Emerging Debt Markets: What Do Correlations and Spreads Tell Us?

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Abstract

This paper proposes a conceptual framework to identify the potential sources of contagion in emerging bond markets and the mechanisms through which shocks originating in a particular emerging or mature market are likely to be transmitted across countries and markets. We then apply this framework to the emerging countries initially included in the EMBI Global Index over the period 1997-2005. We put into light that emerging markets became less and less intertwined over the recent period, and that, at present, the risk of contagion may come mainly from events taking place into mature markets. Finally, we derive policy recommendations in order to reduce emerging countries debt variability thus making them less vulnerable to a shock that takes place in mature markets. Sound macroeconomic policies, and in particular, prudent fiscal ones, could enhance government discipline and limit contagion effects in a wake of a global shock or a shock affecting another emerging country.

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1 Introduction

A salient feature of emerging markets since mid 1990s onwards has been their proneness to volatility spillovers and contagion across countries and markets during crisis episodes. In a context of increased market interdependence, apparently isolated events, initially affecting a particular country or market, may rapidly grow global. International liquidity crises are then likely to occur independently of the state of macroeconomic fundamentals.

The Tequila crisis of 1994-95, the Asian crisis of 1997, the Russian default and the collapse of LTCM in 1998, the Brazilian *real* devaluation at the beginning of 1999, the US High-Yield sell-off in 2000 or the run-up to the Argentina debt default in late 2001, were systemic events rippling through countries or markets around the world. The understanding of the underlying transmission mechanisms becomes essential in order to identify the nature of shock wave propagation at the international level and the potential sources of risk to the emerging market (EM) class. The questions we are trying to address in this paper are the following: *What are the roles of the local and global factors in explaining market comovements? Is there still a risk of contagion nowadays?*

We chose to focus on the emerging debt market because portfolio investment has been one of the major sources of financing to emerging countries from the beginning of 1990s onwards. Its tremendous growth, accelerating in the second half of the 1990s, was fuelled by the increased recourse of emerging countries public sector to financing in international markets. At the same time, emerging debt markets were exposed to external shocks or shifts in market behaviour and show high variability, especially in times of stress.

The analysis of emerging bond market comovement has become all the more important as financial crises in EMs have often been preceded or followed by sovereign debt crises (e.g. Russia in 1998, Brazil in 1999, Argentina in 2001 or Venezuela in 2002). Vulnerabilities in the banking sector and/or turbulence in the exchange market are likely to trigger a sovereign default and herding behaviour by liquidity-constrained investors. The causality running from either banking or currency crises to sovereign debt crises could be explained by the dangerous structure of public debt (rather short-term, currency-denominated or exchange rate indexed), as well as by the existence of implicit or explicit public guarantees on the private sector debt. For instance, in the wake of a banking crisis affecting a poorly regulated financial sector, the losses accumulated on the asset side of the corporate balance sheets are financed by public spending. The bailout of distressed banks thus deteriorates the public

sector stance and raises doubts about the government ability to service its debt (e.g. Argentina in 2001-02). Conversely, doubts about public debt sustainability may end up in a confidence crisis in international markets. The subsequent withdrawal of international lenders from EM leads to a sudden reversal of foreign capital flows. The collapse of the currency raises the burden of foreign currency-denominated public debt therefore making the sovereign default even more likely to occur (e.g. Russia in 1998).

The correlation analysis is one of the major strategies to measure the cross-country transmission of shocks, in the now vast literature on contagion. In the broad sense, contagion[1] was first quantified as an increase in the cross countries/markets linkages in the aftermath of a crisis, relative to the period leading up to the crisis (see early papers by King and Wadhwani (1990), Lee and Kim (1993) and more recently Calvo and Reinhart (1996), Frankel and Schmukler (1998)). In the wake of the Asian crisis, the presence of contagion inferred from increased cross-country correlation coefficients following a shock to one country has been challenged by Ronn (1998) and Forbes and Rigobon (2001, 02). They showed that the unadjusted correlation coefficient used in previous studies on contagion is upward biased during periods of market turmoil. Under specific hypotheses, it is then possible to adjust the sample cross-market correlation coefficients for changes in the volatility of returns in the shock-originating country. An implicit assumption of the underlying model of contagion is that the increased volatility is responsible for the rise in the correlation coefficients of cross-market asset returns. However, Yoon (2002) notes that the contagion may be due to other factors than increased volatility and that the results are strongly dependant upon the underlying distribution of the data-generating process[2].

Apart from these technical shortcomings of the correlation methods, we can also highlight an intuitive one: the role of so-called "third factors", mainly global financial factors driving the market comovement. The prevalence of the global factor upon which EMs are more and more dependent, may overshadow the "true" EM comovement. In order to address some of the shortcomings of the use of unadjusted aggregate correlation coefficients, we stick in this paper to a more restrictive definition of contagion viewed as excess comovement, that is, the transmission of shocks from one market or country to the others, unexplained either by

[1] Viewed as the transmission of shocks across countries/markets

[2] When returns follow, for instance, a STUR process, heteroskedasticity causes the correlation coefficients to be biased downward.

common shocks or by fundamental links among the countries. By adopting a three-factor model of EM bond returns, we are trying to address the question whether the increases in the EMs comovement usually associated with crises episodes, are attributable to common shocks or to a "pure" contagion phenomenon.

Let us briefly review the empirical and theoretical literature on excess comovement to which our paper is related. The first authors that had quantified pure contagion effects in mature markets were Pindyck and Rotemberg (1990). After taking into account common fundamentals, they showed that there is a residual comovement between stocks from very different industries and thus characterized by different idiosyncratic fundamentals. By contrast, little is known with regard to EMs as far as the residual comovement is concerned. Masson (1999) identifies three components of the exchange rate variations, namely: "monsoonal" or common shocks simultaneously affecting all countries, spillovers occurring through trade and economic relations and a residual, that is the component unexplained by the previous systematic relations and referred to as "contagion". Nevertheless, the first two components cannot account for the joint evolution of speculative pressures on pegged exchange rate regimes in EMs following the Mexican peso devaluation at the end of 1994 or the Thai currency crisis of July 1997. Moreover, Bekaert, Harvey and Ng (2005) propose a two-factor model (the factors being the US equity market return and a regional equity portfolio return) with time-varying betas and apply it to stock markets in Europe, South-East Asia and Latin America during the Mexican and Asian crises in the 1990s. They find strong evidence of "additional" contagion, defined as excess correlation of the idiosyncratic residuals in the case of the Asian crisis. As far as emerging debt markets are concerned, the studies of pure contagion mainly focus on countries credit ratings or spreads (Valdés (1997), Baig and Goldfajn (1998)). The common factors are, in this case, the variables driving the probability that the government services its debt. After correction, the correlation of residuals indicates the presence of pure contagion in the case of the Asian crisis of 1997-98.

Regarding the interpretation of the excess comovement, the literature attributes this residual comovement to rational/irrational market behaviour whose driving forces may be exogenous or endogenous to financial markets. First, investors' behaviour may be the consequence of an exogenous change affecting their expectations, their risk perception or their degree of confidence. Multiple equilibria (Jeanne (1997), Jeanne and Masson (2000)), wake-up calls (Goldstein (1998), Baig and Goldfajn (1998), Kaminsky and Schmukler (1999)) or shifts in

investors' risk appetite (Kumar and Persaud (2001)) are the main explanations of markets comovement according to this view. Second, the endogenous instability view, with which our paper is related, supposes that market practices and investors' strategies, even rational at the individual level, may result in excess volatility and comovement beyond fundamental links or common shocks. The rationale for their behaviour may lie in the presence of market imperfections and coordination problems. On one side, presence of high information costs (exacerbated by the financial integration) may lead to imperfect/heterogeneous knowledge of country specific conditions and to herding behaviour by global investors (Calvo (1999), Calvo and Mendoza (2000), Kodres and Pristker (2002)). On the other side, liquidity constraints and investors' incentives in global financial market may have a similar effect. Models of shock transmission based on portfolio rebalancing show that an adverse shock that takes place in a particular market/country is likely to increase the overall risk exposure of globally diversified portfolios. In a rational way, and based on the same methods of potential loss estimation (Value-at-Risk[3]), investors try to limit their loss in the particular market/country by first selling off the assets carrying the highest risk. For instance, during the Asian crisis of 1997-98, South Korean banks, which had previously accumulated Brazilian and Russian bonds, abruptly sold them out, in search of immediate liquidity. As a consequence, asset prices in the issuing countries sank, dragging other EM valuations in their fall. Indeed, a liquidity shock to one market lowers the liquidity of market operators' liquidity and induces portfolio rebalancing to meet market regulations or margin calls[4]. Credit rationing phenomena are likely to occur, driving investors to shed assets from other markets/risk classes, whatever the origin of the shock.

The understanding of the origins and mechanisms of pure contagion in emerging debt markets thus becomes essential in order to assess the potential risks to the EM class and derive policy recommendations. We therefore propose a conceptual framework for shock transmission at the international level with the aim at identifying the potential sources of risk in emerging bond markets and to explain the mechanisms through which a local or global event ripples through countries and markets.

The remainder of our paper is organized as follows. Section 2 presents the main characteristics of the emerging debt market. In Section 3 we propose the conceptual insights

[3] See Schinasi and Smith (1999).

[4] See Valdès (1997), Chakravorti, Ilyina and Lall (2003).

regarding the potential sources of risk to the EM class and the shock transmission mechanism in the wake of a local or global shocks. In Section 4 we present the main methodological issues, describe the data and provide an application of our theoretical framework to the recent events of market turmoil having affected the EM over the period 1997-2005. In Section 5 we derive some policy implications. The last section concludes.

2 A brief overview of the emerging debt market

The emerging debt market originates in the attempts of the international financial community to restructure international banking debt involved in the sovereign debt defaults in Latin America at the beginning of the 1980s. Structural reform and debt restructuring through debt-securities swaps were the key elements of this program. The new dollar-denominated assets called "Brady bonds" were guaranteed on their principal and/or partly on their interests by US-TB of similar maturity. Following the first Brady Plan for Mexico in 1990, from 1990 through 1994, about twenty emerging countries adopted debt-restructuring plans in the context of structural adjustment programs (PAS) supervised by the IMF. As a consequence, many heavily indebted countries gained access to international capital markets. Apart from Brady bonds, euro-bonds (dollar but also euro and yen-denominated) are also traded in the secondary market for debt. As Figure 1 below shows, these securities have progressively substituted to Brady bonds in the total debt market outstanding.

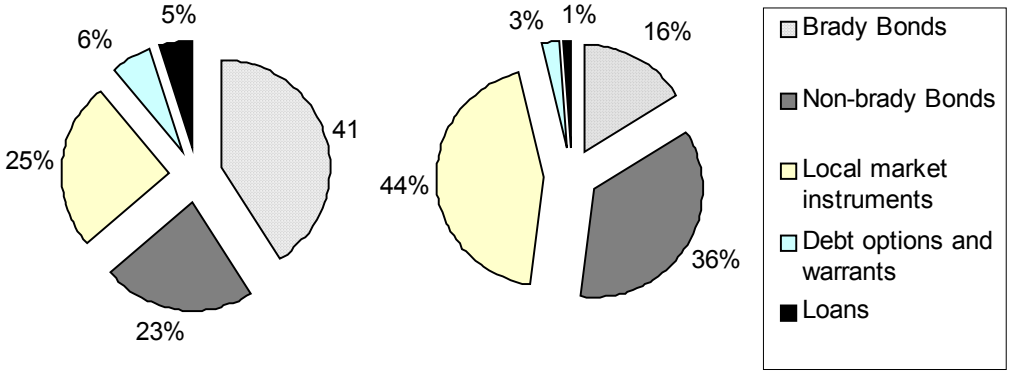


Figure 1: Debt instruments in the secondary market (Source: BIS (2002))

The spectacular rise of EM debt securities outstanding during the second half of the 1990s is mainly the consequence of the rise of public debt financed in international markets. Financial liberalization and market deregulation in the 1990s brought about financial development (through increased competition and diversification) and contributed to the development of

bond markets. The need of sterilization of large capital inflows in presence of fixed exchange rate regimes or the implementation of fiscal adjustment and stabilisation policies in the wake of major financial crises, contributed to emerging bond market deepening.

But, at the same time, emerging debt market proved to be highly volatile. From the beginning of the 1990s onwards, with the gradual integration of EMs into the global markets, emerging debt market bond returns have been characterized by large, simultaneous fluctuations, of greater amplitude than it could have been inferred from the macroeconomic trends of the issuing countries. The strategy of financial liberalization was expected to bring about more risk diversification opportunities and a better response of assets prices to adverse shocks. Nevertheless, the financial crises having affected emerging countries from mid 1990s onwards have been accompanied by large fluctuations and volatility spillovers across countries and markets. The comovement of EM debt bonds returns and spreads generally reflects global investors' undifferentiated attitude to emerging debt valuations. As high-yielding, but also highly risky assets, EM debt bonds are exposed to portfolio rebalancing during turbulent times. Looking for liquidity, investors try to sell risky assets in the first place, in order to limit the potential loss of their portfolio. This strategy may concern different asset classes (stocks, bonds) or different risk categories (speculative, gilt-edge or risk-free bonds, for instance).

3 Shock transmission mechanisms-Key conceptual Issues

In this section we propose a conceptual framework based on the evolution of EM spreads and aggregate correlations in order to characterize investors' attitudes towards risk in EM, highlight the potential sources of risks to the EM class and disentangle the roles of external and country specific comovement.

3.1 Potential sources of risk to the EM class: specific or external-driven comovement?

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 either 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.

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 EMs. These factors can be attributed to the international investors' behaviour that shift between asset classes and markets according to their anticipations and attitude towards risk.

Let us consider the standard single-factor model of individual country returns (for two countries *i, j (i≠j)*):

$$R_i = \beta_i \cdot f + \varepsilon_i$$
$$R_j = \beta_j \cdot f + \varepsilon_j \qquad (1)$$

where R_i and R_j denote the country returns, f the common external factor, coefficients β_i and β_j the sensibilities of countries *i, j* returns to variations in the global factor f and residuals $\varepsilon_i, \varepsilon_j$ the idiosyncratic country-specific factors.

In order to disentangle the role of the common external and country specific factors during episodes of market turbulence, we use two indicators of market comovement. First, we estimate the correlation coefficient of returns labelled unadjusted correlation coefficient in the remainder of the paper:

$$\rho_{unadj} = \rho(R_i, R_j) \qquad (2)$$

Second, we estimate the correlation coefficient of residuals or adjusted correlation coefficient:

$$\rho_{adj} = \rho(\varepsilon_i, \varepsilon_j) = \frac{(\varepsilon_i' \cdot \varepsilon_j)}{(\varepsilon_i' \cdot \varepsilon_i)^{1/2} \cdot (\varepsilon_j' \cdot \varepsilon_j)^{1/2}} \qquad (3)$$

and use it as measure of the comovement in bond returns after removing the influence of common external shocks. A significant increase in this second indicator could be viewed as evidence of "pure contagion" or excess comovement unexplained by the evolution of global factors.

As far as the relationship between the two indicators of comovement is concerned, identical correlations before and after the correction for the presence of external factors suggests that the impact of these factors is irrelevant and comovement is fully explained by local factors ($\beta_{i,j} = 0$). Unadjusted correlation higher than the adjusted one implies that the two country returns are correlated in the same way with the common external factor *f*. Conversely, rolling adjusted correlation coefficients higher than the unadjusted ones indicate that a part of the "true" comovement of EMs is overshadowed by general trends taking place in mature markets. In the case in which EMs are oppositely linked to the common external factors,

removing the impact of this common external factor will actually strengthen the linkages between emerging countries bond returns.

In order to identify the potential sources of risk to the EM class, we then focus on the period leading up to a global or country-specific event and give the major insights of what we are expecting to find (see Table 1). An increase in the unadjusted correlation coefficients while the adjusted ones are constant or decreasing indicates that risks of a sell-off in EM stem mainly from a shock occurring in mature markets. Conversely, constant or decreasing unadjusted correlation coefficients while the unadjusted ones are increasing in the run-up to a crisis warn about a risk of "pure contagion" originating in a given emerging country. A concomitant rise in both correlations during tranquil times indicates that the risk of a broad-based sell-off could come from either front: global factors as well as a given event in another EM. Finally, low or decreasing adjusted and unadjusted correlations coefficients indicates that the given event was largely unanticipated by markets.

ρ_{unadj}	ρ_{adj}	*Source of risk*
↗	≈; ↘	Mature markets
≈; ↘	↗	Emerging markets
↗	↗	Mature and emerging markets
≈; ↘	≈; ↘	Investors' lack of anticipation

Table 1: Evolution of general and EM-driven comovement during the pre crisis period and the potential sources of risk to the EM class

Let us now introduce the three factors used as proxies for the global variables driving part of the comovement in emerging bond markets.

3.2 Global factors description

Investors in EM bonds are facing two kinds of risks: default risk, defined as the implicit probability valued by the market as to the sustainability of sovereign debt and market risk, measured by the price volatility of the claim and reflecting the random nature of investors' gains from securities sales in the secondary market.

It is worth noticing that the sovereign default risk on euro-bonds had been historically very low until the Russian and Argentinean debt crises in the second half of the 1990s. As far as the market risk is concerned, the high price volatility can be explained by the market structure, insufficient developed and highly concentrated, as well by broad-based sell-offs by

investors in times of stress. Consequently, when assessing EM comovement, it is difficult to disentangle the impact of specific and global factors on the dynamics and valuation of both kinds of risk. Due to its specific nature, trends in emerging debt market 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 benchmarks of the US markets because they are the most likely to induce fluctuations in EMs returns[5]. The global factors presented hereafter will be used to capture the impact of international conditions (the factor f in the model 1) on emerging bond returns.

3.2.1 Risk-free interest rate index

Among the three global factors, the most relevant for characterizing financial conditions according to which emerging bonds prices are settled is the US monetary policy. Studies on capital flows volatility showed that emerging bonds returns are sensitive to variations in the international risk-free interest rates. Moreover, changes in the US long-term interest rates are likely to be followed by similar changes in long-term interest rates in other G-7 economies (Calvo, Leidermann and Reinhart (1993), Calvo and Reinhart (1996)). As the individual countries bonds included in the EMBI Global index are denominated in US dollars and their returns benchmarked against the US risk-free interest rates, the US-TB seems to be the most appropriate variable to capture investors risk aversion attitude. Therefore, we take into account the US Treasury Bill returns for maturity compatible with that of bonds included in the EMBI Global (i.e. 5 to 7 years). 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. The evolution of the US-TB Index compared to the average return on EM bonds included in the EMBI Global Index, for the year 1998, is illustrated on Figure 2 (see Appendix 2 for its evolution over the rest of the period). The evolution of bond returns sensitivities to changes in the US-TB returns, as illustrated in Appendix 3, is a good indicator of changes in market behaviour and investors' risk aversion during crisis times.

