order to assess the global comovement of bond market returns we perform principal component analysis[vii] on adjusted bond returns of the sample countries for each calendar year of the period 1997-2005.
Tables 1 and 2 below report the eigenvalues for the first two principal components (i.e. its variance in absolute value and as a percentage of the overall variance of initial series) for both adjusted and unadjusted returns.

	1997	1998	1999	2000	2001	2002	2003	2004	2005
PC(1)	13,18 73,20%	11,99 66,59%	8,58 47,68%	8,97 49,81%	7,88 43,80%	6,22 34,56%	7,01 38,95%	9,92 62,02%	8,65 54,06%
PC(2)	1,31 7,30%	1,52 8,46%	1,54 8,55%	1,42 7,89%	2,28 12,64%	2,77 15,36%	2,38 13,22%	1,4 8,8%	3,38 21,11%
cumulative	80,50%	75,05%	56,23%	57,70%	56,44%	49,92%	52,17%	70,82 %	75,17%

Table 1: Factor eigenvalue and percentage part of the variance explained by the first two principal components (5-day **unadjusted** returns)

	1997	1998	1999	2000	2001	2002	2003	2004	2005
PC(1)	10,05 55,84%	10,70 59,43%	6,73 37,38%	7,35 40,82%	7,33 40,74%	5,82 32,35%	4,89 27,21%	6,81 42,56%	5,99 37,43%
PC(2)	1,46 8,11%	1,98 10,55%	1,98 10,99%	1,53 8,50%	1,55 8,60%	2,07 11,51%	2,14 11,91%	1,88 11,75%	3,43 21,41%
cumulative	63,95%	69,98%	48,37%	49,32%	49,35%	43,85%	39,11%	54,31%	58,84%

Table 2: Factor eigenvalue and percentage part of the variance explained by the first two principal components (5-day **adjusted** returns)

By convention, the principal components are ordered by their explanatory power. The first one explains the most important part of initial series comovement while the second one explains a smaller percentage of the total variance than the first one and so on. The evolution of the part of overall variance explained, each year, by the first two principal components is illustrated in Annex 4.
In the case of emerging markets adjusted returns all countries display positive correlations with the first principal component. The first factor can therefore be interpreted as a general factor, common to all emerging markets.
The explanatory power of the first principal component increases in 1998 (during the Asian and Russian crises) to almost 60 percent. In the following years, the first principal component of the adjusted returns

explains less and less of the emerging countries comovement: 37 percent in 1999, 41 percent in 2000 and 2001, 32 percent in 2002 and only 27 percent in 2003 which suggests that emerging markets are more and more segmented. In 2004 there is a surge in emerging country links with the first component, for both adjusted and unadjusted returns, which means that an external event (e.g. the anticipated rise in US interest rates) triggered a change in market attitude towards emerging market bonds. This trend tends to attenuate at the beginning of 2005.

As far as the second factor is concerned, it could be viewed as a differentiating factor among the emerging countries in our sample. Its contribution in explaining the overall variance in the sample varies slightly over the period 1997-2001 (between 8 and 10 percent) and starts to rise from 2002 onwards. The beginning of 2005 sees a surge in the variance explained by the second factor which may indicate increased regional tiering among emerging market bonds.

Overall, the two first common factors account for 64 percent of the variance of adjusted returns in 1997, 70 percent in 1998, only 50 percent in 1999-2000, and less than 40 percent over the last two years of the sample period. Their cumulative contribution increases in 2004 to 54 percent and to 58 percent in 2005. However, towards the end of the period, the composition of the excess comovement changed, with the second component (as a differentiating factor) gaining in importance compared with the beginning of the sample period.

As there are eighteen normalized variables, there will be eighteen orthogonal vectors explaining the overall variance in the sample[7]. For each year we retained the number of principal components necessary to describe at least 80 percent of the overall variance. As indicated in the Annex 4, we need more and more orthogonal factors to account for the variation of countries adjusted returns or in other terms, individual returns seem to be less and less correlated with one major factor and thus less and less dependent on one another. In 1997 and 1998, the first five principal components accounted for 80 percent of the overall variation whereas during more recent years, eight or even nine principal components are needed to explain the same portion of the variation in the series of adjusted returns.

The previous analysis put into light that emerging markets seem to be less and less integrated. The drop in the explanatory power suggests the absence of a general common factor driving the comovement across emerging countries. At the same time, it highlights the ineffectiveness of the overall average as measure of a global measure of market linkages.

Use of Principal Component Analysis to identify clusters

If there are only two or at most three principal components which explain most of the total variation in the original variables, the factor scores of all cases (i.e. all countries) on these factors may reveal the presence of clusters. The factor loadings for each country in the sample could be viewed as a measure of association between individual countries adjusted returns and the principal components which account for the major part of the total variance. In fact, they represent the correlations of the variables (countries) with the factors. Therefore countries displaying factor loadings of opposite signs for the first or the second principal components can be assigned to different clusters. The sample fragmentation becomes more difficult whenever factors exhibit only positive or negative weights-indicating that the factor corresponds to a similar (upward or downward) movement in individual country returns.

We notice that some countries are highly correlated with this first factor (see Annex 6 for PCA country loadings) indicating the presence of a set of "core" countries moving together whereas the other countries are less sensitive to general trends. Positive and negative (and significant in many cases) correlations with the second factor reinforces the idea of a two-tier system in emerging markets.

As the two principal components are orthogonal, countries highly correlated with the first factor tend to exhibit negative correlations with the second factor. Therefore, one intuitive criterion for identify the eventual presence of two clusters of countries is to group together countries highly correlated with the first factor (e.g. PC (1) $\geq$ 0,7) and negatively correlated with the second (e.g. PC (2) $\leq$ -0,15) in one cluster, and

[7] The eigenvalues for a given factor measure the variance in all the sample variables which is accounted for by that factor. If a factor has a low eigenvalue then it contributed little to the explanation of variances in the series of adjusted returns and might be ignored as redundant. In order to establish the number of factors driving the comovement in emerging bond markets we can apply the Kaiser criterion according to which all components with eigenvalues less than unity should not be taken into account. However, we chose a widely used variance explained criteria which consist in keeping enough factors to account for 90 or sometimes 80 percent of the overall variance.

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countries less correlated on the first factor (and therefore less correlated with all other emerging countries) and positively correlated with the second factor, in another cluster. This strategy ensures that although countries in the second cluster are not always significantly correlated with all countries in their cluster, the within cluster correlations are higher than the correlations between clusters.

3.2. Cluster analysis

We furthermore refine our analysis by performing cluster analysis[viii] on the series of adjusted returns of emerging countries with the aim of identifying a set of country groups (in particular two subgroups to keep the analysis coherent with the previous two methods) which both minimizes the within group variation and maximizes the between group variation.
Figures 3, 5, 7, 9, 11, 13, 15, 17 and 19 in Annex 5 illustrate the clusters composition computed by the K-means procedure imposing the presence of two clusters. It is worth noticing that we performed clustering taking into account different numbers of groups but the two-tier system seems to best separate (if there is any discrimination on the part of investors) the EMBI countries.
Within each cluster, countries are ordered according to their distance to the cluster center that is the average distance within-group. From the scatter plots of cluster membership by their distance to the cluster center we can notice that the majority of countries in each cluster are situated to a distance inferior to 16. Farther than this limit, countries are regarded as outliers which alter the final classification (as it is strongly the case from 1998 through 2001).

4. AGGREGATE RESULTS

The evolutions of the average correlation coefficients within and between groups, using the whole sample, according to the PCA taxonomy are illustrated in Annex 5. We took into account in the group composition, the country loadings displayed by the unrotated PCA procedure as well as the maximum and minimum annual average correlations of each country with the other emerging countries in the sample (from the annual correlation matrixes previously computed). As several countries may have changed group over the calendar year, we check whether clustering analysis provides a better separation of the two groups. We tried to improve our findings by removing outliers (see the results of clustering analysis in the Annex 5) and countries ambiguously high correlated with the two principal components. The charts presented in the Annex 5 (figures 2, 4, 6,8,10,12,14,16 and 18) enable us to detect periods where the "two-tier paradigm" prevails in emerging markets.
We then inquire on the underlying factors driving the market segmentation and we check the pertinence of investors' discrimination according to the credit rating, regional aspects or crises occurrence in the near past.
The idea consists in identifying two distinct clusters in the sample which simultaneously exhibit higher within group variance or comovement and lower (minimum) between group variance. Average correlations of the two clusters move in opposite directions, the first one being characterized by a higher variance (as it is highly correlated with the first principal component, as described in the previous section). By clusters construction, countries uncorrelated or very low correlated with the other emerging countries fall in the second group characterized by a lower variance.
Let us briefly analyze the emerging market comovement year by year.
In **1997**, we notice a clear discriminating behavior of global investors roughly to the Hong Kong stock market collapse in October when correlations within both groups rise abruptly. However there is still evidence of investors' differentiation as regard to risk of securities in the two categories after that date. Over the last quarter of the year it becomes clear that the shocks from Asia affected mainly the most vulnerable emerging countries. As the average between clusters rose sharply at the time of the Hong – Kong collapse, we performed rotated PCA in order to better separate the two groups of countries. The results are summarized in the table below.

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1997

Group 1	Rating	Region	Group 2	Rating	Region
ARG	**BB-/BB**	L.A.	**COL**	**BBB-**	L.A.
BRA	**B+/BB-**	L.A.	**CRO**	**BBB-**	Eu&ME&Afr
BUL	**n.r.**	Eu&ME&Afr	**KOR**	**AA-/A-/BB-**	Asia
ECU	**n.r.**	L.A.	**MAL**	**A+**	Asia
MEX	**BB**	L.A.	**PHI**	**BB+**	Asia
MOR	**n.r.**	Eu&ME&Afr	**POL**	**BBB-**	Eu&ME&Afr
PAN	**BB+**	L.A.	**RUS**	**BB-**	Eu&ME&Afr
PER	**n.r.**	L.A.	**SAF**	**BB+**	Eu&ME&Afr
VEN	**B/B+**	L.A.	**TUR**	**B**	Eu&ME&Afr

ROTATED PCA

The first group is composed of countries rated as underinvestment grade and mainly from Latin America. The second group of countries, mainly from Europe, South Africa and Asia, displays lower comovement than the first one over the whole period which could indicate that these emerging debt instruments are perceived as less risky than those in the first cluster. Indeed, all countries in this category, excepted for Turkey are rated as investment grade.

In **1998**, correlation matrixes, PCA and clustering show that the major part of the emerging markets comovement is driven by events in Russia. The countries loadings for the first component are extremely high which is consistent with the crossover nature of the investor base.

The first principal component is a factor which makes the emerging markets move together, especially during periods of market turmoil. If there is evidence of indiscriminate behavior of global investors and broad-based sell-off across emerging markets (whenever a negative event occurs in one connected market) this is captured by the first principal component. All emerging markets are affected by the events in Russia even if Colombia, Malaysia and Korea show lower comovement with the rest of the sample. Figure 4 in Annex 5 shows that the distinction based on PCA prevailed roughly during the first half of the year but cannot be explained either by regional aspect or credit rating.

In **1999** there is evidence of market tiering (see figure 6 in Annex 5) although the composition of groups changes during the year. In particular, Bulgaria and Poland are perceived as risky at the beginning of the period, in the aftermath of the Russian crisis. Investors' attitude changes over time in such a way that at the end of the year these countries fall into the second cluster, characterized by lower volatility. The rotated PCA (see table below) highlight the presence of two groups of countries along 1999. The first cluster regroups Latin American countries rated underinvestment grade (thus viewed as riskier by global investors) whereas the second is composed of Asian and European&Middle Eastern countries rated investment grade by S&P (with the exception of Bulgaria, Morocco and the Philippines).

1999

Group 1	Rating	Region	Group 2	Rating	Region
ARG	**BB**	L.A.	**BUL**	**B+**	Eu&ME&Afr
BRA	**B+**	L.A.	**CRO**	**BBB-**	Eu&ME&Afr
COL	**BBB-/BB+**	L.A.	**KOR**	**BB+/BBB-/BB**	Asia
ECU	**n.r.**	L.A.	**MAL**	**BBB-/BBB**	Asia
MEX	**BB**	L.A.	**MOR**	**BB**	Eu&ME&Afr
PAN	**BB+**	L.A.	**PHI**	**BB+**	Asia
PER	**BB**	L.A.	**POL**	**BBB-/BBB**	Eu&ME&Afr
TUR	**B**	Eu&ME&Afr	**RUS**	**CCC-/SD**	Eu&ME&Afr
VEN	**B+/B**	L.A.	**SAF**	**BB+**	Eu&ME&Afr

ROTATED PCA

In **2000**, investors' discriminating attitude prevailed roughly until the Argentinean sell-off (see Figure 8 in Annex 5). In the wake of the Argentinean sell off. the debt issued by countries like Brazil, Mexico, Venezuela, Russia or the Asian countries was (temporary) perceived as riskier, Irrespective of their credit rating whereas issuers from Europe were not affected by this increase in the risk aversion of global investors.

The following year proves to be a period of indiscriminate behavior of global investors and high overall comovement. Events in Turkey and Argentina negatively affected the risk perception of emerging countries by global investors.

However, in 2003 average correlations within clusters start to decline[8] indicating less market comovement triggered by emerging markets specific factors.

Over the period 2003 to present, one can notice that markets are less and less intertwined as the explanatory power of underlying factor decline. However, every year, there is still a bunch of countries

[8] Which is in line with the correlation analysis (based on adjusted and unadjusted returns, see section 3).

highly linked to this common factor which indicates that these emerging countries are more vulnerable to negative events taking place in another emerging market.
In 2003, the high variance cluster is composed mainly of Latin American issuers rated below investment grade by S&P (see table below).

2003

Group 1	Rating	Region
BRA	B+	L.A.
COL	BB	L.A.
ECU	CCC+	L.A.
MEX	BBB-	L.A.
MOR	BB	Eu&ME&Afr
PAN	BB	L.A.
PER	BB-	L.A.
RUS	BB	Eu&ME&Afr
TUR	B-/B/B+	Eu&ME&Afr
VEN	CCC+/B-	L.A.

Group 2	Rating	Region
ARG	SD	L.A.
BUL	BB/BB+	Eu&ME&Afr
CRO	BBB-	Eu&ME&Afr
KOR	A-	Asia
MAL	BBB+/A-	Asia
PHI	BB+/BB	Asia
POL	BBB+	Eu&ME&Afr
SAF	BBB-/BBB	Eu&ME&Afr

UNROTATED PCA

The presence of Mexico, upgraded the previous year, is due to regional aspects. It is worth noticing that Argentina appears in the second cluster because it is negatively correlated or almost uncorrelated with all the countries in the sample but cluster analysis (see figures 13,15 and 17 in Annex 5) suggests that Argentina is an outlier, especially after its government default in 2002.
In 2004, the first group of countries was more affected by the change in investors' behavior regarding the emerging markets (see figure 17 in Annex 5). As illustrated by the table below, the most vulnerable are the subinvestment grade credits, mainly from Latin America and this situation lasts at beginning of 2005.

2004

Group 1	Rating	Region
ARG	SD	L.A.
BRA	B+/BB-	L.A.
COL	BB	L.A.
ECU	CCC+	L.A.
MEX	BBB-	L.A.
MOR	BB	Eu&ME&Afr
PAN	BB	L.A.
PER	BB-/BB	L.A.
PHI	BB/BB-	Asia
VEN	B-/B	L.A.

Group 2	Rating	Region
BUL	BB+/BBB-	Eu&ME&Afr
MAL	A-	Asia
POL	BBB+	Eu&ME&Afr
RUS	BB/BB+	Eu&ME&Afr
SAF	BBB	Eu&ME&Afr
TUR	B+/BB-	Eu&ME&Afr

ROTATED PCA

5. CONCLUSION

The objective of the present paper was to assess the respective part of common external factors and market behavior in explaining comovements in emerging bond returns. We tried to address the following questions regarding the linkages among emerging debt markets: *Are markets integrated or segmented? Are global investors treating them indiscriminately or there is evidence of market tiering? What are the underlying factors driving the market segmentation? Are returns in each emerging country driven by common external factors or an idiosyncratic shock occurring on one emerging market is likely to propagate across the other emerging markets?*
Our analysis covered 18 out of 33 emerging countries initially included in the EMBI global over the period 1997 to present. In order to distinguish between common external and idiosyncratic factors in explaining bond markets comovement, we performed 60-day rolling regressions of initial emerging bond returns against three external factors (US_TB, SPX_Index and US_HY). The correlation coefficients of residuals thus became a measure of the excess-comovement of emerging bond markets - the comovement unexplained by common external factors- generally attributed to market behavior.
As far as the links of emerging market returns with the three external factors are concerned, we noticed that the links with the US_TB decrease over time (as reflected by sensitivities and correlation coefficients close to zero from the end of 1999 onwards). However, links with HY and SPX Indexes are high and extremely volatile over the sample period indicating that these two external factors had a role to play in

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explaining emerging market comovements. Still, during the first half of the sample period, these two external factors had a more homogenous impact on emerging bond returns compared with the latter part of the period. In the latter part one can notice that emerging markets behave differently as regards to the external factors. More precisely, there is a group of countries characterized by regression and correlation coefficients extremely volatile whereas in the second group the impact of external factors seems to be almost inexistent.

Although the linkages of emerging market returns with the external factors are particularly strong during periods of market turmoil, global comovement, as measured by adjusted and unadjusted correlation coefficients, is decreasing over the period under consideration.

Furthermore we put into question the average correlations method which may not be useful in summarizing market results if the underlying distribution of bond returns is not unimodal. To this effect, we used several methods on a year-to-year basis in order to identify periods where the "two-tier paradigm" of emerging markets prevails.

The analysis of correlation matrixes enabled us to identify groups of countries moving together during the recent events in emerging markets. These findings were further refined by performing Principal Component and Cluster Analysis. In order to separate the two groups of countries we provided an intuitively method of cluster construction based on the correlations with the first two principal components.

The results of the Factor analysis methods were convergent and indicate the presence of two groups of countries within the EMBI global sample during tranquil times: the first three quarters of 1997, from the third quarter of 1999 to the end of 2000 and from 2003 onwards. One of them, which we labeled the "core group" driving the major part of the markets comovement, is characterized by high within average correlations whereas the other is characterized by a relatively low within average. By construction of the two clusters, countries in each group are more correlated with countries within the same group than with countries outside their group. We finally put into light that regional patterns and credit quality differentiation have an important role to play in investor discriminating behavior regarding the emerging bond markets.

References

BAIG, T. and I. GOLDFAJN (1998) "Financial Market Contagion in the Asian Crisis" *IMF Working Paper* no 98/155.

CALVO, S. and C.M. REINHART "Capital Flows to Latin America: Is There Evidence of Contagion Effects?" dans CALVO, G.A., GOLDSTEIN, M. et E. HOCHREITER (eds.) Private Capital Flows to Emerging Markets after the Mexican Crisis, Institute for International Economics, Austrian National Bank, 1996.

CHAKRAVORTI, S., and S. LALL (2003) "Managerial Incentives and Financial Contagion", *FRB of Chicago Working Paper* no 2003-21

CHRISTIE, W.G. and R.D. HUANG (1995) "Following the Pied Piper: Do Individual Returns Herd around the Market?", *Financial Analysts Journal*, Jul/Aug, 51,4.

CHOE, H., KHO, B-K., and R. STULTZ (1999) "Do Foreign Investors Destabilize Stock Markets? The Korean Experience in 1997", *Journal of Financial Economics*, no 54, pp 224-64.

JEANNE, O. and P.R MASSON (1998) "Currency Crises, Sunspots and Markov-Switching Regimes", *CEPR Discussion Paper* no 1990, October.

KAMINSKY, G.L. and S.L. SCHMUCKLER (1999) "What Triggers the Market Jitters? A Chronicle of the Asian Crisis", *Journal of International Money and Finance*, no 18, pp 537-530.

KIM, W. and S.J. WEI (1999) "Foreign Portfolio Investors Before and During a Crisis", *Journal of International Economics*, no 56, pp 77-96.

KUMAR, M.S. and A. PERSAUD (2001) "Pure Contagion and Investors' Shifting Risk Appetite: Analytical Issues and Empirical Evidence", *IMF Working Paper* no 01/134

LAKONISHOK, J., SCHLEIFER, A. and R.W. VISHNY (1991) "Do Institutional Investors Destabilize Stock Prices? Evidence on Herding and Feedback Trading" *NBER Working Paper* no 3846, September.

MASSON, P.R. (1999) "Multiple Equilibria, Contagion and the Emerging Market Crises", *IMF Working Paper* no 99/164.

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JP MORGAN (1999) "Introducing the J.P. Morgan Emerging Markets Bonds Index Global (EMBI Global)", New York, August, 3.

Notes :

i)

	March 1997	February 2005
	Index Weight	Index Weight
Argentina	20,00%	1,85%
Brazil	19,20%	19,20%
Bulgaria	1,80%	0,81%
Colombia	1,10%	3,37%
Croatia	0,60%	*
Ecuador	1,30%	1,33%
Malaysia	2,50%	3,48%
Mexico	15,20%	18,30%
Morocco	1,10%	0,33%
Panama	1,90%	2,01%
Peru	1,30%	2,45%
Philippines	2,90%	5,32%
Poland	2,70%	1,19%
Russia	6,30%	13,04%
South Africa	0,50%	1,71%
South Korea	7,50%	*
Turkey	0,90%	7,48%
Venezuela	5,60%	5,64%
Latin America	*65,60%*	*54,15%*
Asia	*12,90%*	*8,80%*
Eur&MidEast&Afric	*13,90%*	*24,56%*
Total	*92,40%*	*87,51%*

Korea were dropped out from the index during 2004

The EMBI global is a traditional, market capitalization-weighted index which currently covers 31 emerging market countries. Included in the EMBI global are US-dollar denominated Brady Bonds, Eurobonds, traded loans and local market debt instruments issued by sovereign and quasi sovereign entities.
It differs from its predecessor – the Emerging Markets Bond Index Plus (EMBI+) - by the country selection criteria (the per capita income level as defined by the World Bank and the country debt restructuring history instead of selecting country solely on a sovereign credit rating basis). Precisely, EMBI Global includes countries classified as having low or middle per capita income by the World Bank or having restructured their external or local debt in the last 10 years or currently being in process of restructuring its external or local debt. By contrast, countries included in the EMBI+ must only be rated (BBB-)/(Baa3) or lower by S&P and Moody`s.
These two selection criteria allow the EMBI global to include a number of higher rated countries that international investors have nevertheless considered part of the emerging market universe. The index considers for inclusion emerging markets issues denominated in US dollars with a minimum current face outstanding of US$500 million and at least 2 1/2 years to maturity at the time of the inclusion in the index. No additional liquidity tests are required as it is the case with the EMBI+.

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[ii] The total return from one trading day to the next, on a single instrument included in the EMBI global takes into account the bond price and the coupon payment (or/and amortization if applicable) according to the following relation:

$$TR_t = \frac{ESV_{s(t)} + C_{v(t)} + AM_t}{ESV_{s(t-1)}} - 1$$

where
$ESV_{s(t)}$ is the effective settlement value that is principally the bond price.
$C_{v(t)}$ is the coupon payment to which a holder on trade date *t* is entitled on value date *v(t);* (that is the date used to compute the accrued interests and generally coincides, but not always, with the settlement date) The coupon payment is determined by the instrument structure, ex-coupon conventions and holiday calendar
AM_t is the bond amortization (if applicable), also determined by the instrument structure, ex-coupon conventions and holiday calendar;

[iii] The price of day ***i*** between the first day of market closure (denoted by ***k***) and the first day of market opening (denoted by ***n*** **,** with n>k) is computed according to the relation: $R_i = R_{k-1} + \left(\frac{R_n - R_{k-1}}{n-k+1} \right) \cdot (i-k+1)$

[iv] SPX Index stands for Standard & Poor`s 500 (S&P500) Composite Stock Price Index which serves as a common yardstick against which all US stock performance is measured. It is especially used to compare and evaluate the performance of institutional portfolios and has become one of the US Department of Commerce's 12 economic indicators.
S&P500 is a market capitalization-weighted index that tracks the continuous price only and daily total return performance of 500 common stocks of leading domestic and foreign companies in leading industries within the US that are listed on the New York Stock Exchange (NYSE), the American Stock Exchange (AMEX) and the Nasdaq National Market System. The S&P500, a measure of large capitalization stocks, accounts for about 64% of the market value of shares listed on the three exchanges.

[v] In this case, the estimated model would be the following:

$$R_{i,t} = \beta_0` + \beta_1` \cdot R_{j,t} + \beta_2` \cdot R_{US_TB,t} + \beta_3` \cdot R_{SPX_Index,t} + \beta_4` \cdot R_{US_HY,t} + \varepsilon_t` \qquad (23)$$

That could be explained by the fact that, in the bivariate case, the partial correlation of unadjusted returns is no more than the canonical correlation between the residuals of the partial regressions of these returns on a constant and the common external factors.
Therefore the partial correlation coefficient between the two countries returns, while the other dependent variables are constant, becomes:

$$\rho(R_{i,t}, R_{j,t} / R_{US_TB,t}, R_{SPX_Index,t}, R_{US_HY,t}) = \frac{(R_{i,t}*' \cdot R_{j,t}*)}{(R_{i,t}*' \cdot R_{i,t}*)^{1/2} \cdot (R_{j,t}*' \cdot R_{j,t}*)^{1/2}} \qquad (24)$$

where $R_{i,t}*$, $R_{j,t}*$ are respectively the residuals of a regression of initial returns on the three external factors and a constant. These terms are actually equal to ε_i and respectively ε_j in relation *(22).*
The two pair wise correlation coefficients are therefore equivalent, that is

$$\rho(\varepsilon_i, \varepsilon_j) = \rho(R_{i,t}, R_{j,t} / R_{US_TB,t}, R_{SPX_Index,t}, R_{US_HY,t}) \qquad (25)$$

However, in spite of the fact that the output is the same in terms of linear association between returns, the first method enables us to have also a measure of bond returns sensitivity to variations of the external factors previously mentioned.

[vi] A first approach for identifying groups of countries moving together was based on the matrixes of adjusted correlations of five-day returns captured on nine successive years from 1997 to 2005. Emerging countries were divided into several groups based on the maximum coefficient in the matrixes of adjusted correlations in such a way that each country in a given group exhibited the strongest correlation with another country of the same group. According to this criterion, we noticed that the comovement of emerging bond returns presented marked regional features in the first year of the sample period. More precisely, in 1997 there was evidence of market segmentation, with a Latin American group, an Asian group and two European & Middle Eastern groups. The only exceptions to the regional segmentation were Russia which was viewed as "Latin" by global investors (maybe because its

sovereign debt was mainly composed of Brady Bonds) and Colombia which had strong linkages with European bonds (that could be due to the fact that Colombian bonds were the only rated investment grade from Latin America and thus seen as less risky by global investors). With the exception of 1998, when correlation analysis proved to be ineffective in detecting groups of countries, markets in Asia (Korea, Malaysia and the Philippines) showed higher comovement within the group than with other emerging markets until 2001. At the same time there was higher comovement within the Latin American group than cross regional comovement-except for Poland (highest correlated with Mexico) and Bulgaria (highest correlated with Brazil) falling in the Latin group in 1999 and respectively in 2000.

Starting with 2001, factors behind market tiering became less obvious. For instance, the Philippines appeared to be more correlated with Latin American countries than with Malaysia and Korea. The fact that the Philippines was the only under investment grade of the three Asian countries in our sample, could explain its risk perception by global investors. But, at the same time, Mexico, upgraded in 2002 to investment grade, remained highest correlated during 2002 and 2003 with Brazil (underinvestment grade and even downgraded in mid 2002 from (BB-) to (B+)).

In 2004 we identify a Latin American group underinvestment grade (Brazil, Colombia, Peru, Panama and Ecuador) characterized by high correlations. Inspite the upgrading in 2002 and improved economic policy, Mexico remains associated with the other low grade bonds of countries in the region. We also notice strong correlations between Russia and Turkey which indicates investors' cautiousness towards underinvestment bonds. In 2005, following the upgrade of Russia, this country shows high correlations with Mexico and seems to be uncorrelated with the other emerging market bonds. The Latin American group is still highly correlated in 2005. Still investors discrimination according to the credit quality become apparent as Mexico become uncorrelated with the other low grade bonds of Latin American countries.

[vii] This multivariate procedure capture the simultaneous movement of bond returns using a small set of factors called principal components. It condenses the complexity of the simultaneous movements of emerging markets bond returns, capturing these movements using just a few vectors.

The choice of this method was also motivated by the fact that normality is not a necessary assumption for PCA as it is for OLS regressions.

Precisely, the method provides a first linear combination of initial variables such as the maximum variance is extracted from the variables. It then removes this variance and seeks a second linear combination which explains the maximum proportion of the remaining variance and so on. The results are orthogonal (uncorrelated) factors and the higher the degree of comovement among country series, the smaller the number of factors explaining a given portion of the overall variance.

For each year, the cases (rows) are represented by the cross-sectional returns whereas the variables (columns) are the eighteen emerging countries in the sample.

The procedure starts by standardizing the initial data so that each variable have a zero mean and a unit standard deviation. In this way all series will be uniformly treated and the construction of the principal components will not be influenced disproportionately by the series of adjusted returns exhibiting the largest variance in our sample.

[viii] As it is usually recommended in the case of large samples, we performed K-means clustering on the transposed and standardized observations in order to ensure that variables receive equal treatment (as variables with large values would contribute more to the calculations of distance measures than those with small values). In our case, the rows or the cases are represented by the eighteen countries and the variables are the adjusted returns on each trading day for all the countries in the sample. The K-means cluster analysis begins by the use of the first K cases (*k=2*) in the data file as temporary estimates of the K cluster centers. Initial cluster centers are selected by assigning each case in turn to the cluster with the closest center and then the clusters are recomputed again. This process continues until no further changes occur in cluster centers and the maximum number of iterations (10 by default) is reached. The procedure is based on the Euclidian distance as a measure of similarity (or distance) for different pair of observations (cases represented by the eighteen countries in our case). If we think of each case as plotted in a two-dimension system, then the Euclidian distance is the square root of the sum of the square of the X - distance and the square of the Y-distance. As the cluster analysis is not based on the correlation matrix (this option can only be chosen with the hierarchical clustering-inadequate for large number of cases), the results of this method will be slightly different from the PCA and other correlation –based methods. Clustering resembles Principal Component analysis as both aim at identifying related groups of variables. However, cluster analysis is more ad-hoc, the number of clusters is intuitive and the presence of outliers strongly affects the final output. Therefore we use clustering in order to support the findings of PCA especially in the case of the countries very closed to one another and to the cluster center.

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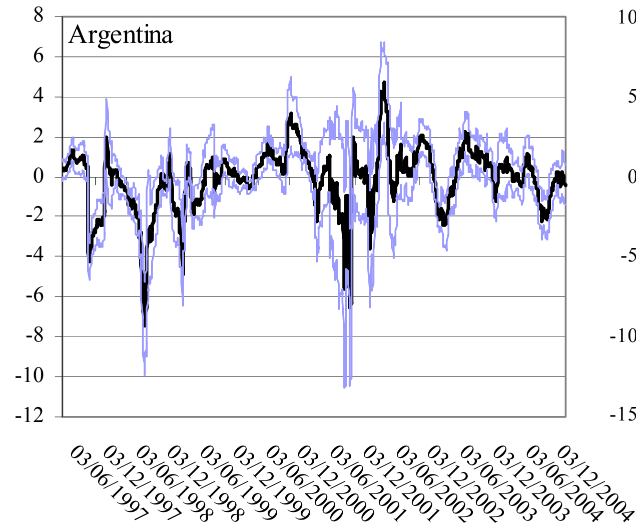
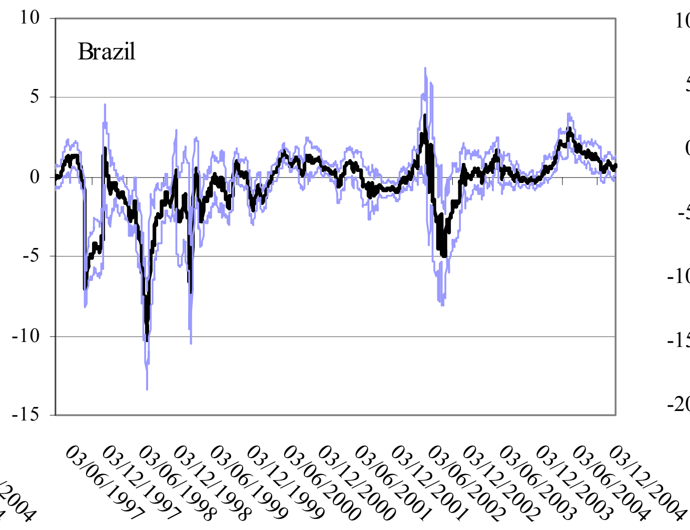
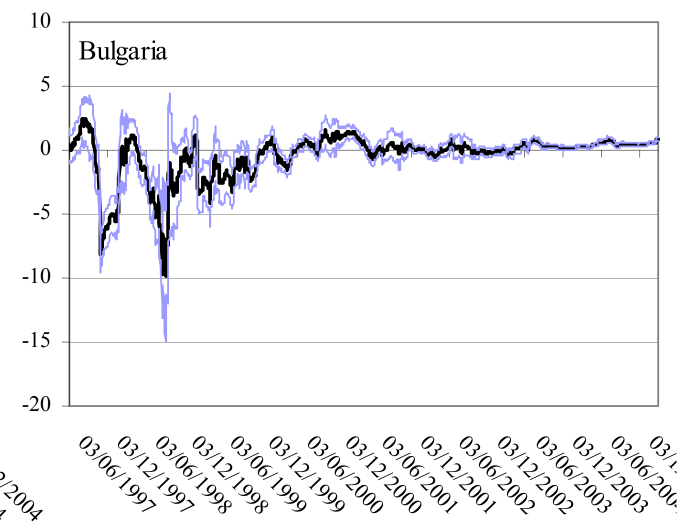
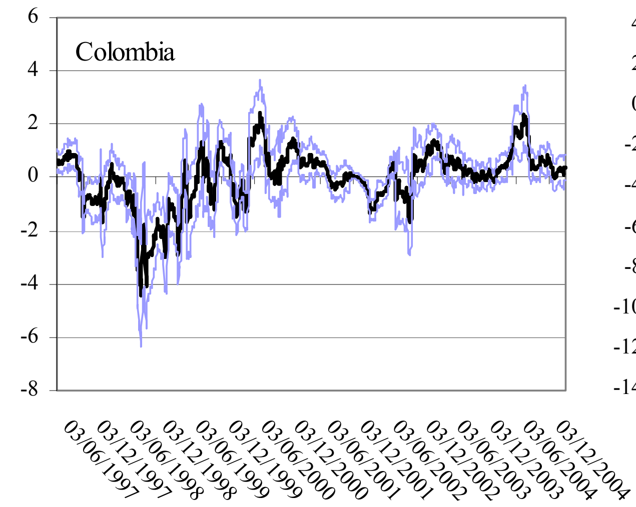
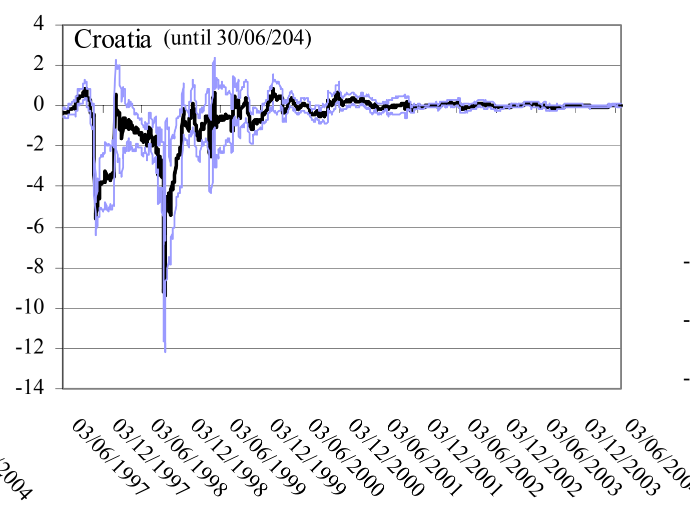
ANNEX 1