The US-TB is characterized by lower risk of variation than EM bonds or US-High Yields and also by a lower return. Generally, the yield on EM bonds is composed of the yield on the underlying US-TB and a default premium (spread) due to the existence of a country default

[5] As the EMBI Global is composed of dollar-denominated EM bonds, we avoid using other non-US variables (for instance European or composite indexes) for our common factors in order to evacuate the additional and intractable problem implied by the exchange rate expectations issues.

probability. This probability of default may be close to zero whenever markets have confidence in the government ability to pay off his debt reflecting improved perceptions of credit quality.

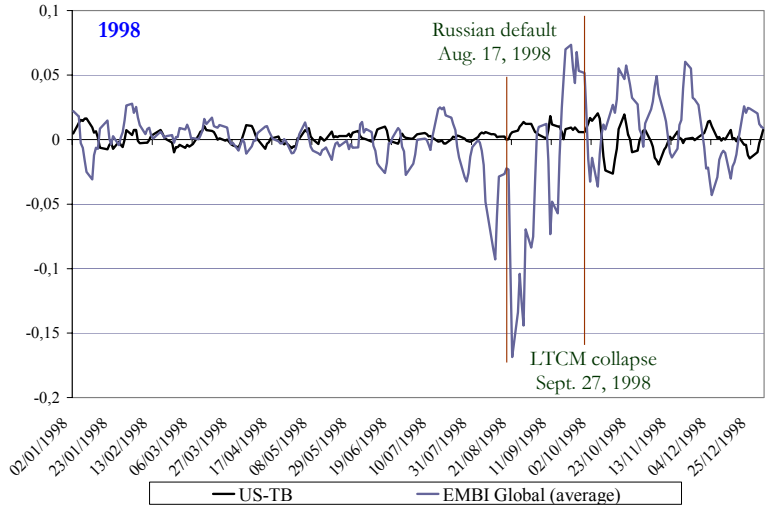


Figure 2: Evolution of US-TB and average EMBI Global returns-1998

Conversely, when market participants put into question the government ability to repay his loans, the yield on EM bond will rise in order to compensate the security holders for the increased risk they undertake. During market rallies, whenever the EM prospects are encouraging, investors dump low yielding risk free TB and buy emerging debt securities that offer a higher return. The higher liquidity and the lower market risk come at the price of lower rates of return than debt or equity securities. The increase in the demand for high-yield EM bonds will eventually lead to a decline in spreads. This trend may also be the consequence of low risk-free interest rates that reduce the debt service and an improvement in their macroeconomic fundamentals.

Conversely, global investors may shift to TB in times of stress, whenever they have a perception of heightened risk and are uncertain as to the economic prospects in emerging countries. A confidence crisis may erupt and prompt investors to reassess their exposures and repatriate funds away from emerging debt markets irrespective of the issuer quality, as long as the securities are carrying a non zero market risk. The flight to safety effect has often been a common pattern of crisis episodes.

3.2.2 Equity market index

We took into account the SPX-Index (Standard & Poor's 500 Composite Stock Price Index) i.e. the composite index of US stock market as a proxy for the stock market portfolio[6]. 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 behaviour of the SPX-Index is thus similar to that of the entire US stock market[7]. Its evolution compared to the average return on EM bonds included in the EMBI Global Index, for the year 1998, is illustrated on Figure 3 (see Appendix 2 for its evolution over the rest of the period).

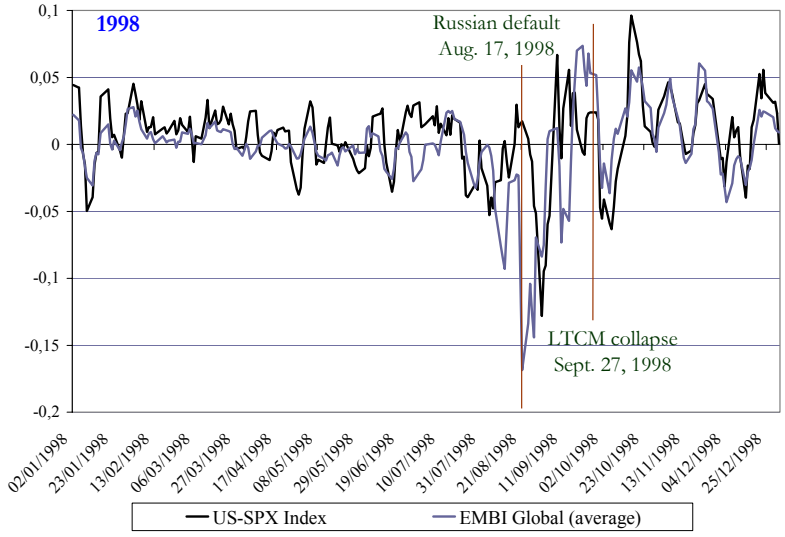


Figure 3: Evolution of SPX and average EMBI Global returns-1998

Emerging bond sensitivities to changes in equity market returns could be viewed as a proxy for the global portfolio relocations between bonds and equity. The investors' behaviour towards stocks depends on the growth perspectives of the concerned country (higher rates of

[6] US and Euro stock markets have closely evolved from 1997 onwards. Therefore we think that the use of a composite equity index reflecting the evolution of US, European and Japanese equity indexes would be unlikely to provide new information as there is a strong correlation between equity indexes of the major world markets.

[7] SPX-Index 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. It represents a measure of large capitalization stocks and accounts for about 64 percent of the market value of shares listed on the three exchanges.

investment, productivity growth, etc). Therefore, investors tend to prefer equities whenever the economy is doing well and shift to safer assets whenever the situation deteriorates.

3.2.3 US High Yield corporate sector index

We take into account the performance of the US High Yield corporate sector with the aim of capturing the global investors' behaviour regarding two competing fixed-income asset classes (USHY and EMBI Global). The US corporate high yield bonds are often perceived by global investors as competing asset class to EM 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 EM bonds. Over the period under consideration the USHY sector experienced downgrading and massive sell-offs that had an impact on the emerging bond markets as well. The selected JOAO Index is characterized by an average rating comparable to that of emerging markets (below (BBB)/(Baa) according to S&P/Moody's ratings). As far as emerging debt securities are concerned, their notation ranks from selective default (SD)/(C) to (A-) /(A3)[8]. Therefore the two indexes (US-HY and EMBI Global) are representative of EM and US high-yield fixed-income securities that roughly reflect the same degree of risk. Nonetheless, the relationship between HY returns and EM debt returns is not straightforward. In the context of increased risk aversion, investors are likely to treat these two assets classes indiscriminately by selling them out against risk-free assets in search of instant liquidity. Troubles in the US-HY sector often reverberate through the EMs and, over the last years, sell-offs in the first market have triggered similar sell offs in the latter market. Turbulence 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 EM bonds).

However, investors may have a different attitude as regards these two asset classes according to the sovereign and corporate default risk perception. If there are concerns about the ability of corporate/sovereign issuers to service or to roll-over their debt in the HY/EM bond markets, we could expect global investors (in particular cross-over investors) to shift to the

[8] Most of the time, the major part of EM securities are viewed as "speculative ", that is of low solvency and whose ratings rank from (B-)/(B3) and (BB+)/(Ba1)). Nevertheless, over the recent period, an increasing number of emerging countries have graduated to investment grade quality and are rated (BBB)/(Baa2) or even (A-)/(A3).

alternative market more attractive in terms of risk-return. For instance, doubts about the sequencing of lenders reimbursement in the case of a sovereign debt crisis, and sometimes, higher market risk associated to EM bonds compared to corporate HY ones, leads to a situation in which the former asset group may be viewed as more prone to a broad-based sell-offs (as this was the case during the Argentinean crisis of 2001-02). The evolution of the US-HY Index compared to the average return on EM bonds included in the EMBI Global Index, for the year 1998, is illustrated on Figure 4 below (see Appendix 2 for its evolutions over the rest of the period).

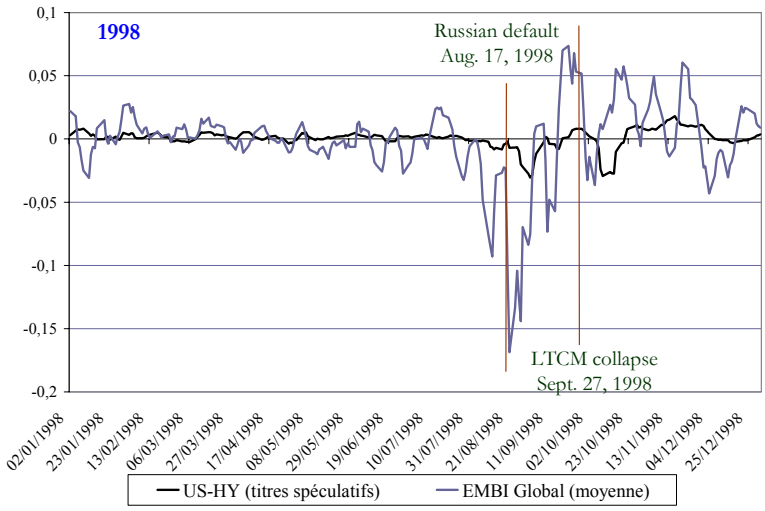


Figure 4: Evolution of US-HY and average EMBI Global returns-1998

In a context of a diversified portfolio, these three factors may be viewed as the alternative assets to EM bonds. We furthermore describe different portfolio rebalancing strategies in reference to the main asset classes (EM bonds, corporate HY bonds, stocks and treasury bills) in order to identify the mechanisms through which shocks originating in an emerging or in a mature market are transmitted across countries.

3.3 Impact of global and country specific shocks on spreads and cross-country average correlations

The recent episodes of market turbulence were characterized by an increase in cross country market correlations- but the question is whether this increase is attributable to common external shocks or to a "pure" contagion phenomenon, explained by a specific event taking place in an EM. Therefore, we propose a conceptual framework, from a two-country perspective, in order to analyse the impact of EM specific events as well as global shocks (in particular US long-term interest rate variations, boom/busts in US- HY and equity markets)

on EM spreads as well on the two indicators of market comovement (ρ_{adj} , ρ_{unadj}). We now adopt the point of view of an investor holding a diversified portfolio at the international level composed of the four types of assets previously mentioned. The country-specific or external shocks refer to volatility shocks. They lead to an increase in the conditional variance of the asset traded on that market and in the portfolio global risk exposure. If all the market operators follow the same management rule (of Value-at-Risk type), then, portfolio relocations may result in herding behaviour as regards to the asset they are trying to get rid of. The rise in volatility and the intensification of cross markets linkages will lead to greater losses than those implied by the initial positions. We therefore try to explain, in terms of portfolio composition, why investors are likely to sell out all risky assets they hold whenever an adverse shock hits one of them. The assets broad-based sell-off is then synonymous of contagion in financial markets.

Consider two emerging countries *i* and *j,* issuers of assets A and B respectively, and suppose that the (positive or negative) specific shock affects country *i*. The investors' decisions and attitude toward risk are perceptible through the evolution of spreads and of the two series of correlations (initial and adjusted for the presence of global factors). The tables presented hereafter propose different interpretations for all possible transmission mechanisms of shocks originating in an particular EM (Tables 2 and 3) or in mature markets, in particular a shock affecting the US-LT interest rates (Tables 4 and 5), US equity market (Tables 6 and 7) and US-HY market (Tables 8 and 9).

EM spreads	ρ_{unadj}	ρ_{adj}	*Description*	*Impact on the EM market*
↗	≈; ↘	↗ ↘	Increase in the portfolio risk exposure, investors tend to dump risky assets and move either: → Up in the credit quality spectrum (positively correlated EM spreads) or → Towards less risky EM bonds (Asset B, negatively correlated EM spreads)	→EM sell-off →Investors discrimination
↘	≈; ↘	≈;↘	Increase in the portfolio risk exposure, shift towards less risky EM bonds (Asset B) within the EM class.	→Investors discrimination

Table 2: Impact of a negative EM specific event (in country *i*) on spreads and correlations

EM spreads	ρ_{unadj}	ρ_{adj}	*Description*	*Impact on the EM market*
↗	≈; ↘	↘	Increase in the attractiveness of EM bonds. Investors shift to less risky EM bonds (Asset A)	→Investors discrimination
↘	≈; ↘	↗ ↘	Increase in the attractiveness of EM bonds. Investors buy either: → Any kind of EM bonds or → Safer EM bonds (Asset A)	→EM rally →Investors discrimination

Table 3: Impact of a positive EM specific event (in country *i*) on spreads and correlations

In this configuration, an increase in ρ_{unadj} may indicate that there is a global event also driving the comovement. This event can be either an independent event (pure coincidence), or a consequence of the specific (negative) EM shock. Whenever spreads ↗ and ρ_{unadj} ↗, it is possible that the EM specific shock ripple through emerging and mature markets altogether triggering a global crisis. In this case there is evidence of contagion to mature and EMs through a direct (from country *i* → country *j*) as well as an indirect link (country *i* → mature markets → country *j*).

Let us now consider a shock affecting US-TB returns and the long-term interest rates. This kind of shock can also be interpreted in terms of market liquidity: a positive shock (i.e. a fall in the interest rates) is often synonymous of excessive liquidity whereas an adverse shock may result in a liquidity shortage in mature markets.

EM spreads	ρ_{unadj}	ρ_{adj}	*Description*	*Impact on the EM market*
↗	↗	↗ ≈; ↘	Increase in the portfolio risk exposure, investors tend to dump risky assets and move up in the credit quality spectrum. → Sell-off all kinds of risky assets; → Sell-off of most vulnerable EM bonds (of issuers whose financial situation is expected to deteriorate)	→EM sell-off →Investors discrimination

Table 4: Impact of a negative shock affecting the long-term interest rates on spreads and correlations

↘	↗	↗	Investors shift to other more yielding assets like emerging debt bonds or High Yield corporate bonds. The easing of EM financing conditions may lead to improved fundamentals and to EM spread reduction. Hence a better investors perception and a broadly based buying of all kinds of risky assets.	→EM rally

Table 5: Impact of a positive shock affecting the long-term interest rates on spreads and correlations

In this configuration, a decrease in ρ_{unadj} would suggest that there is a specific EM event also driving the comovement. This event can be either an independent event (pure coincidence), or a consequence of the (negative or positive) shock on long-term interest rates: anticipating a rise/fall in the US-TB yields the investors expect a deterioration/improvement of the financial situation of highly indebted EM countries. They may dump the EM asset suddenly perceived as riskier as well as other EM assets issued by countries characterized by strong fundamental links with the crisis hit country or showing similar macroeconomic characteristics.

Let us now consider a shock affecting mature stock markets.

EM spreads	ρ_{unadj}	ρ_{adj}	*Description*	*Impact on the EM market*
↘	↗	↗ ≈;↘	Portfolios rebalancing towards fixed income securities (part of which could also entail high exposure to EM): → Broadly-based buying of all kind of EM bonds; → Buying of less risky EM bonds.	→EM rally →Investors discrimination
↗	↗	↗ ≈;↘	The negative wealth effects are too strong and market reacts by shedding either: → All kind of risky assets (indiscriminate behaviour) or → The riskiest EM bonds (shifts within the EM class)	→EM sell-off, contagion →Investors discrimination

Table 6: Impact of a negative event affecting the mature equity markets on spreads and correlations

EM spreads	ρ_{unadj}	ρ_{adj}	*Description*	*Impact on the EM market*
↘	↗	↗ ≈; ↘	Investors indiscriminate attitude towards risky assets (equity or EM) reflected by a broadly-based buying of all kind of EM bonds (positively correlated spreads); →Overweighing of less risky EM bonds (negatively correlated EM spreads)	→EM rally →Investors discrimination
↗	↗	↗ ≈; ↘	Global portfolio reallocations from fixed-income securities to equity. Investors dump either →All kind of risky assets, or →Only the most vulnerable EM bonds	→EM sell-off, contagion →Investors discrimination

Table 7: Impact of a positive event affecting the mature equity markets on spreads and correlations

In this configuration, a decrease in ρ_{unadj} would suggest that the impact of the external shock is not relevant.

Let us finally consider a shock affecting the US-HY market.

EM spreads	ρ_{unadj}	ρ_{adj}	*Description*	*Impact on the EM market*
↘	↗	↗ ≈; ↘	Investors shift within the same class of risk, between local corporate and EM bonds → Broadly-based buying of all kind of EM bonds; →Buying of safer EM bonds (negatively correlated EM spreads)	→EM rally →Investors discrimination
↗	↗	↗ ≈;↘	Shock associated to an increase in the overall risk of the portfolio. Investors tend to reduce the exposure in similar securities in terms of risk (in particular EM) and move up in the credit quality spectrum towards TB. They dump either →All kind of risky assets, indiscriminate behaviour; →Most vulnerable EM bonds	→EM sell-off →Investors discrimination

Table 8: Impact of a negative shock affecting the HY market on spreads and correlations

EM spreads	ρ_{unadj}	ρ_{adj}	*Description*	*Impact on the EM market*
↘	↗	↗ ≈;↘	Increase in the attractiveness of securities presenting similar degree of risk (in particular EM bonds) →investors indiscriminate behaviour, broadly-based buying of EM bonds ; →(Substitution effect) overweighing of safer EM bonds shifts within the EM class.	→EM rally →Investors discrimination
↗	↗	↗ ≈;↘	Investors shift within the same class of risk, between EM and HY bonds which triggers either a →Sell -off of all kind of EM valuations; →Sell-off of most vulnerable EM valuations;	→EM sell-off →Investors discrimination

Table 9: Impact of a positive shock affecting the HY market on spreads and correlations

In this configuration, a decrease in ρ_{unadj} would suggest that the impact of the external shock is not relevant.

We furthermore use this framework in order to assess comovements in EM bond returns and disentangle the roles of external and local factors during the recent episodes of market volatility over the period 1997-2005.

4 Application to the period 1997-2005

4.1 Methodological Issues and Data

We use daily and five-day returns for 18 out of 33 emerging countries initially included in the JP EMBI Global (Emerging Markets Bond Index Global) 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 percent of the Index in 1997 and for 87,5 percent at present[9]. The EMBI Global provided by JP Morgan, is a traditional, market capitalization-weighted index covering the EM countries (see Appendix 1 for more details). The adjustment for the presence of common external factors is performed using daily and five-day returns[10]computed from the bond index value of total return, according to the following relation:

$$R_{t/t-i} = \ln(I_t / I_{t-i}) \quad i = 1 \text{ or } 5 \qquad (4)$$

where I_t and I_{t-i} represent the closing cumulative total return index level on day t and the last total index return on the previous and respectively on the last fifth trading day (t - i, i = *1* or *5*). R_t is the (log) net rate of return between dates t and t - i *(i = 1* or *5)* and t 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 compute the inferred price between the last trading day and the opening day (See note *ii*) in the Appendix 1). 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 5-day returns according to the relation 4. 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 retain

[9] See Appendix 1 for changes in the EMBI Global Index composition. The other countries included in the Index are Chile, China, Côte d'Ivoire, Dominican Republic, Egypt, El Salvador, Hungary, Indonesia, Lebanon, Nigeria, Pakistan, Thailand, Tunisia, Ukraine and Uruguay.

[10] 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 give only the results using 5-day returns. See note *i*) in the Appendix 1.

2010 trading dates. Data for non-Asian countries were lagged by one day in order to adjust the data 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[11]. More precisely, the bond returns (daily or computed on a 5-day basis, which corresponds to a holding period by international investors) are adjusted for the presence of common external factors by performing rolling linear regressions of individual countries returns against the US TB5-7Y, SPX-Index and High Yield Index. The rolling regressions are performed over a 60-day window in order to separate the impact of external, and respectively, idiosyncratic factors of the EMs' 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, 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 three-factor estimated model can be written as following:

Suppose 2 emerging countries *i, j* among the 18 countries in the sample. The model implies rolling regressions over a 60-day window of the type:

$$R_{i,t} = \beta_{i,0} + \beta_{i,1} \cdot R_{TB,t} + \beta_{i2} \cdot R_{SPX,t} + \beta_{i,3} \cdot R_{HY,t} + \varepsilon_{i,t} \qquad (5)$$

$$R_{j,t} = \beta_{j,0} + \beta_{j,1} \cdot R_{TB,t} + \beta_{j,2} \cdot R_{SPX,t} + \beta_{j,3} \cdot R_{HY,t} + \varepsilon_{j,t}$$

where $R_{TB,t}$, $R_{SPX,t}$ and $R_{HY,t}$ are the returns of US-TB Index, SPX-Index and US-HY Index, β-coefficients reflect the sensitivities of emerging bond returns to changes in global factors whereas the residuals $\varepsilon_{i,t}$, $\varepsilon_{j,t}$ capture the impact of local, country-specific factors driving the comovement.

As we have already mentioned in Section 3, the correlation coefficient of residuals becomes a measure of the comovement in bond returns after removing the influence of the three common external shocks. As far as the three factors loadings are concerned, they can be viewed as the sensitivities of emerging bond markets to changes in US-TB, SPX or HY Indexes or, equivalently, as a measure of the variation induced in bond returns by a one

[11] These factors will affect emerging countries differently according to their macroeconomic characteristics (i.e. trade links, international financing requirements, degree of integration in the world economy).

percent variation of the exogenous variables. In terms of prices, the beta coefficients measure the growth rate of the EM bond price relative to the growth rate of the return on the external factors. The evolution of the sensitivities to changes in the global factors for each individual country of our sample are given in Appendixes 3 to 5.

The periods of broad-based buying or selling of EM bonds points out to the presence of different factors: external common shocks affecting mature markets, EMs specific shocks, commercial, financial or common lender links among countries. The amplitude of average correlations of individual countries initial returns make it impossible to disentangle the impact of common and local factors. However, the unweighted mean of unadjusted returns of countries included in the EMBI Global enables us to evacuate the potential role of fundamental factors. Moreover, sample diversification across Europe, Asia, Africa, Middle East and Latin America also help evacuate potential financial and real link between individual countries in the sample. Therefore, unadjusted correlations will solely reflect the influence of global and emerging country specific factors.

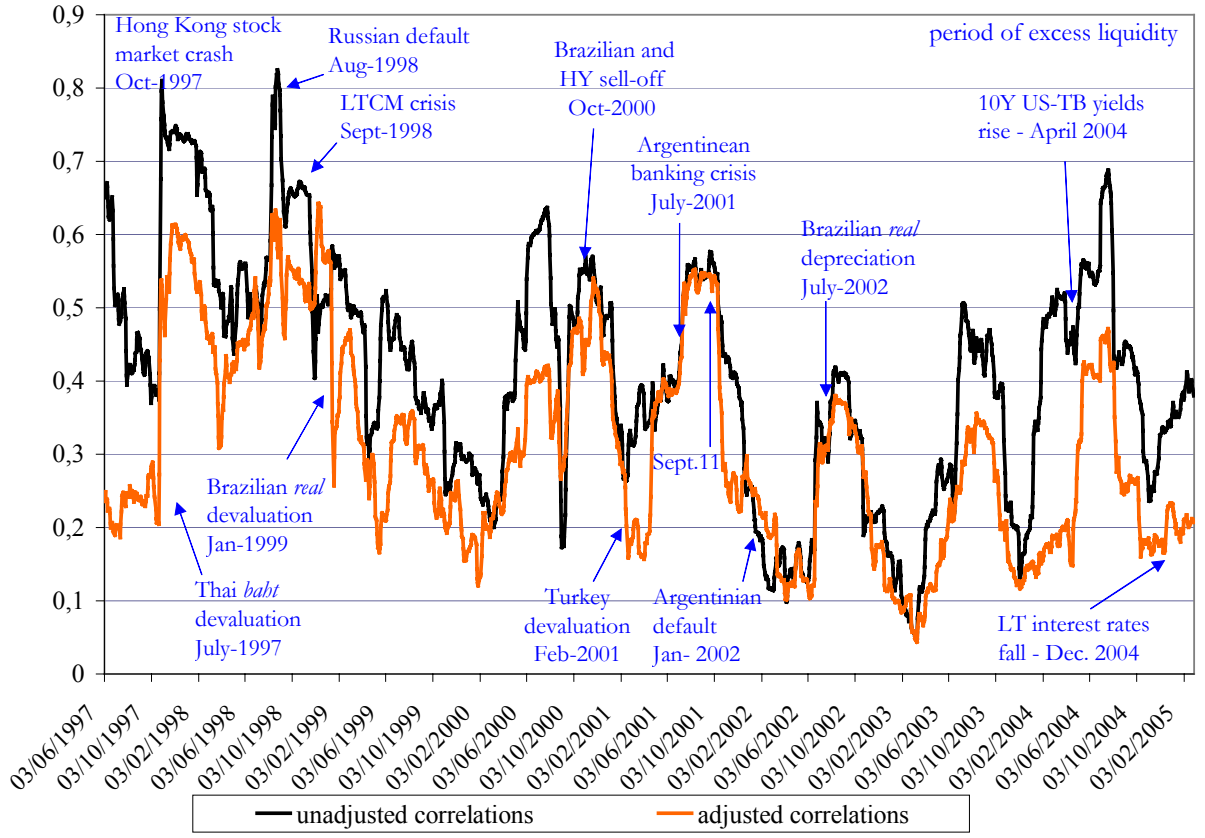
4.2 Main results

We first present the evolution of an aggregate measure of the two indicators of market comovement and the major trends that are emerging. We then apply the previous conceptual framework to the major episodes of market turmoil over the period 1997-2005.

4.2.1 Evolution of the adjusted and unadjusted cross-country average correlations

Figure 5 plots the evolution of aggregate correlations, unadjusted and adjusted for the presence of common external factors, as measures of the overall and respectively the excess comovement (pure contagion) in emerging bond markets. 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. Appendix 6 presents the correlation matrixes of individual countries adjusted returns.

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. For instance, annual average correlations represent 0.56 in 1997, 0.59 in 1998, 0.41 in 1999, 0.43 in 2000, 0.42 in 2001, 0.24 in 2002, 0.27 in 2003, 0.43 in 2004 and 0.38 in 2005.



Figures 5-6: Evolution of adjusted and unadjusted rolling average correlations and EMBI Global spreads (see also Appendix 7)

It is worth noticing that the size of the rolling regression window (60 days) can only influence the correlation persistence in time[12], but our objective here is to put into light the ascending and descending movements, the peaks and droughts in emerging debt markets comovement.

The large spikes in global average correlations are usually associated with 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 that tend to unwind their open positions in EMs during bad times. The most important rises in correlations take place during the Hong Kong stock market crash of October 1998 (when the potential of contagion of the Asian crisis to global financial markets become clear), Russian sovereign default of August 1988 (of around 0.8) and also during the 2000 generalized sell-off of Argentinean bonds and speculative corporate bonds in the US-HY market (of around 0.55). This indicates investors' indiscriminate behaviour during crisis times, when sell-offs of EM bonds are mainly motivated by the concern of lowering the global risk exposure of their portfolio. However, over the recent period, the peaks associated to crisis episodes are considerably lower than the levels previously reached (for instance, during the Brazilian real depreciation of 2002, the average correlations are inferior to 0.4).

At the same time, we highlight a gradual 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 that are proxies for the EM-driven comovement. Thus, emerging bond returns comovement appears to be less and less specific to EMs and mainly driven by events taking place in mature markets, as showed by the widening gap between adjusted and unadjusted average correlations over the two last years.

Figure 6 shows the evolution of EMBI Global average spread over the period under consideration. The all time high, of more than 1600 b.p., was reached during the Russian crisis and the LTCM collapse of summer-fall 1998. The peaks of intermediate size are associated with systemic events taking place in mature or EMs: Brazilian *real* devaluation of 1999 (spreads of around 1100 b.p.), September 11, 2001 (spreads as high as 900 b.p.) or Argentinean banking crisis of 2001 and Brazilian real depreciation of 2002 (spreads of around 800 b.p.). These trends seem to suggest better investors' differentiation of the risks carried by EM bonds during the recent period. This could be due to the absence, over the recent

[12] Similar results are obtained using a 90-day window or 10-day returns.

period, of major adverse event in EMs and by a lower risk taking on the side of investors in the wake of the Asian crisis. Additionally, volumes traded today in international markets are lower to those having preceded the outburst of the Asian crisis. Precisely, international debt flows decreased from $140 billion in 1996 and $196 billion in1997 to $56 billion in 1998 and $98 billion in 2000 (IMF). We also have to bear in mind that some emerging countries opted for greater exchange rate flexibility, placing inflation targeting mechanisms at the core of their monetary policy (for instance, Philippines, South Africa, Mexico and Poland in 2000). Greater flexibility enables them to better cope with external shocks, conditionally on the presence of large and developed financial markets providing diversified hedging instruments of the exchange rate risk. The quality of the financial systems, which played a major role in the Asian crisis of 1997-98, has improved in many emerging countries during the recent period. Financial systems are more stable now than at the eve of previous crisis episodes.

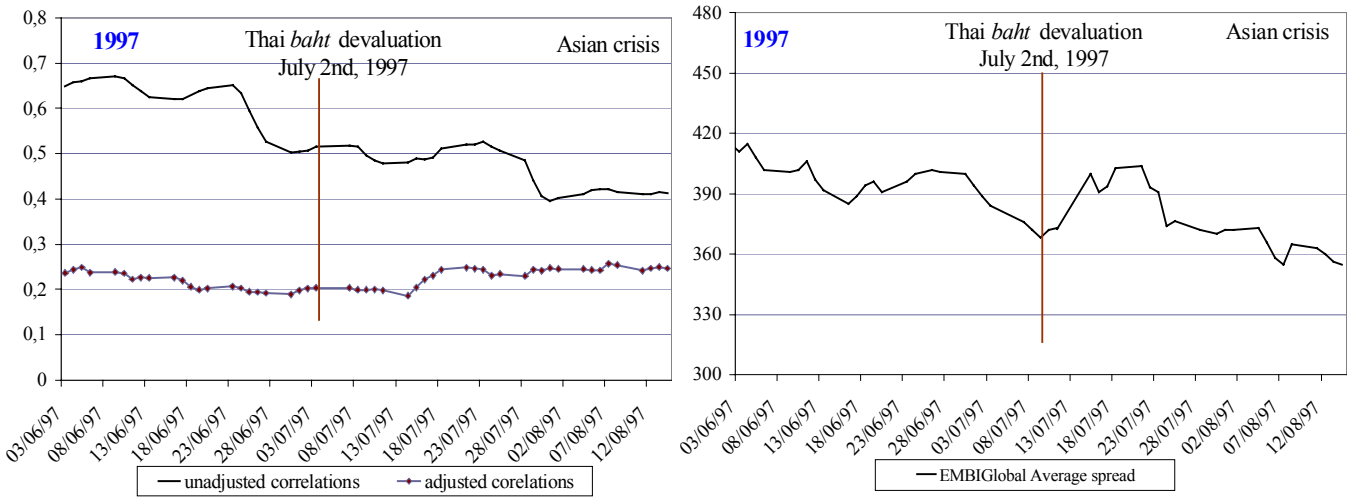
4.2.2 Interpretation of major episodes of market turbulence 1997-2005

We briefly analyse the evolution of adjusted and unadjusted aggregate correlations in connection with the key events, supposed exogenous, taking place during the sample period[13]. Our aim is to identify the potential sources of risk and highlight the roles of global as well as country specific factors in explaining the comovements amongst EM returns.

On July 2, 1997, the Central Bank of Thailand announced the abandonment of the exchange rate peg and the move toward a managed floating regime. An IMF stand-by credit of $3.9 billion was made available. The Thai baht value fell by 15-20 percent.

1) The Thai *baht* devaluation (July 2, 1997) seems to have had little impact on investors' attitude toward EM bonds. From Figures 7a-b we can see that both unadjusted and adjusted average correlations as well as spreads decreased in the run-up to the crisis indicating that this event was largely unanticipated by markets. This negative EM-country specific shock triggered a decrease in ρ_{unadj} whereas ρ_{adj} maintained at the same level indicating a lack of spillover effects to the other EM or to mature markets.

[13] The crisis dates have been established on the basis of the IMF EM Financing (1999-2001), IMF Global Financial Stability Report (2002-04), IMF World Economic Outlook (1999-2004) and BIS 68th -74th Annual Reports. Spreads on EMBI Global are available starting with 1998. For 1997 we used spreads on the EMBI+ provided by Bloomberg. For harmonization purposes, they are presented as 60-day rolling average of spreads on individual emerging countries valuations, compared to the US-TB returns.



Figures 7a-b: Evolution of correlations and spreads during the Thai *baht* devaluation

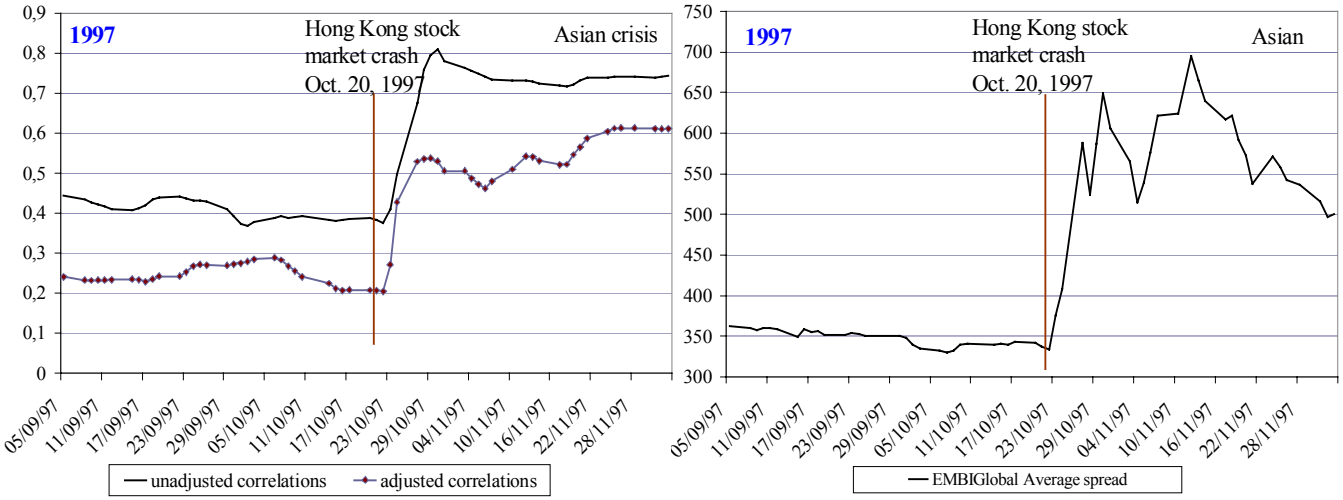
Until October 1997, investors had been treated the Thai *baht* devaluation as an isolated event and thus, they did not anticipate a worsening of other countries' fundamentals[14]. We are in the presence of a standard currency crisis whose origin lies in the financial sector. Investors did not anticipate that the currency crisis would affect long-term growth in South-East Asia. At the same time, favourable financial conditions at the international level (low interest rates) helped to maintain the attractiveness of EM securities, viewed as highly profitable by global investors.

On October 20-23, 1997, the Hong Kong stock market suffered its heaviest loss ever, even more marked than that recorded during the 1987 crash. Fears regarding the interest rates and pressures on the Hong Kong dollar triggered a drop for a quarter of its value in four days.

2) The Hong Kong stock market crash (October 20-23, 1997) was a negative EM-country specific event that marked a reversal in the evolution of spreads and correlations. We assist to a change in investors' attitude towards risk as showed by the significant rise in spreads, from nearly *300* b.p. before the crisis to around *700* b.p. in November 1997 (Figure 8b). Adjusted correlations, as a measure of the excessive comovement in emerging debt markets, reached a peak of 0.53 at the end of October (Figure 8a). The residual comovement doubled in the aftermath of the stock market crash, suggesting a broad-based sell-off in EM. The

[14] Indeed, further to the Thai *baht* floating, contagion spread only to other Asian currency markets (devaluation of the Philippine *peso*, depreciation of the Singapore dollar in mid-July, free floating of the Indonesian *rupee* and speculative attack on the Hong Kong dollar in August).

Hong-Kong crisis could thus be viewed as a clear example of significant increased market comovement after controlling for the common external factors (true contagion).