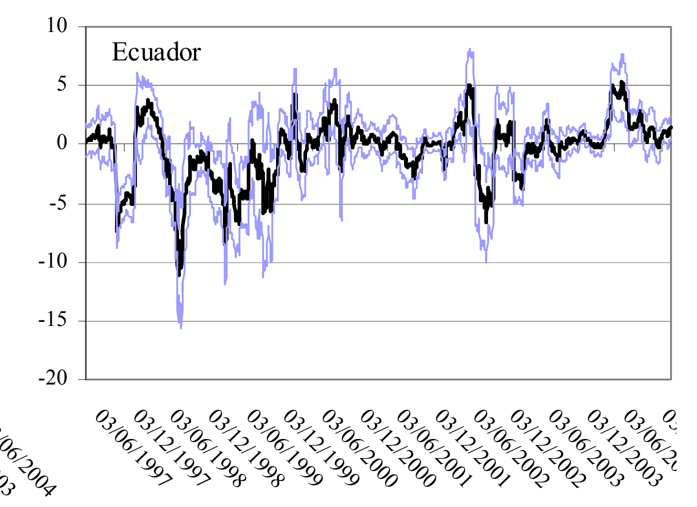




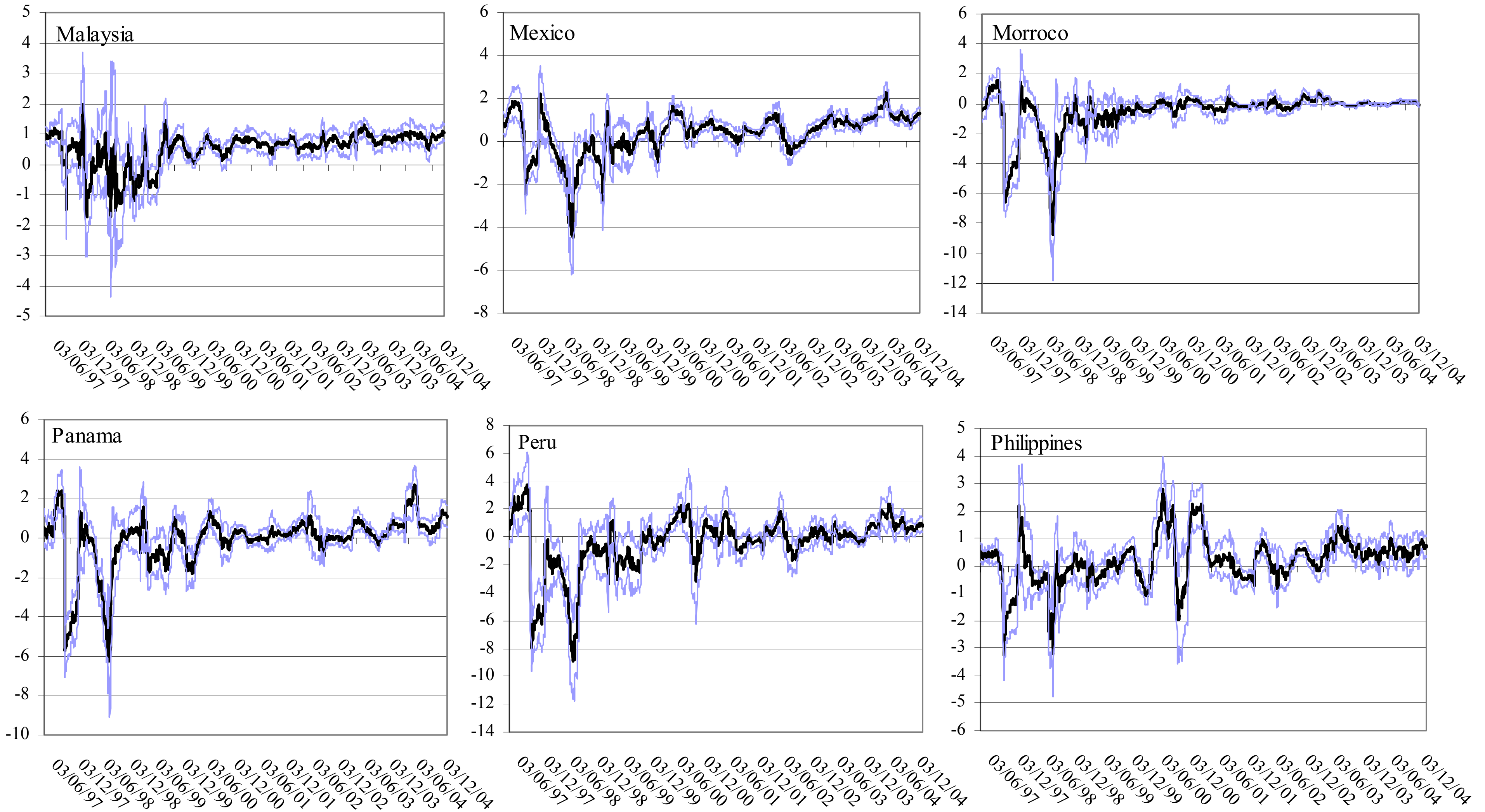








US_TB5-7Y coefficient estimates (95% confidence interval) - 5day Returns



US_TB5-7Y coefficient estimates (95% confidence interval) - 5day Returns

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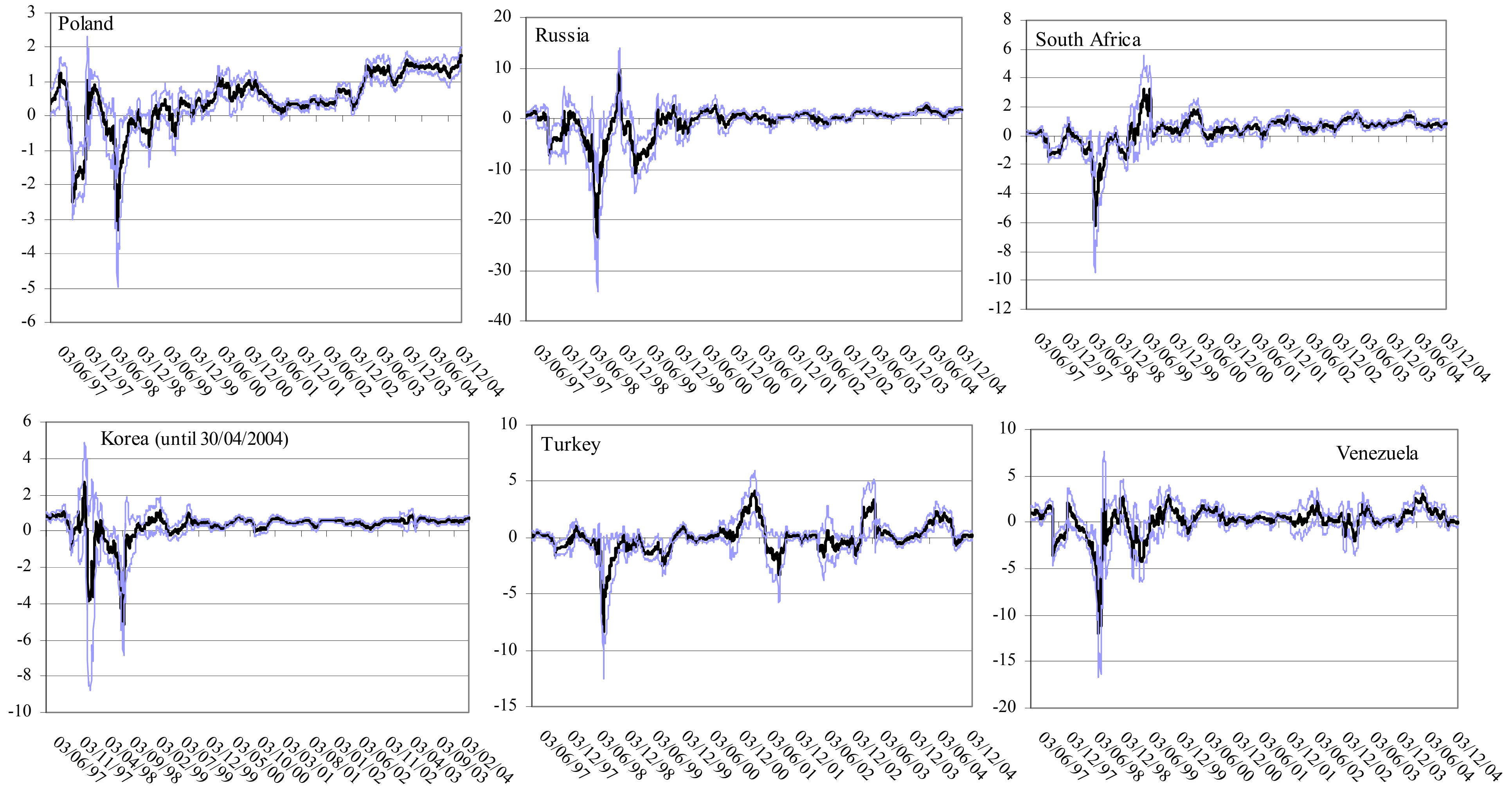
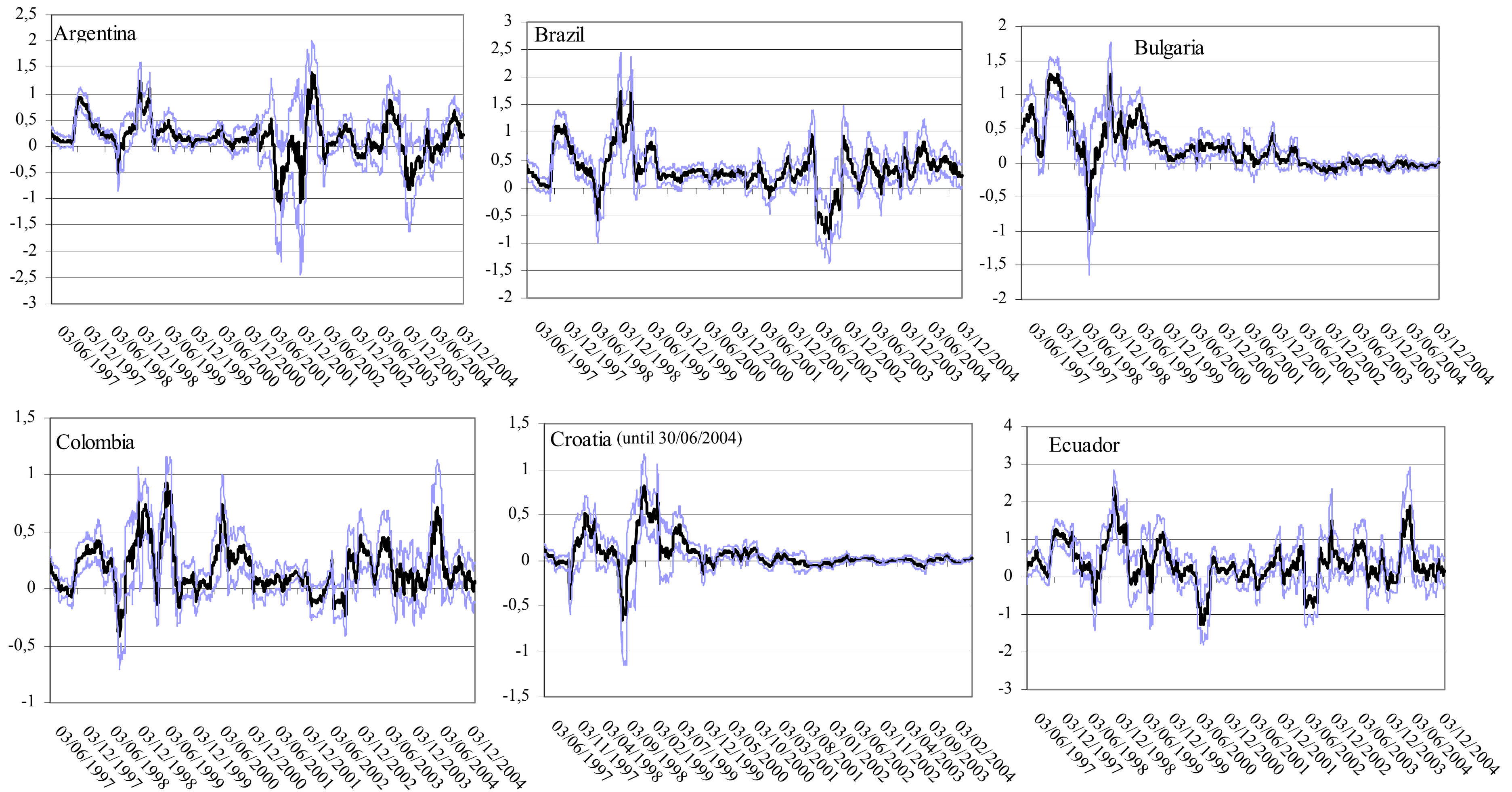


US_TB5-7Y coefficient estimates (95% confidence interval) - 5day Returns

ANNEX 2



SPX_Index coefficient estimates (95% confidence interval) - 5day Returns

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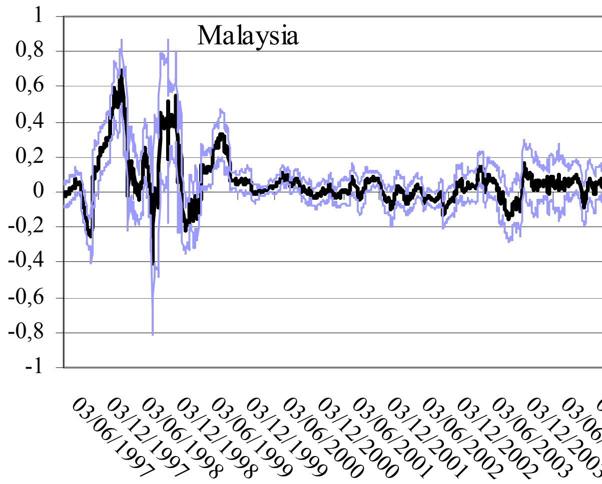