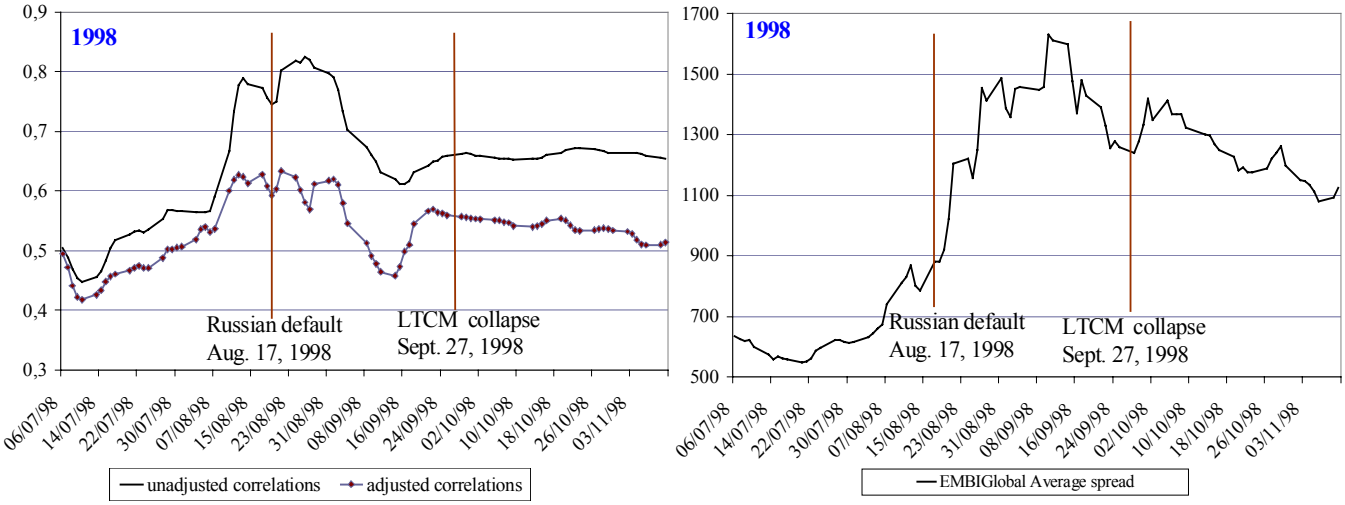
Figures 8a-b: Evolution of correlations and spreads during the Hong Kong stock market crash

Moreover, the surge in ρ_{unadj} with a peak of 0.8 at the end of October indicates that the links among financial markets intensified in the wake of the Hong-Kong market crash. From that moment on, the Asian crisis became global and spread to mature markets as well to other EMs. Indeed, until the end of the month, Korea and Thailand's sovereign ratings were downgraded by S&P and The Dow Jones Industrial Average lost *554* points on October 27, the biggest loss since its introduction. Equity markets in Brazil, Argentina and Mexico saw their biggest single day losses as the crisis ripples across the globe. On October 31, the Thai *baht* reached its lower level in terms of US dollar since the beginning of the crisis[15]. At the same time, an important IMF standby credit for Indonesia had been approved and financial support of $3 billion, immediately disbursed. However, the $23 billion mobilized by the international community provided only temporary relief to Asian markets and in November 1997, the crisis spread to South Korea.

On August 17, 1998, Russia devaluated the rouble and announced the restructuring of its public debt. Payments on short-term government debt were suspended and a moratorium on commercial debt service to non-residents imposed. Financial markets had been closed from August 8 through October 30. The US Hedge Fund Long-Term Capital Management (LTCM) went bankrupt on September 27.

[15] Effective devaluation of *37* percent (IMF (1998))

3) The Russian default (August 17, 1998) marked a reversal in emerging debt markets comovement from the outburst of the Asian crisis. Figure 9a shows that both correlations (ρ_{unadj} , ρ_{adj}) increased prior to the crisis and maintained at very high levels during the crisis. A possible interpretation would be insufficient investors' differentiation in the run-up to the crisis, and then, "herd behaviour" during or after the crisis. High adjusted and unadjusted correlation coefficients indicate a risk of contagion in EMs that could come either from mature markets (reflecting the global turbulent situation in the aftermath of the Asian crisis) or specific events taking place in Russia. As far as the specific factors are concerned, the Russian crisis was triggered by major macroeconomic and financial weaknesses (e.g. weakly enforced tax system, high public indebtedness, low industrial production). On January 1, 1998 the Russian rouble was pegged to the dollar with a 15 percent fluctuation band but in May, the refinancing rate reached 150 percent. Some other EM specific events contributed to the investors' loss of confidence like, for instance, the riots having accompanied the adoption of the Currency board in Indonesia, the speculative attacks on the South African *rand* in June, the brutal increase in interest rates in Brazil to levels close to those reached during the Asian crisis or the exchange rate pressures in Chile.



Figures 9a-b: Evolution of correlations and spreads during the Russian sovereign default and LTCM crisis

The sovereign debt moratorium is a negative EM-country specific shock followed by a significant rise in spreads and correlations. Spreads soared to an all-time high, of around 1500 b.p. in September 1998 (Figure 9b) suggesting investors' higher risk aversion as regards the EM group as a whole. As in the case of the Hong-Kong crash, we are in presence of a

systemic event taking its origin in a particular emerging country and having important spill-over effects on both mature and EM. Investors' "flight to quality and liquidity", in a context of increased uncertainty in financial markets, led to indiscriminate sell-offs of EM bonds. In September, the confidence crisis gained stock markets of Latin America and exchange rates came under pressure[16]. Banks, Hedge Funds and other financial institutions in industrial countries started accumulating important losses. The situation worsened with the collapse of the US Hedge Fund LTCM on September 27, 1998. Even if it represents the direct consequence of the Russian crisis, the LTCM collapse could explain the very high levels reached by spreads and unadjusted correlation during the period[17].

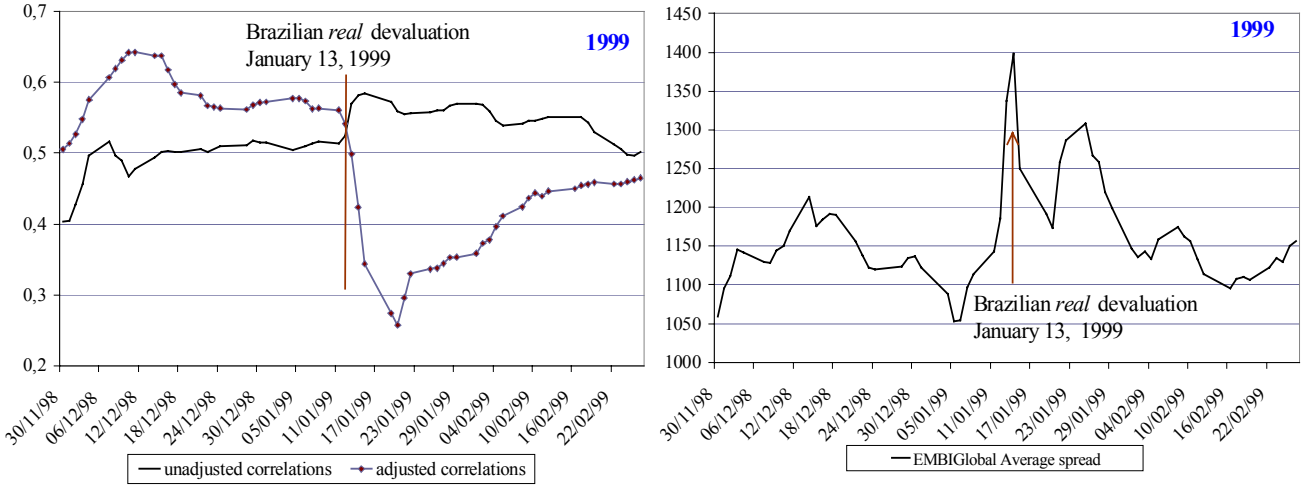
The conjunction of a tightly managed exchange rate regime and growing internal and external macroeconomic imbalances proved unsustainable in Brazil. At the end of 1998, the exchange rate came under great pressure. Speculative attacks on the Brazilian real ended up in its floating at mid-January, 1999.

4) The Brazilian *real* devaluation (January 13, 1999) is characterized by a particular configuration of correlations and spreads. Figure 10a-b shows that both correlations increased in the run-up to the devaluation indicating the presence of risks originating in emerging and mature markets. However, adjusted correlations were higher than the initial ones and this suggests that emerging debt markets evolved in opposite way compared to mature markets. After correction for the presence of global factors, the "true" comovement is higher. Indeed, the run up to the Brazilian *real* devaluation was characterized by investors' loss of confidence (since the Russian crisis on) in the sustainability of monetary arrangements and of the fiscal stance in Brazil and other Latin American countries. On one hand, we have to bear in mind that the Brazilian crisis started towards the end of 1998 and that expectations about the abandonment of its tightly managed exchange rate arrangement and investors' exit from the EM class occur before the devaluation, as shown by the increase in adjusted correlations (ρ_{adj}). On the other hand, the confluence of shocks in mature markets (LTCM collapse, interest rate cuts, boom in equity markets) heightened investors'

[16] Malaysia pegged its currency on the US dollar and adopted capital controls, Colombia widened the exchange rate fluctuation band by *9* percent, interest rates in Brazil doubled, reaching *50* percent on September 10, short-term interest rates in Mexico peaked at *48* percent, Chile proceeded to interest rate rises and allowed for more exchange rate flexibility whereas China tightened foreign exchange regulations (BIS (1999)).

[17] It is worth noticing that LTCM had previously announced (on September 2) annual losses of 52 percent. Nevertheless, news of the funds increasing difficulties came to light well before this date.

risk aversion and made them liquidate positions in EM class and shift towards risk-free assets and cash holdings. In the aftermath of the Brazilian *real* devaluation, spreads and adjusted correlations (ρ_{adj}) decreased, indicating the lack of spillover effects to the other EM (i.e. investors discriminate between the country in crisis in the other EM valuations). The increase in ρ_{unadj} points out to the presence of another external event affecting the market comovement. One possible explanation is that events in Brazil reinforced global investors risk aversion already high in the aftermath of the Russian crisis.



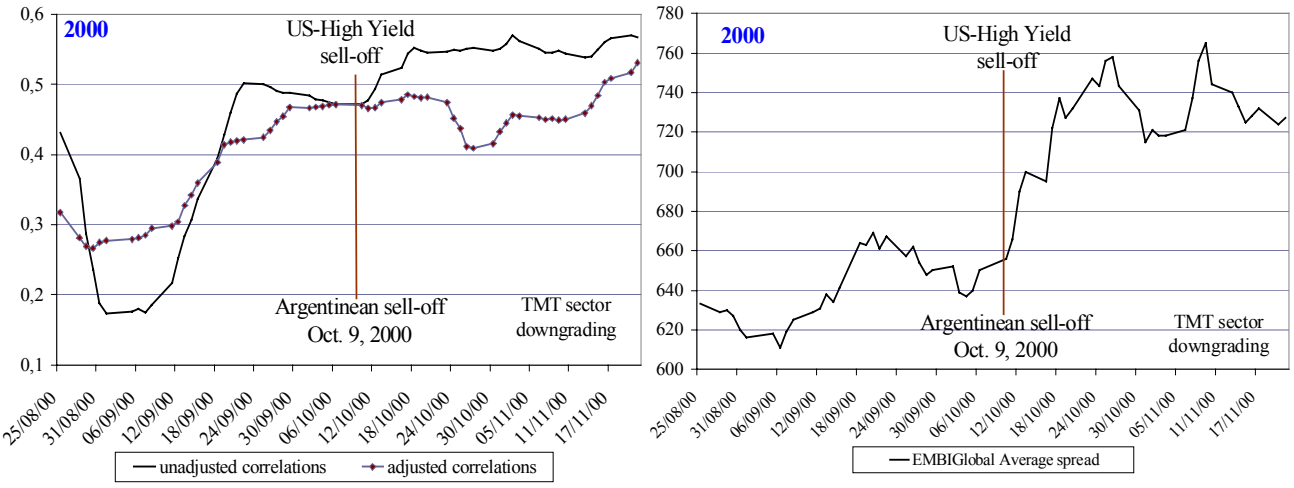
Figures 10a-b: Evolution of correlations and spreads during the Brazilian *real* devaluation

From the end of the Brazilian currency crisis on, investors seem to better discriminate crisis-hit countries from the rest of the emerging countries group. The upgrade of South Korea to (BBB-) at end-January 2000 seems to confirm the stabilisation trend of Asian financial markets. At the same time, high levels of unadjusted correlations (ρ_{unadj}) indicate a strong dependence of emerging debt markets upon global trends. Declining interest rates in major mature markets may be the common shock that led to better investors' differentiation between potential borrowers (from Asia and Europe, for instance) once the confidence had been re-established.

In a context of global growth slowdown and declining corporate profits expectations in the US, the US High-Yield market experienced an episode of broad-based sell-off in October 2000. The market closed from October 9 to 20. At the same time, in Latin America, the failure of Argentina in committing to control its fiscal deficit raised doubts about the government ability to service the public debt and brought about the need for public debt

restructuring. In the absence of a strong political commitment to tackle the fiscal difficulties, investors progressively lost confidence in the government solvency and triggered a broad-based sell-off of Argentinean sovereign bonds in October 2000.

5) In the run-up to the Argentinean sell-off and US-High Yield sell-off (October 2000) we notice a sharp increase in both adjusted and unadjusted correlation coefficients (ρ_{unadj} , ρ_{adj}) indicating that risks of a broad-based sell-off may come either from EMs (e.g. Argentina and Turkey fears) or from mature markets (e.g. global earning slowdown, deterioration in US credit market, revision of expectations of the US monetary policy, poor performance of mature equity markets (Nasdaq), downgrading of the TMT sector, etc). The simultaneous occurrence of an adverse EM-country specific and a High-Yield shock triggered an increase in spreads and adjusted and unadjusted correlations in the aftermath of these events (see Figures 11a-b). This configuration indicates that global investors evaluated the default risk as being high. They tended to dump risky assets (risky corporate bonds or EM bonds altogether) and moved up in the credit quality spectrum toward safer assets (TB for instance). However, adjusted correlations (ρ_{adj}) maintained below 0.5.



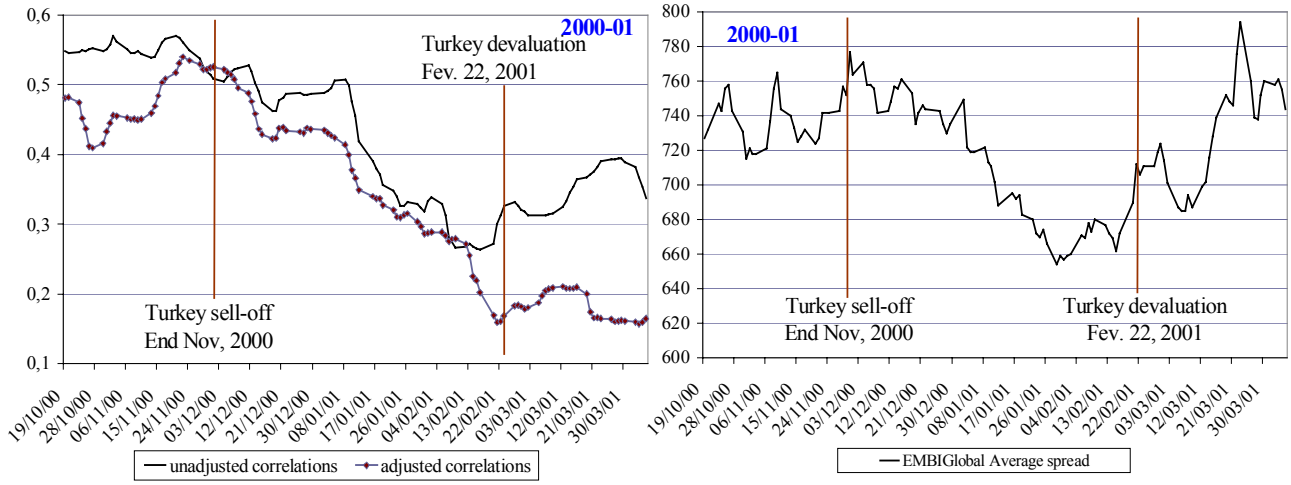
Figures 11a-b: Evolution of correlations and spreads during the Argentinean sell-off and US-HY sell-off

The decreasing adjusted correlations points out to better investors' differentiation of EM bonds according to their risk. The most affected by the shift in market confidence seem to be the bonds issued by highly indebted countries, lacking fiscal discipline or/and having a fragile banking sector.

Massive capital inflows in Turkey in the 1990s had been channelled through the domestic banking sector to the public sector one. The worsening of the public and current account

deficits in 2000, as well as the abrupt rise in the short-term external debt (accounting for 130 percent of foreign reserves) resulted in high interest rate variability. At the end of 2000, we assist to a broad-based sell-off of sovereign bonds and to a liquidity shortage in the interbank market that led to the failure of a medium-sized bank. The IMF intervened through a $10 billion support package for crisis resolution, conditionally on the adoption of structural reforms. However, underlying fragilities remained. Political conflicts in early 2001 raised new doubts on the part of investors, as to the government ability to restructure the banking sector and to control inflation. On February 22, 2001, massive capital outflows, as well as the steep rise in interest rates, constrained the monetary authorities to let the currency float.

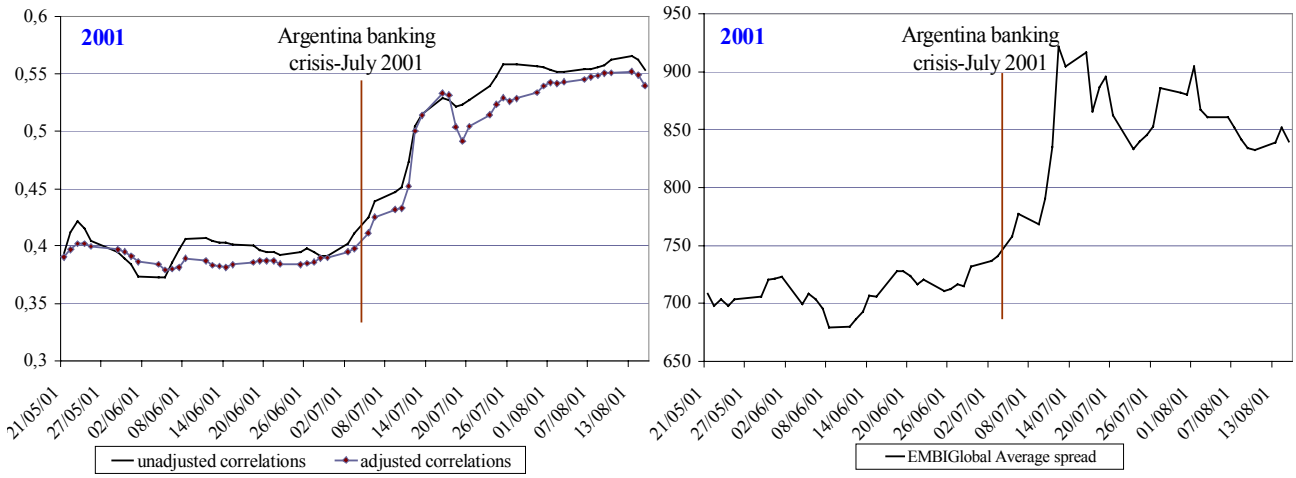
6) From Figure 12a we can see that the Turkey sell-off (end November 2000) had been preceded by a spike in ρ_{adj} whereas ρ_{unadj} decreased, suggesting that the risks of a sell-off to the EM stem from country-specific shocks. In the aftermath of this country specific event, both correlations and spreads were on a downward path, indicating investors' differentiation (shifts within the EM class, towards safer valuations) and the lack of spillover effects. However, in the aftermath of the Turkey devaluation (22 February 2001), we can notice a brief episode of sell-off in EM that reverberated through mature markets as shown by the increasing correlations and EM spreads (Figure 12b). The correlations decreased and maintained at low level immediately after the announcement of a multilateral support packages by the IMF. Despite investors' discrimination, EM spreads maintained at a high level, indicating their increased risk aversion (mainly caused by fears about the situation in Argentina and Brazil).



Figures 12a-b: Evolution of correlations and spreads during the Turkey sell-off and devaluation

Increasing liquidity needs led Argentinean authorities to swap around $30 billion of maturing external debt for longer-term bonds in June 2001. One month later, the authorities announced a program of fiscal balance imposing that public expense should not be higher than the effectively collected revenues. The fall in the government fiscal revenues and doubts about the viability of the Currency Board resulted in a bank run by domestic lenders. Households began to withdraw their savings from local banks. The banking crisis lasted until December 2001 when the government restricted the access to bank accounts (deposit freezing, "corralito") and closed insolvent financial institutions.

7) In the case of the Argentinean crisis (declaration of the sovereign debt moratorium) of July 2001 ρ_{unadj} and ρ_{adj} evolved extremely close, before, during and after the crisis which may indicate that risks to the EM class stemmed mainly from emerging countries specific events (developments in the highly correlated Argentinean and Brazilian emerging debt markets, Brazil's energy crisis and political instability).



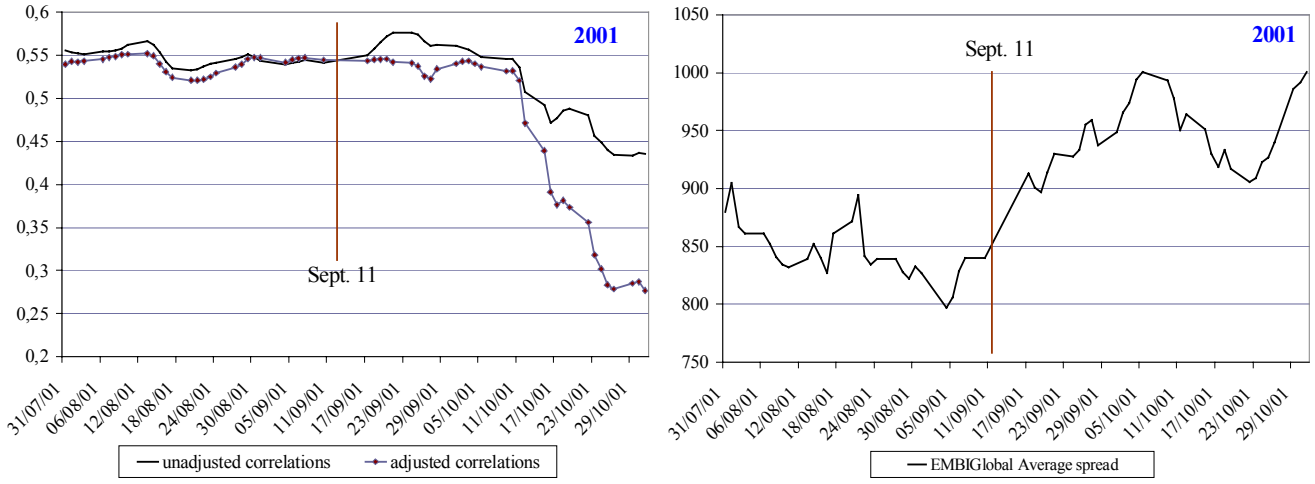
Figures 13a-b: Evolution of correlations and spreads during the Argentinean banking crisis

As Figure 13a shows, the Argentinean crisis is another case of increased market comovement in the post-crisis period, during which the investors' fears regarding Argentina specific risks spread across EMs (broad-based sell-off confirmed by the rise in ρ_{adj}). This trend is confirmed by the sharp increase in the EM spreads in the aftermath of this adverse EM-country specific shock. The close evolution of the two correlation coefficients suggests that the global factors were irrelevant in explaining market comovement during this period.

Actually, the favourable context of the monetary easing in the US (which should benefit to HY and EM bonds) had been overshadowed by credit concerns in particular EMs.

The terrorist attack of September 11 affected, for one week, the US equity and fixed income markets as well as the Pension Funds. The Federal Reserve reacted promptly by liquidity provision to the banking system and policy interest rates cuts.

8) As showed by Figure 14a, this unanticipated adverse shock affecting mature markets led to a slight increase in unadjusted correlations that faded away until October. During this period, the emerging debt markets comovement overpassed 0.5 as a result of persistent unbalances that undermined investors' confidence in EM bonds (turmoil in Argentina, energy crisis and political instability in Brazil, pressures on the exchange rate in Turkey).

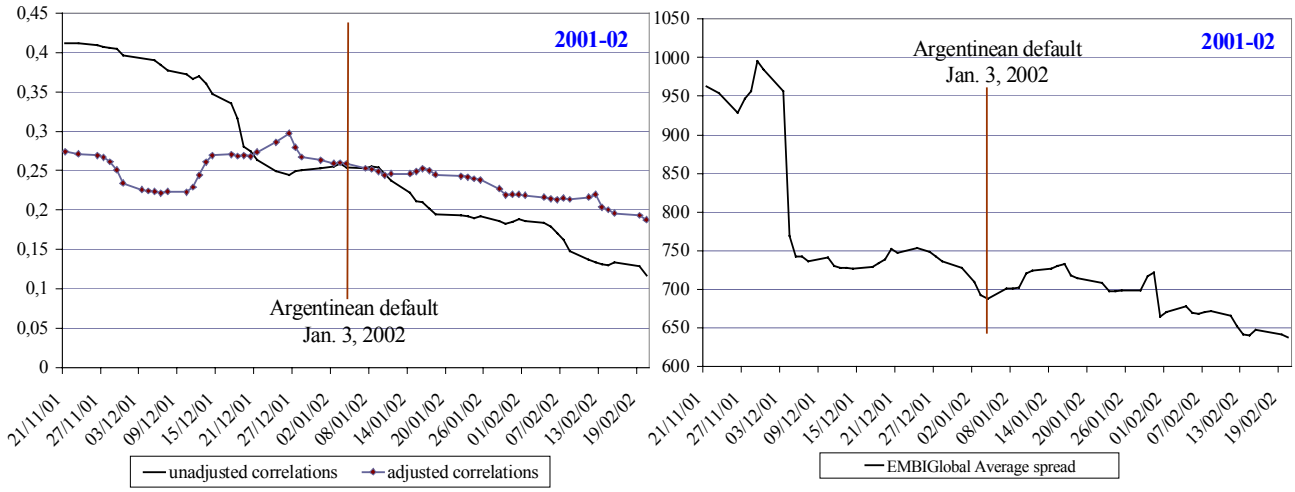


Figures 14a-b: Evolution of correlations and spreads during September 11, 2001

In Argentina, the amplitude of bank deposits flight led the government to impose strict controls on bank withdrawals and transfers. At the end of December 2001, the government suspended the payment of the external debt. In early January 2002, the Currency Board regime was abandoned and the government announced the adoption of a dual exchange rate regime, finally replaced by a floating exchange rate one.

9) In the run-up to the Argentinean default of December 2001-January 2002, we notice an increase in ρ_{adj} indicating that risks may come from a shock affecting the EM (Figure 15a). However both correlations were extremely low, at around 0.2, suggesting that investors were having a differentiated behaviour as regard to EM valuations and had already discounted Argentinean bonds. This event is a typical example of an EM anticipated shock perceived as

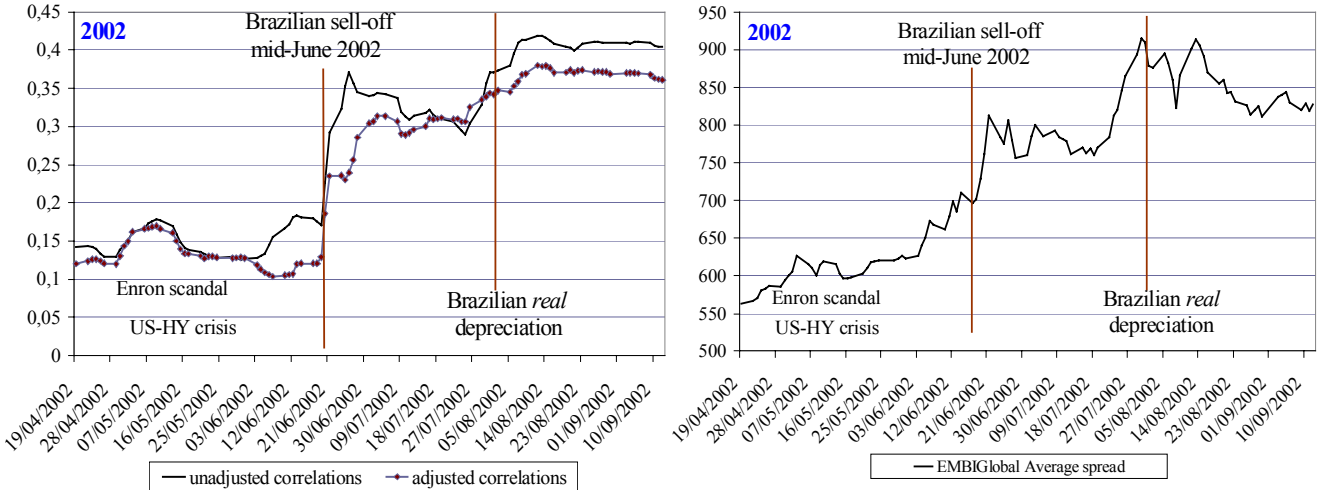
isolated by investors. In the aftermath of the Argentinean default, both correlations decreased and investors' shifted within the EM class, toward safer assets.



Figures 15a-b: Evolution of correlations and spreads during the Argentinean default and currency crisis

Year 2002 proved to be extremely difficult for emerging countries in Latin America. Investors' loss of confidence in the sustainability of the Argentinean public debt resulted in a surge in bond spreads (to around 2000 b.p.) and a generalized sell-off of Argentinean bonds in June 2002. In late July, the nominal exchange rate of the Brazilian real in terms of US dollar pursued its collapse, reaching the 3:1 threshold, the lowest level from the adoption of the Real Plan in 1994.

10) The Brazilian sell-off (mid June 2002) taking place during a period of global turbulence in mature markets (Enron scandal, US-HY crisis) was preceded by spikes in both adjusted and unadjusted correlations (Figures 16a-b) which indicates that the risks of contagion stemmed from shocks originating in both emerging (elections fears in Brazil and Turkey, Argentina concerns) and mature markets.



Figures 16a-b: Evolution of correlations and spreads during the Brazilian sell-off and depreciation

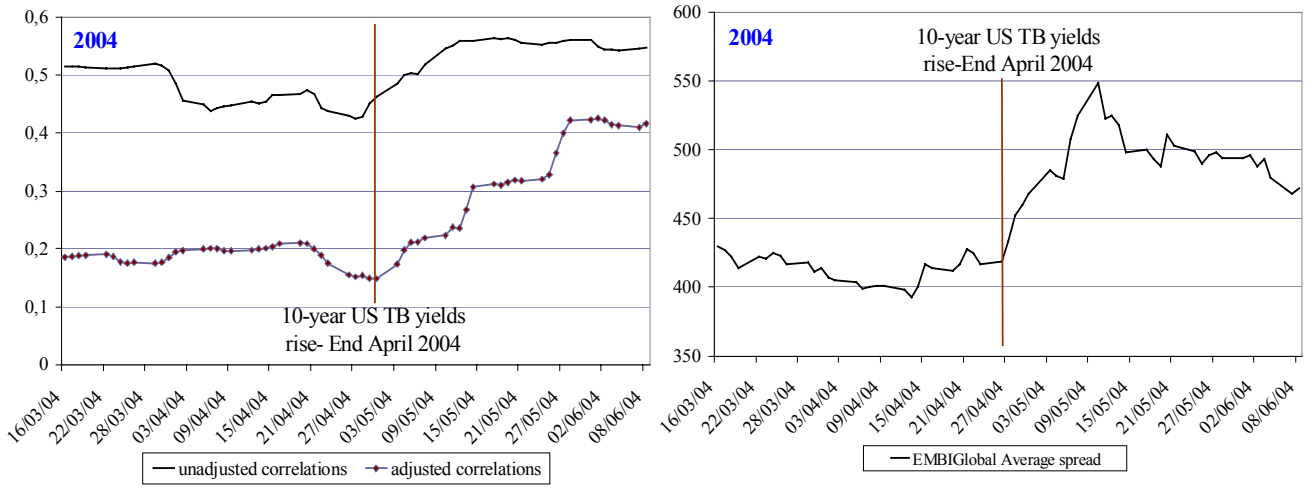
These adverse shocks are typical examples of increased market comovement during the crisis periods compared to tranquil ones. The increase in both correlations indicates that global investors associated these events with an increase in the overall risk of the portfolio. They tended to dump risky assets and moved up in the credit quality spectrum, toward TB. Similar trends were noticed one month later, in the aftermath of the Brazilian *real* depreciation (end July 2002).

From mid-2003 onwards, the excess overall liquidity, due to the ease of the monetary conditions and investors' decreasing risk aversion, made EM asset class especially attractive. The memory of past crises was progressively fading away. However, a clear reversal took place in April 2004: the expectations of a monetary tightening in mature markets led to a surge in EMs sovereign spreads.

11) The rise in the 10-year US-TB yields (end-April 2004), followed by similar measures in the Euro Area and Japan, was preceded by a significant gap between unadjusted correlations (ρ_{unadj}), on a slightly increasing path, and the adjusted ones (ρ_{adj}). This pattern indicates the presence of a contagion risk coming from mature markets. As Figures 17a-b show, this adverse shock affecting the US-TB interest rates was followed, as expected, by an increase in spreads and correlations, indicating a sell-off episode in EM (i.e. in presence of higher long-term interest rates, investors dump risky assets and move towards US-TB). However, adjusted correlations (ρ_{adj}) were well below unadjusted ones (ρ_{unadj}), which suggests a differentiated behaviour as regard to EM. Investors tended to shed bonds issued by emerging

countries perceived as most vulnerable to a deterioration of their financing conditions. The abrupt rise in spreads (even if they reach levels inferior to those of past crises) shows that investors' assessment of bonds issued by countries heavily dependent on external finance may easily change. In response to heightened uncertainty, they may sell-off bonds perceived as risky and prefer better quality bonds or TB.

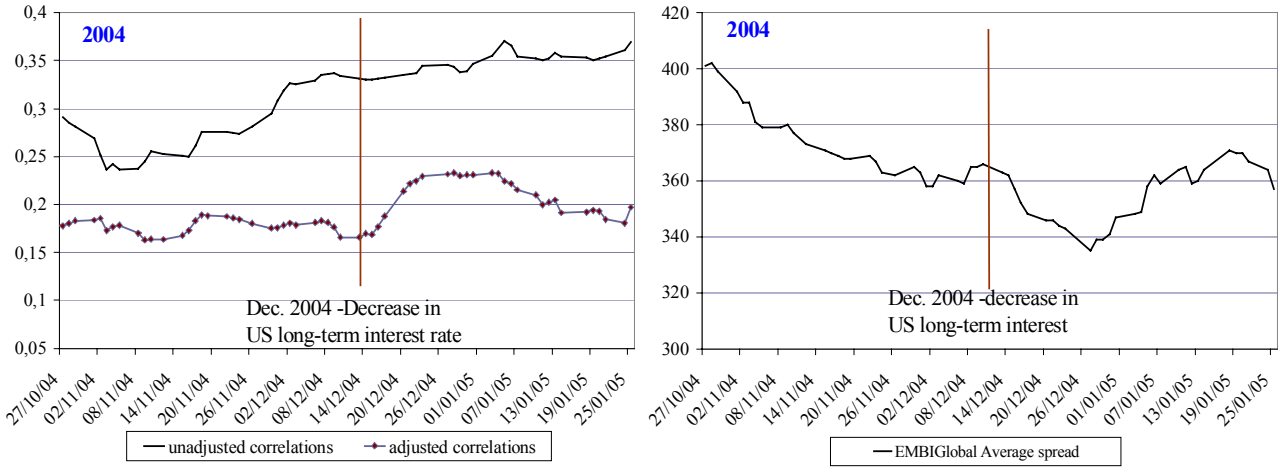
Figures 17a-b: Evolution of correlations and spreads during the 10Y US-TB yields rise



At the end of 2004 we notice an atypical evolution of long-term interest rates as a consequence of the gradual tightening[18] *of policy interest rates in the United States during the second semester 2004. As the long-term yields hadn't followed the same trend, the term structure of interest rates started to flatten.*

12) In the run-up to the fall in the US TB yield (mid September 2004) we notice, as expected in the case of a positive shock on US-TB interest rate, an increase in ρ_{unadj} whereas ρ_{adj} is very low and decreases (Figure 18a). This configuration indicates that risks to the EM class, although moderate compared with the previous episodes, stemmed mainly from developments in mature markets. The EM spreads compression (Figure 18b), as well as the decrease in ρ_{adj} in the aftermath of this event, indicates that the excess liquidity spurred the investors' interest in risky assets (in particular, in EM bonds) and triggered a brief episode of indiscriminate broad-based buying.

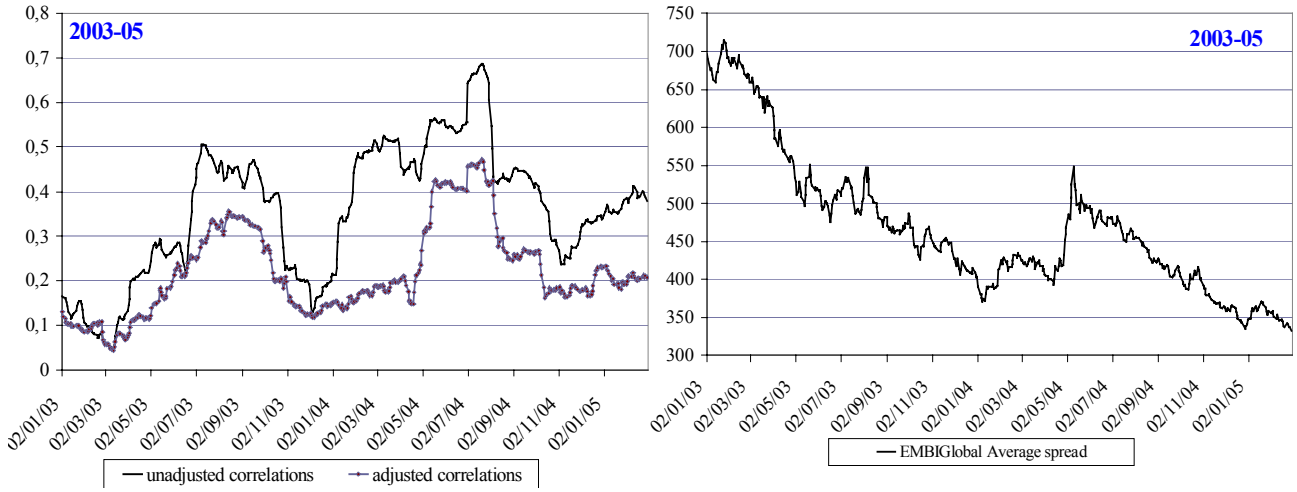
[18] The Federal Reserve raised 8 times, by 25 b.p. the rates of Federal Funds.