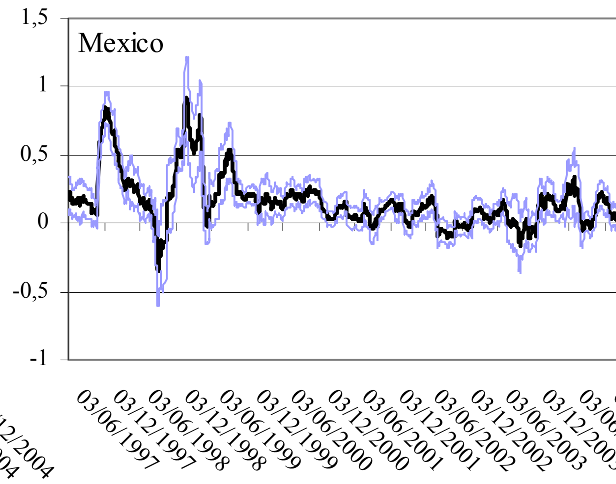

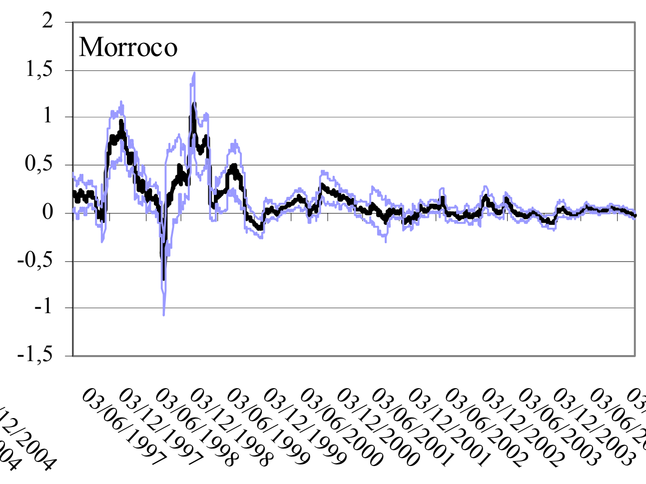

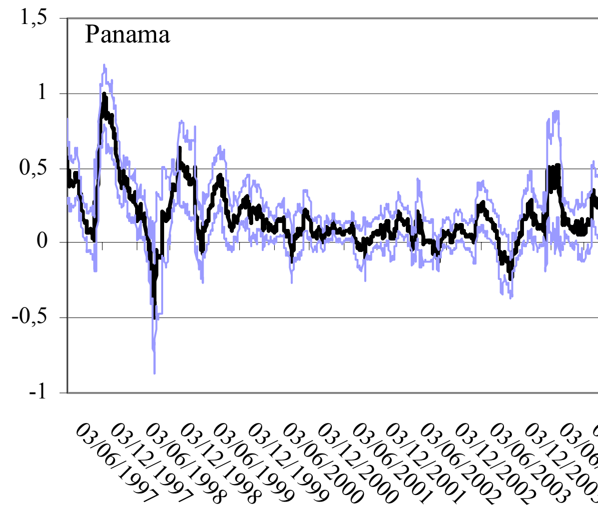

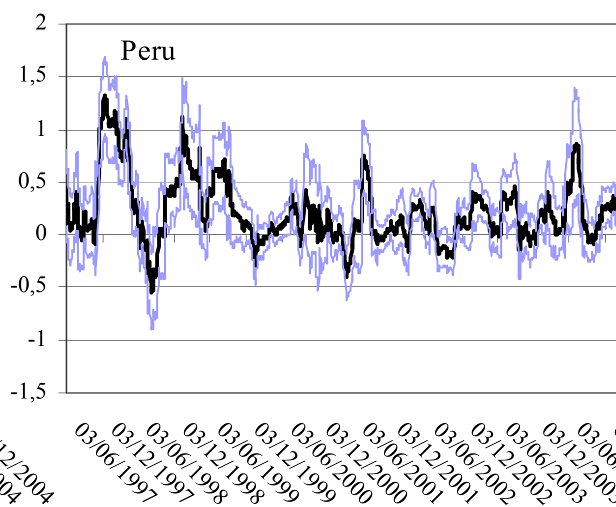

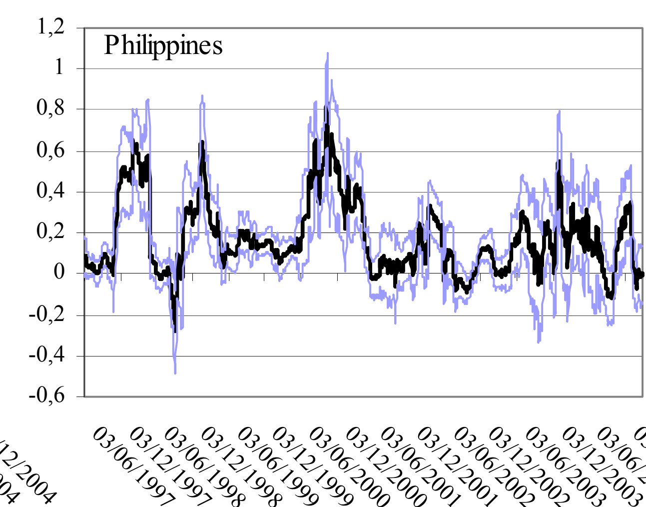

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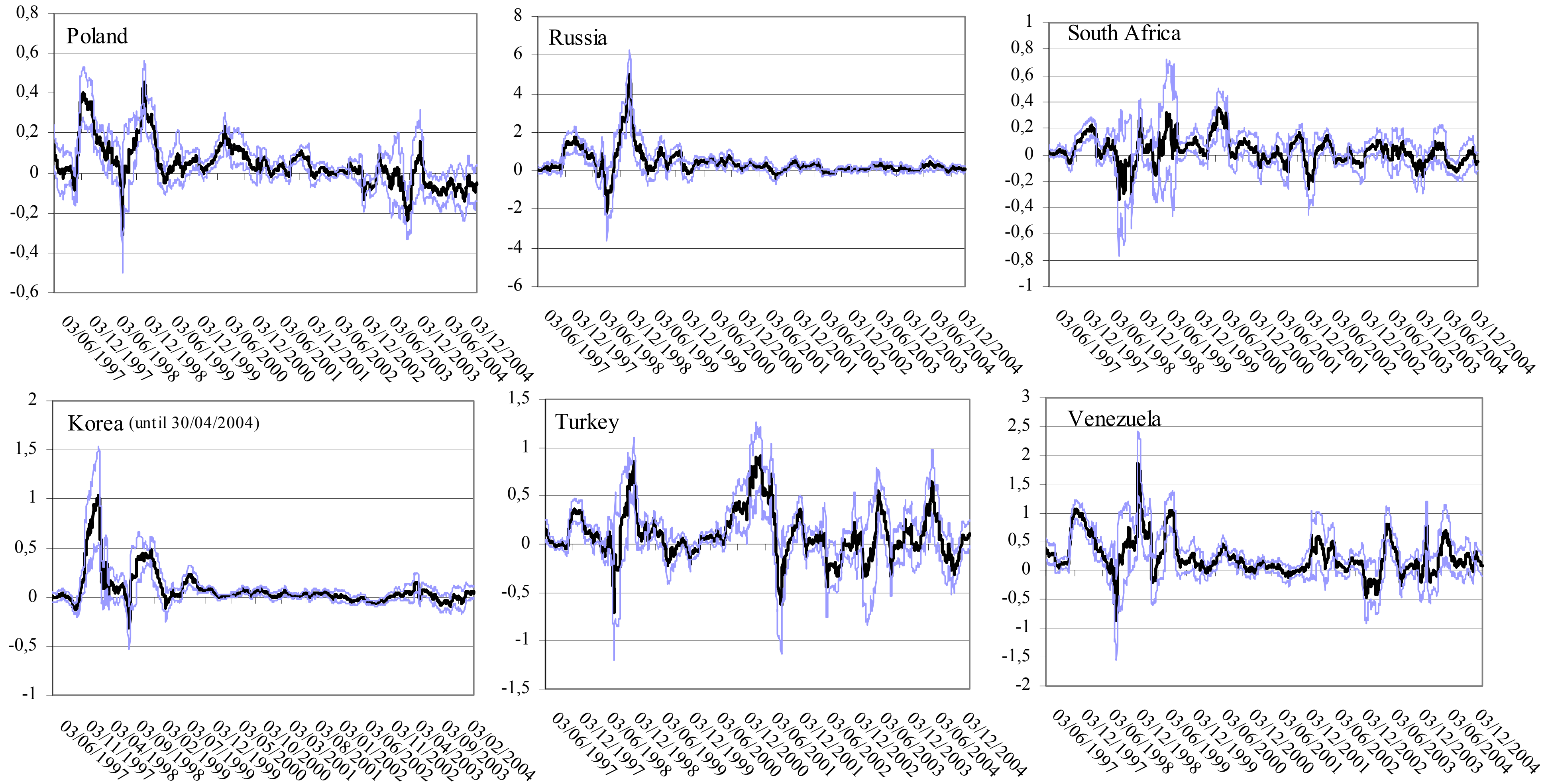

SPX_Index coefficient estimates (95% confidence interval) - 5day Returns

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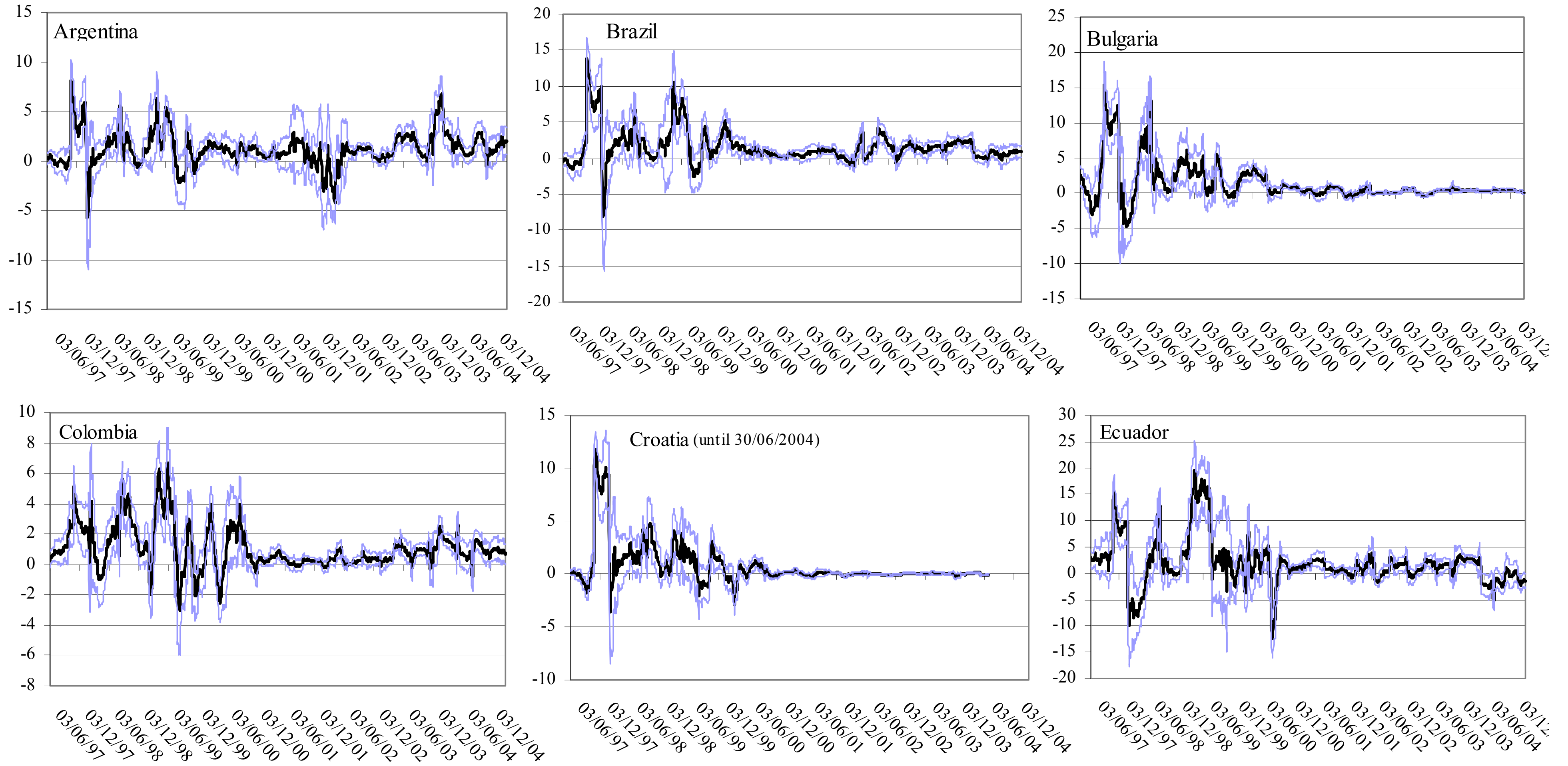
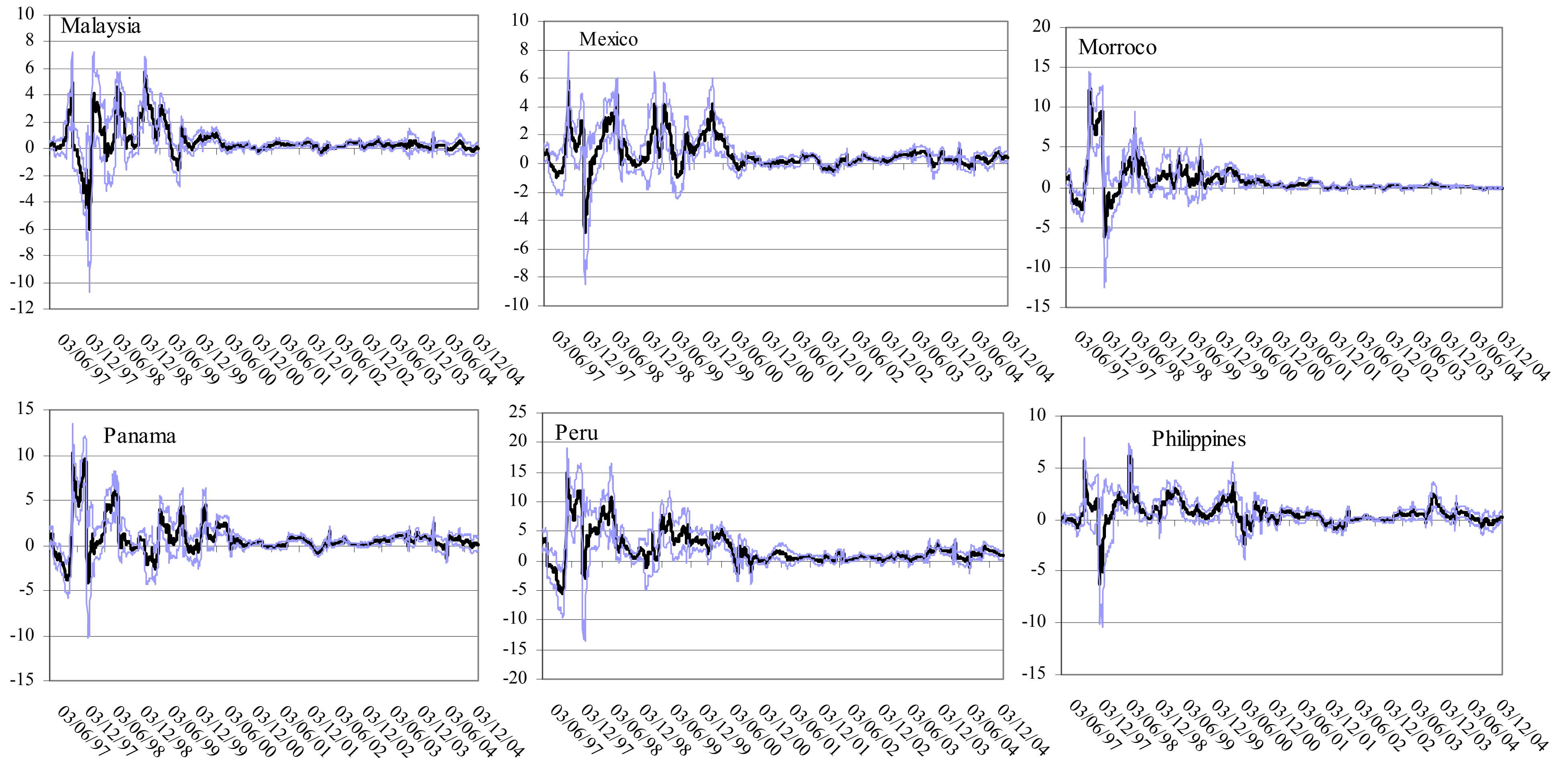
ANNEX 3



US_HY coefficient estimates (95% confidence interval) - 5day Returns



US_HY coefficient estimates (95% confidence interval) - 5day Returns

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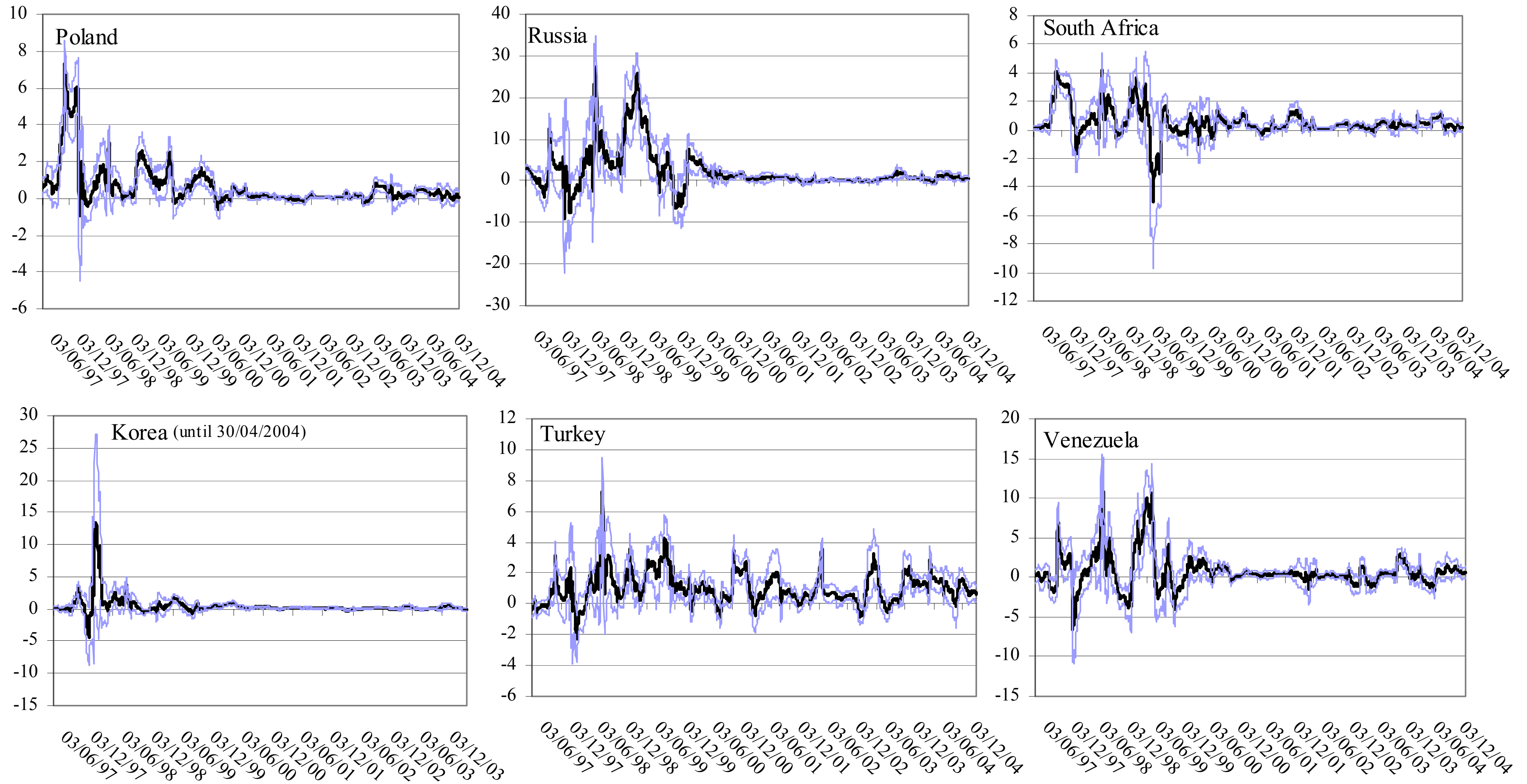