Figures 18a-b: Evolution of correlations and spreads during the decrease in US long-term interest rates

13) The period of excess global liquidity in mature markets starting roughly in 2003 is characterized by low spreads and adjusted correlations displaying a mean value around zero over the last three years (with the exception of the peaks in July 2003 in the aftermath of the Iraq war and the rise in oil prices and in July 2004 following the tightening of US monetary policy) indicating a lack of generalized EM comovement and better investors' discrimination (Figures 19a-b). This could be due to the upgrade of some emerging countries of the EMBI Global to investment grade (e.g. Mexico, Bulgaria and Croatia) and to improved macroeconomic fundamentals. Sustained overall growth and strong exports enabled Asian and Latin America countries to record current surpluses, used, in many cases, to pay out the external debt service and to build up foreign reserves. As far as the fiscal stance is concerned, we assist to a reduction of public deficits and to an improvement in the maturity structure and currency composition of the public debt. Many Latin American countries introduced rules designed to enhance fiscal discipline[19]. The increasing gap between the two series of correlations highlights that, at present, the risks of a generalized sell-off stem mainly from global factors, but these risks are moderate compared with previous episodes of market turbulence.

[19] For instance, Chile adopted in 2000 a rule for the structural public surplus of minimum 1 percent of GDP, Brazil introduced in 2000 a law of fiscal responsibility which sets a primary surplus target at each level of the government. Similar regulations have been adopted in 2004 by Colombia, Peru and India (IMF (2004)).



Figures 19a-b: Evolution of correlations and spreads during the period of excess global liquidity

Over the recent period, the EMs became less and less intertwined and at present, the risk of contagion may come mainly from events taking place in mature markets. However, a shock coming from mature markets is likely to affect emerging countries asymmetrically. In particular, the countries most vulnerable to a global negative event are those having huge financial needs, have little fiscal discipline and display large public and external debt structural biases.

Table 10 hereafter summarizes the major trends in spreads and aggregate correlations in the aftermath of the major events taking place during the period under consideration (↗or ↘ indicates that the means are different at 1 percent, ≈ indicates that the means are not significantly different at 10 percent). We find evidence of pure contagion (excess comovement) in the case of the Hong-Kong market crash of October 1997, Russian crisis and LTCM collapse of 1998 and Argentinean banking crisis of 2001. In the wake of these events, the comovement unexplained by the common factors and captured by ρ_{adj} significantly increases to levels superior to the 0.5 threshold.

Potentially systemic events over the period 06/1997- 02/2005	*EMBI Global Spreads (b.p.)*	ρ_{unadj}	ρ_{adj}
- Thai *baht* devaluation (July 2, 1997)	405 ↘ 375.06	0.62 ↘ 0.46	0.22 ≈ 0.23
- Hong Kong stock market collapse (Oct. 20, 1997)	348.5↘ 550.53	0.41 ↗ 0.7	0.25 ↗ 0.51 *pure contagion*
- Russian default (July 17, 1998)	643.2 ↗ 1340	0.56 ↗ 0.71	0.5 ↗ 0.56 *pure contagion*
- Brazilian *real* devaluation (Jan. 15, 1999)	1134 ↗ 1179.5	0.49 ↗ 0.55	0.58 ↘ 0.40
- Argentinean bonds and US HY sell-off (Oct. 2000)	640.47 ↗ 728.37	0.36 ↗ 0.54	0.37 ↗ 0.46 *pure contagion*
- Turkey devaluation (Feb. 22, 2001)	678.5 ↗ 729.5	0.33 ≈ 0.35	0.29 ↘ 0.18
- Argentina banking crisis (July 3, 2001)	709.217↗ 852.87	0.4 ↗ 0.53	0.39 ↗ 0.51 *pure contagion*
- September 11, 2001	847.4 ↗ 942.57	0.55↘ 0.53	0.54↘ 0.46
- Argentinean default and currency crisis (Jan. 3, 2002)	813.6 ↘ 671.5	0.35 ↘ 0.19	0.26 ↘ 0.23
- Brazilian sell-off (mid-June, 2002)	628.3 ↗ 783.17	0.15 ↗ 0.30	0.13 ↗ 0.27
- Brazilian *real* depreciation (End July 2002)	790.43 ↗ 851.67	0.31 ↗ 0.40	0.29 ↗ 0.37
- 10-year US Treasury yield rise End April 2004)	413.53 ↗ 493.17	0.48 ↗ 0.53	0.19 ↗ 0.36
- Decrease in US long term interest rate (Dec. 2004)	374.93 ↘ 355.27	0.28 ↗ 0.35	0.18 ↗ 0.20
- Period of excess global liquidity (from 2003 onwards)	↘	↗	↘

Table 10: Evolution of spreads and correlations following the crisis compared to tranquil times

(30-day window; [T-30, T+30])

5 Implications for policy

After controlling for the major common factors affecting the EM bond returns, we highlighted that the adjusted correlations, as measure of "pure contagion", systematically decline from 1997 through 2005 (Figure 2). At the same time, the widening gap between adjusted and unadjusted average correlations from 2003 onwards suggests that the comovement of EMs returns during the recent period appears to be less specific to particular EMs and driven more by external

events. The risk of "pure" contagion is very low at present. However, the risk of broadly defined contagion may come mainly from events taking place in mature markets.

We also showed that, over the recent period, investors seem to better differentiate between individual emerging countries, as confirmed by decreasing and very low average correlations and spreads. However, some individual pairwise correlations remain high, even during the recent period. For instance, in 2005, the average adjusted correlation of residuals is 0.38 whereas some emerging countries exhibit extremely high pairwise correlations (e.g. 0.78 for Venezuela and Brazil, 0.74 for Brazil and Colombia, Venezuela and Colombia, or 0.7 for Panama and Colombia). This suggests that the distribution of bond returns is not unimodal and that there are underlying groups characterized by high within-group comovement. The opposite evolution of the underlying groups during periods of turbulence in financial markets could then explain the very low levels reached by the aggregate average correlations over the recent period.

Several emerging countries characterized by important maturity mismatches (high share of short-term debt and/or at floating interest rates) could be particularly vulnerable to a global shock, like, for instance the tightening of monetary conditions in industrial countries. From this point of view, Brazil and Turkey hold a share of debt at floating rate of 50 percent and respectively, 40 percent of their total debt, at the end of 2004 (BIS (2005)). Other global risks that may affect EM bonds valuations are shocks in the US-HY market (e.g. the downgrading of Ford and General Motors at the end of 2005) or a rise in oil prices.

Let us briefly review the major measures undertaken in some emerging countries, in the wake of recent financial and sovereign debt crises, in order to reduce their fiscal vulnerability and thus to be perceived as being safer by the market operators. Massive reductions in the debt position have been implemented in Thailand (reduction of 62 percent from 1996 to 2004), Mexico (42 percent), Venezuela (22 percent) and Hungary (20 percent)[20].

As external debt mismatches have been the major aggravating factor of recent international financial crises, considerable efforts have been made to improve the maturity and currency structure of public debt. Countries like Russia, Turkey, Poland, Czech Republic or Mexico took measures to improve the maturity debt structure in order to reduce the vulnerability to international liquidity shocks. Other measures aimed at stabilizing the macroeconomic stance, thus improving investors' confidence, include the issuance of inflation rate-indexed rather than exchange-rate indexed bonds (e.g. in Brazil and Colombia) or fiscal policy regulations setting

[20] IMF Global Financial Stability Report (2006)

targets and limits to several ratios of fiscal vulnerability (e.g. in Brazil and Poland). Measures of active public debt management have also been undertaken, such the use of excess foreign reserves to buy back the external debt (e.g. Brazil in 2006), debt currency swaps (e.g. Mexico in 2005) or public borrowing in domestic currency in international markets (e.g. Colombia in 2004 or Brazil in 2005).

A more flexible exchange rate could increase resilience to external shocks, but at the same time, the move toward greater flexibility requires the presence of derivative markets to hedge the underlined exchange rate risk. The credibility of the public sector in international capital markets can be enhanced through the adoption of an inflation-targeting framework that could also help mitigating the maturity and currency mismatches of public debt. Recent measures in order to diversify the investors' base, thus making it more stable in case of panic, need also be encouraged.

Improvements in the supervision and regulation of domestic banking sectors may indirectly impact on investors' behaviour in emerging bond markets. Indeed, the presence of implicit or explicit guarantees on bank deposits is likely to deteriorate the fiscal stance in the wake of a banking crisis. Measures aimed at controlling currency and maturity mismatches of the private sector debt could also lead to a reduction in the fiscal vulnerability and thus improve market perception of the public debt sustainability.

Finally, the financial markets regulatory framework should be strengthened in order to allow greater transparency of financial and macroeconomic data. Global investors will therefore be less likely to sell off all EM bonds during turbulent times, independently of the quality of their macroeconomic fundamentals.

6 Conclusion

The crises taking place in the 1990s heightened the interest for contagion and systemic risk. In this paper we assessed the respective part of common external factors and market behaviour in explaining comovements in emerging bond returns. Our analysis of emerging debt market was motivated by the fact that this market has been the main source of financing to EMs from the beginning of 1990 onwards, characterized by large fluctuations in the wake of external shocks and shifts in market behaviour.

We have developed a conceptual framework based on the evolution of EM spreads and aggregate correlations in order to characterize investors' attitudes towards risk in EM, highlight the

potential sources of risks to the EM class and distinguish between external and country specific-driven comovement.

This conceptual framework was then applied to a sample of 18 out of 33 emerging countries initially included in the EMBI Global Index from March 1997 through February 2005. In order to disentangle the roles of 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 Treasury Bill returns for a maturity compatible with that of bonds included in the EMBI Global, a composite index of US stock market as a proxy for the stock market portfolio (SPX-Index) and a US High Yield corporate sector index (JOAO Index). The correlation coefficients of residuals are a measure of the excess comovement of emerging bond markets, comovement unexplained by common external factors and generally attributed to market behaviour. We found evidence of such excess comovement in the case of the Hong-Kong market crash of October 1997, the Russian crisis and LTCM collapse of 1998 and the Argentinean banking crisis of 2001.

Our analysis puts into light that, over the recent period, EMs became less and less intertwined and that at present, the risk of contagion may come mainly from events taking place in mature markets. Nevertheless, the links between EMs seem to weaken over the recent period. Their comovement becomes less and less specific and mainly driven by global events taking place in mature markets. At present, contagion risks, even lower compared to previous crisis episodes, may mainly come from shocks affecting mature markets.

Finally, policy recommendations may be derived from EMs past experience in order to reduce their debt variability thus making them less vulnerable to a shock that takes place in mature markets. Sound macroeconomic policies, in particular, prudent fiscal ones, could enhance government discipline and limit the spillover effects in a wake of a global shock or of a shock affecting another emerging country.

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APPENDIX 1

	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&Africa	*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+.

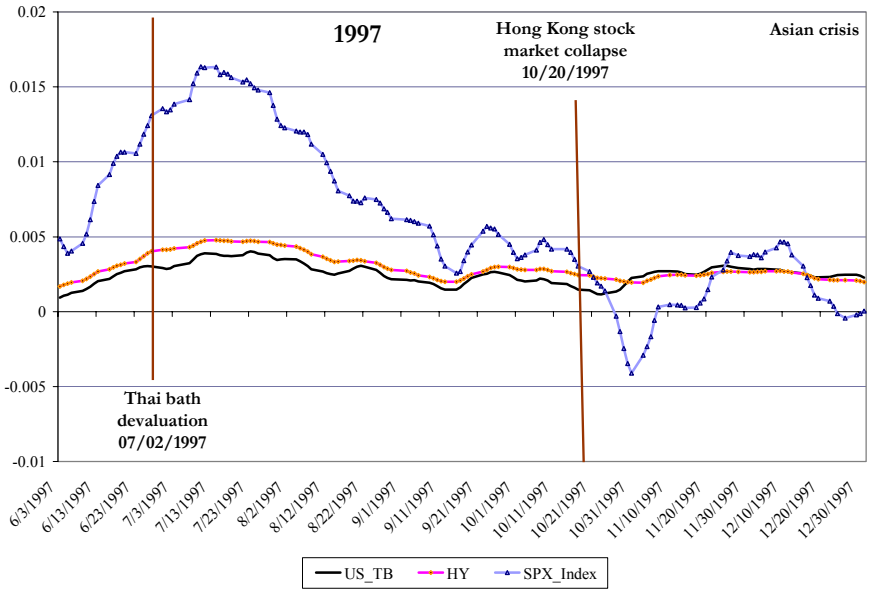
Source: JPMorgan Methodology Brief "Introducing the JP Morgan Emerging Bond Index Global", 1999.

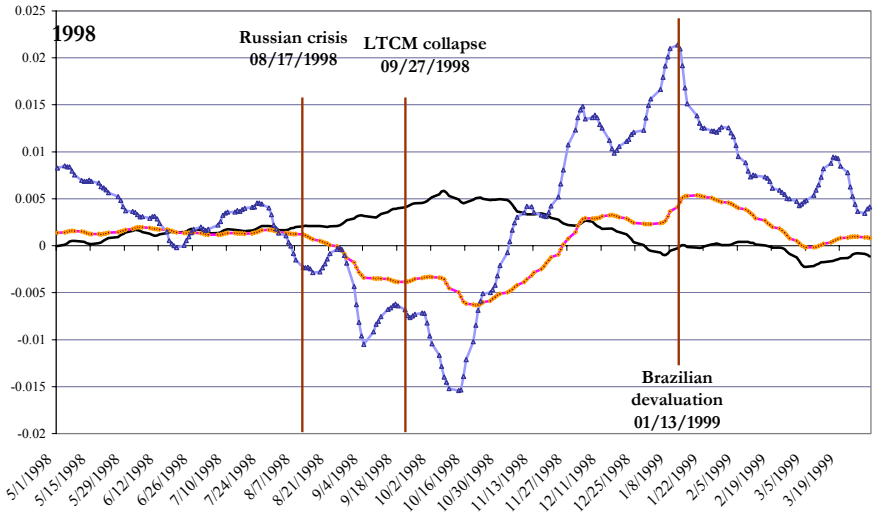
i) The total return from one trading day to the next, on a single instrument included in the EMBI global takes into account the bond price and the coupon payment (or/and amortization if applicable) according to the following relation: $TR_t = \frac{ESV_{s(t)} + C_{v(t)} + AM_t}{ESV_{s(t-1)}} - 1$, where $ESV_{s(t)}$ 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. 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: $R_i = R_{k-1} + \left(\frac{R_n - R_{k-1}}{n-k+1}\right) \cdot (i-k+1)$

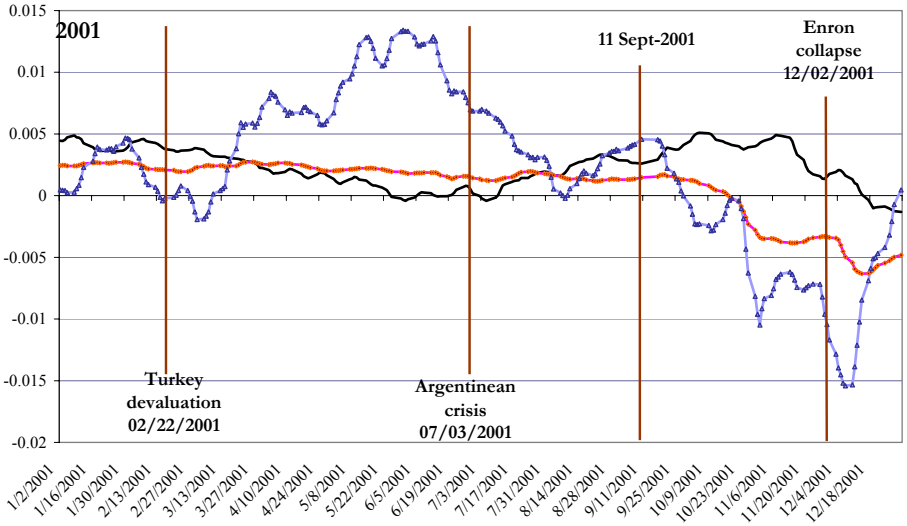
ii) SPX Index stands for Standard & Poor`s 500 (S&P500) Composite Stock Price Index which serves as a common yardstick against which all US stock performance is measured. It is especially used to compare and evaluate the performance of institutional portfolios and has become one of the US Department 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.