US_HY coefficient estimates (95% confidence interval) - 5day Returns

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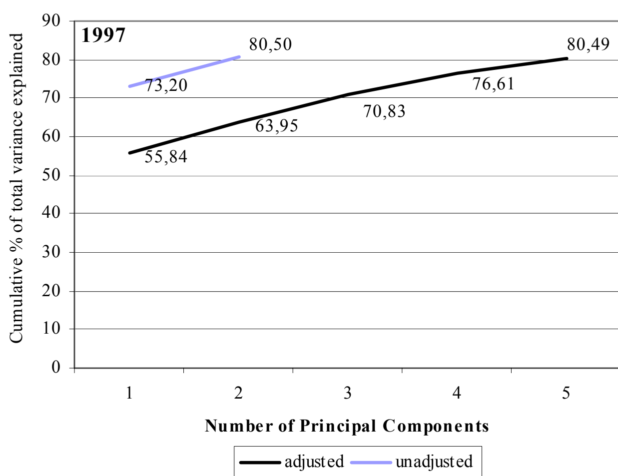
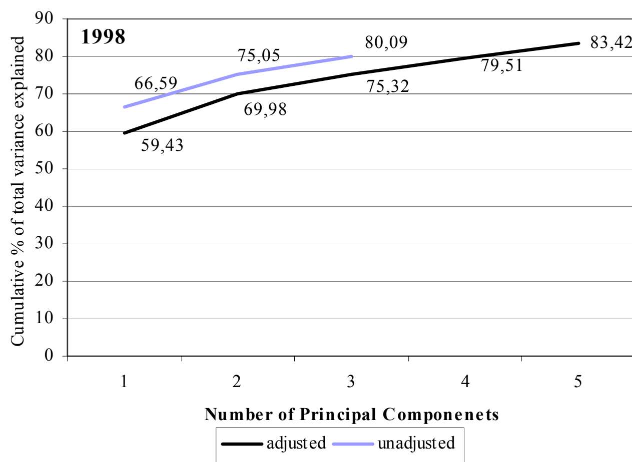
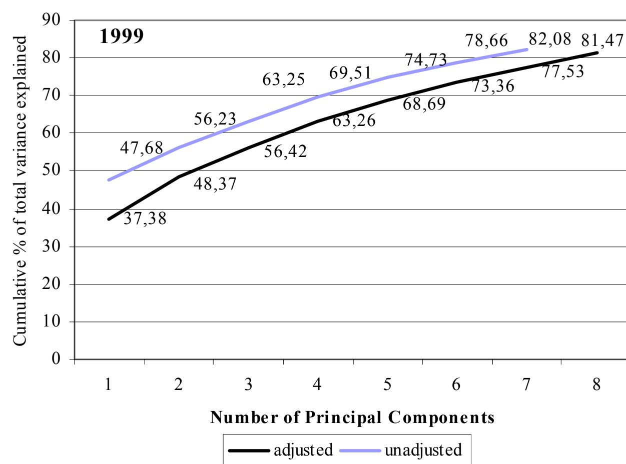
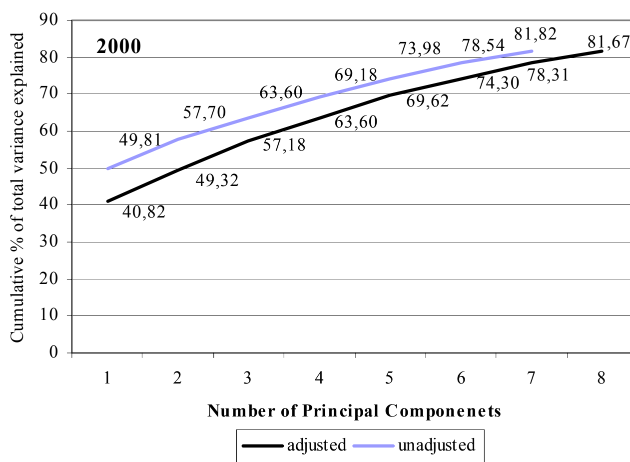
ANNEX 4

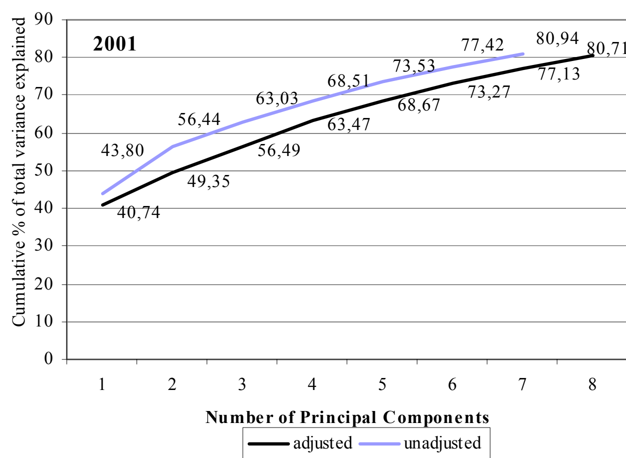
Explanatory Power of the first Principal Components-adjusted and unadjusted returns

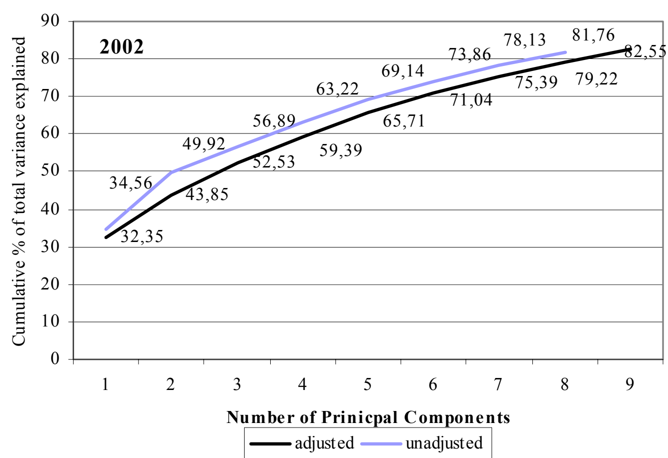












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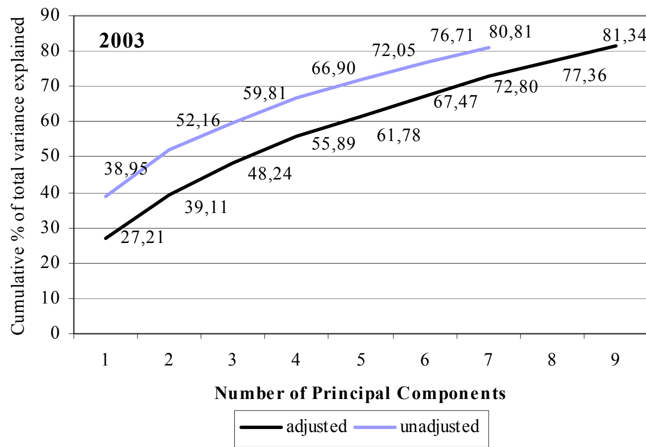
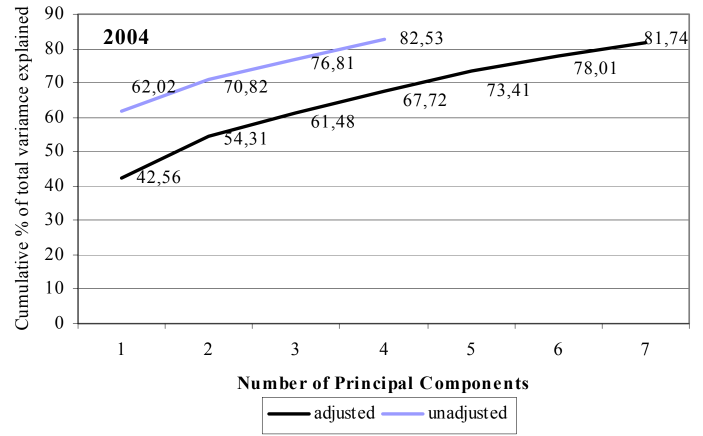
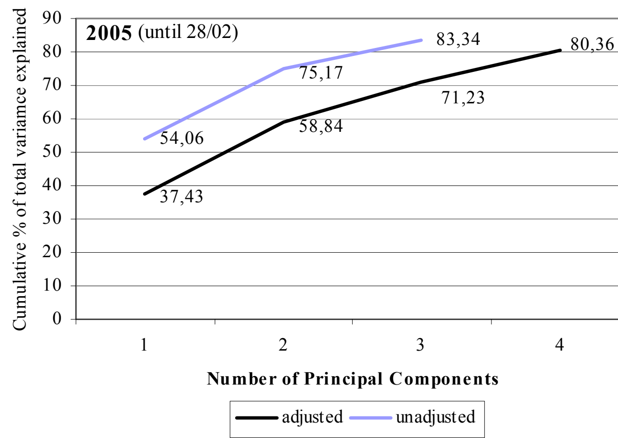
Explanatory Power of the first Principal Components-adjusted and unadjusted returns







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ANNEX 5

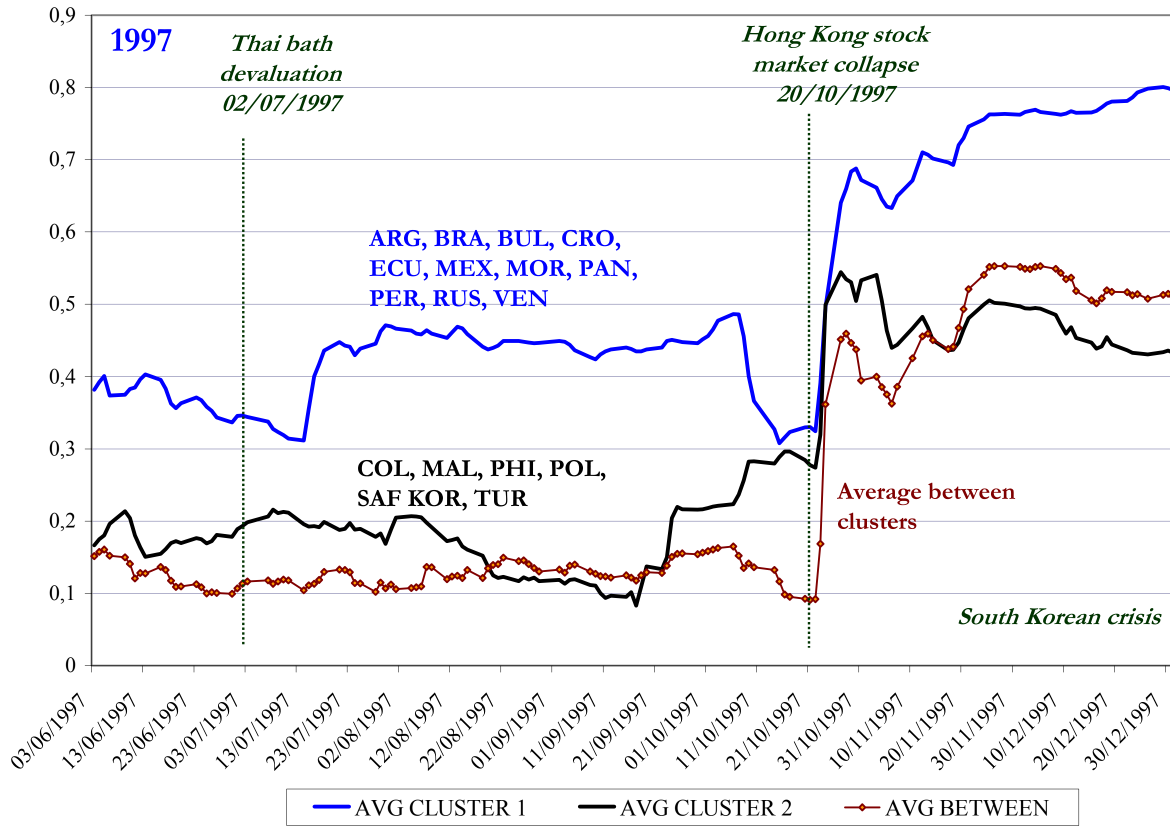

Figure 2 : 1997 - Groups composition according to the PCA taxonomy and country average correlations of adjusted returns

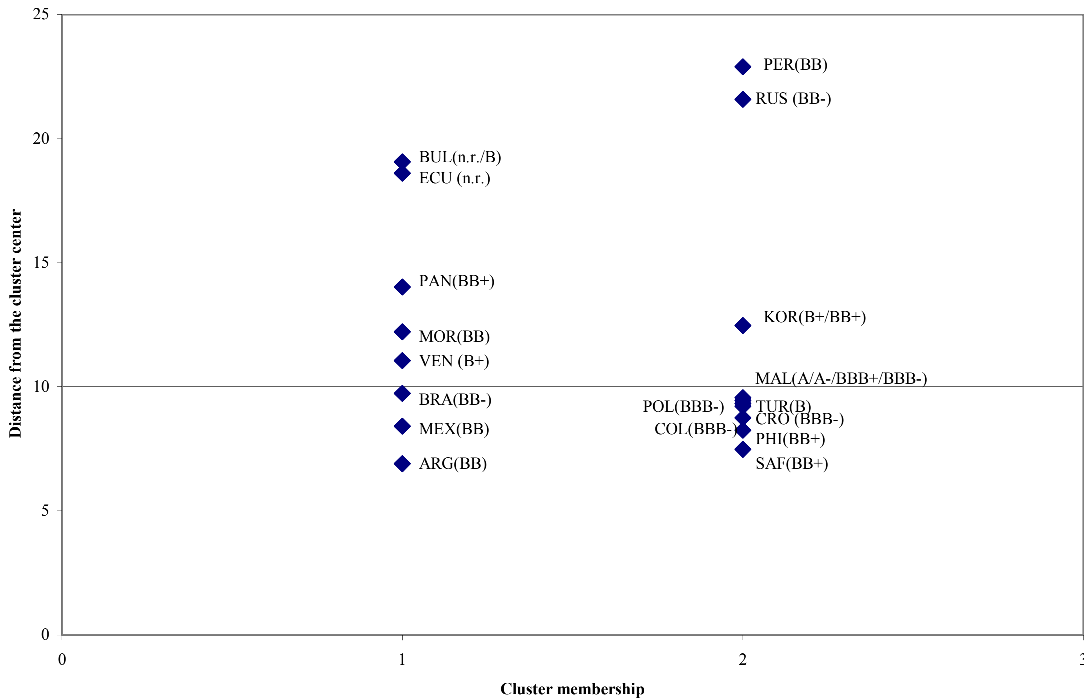

Figure 3: 1997 - Cluster analysis ($k = 2$)

Changes in S&P Sovereign rating over the period (3/10/97-end 97)

Argentina: 2/4/1997—upgraded from (BB-) to (BB)
Brazil: 2/4/1997—upgraded from (B+) to (BB-)
Venezuela: 5/6/1997: upgraded from (B) to (B+)

South Korea: 24/10/1997—downgraded from (AA-) to (A+);
25/11/1997 downgraded from (A+) to (A-);
11/12/1997—downgraded from (A-) to (BBB-);
22/12/1997—downgraded from (BBB-) to (B+).

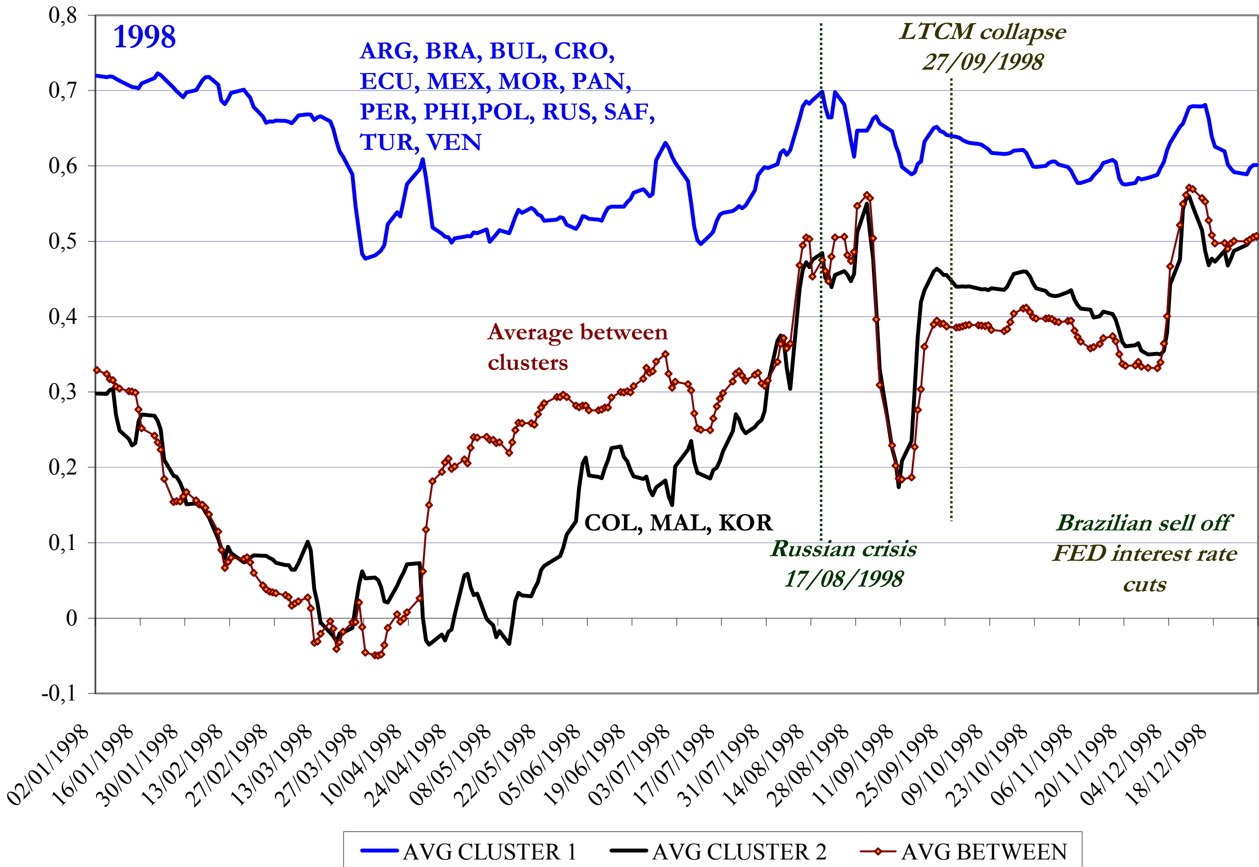

Figure 4 : 1998 - Groups composition according to the PCA taxonomy and country average correlations of adjusted returns

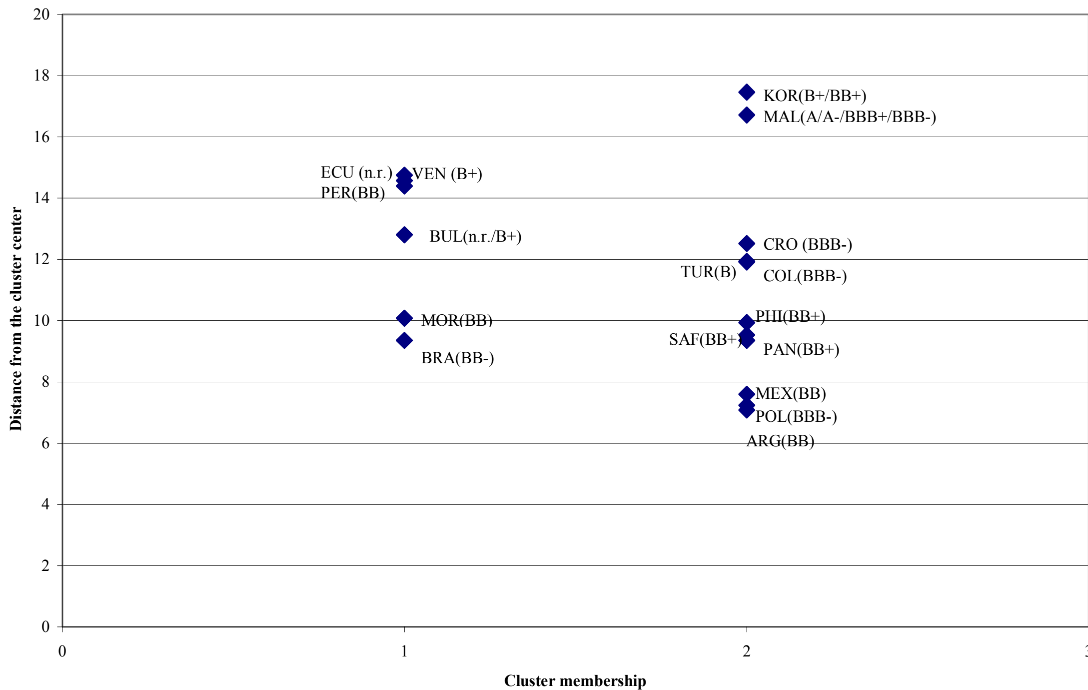

Figure 5 : 1998 - Cluster analysis ($k = 2$)

Changes in S&P Sovereign ratings over the period

Bulgaria: rated starting with 17/04/98 : (B+)
Korea: 18/02/1998: upgraded from (B+) to (BB+)
Malaysia: 17/04/1998: downgraded from A to (A-);
24/07/1998: downgraded from (A-) to (BBB+);
15/09/1998: downgraded from (BBB+) to (BBB-).

Morroco: rated starting with 2/03/1998 : (BB)
Russia: 9/06/1998: downgraded from (BB-) to (B+)
13/08/1998: downgraded from (B+) to (B-)
17/08/1998: downgraded from (B-) to (CCC)
16/09/1998: downgraded from (CCC) to (CCC-)

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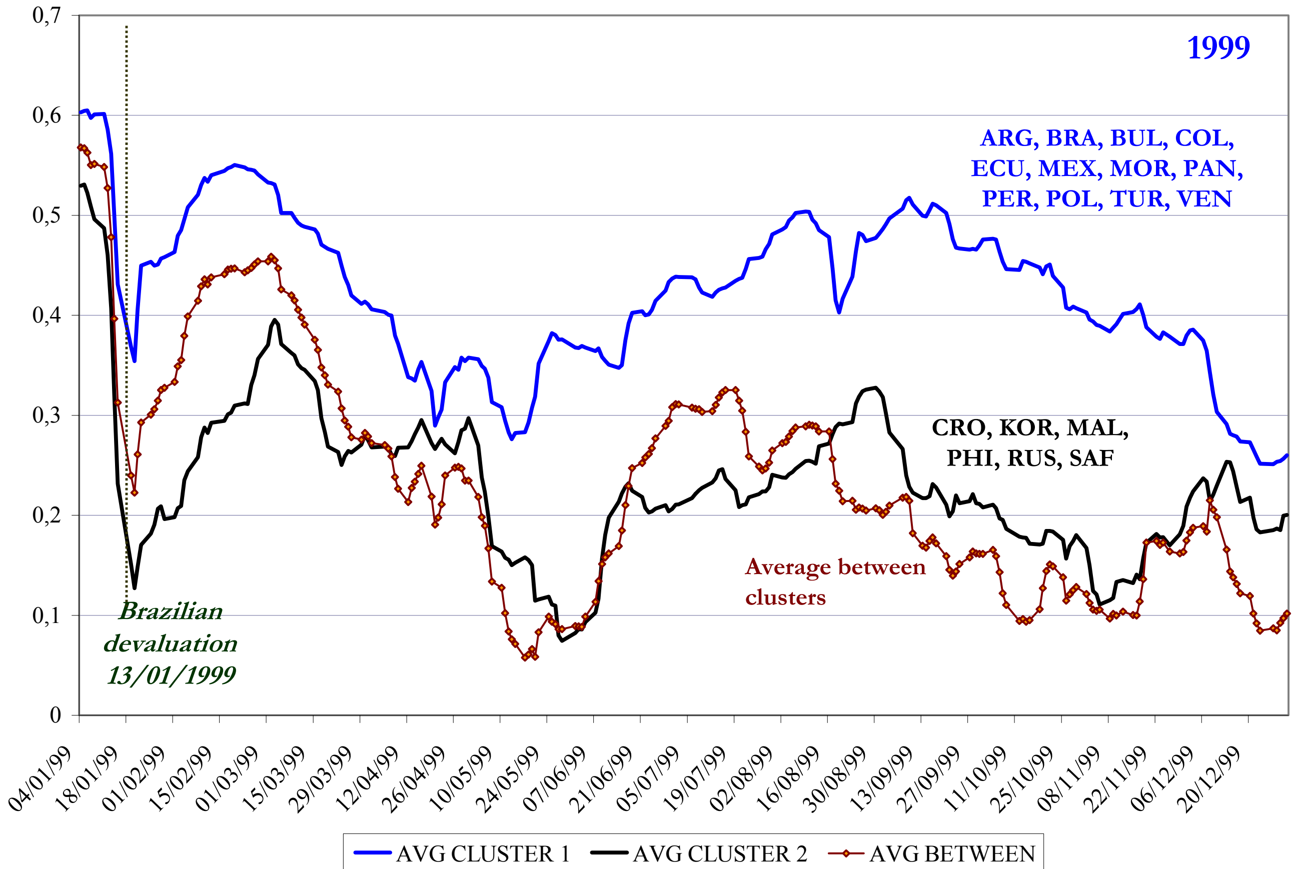

Figure 6 : 1999 - Groups composition according to the PCA taxonomy and country average correlations of adjusted returns

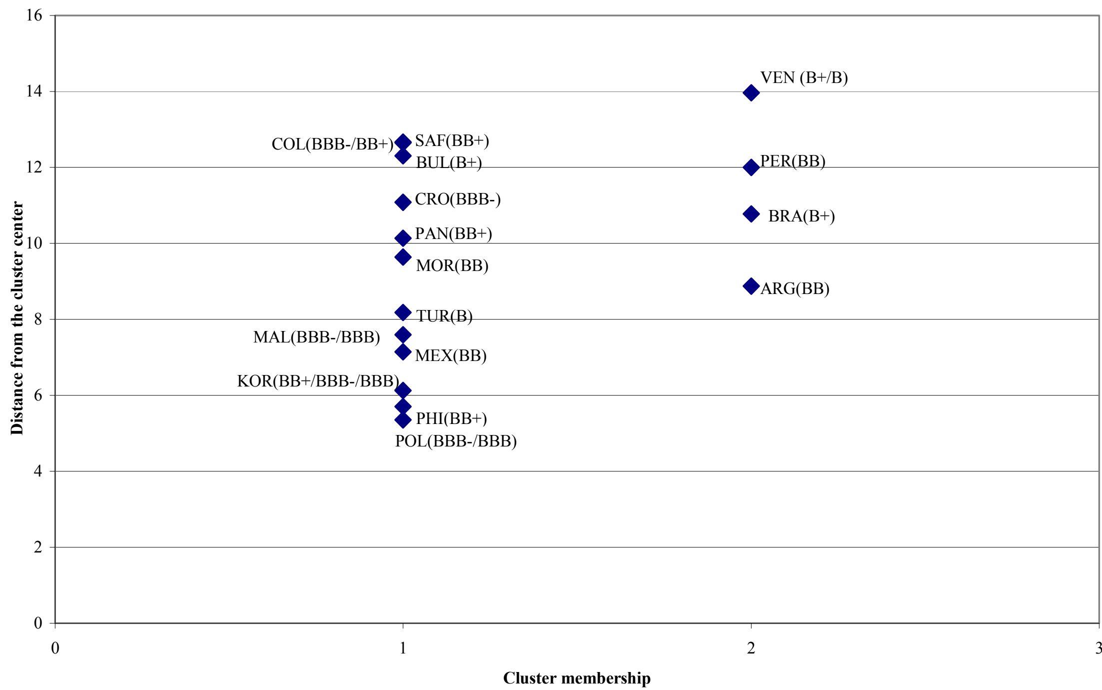

Figure 7 : 1999 - Cluster analysis (k = 2)

Changes in S&P Sovereign rating over the period

Colombia: 21/09/1999: downgraded from (BBB-) to (BB+)
Korea: 25/01/1999: upgraded from (BB+) to (BBB-);
11/11/1999: upgraded from (BBB-) to (BBB)
Malaysia: 10/11/1999: upgraded from (BBB-) to (BBB)

Poland: 10/06/1999: upgraded from (BBB-) to (BBB)
Russia: 27/01/1999: downgraded from (CCC-) to SD
Ecuador: n.r.
Venezuela: 21/12/1999: downgraded from (B+) to (B)

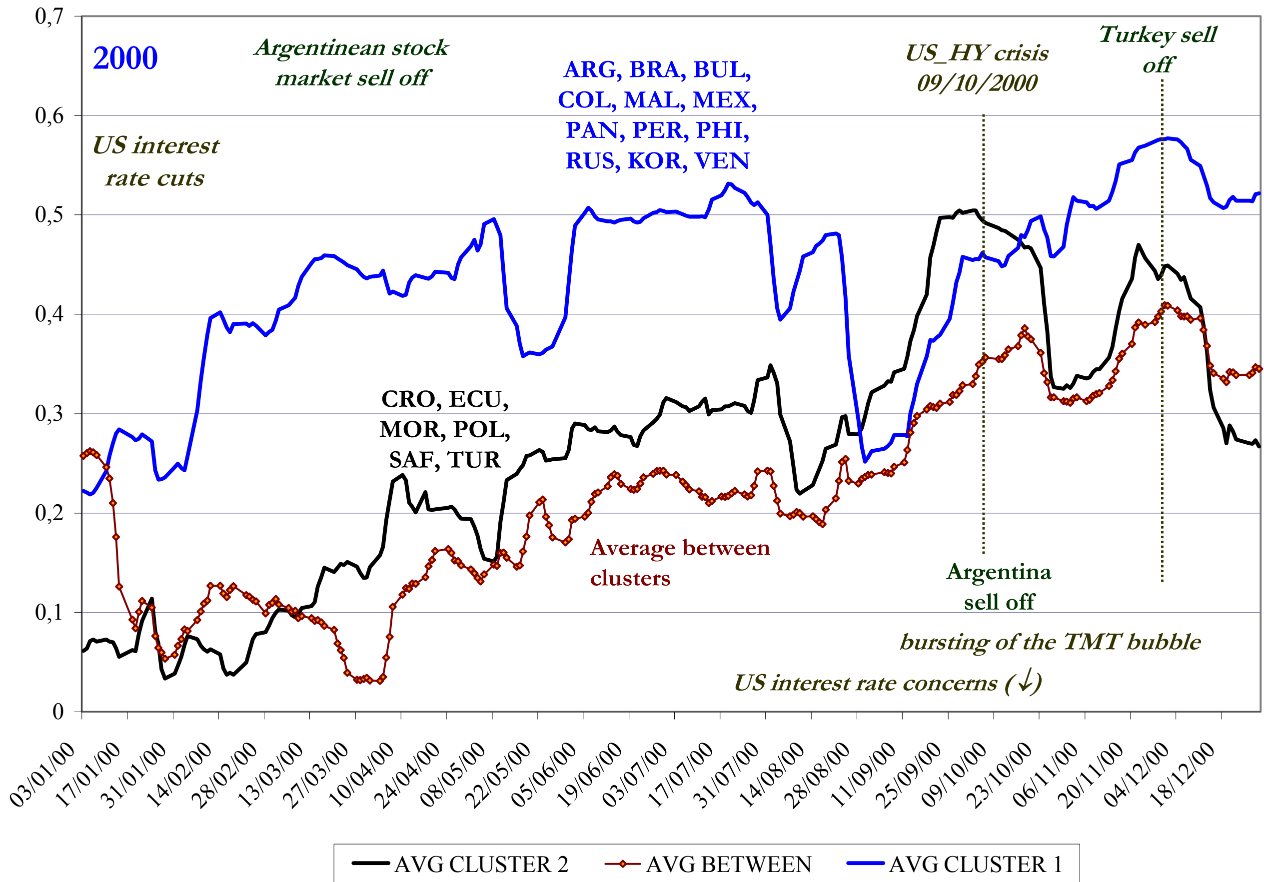

Figure 8 : 2000 - Groups composition according to the PCA taxonomy and country average correlations of adjusted returns

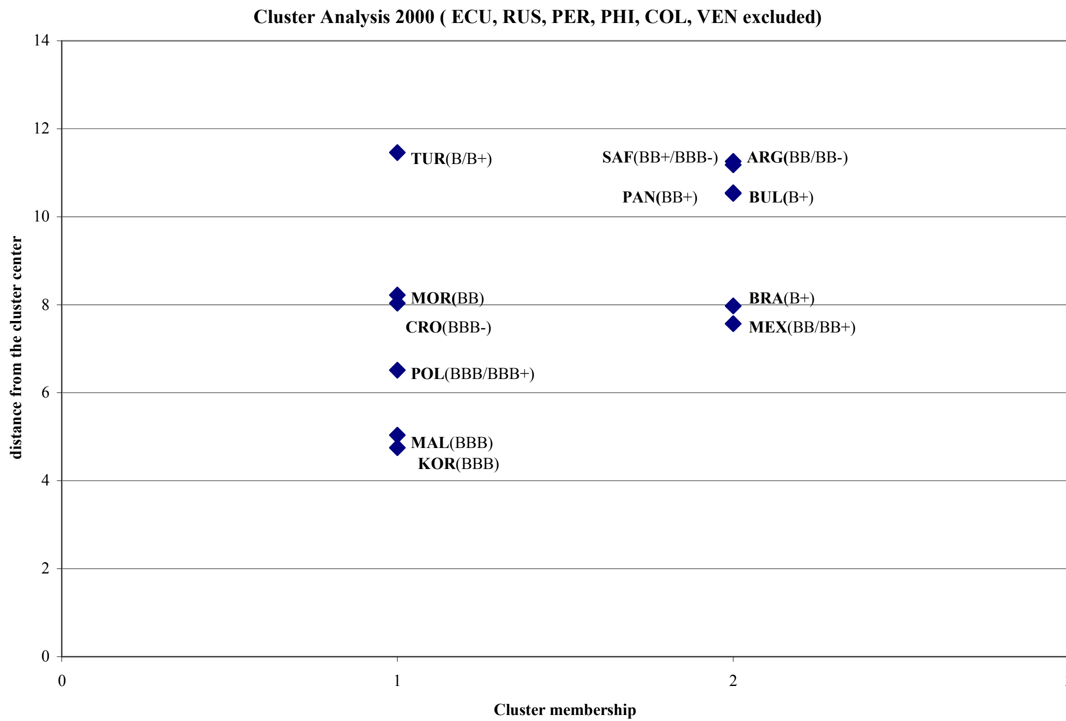

Figure 9 : 2000 - Cluster analysis ($k = 2$)

Changes in S&P Sovereign rating over the period

Argentina: 14/11/2000: downgraded from (BB) to (BB-)
Colombia: 5/24/2000: downgraded from (BB+) to (BB)
Ecuador: rated starting with 31/07/2000: (B-)
Mexico: 13/03/2000 upgraded from (BB) to (BB+)
Poland: 10/05/2000: upgraded from (BBB) to (BBB+)
Russia: 12/8/2000: upgraded from SD to (B-)
Peru: 11/1/2000: downgraded from (BB) to (BB-)
Philippines: (BB+)
South Africa: 2/25/2000: upgraded from (BB+) to (BBB-)
Turkey: 4/25/2000 upgraded from (B) to (B+)

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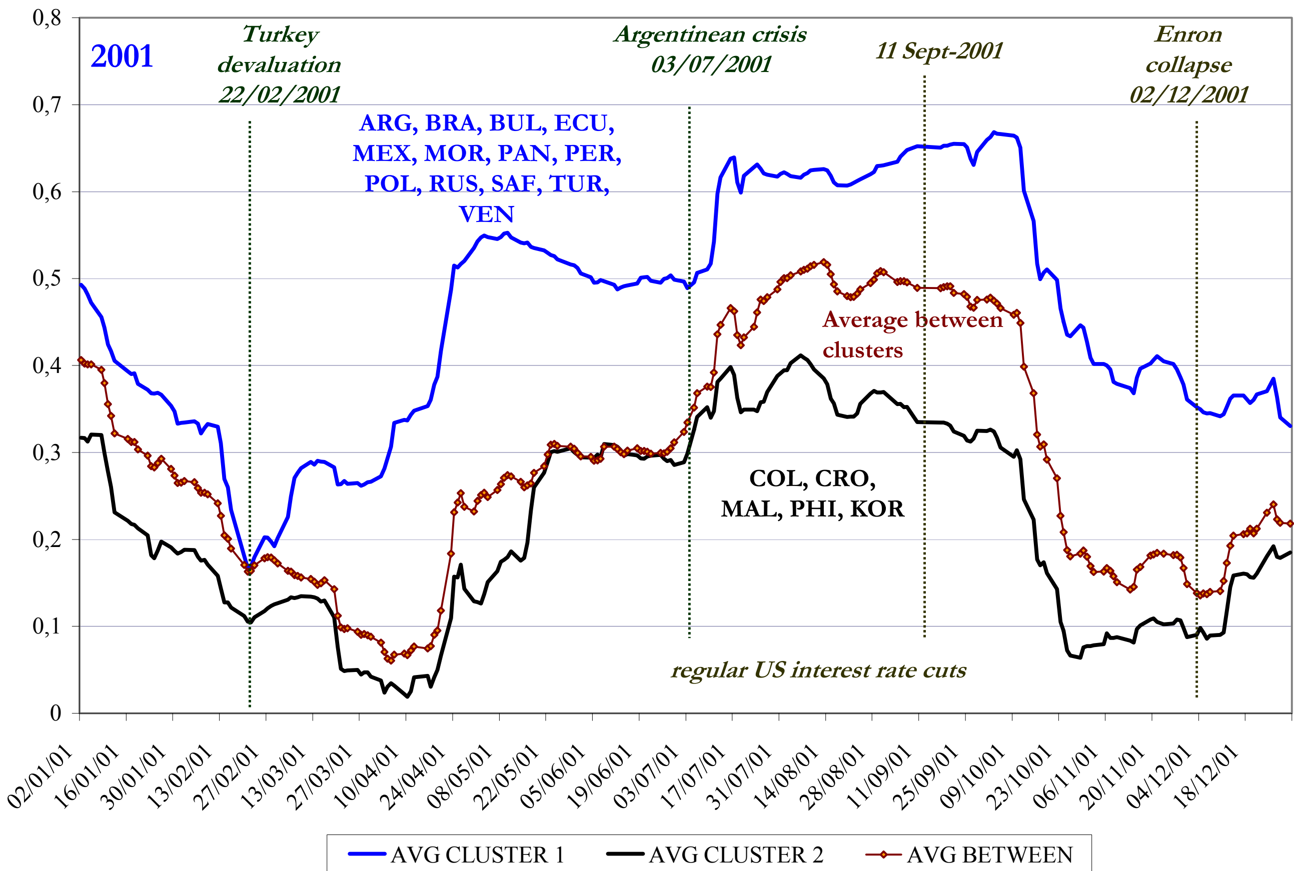