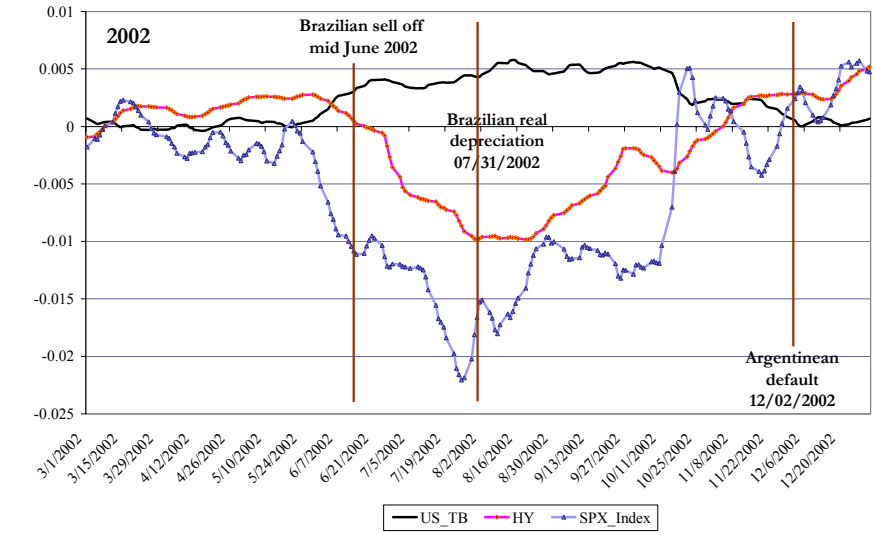
APPENDIX 2

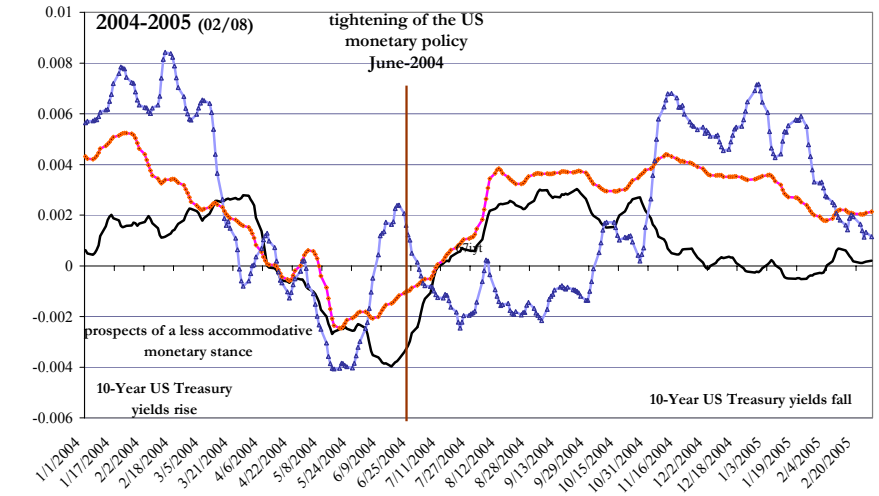
Evolution of the global factors (60-day rolling average)