Figure 10 : 2001 - Groups composition according to the PCA taxonomy and country average correlations of adjusted returns

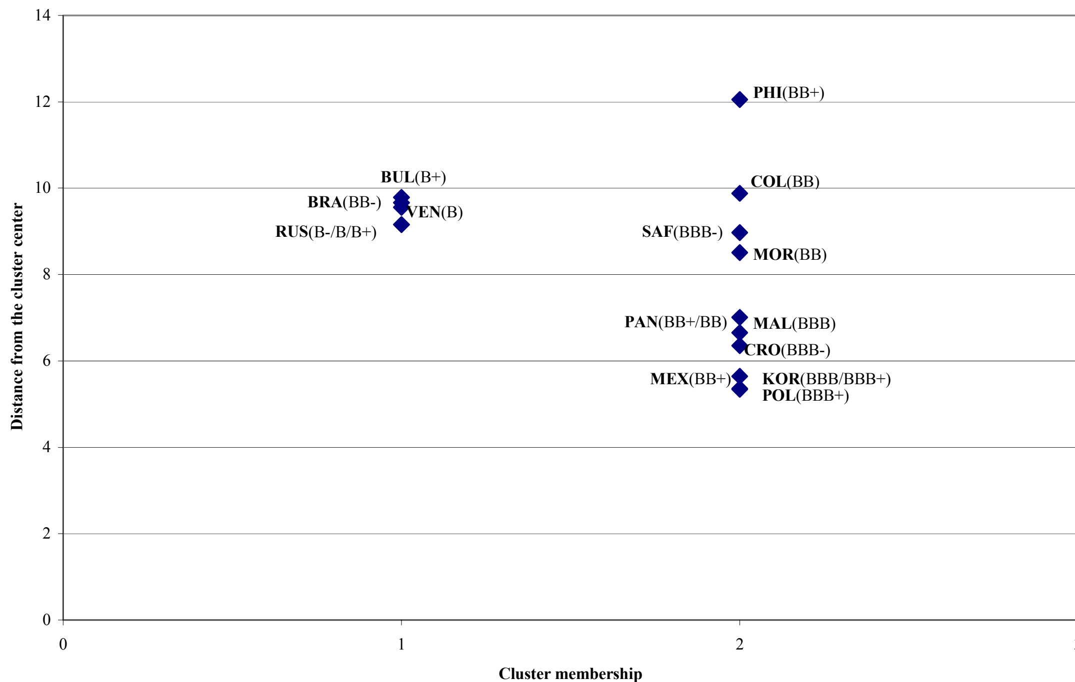

Figure 11 : 2001 - Cluster analysis (*k = 2*)

Changes in S&P Sovereign Rating over the period

Ecuador: 2/04/2001: downgraded from (B-) to (CCC+)
Russia: 28/06/01:upgraded from (B-) to (B) ;
19/12/01: upgraded from (B) to (B+)
Korea: 13/11/01: upgraded from (BBB) to (BBB+)
Turkey: 23/02/2001:downgraded from (B+) to (B)
16/04/2001: downgraded from (B) to (B-)

Argentina: 26/03/2001: downgraded from (BB-) to (B+)
8/05/2001: downgraded from (B+) to (B)
12/07/2001: downgraded from (B) to (B-)
9/10/2001: downgraded from (B-) to (CCC+)
30/10/2001: downgraded from (CCC+) to (CC)
6/11/2001: downgraded from (CC) to SD
Panama: 20/11/01: downgraded from (BB+) to (BB)

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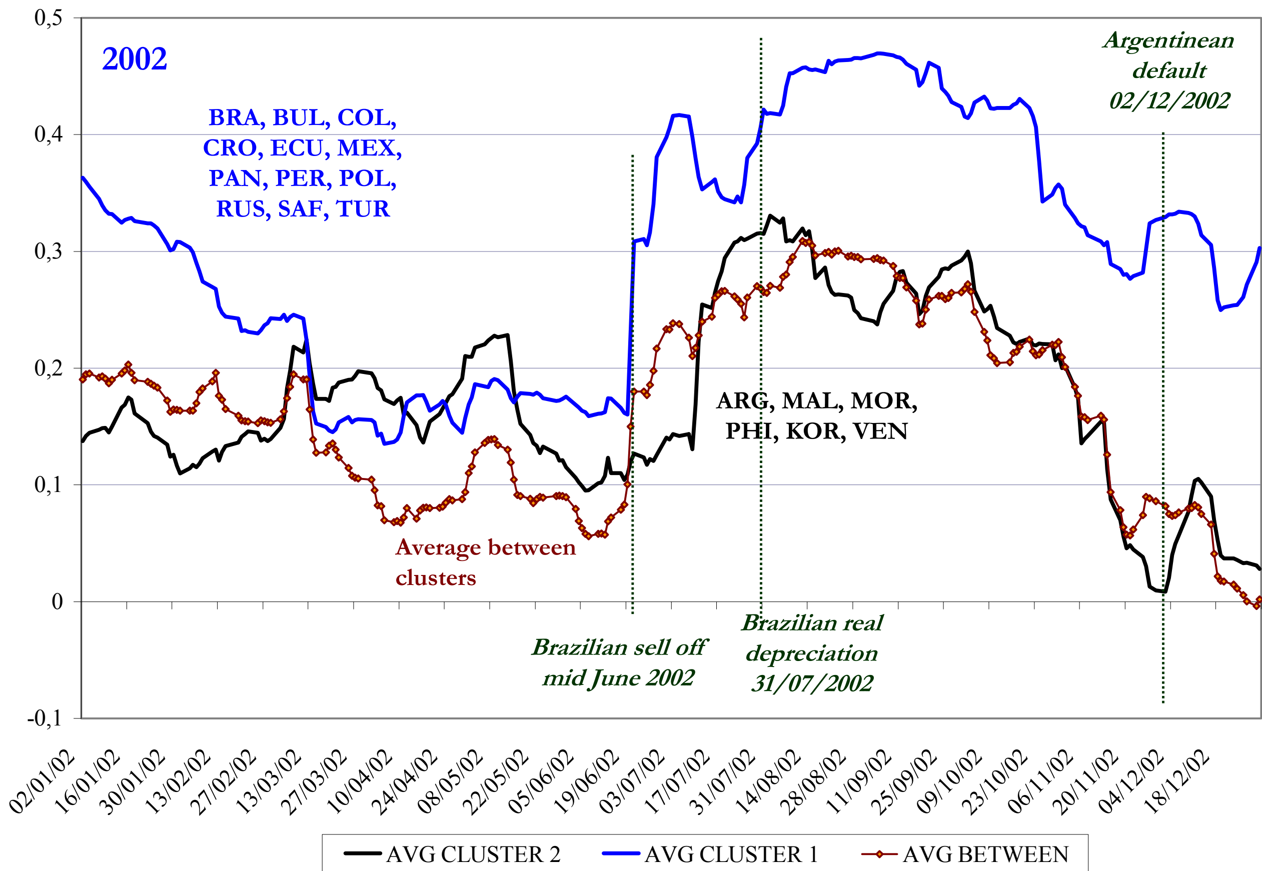

Figure 12 : 2002 - Groups composition according to the PCA taxonomy and country average correlations of adjusted returns

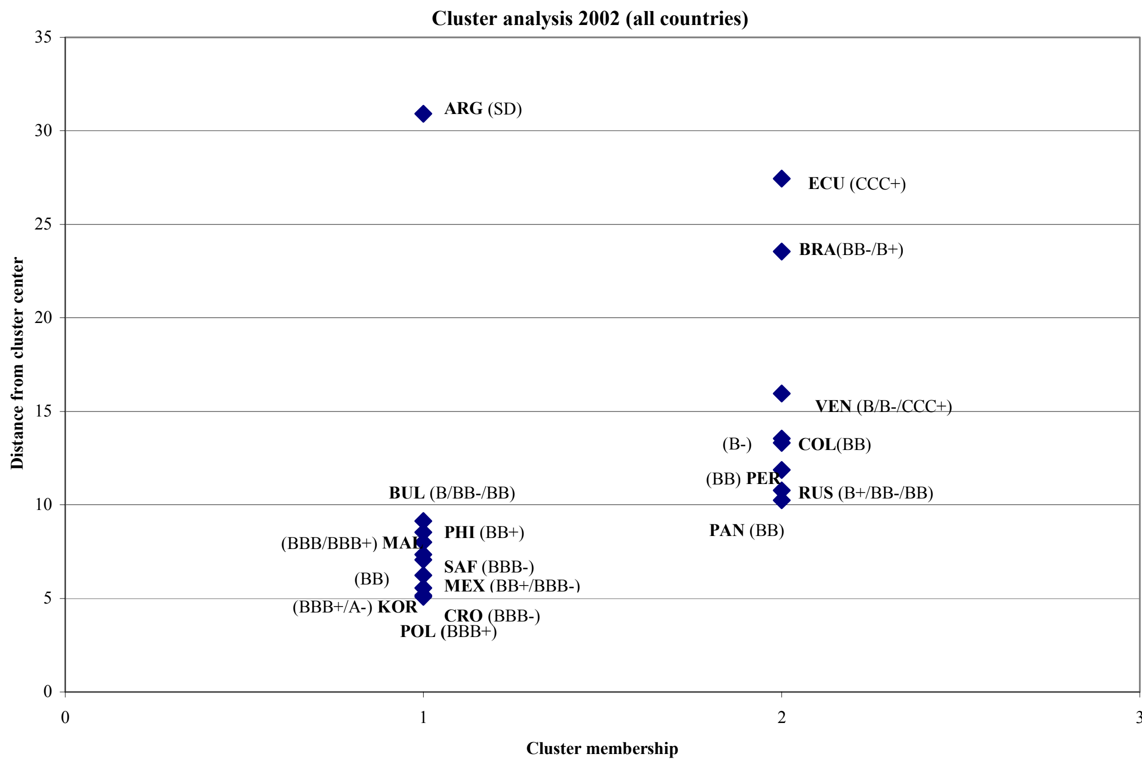

Figure 13 : 2002- Cluster analysis ($k = 2$)

Changes in S&P Sovereign rating over the period

Brazil: 2/07/02—downgraded from (BB-) to (B+)
Bulgaria: 14/01/02 : upgraded from (B+) to (BB-)
29/10/02 : upgraded from (BB-) to (BB)
Malaysia: 20/08/02 –upgraded from (BBB) to (BBB+)
Mexico: 7/02/02—upgraded from (BB+) to (BBB-)

Russia: 26/07/02—upgraded from (B+) to (BB-);
5/12/02—upgraded from (BB-) to (BB)
Korea: 24/07/02—upgraded from (BBB+) to (A-)
Venezuela: 24/09/02—downgraded from (B) to (B-);
13/12/02—downgraded from (B-) to (CCC+)

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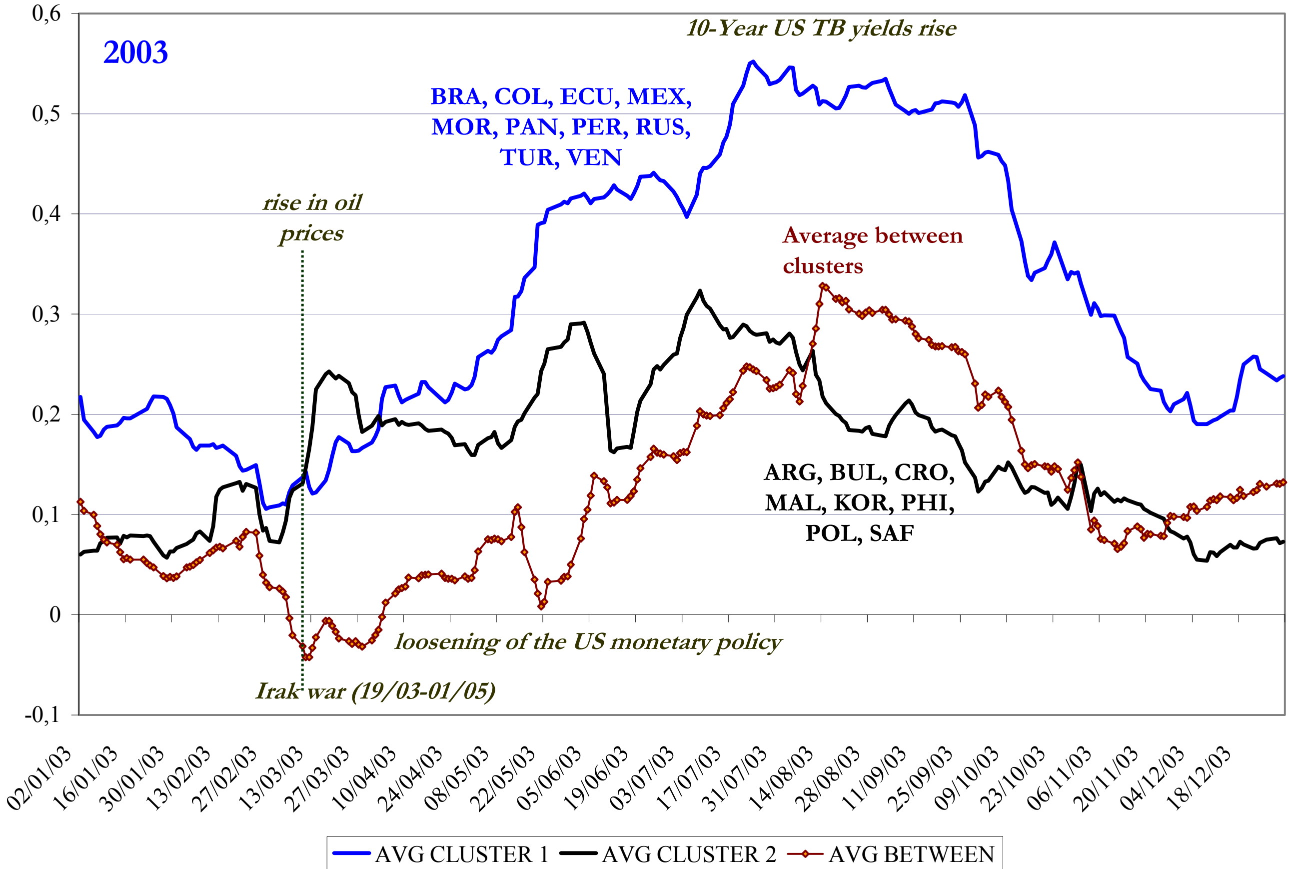

Figure 14: 2003 - Groups composition according to the PCA taxonomy and country average correlations of adjusted returns

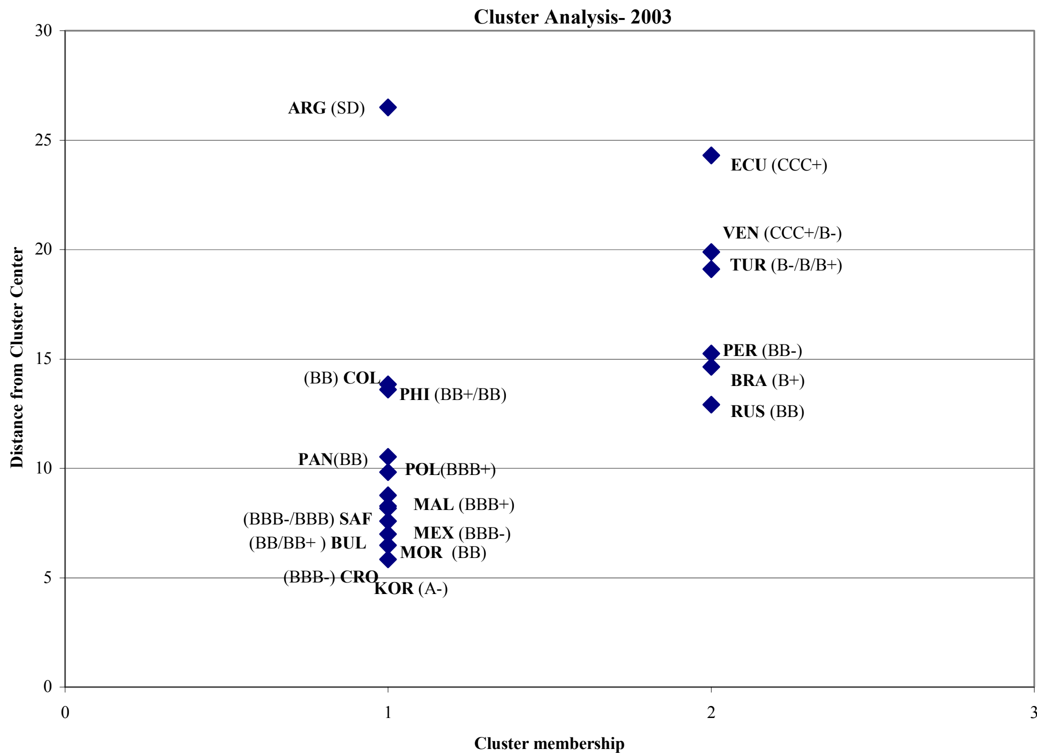

Figure 15 : 2003 - Cluster analysis ($k = 2$)

Changes in S&P Sovereign rating over the period

Bulgaria: 24/07/03 –upgraded from (BB) to (BB+)
Turkey : 28/07/03 : upgraded from (B-) to (B)
16/10/03 : upgraded from (B) to (B+)
South Africa: 2/05/03: upgraded from (BBB-) to (BBB)

Philippines: 24/04/03—downgraded from (BB+) to (BB)
Venezuela : 30/07/03: upgraded from (CCC+) to (B-)
Malaysia : 8/10/03 : upgraded from (BBB+) to (A-)

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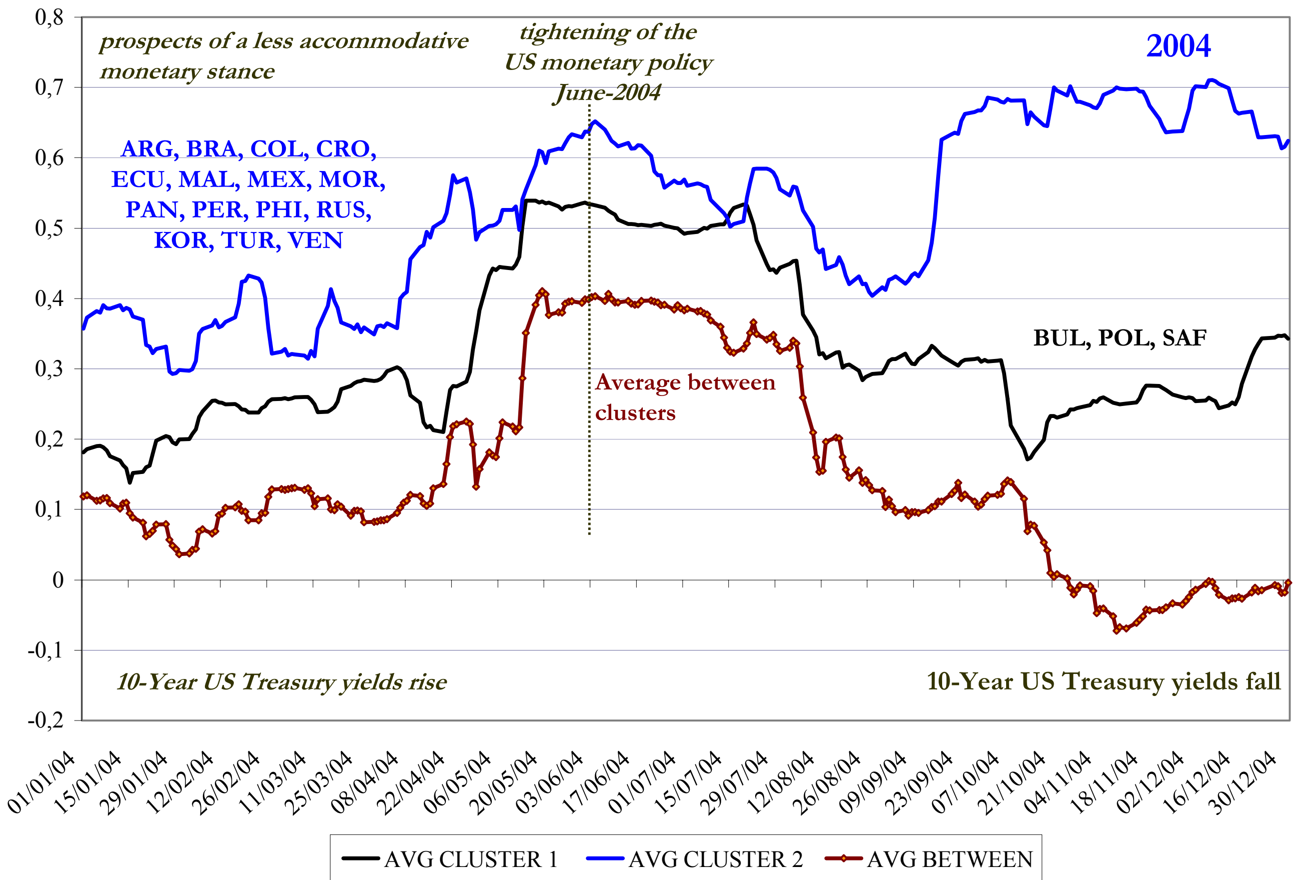

Figure 16 : 2004 - Groups composition according to the PCA taxonomy and country average correlations of adjusted returns

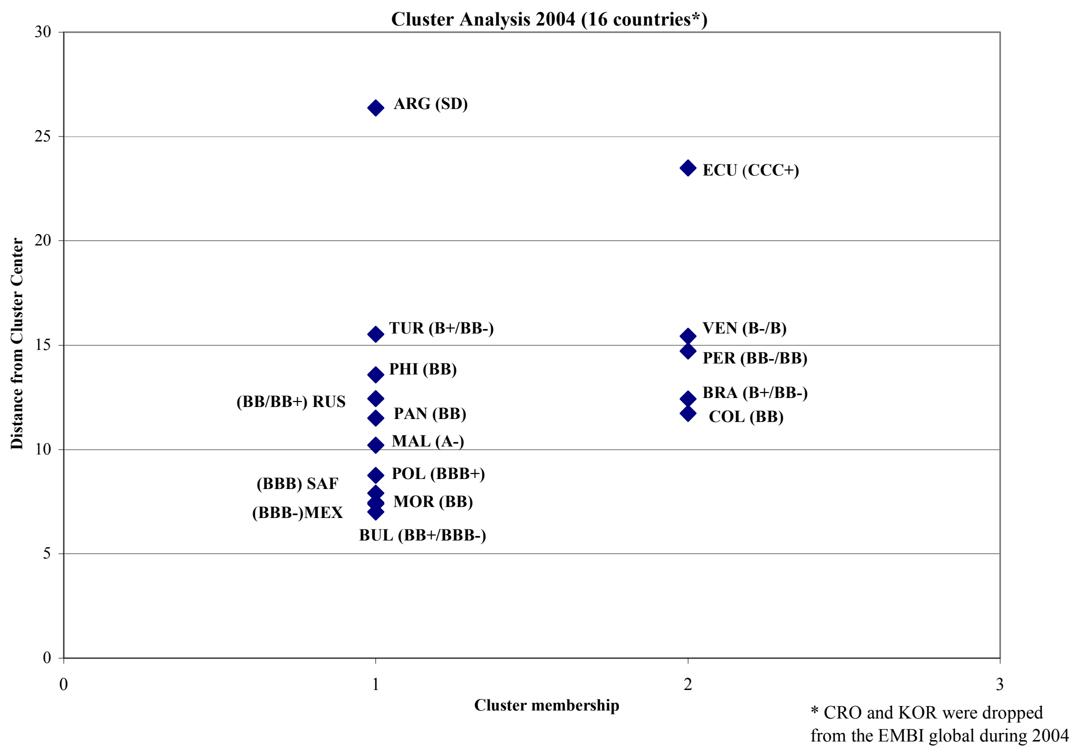

Figure 17 : 2004 - Cluster analysis (k = 2)

Changes in S&P Sovereign rating over the period

Bulgaria : 4/08/04 : upgraded from (BB+) to (BBB-)
Brazil : 17/09/04 : upgraded from (B+) to (BB-)
Turkey : 17/08/04 : upgraded from (B+) to (BB-)
Peru : 8/06/04 : upgraded from (BB-) to (BB)
Venezuela : 25/08/04 : upgraded from (B-) to (B)
Russia : 27/01/04 : upgraded from (BB) to (BB+)

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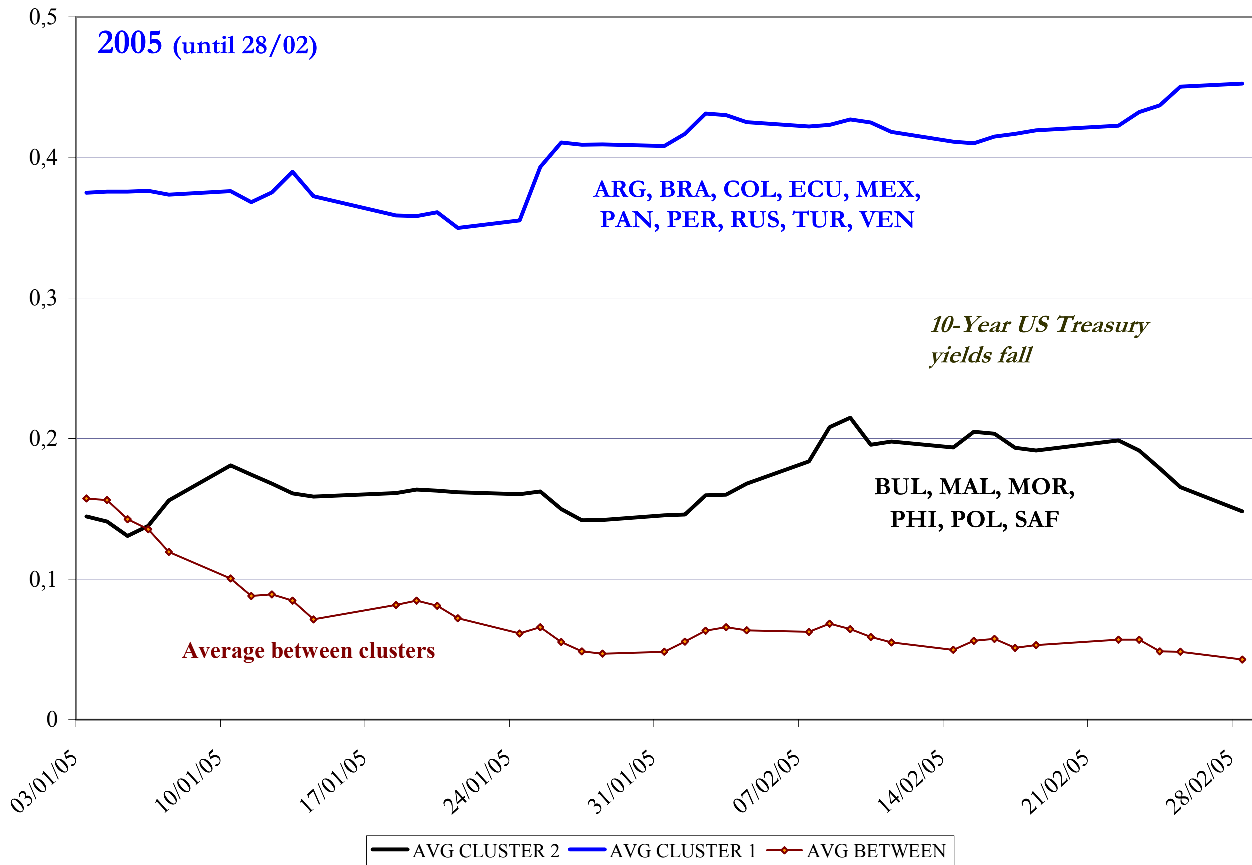

Figure 18 : 2005 - Groups composition according to the PCA taxonomy and country average correlations of adjusted returns

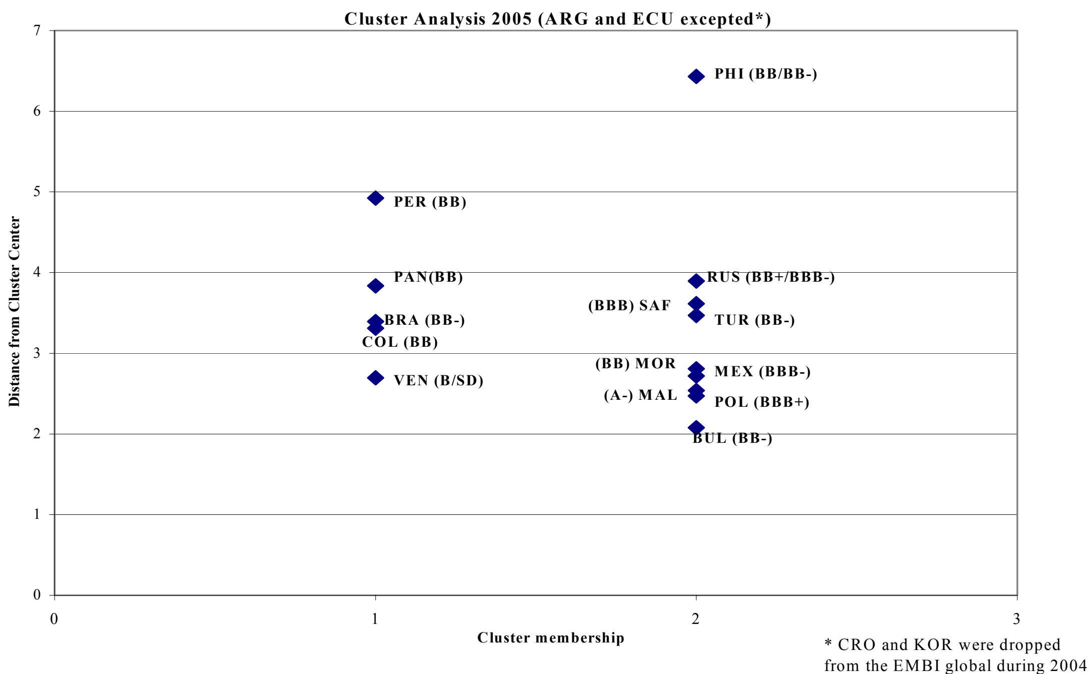

Figure 19 : 2005 - Cluster analysis ($k = 2$)

Changes in S&P Sovereign rating over the period

Ecuador : 24/01/05 : upgraded from (CCC+) to (B-)
Venezuela :18/01/05 : downgraded from (B) to (SD)

Russia : 31/01/05 : upgraded from (BB+) to (BBB-)
Philippines : 17/01/05 : downgraded from (BB) to (BB-)

ANNEX 6

Component matrix- first factor loadings-adjusted returns

Z SCORE	1997	1998	1999	2000	2001	2002	2003	2004	2005
ARG	0.9309	0.9317	0.8224	0.7323	0.7417	0.2552	0,187	0,1637	0,3130
BRA	0.9154	0.9285	0.8123	0.8591	0.8416	0.8292	0,813	0,7495	0,9397
BUL	0.7845	0.9177	0.6964	0.7028	0.7574	0.6563	0,387	0,5956	0,2652
COL	0.6502	0.5880	0.5859	0.5471	0.5340	0.5275	0,685	0,8852	0,8709
CRO	0.7637	0.6741	0.3171	0.2604	0.4569	0.1698	0,312	xx	xx
ECU	0.7865	0.8584	0.4571	0.4007	0.6988	0.6753	0,646	0,7273	0,7343
MAL	0.3464	0.2757	0.3243	0.6689	0.3357	0.0848	0,238	0,4436	0,1315
MEX	0.8279	0.9033	0.8930	0.7431	0.8358	0.8323	0,257	0,8236	0,5586
MOR	0.8640	0.8852	0.7491	0.6180	0.6680	0.5154	0,757	0,1554	-0,1842
PAN	0.7903	0.9012	0.7083	0.6990	0.6746	0.7334	0,229	0,8563	0,8018
PER	0.8404	0.7817	0.7432	0.6720	0.6497	0.7176	0,535	0,8242	0,7356
PHI	0.6890	0.6812	0.6345	0.6941	0.5557	0.5183	0,751	0,5897	-0,2087
POL	0.7711	0.8306	0.6624	0.5968	0.4086	0.2530	0,458	0,1425	0,1031
RUS	0.7654	0.7415	0.3203	0.7000	0.8868	0.8568	0,217	0,7400	0,7255
SAF	0.6756	0.5783	0.2190	0.5651	0.5055	0.3181	0,71	0,5522	-0,1633
KOR	0.1322	0.6397	0.5076	0.6331	0.1790	0.0821	0,566	xx	xx
TUR	0.6170	0.6189	0.1089	0.3617	0.5741	0.6024	0,493	0,6908	0,8195
VEN	0.8447	0.8116	0.6894	0.7424	0.7111	0.5654	0,382	0,7372	0,9023

Component matrix- second factor loadings-adjusted returns

Z SCORE	1997	1998	1999	2000	2001	2002	2003	2004	2005
ARG	-0.1478	-0.0326	-0.1584	-0.1436	0.1296	-0.0421	0,095	-0,3874	-0,3510
BRA	-0.1084	0.1160	-0.1382	0.0577	-0.0801	0.1726	-0,26	-0,3193	-0,1594
BUL	-0.1658	-0.0371	0.3034	0.2517	-0.1557	-0.0952	0,294	0,5253	0,6075
COL	0.3503	0.5421	-0.3992	0.1908	-0.0077	-0.1870	-0,263	-0,0408	-0,2559
CRO	-0.0336	0.1942	0.5563	0.3929	-0.0597	-0.2319	0,066	xx	xx
ECU	-0.2246	0.2249	-0.3230	0.3215	0.0738	-0.1164	0,022	-0,1302	0,5578
MAL	0.6422	0.8218	0.6189	-0.5331	0.7918	0.8538	0,857	0,0118	0,7410
MEX	-0.0521	0.0092	-0.0992	0.1226	0.0703	0.1101	0,861	0,0254	0,6398
MOR	-0.0643	-0.1181	0.1547	-0.0810	0.0345	0.1912	-0,242	-0,1597	-0,0744
PAN	-0.1452	-0.1408	-0.2625	0.1522	-0.0015	-0.0009	0,019	0,0627	-0,3558
PER	-0.2156	0.1958	-0.3415	0.0935	0.1000	-0.1390	-0,307	-0,0923	-0,3461
PHI	0.4075	0.2298	0.3810	-0.4643	-0.0100	0.2124	-0,157	-0,2382	0,7669
POL	-0.0413	-0.4165	0.0182	0.1263	-0.2995	-0.5259	0,444	0,8469	0,6423
RUS	-0.0356	-0.1094	0.3438	0.3107	-0.1569	-0.0313	0,066	0,0955	0,4251
SAF	0.2816	-0.4352	-0.1036	0.0961	-0.1644	-0.2702	0,061	0,6408	-0,0668
KOR	0.6783	0.0215	0.5550	-0.5835	0.8169	0.8490	0,058	xx	xx
TUR	0.1449	-0.5696	-0.1857	0.3432	-0.1970	-0.0275	0,083	-0,0444	0,0950
VEN	-0.0914	0.0227	-0.2244	-0.1215	-0.0358	0.1189	-0,191	-0,3152	-0,3549

Separation criteria:
Cluster 1 : PC(1) >=0,7 or PC(2) <= -0,15
Cluster 2 : PC(1) < 0,7 or PC(2) > -0,15

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