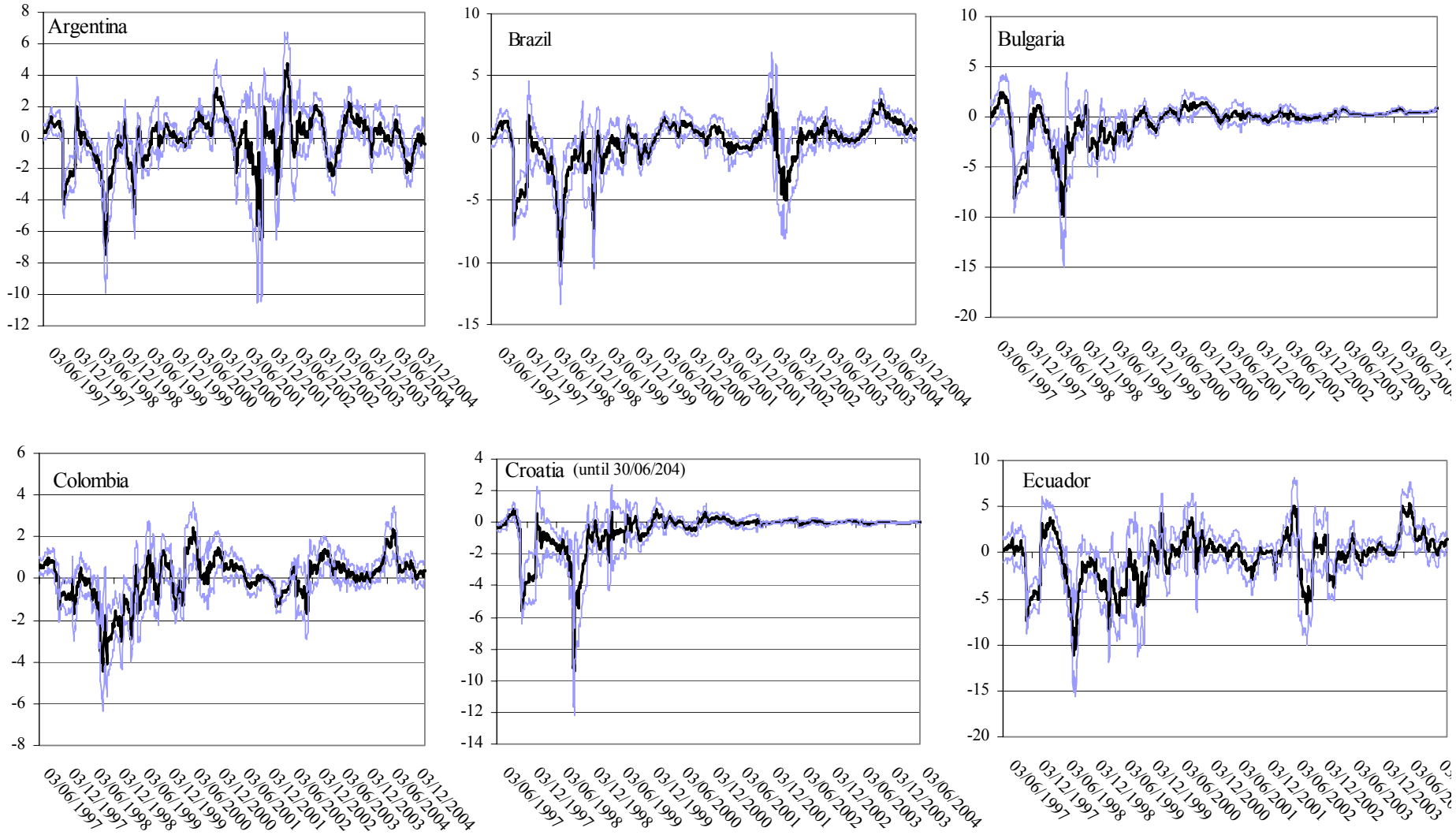




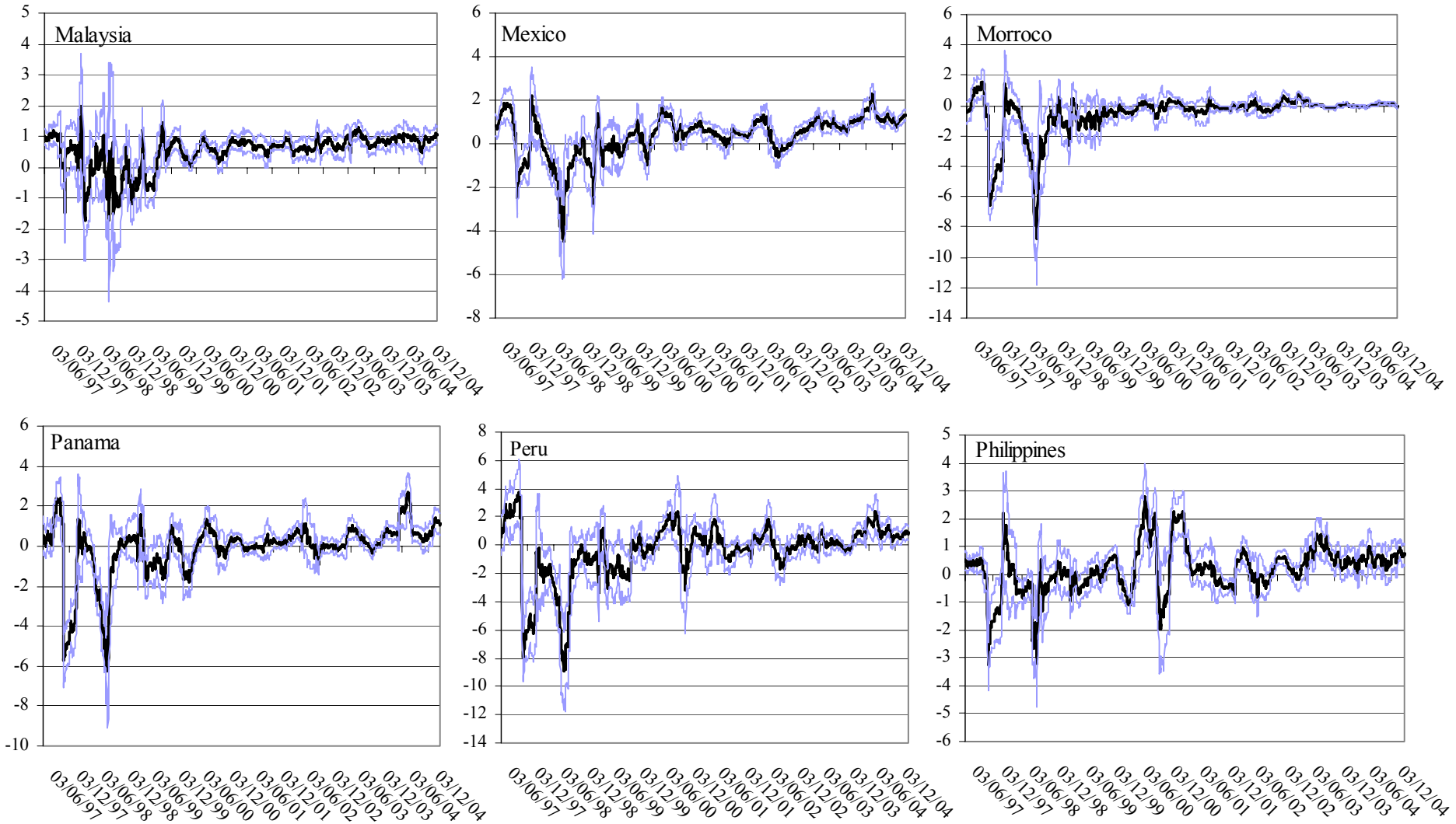




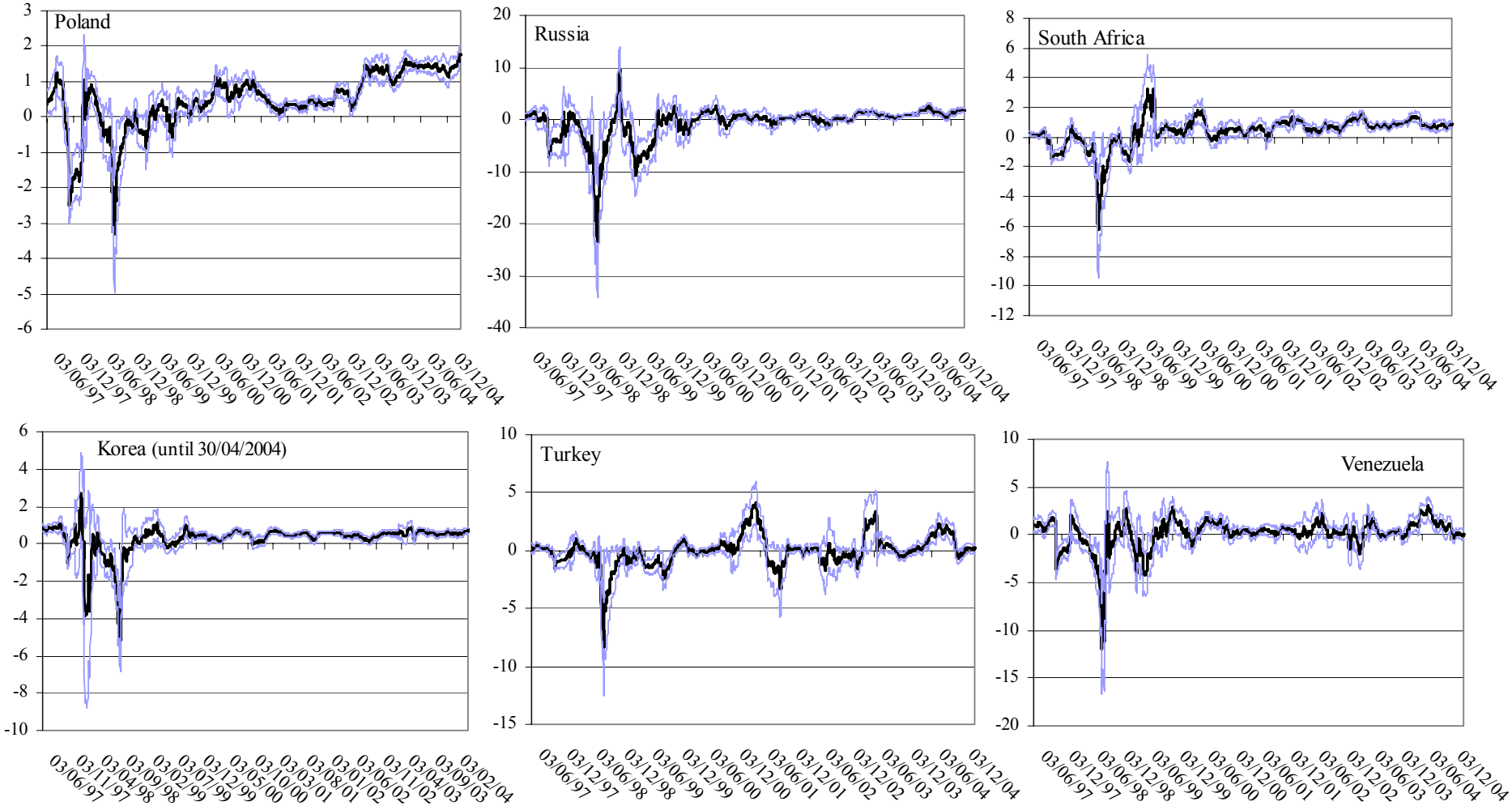
APPENDIX 3



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

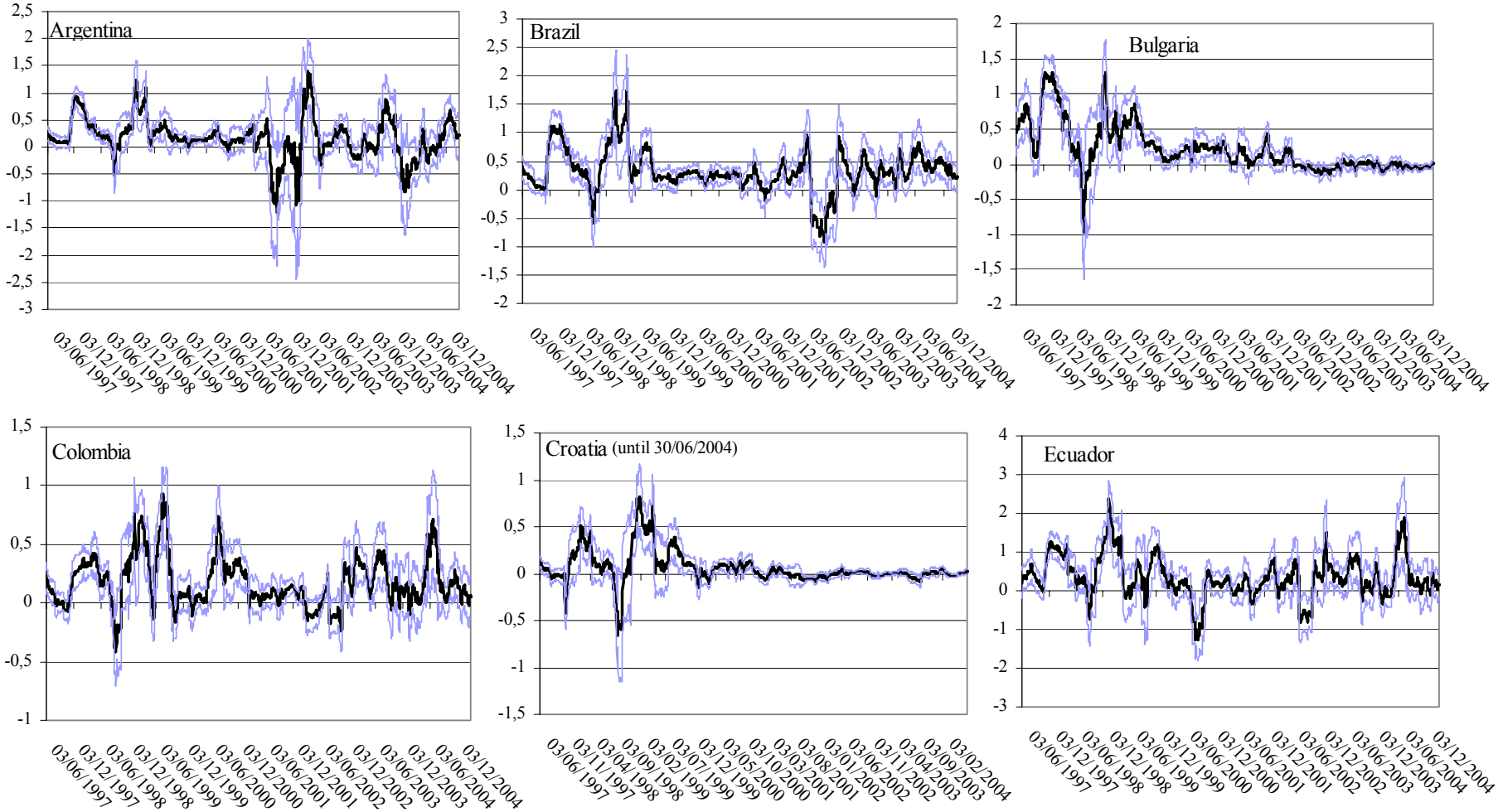


US_TB5-7Y coefficient estimates (95% confidence interval) - 5day Returns

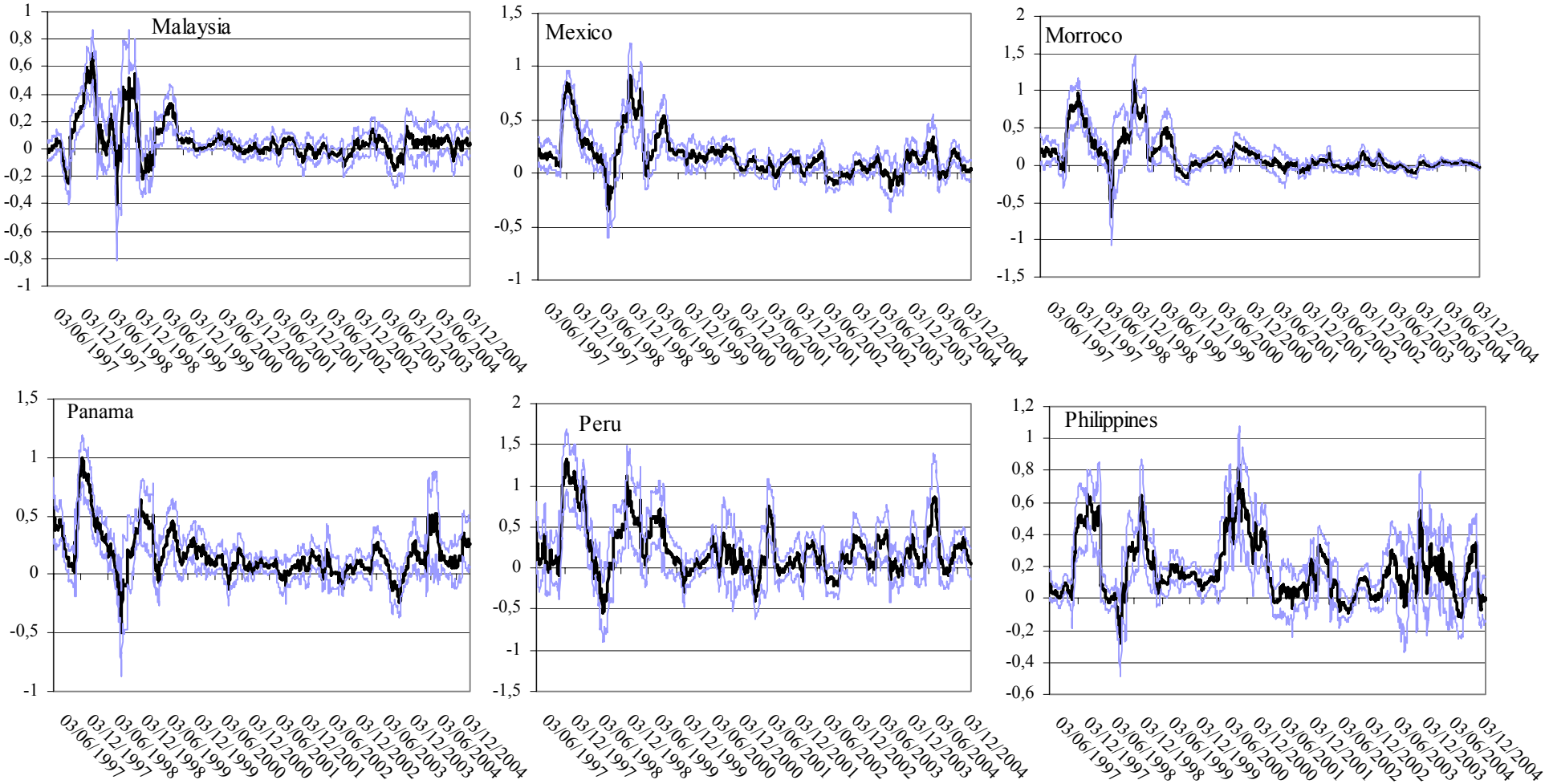


US_TB5-7Y coefficient estimates (95% confidence interval) - 5day Returns

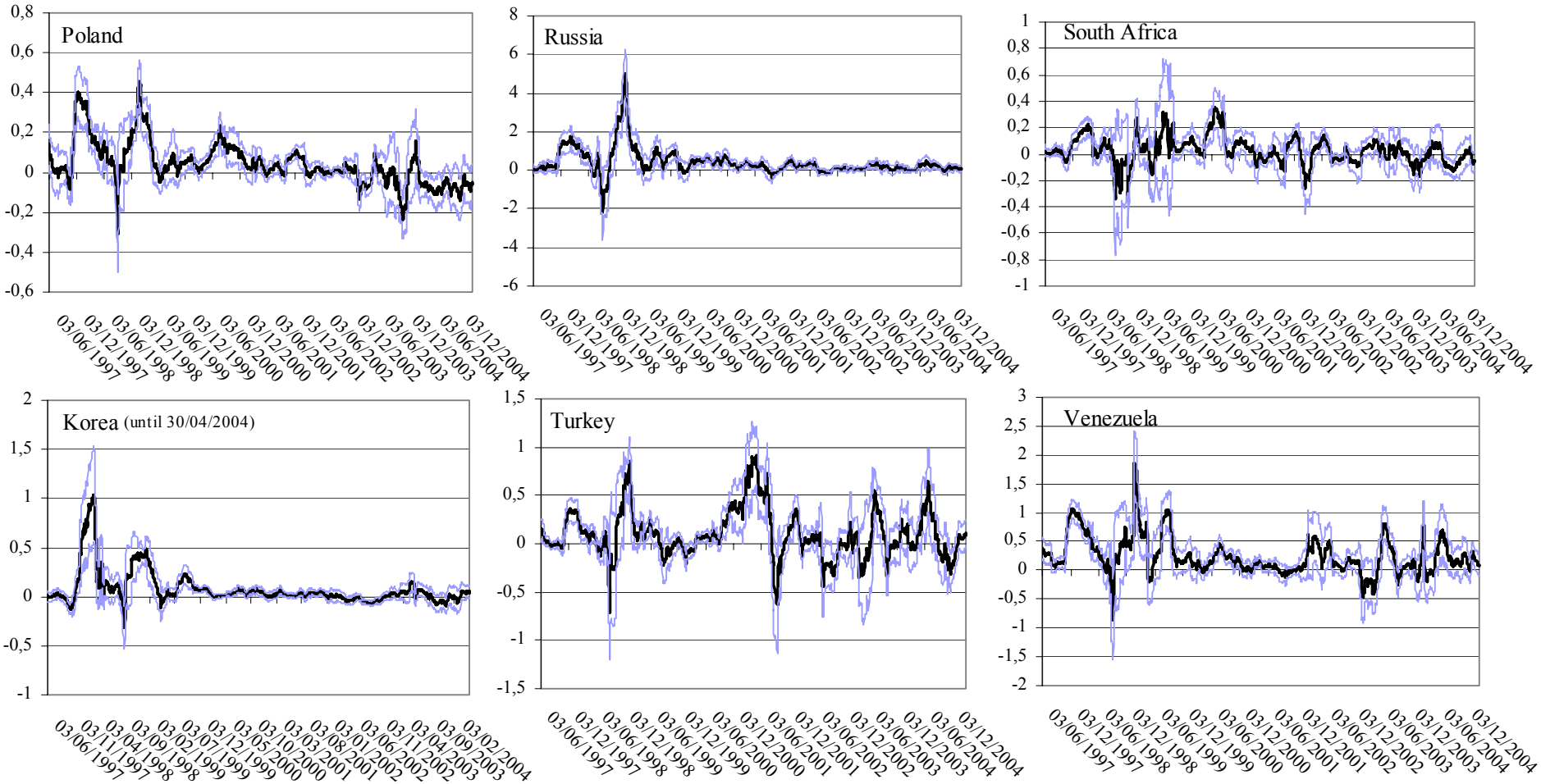
APPENDIX 4



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

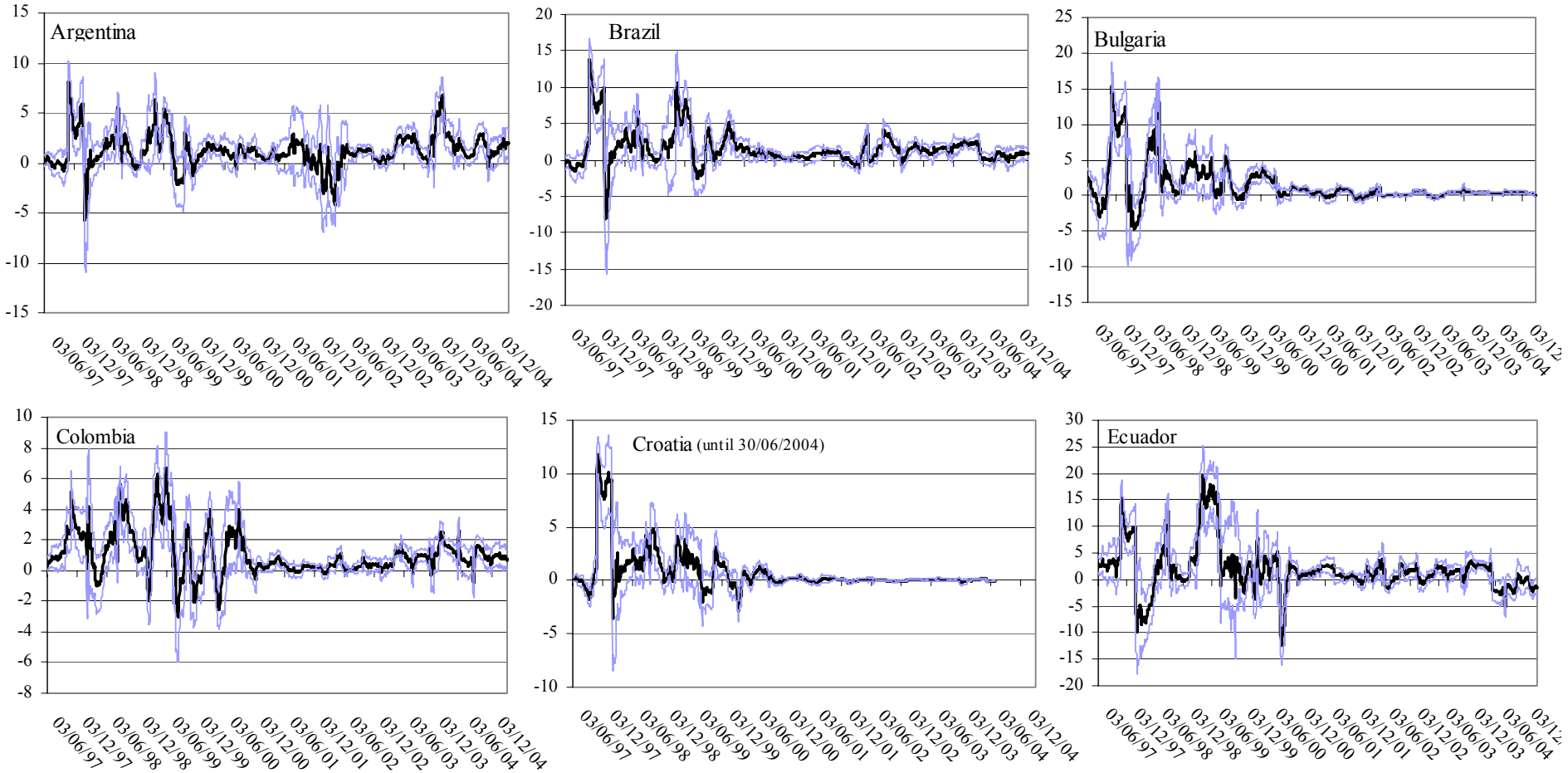


SPX-Index coefficient estimates (95% confidence interval) - 5day Returns

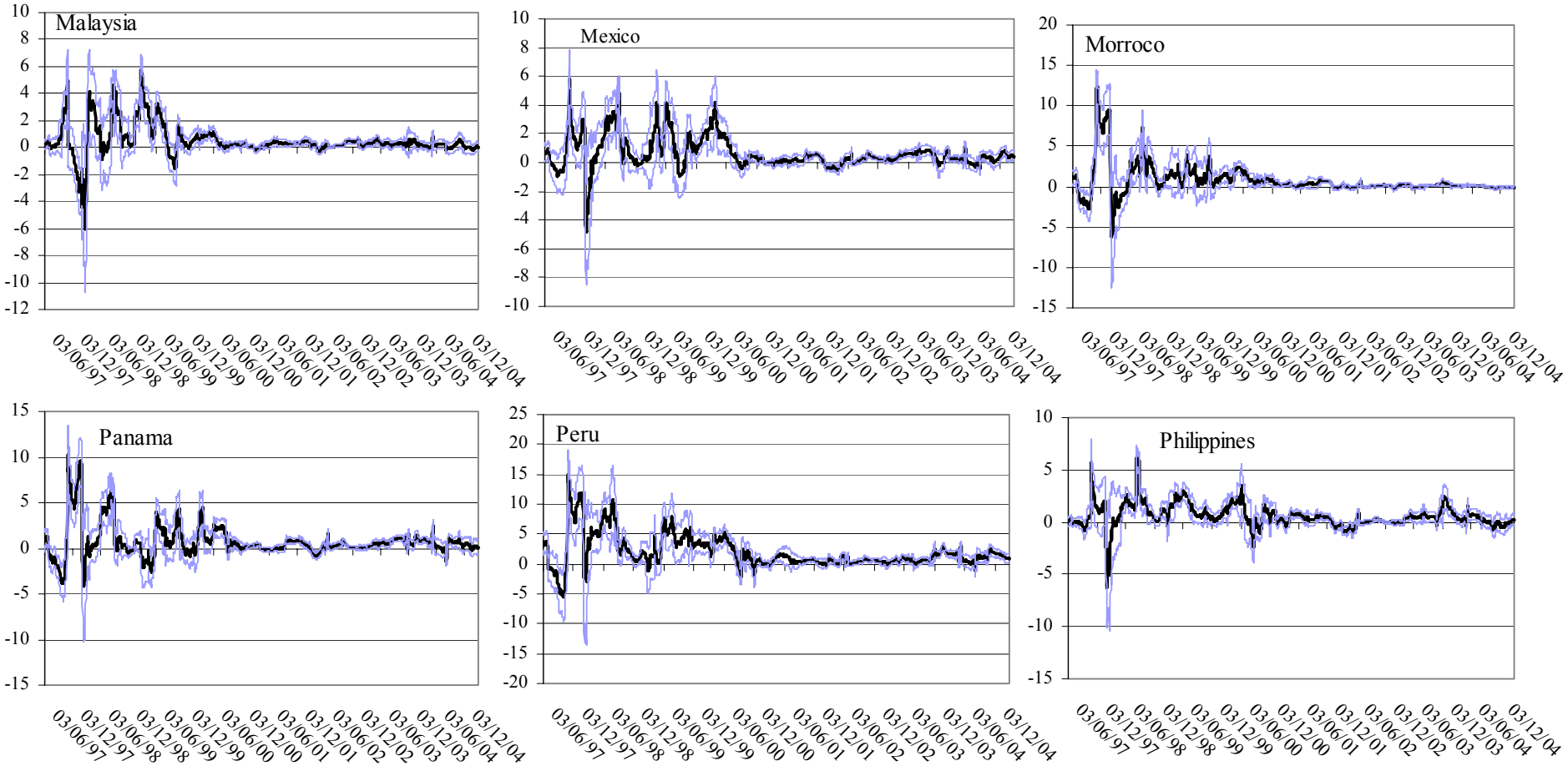


SPX-Index coefficient estimates (95% confidence interval) - 5day Returns

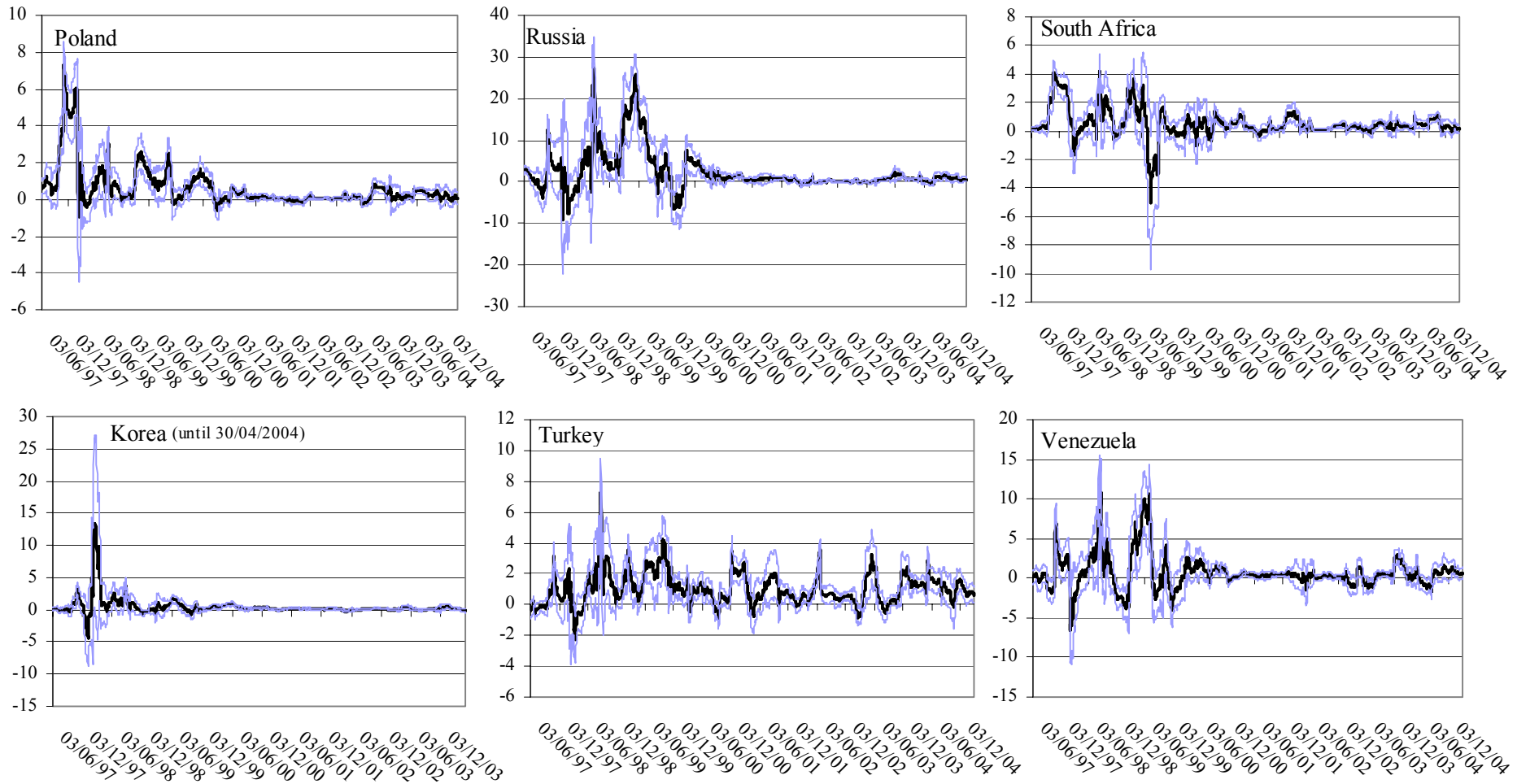
APPENDIX 5



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



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



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

APPENDIX 6

Residual correlation matrixes (adjusted returns), rolling regressions over a 60-day window, 5-day returns

1997	Argentina	Brazil	Bulgaria	Colombia	Croatia	Ecuador	Malaysia	Mexico	Morocco	Panama	Peru	Philippines	Poland	Russia	South Africa	South Korea	Turkey
Brazil	0,80																
Bulgaria	0,56	0,57															
Colombia	0,42	0,42	0,28														
Croatia	0,38	0,42	0,35	0,35													
Ecuador	0,65	0,61	0,61	0,14	0,19												
Malaysia	0,14	0,05	0,26	0,16	-0,05	0,31											
Mexico	0,79	0,74	0,63	0,46	0,34	0,55	0,23										
Morocco	0,66	0,52	0,49	0,35	0,47	0,45	0,17	0,53									
Panama	0,44	0,41	0,42	0,11	0,38	0,38	0,05	0,44	0,54								
Peru	0,60	0,59	0,52	0,25	0,47	0,47	0,16	0,53	0,47	0,55							
Philippines	0,30	0,19	0,24	0,24	0,24	0,18	0,34	0,32	0,23	0,29	0,21						
Poland	0,39	0,43	0,39	0,51	0,42	0,19	0,19	0,44	0,37	0,14	0,35	0,22					
Russia	0,58	0,55	0,57	0,35	0,38	0,38	0,04	0,51	0,52	0,31	0,57	0,21	0,39				
South Africa	0,20	0,28	0,16	0,38	0,13	0,25	0,19	0,28	0,33	0,31	0,18	0,09	0,35	0,13			
South Korea	0,20	0,23	0,26	0,22	0,16	0,31	0,67	0,23	0,26	0,09	0,17	0,43	0,19	0,18	0,27		
Turkey	0,21	0,08	-0,04	0,28	0,23	0,06	0,17	0,12	0,24	0,33	0,25	0,23	0,18	0,07	0,38	0,03	
Venezuela	0,63	0,64	0,28	0,37	0,34	0,42	0,06	0,60	0,52	0,57	0,63	0,23	0,28	0,42	0,31	0,18	0,30

$\rho_{adj} < 0$
$0 \le \rho_{adj} < 0,4$
$0,4 \le \rho_{adj} < 0,7$
$0,7 \le \rho_{adj} < 1$

1998	Argentina	Brazil	Bulgaria	Colombia	Croatia	Ecuador	Malaysia	Mexico	Morocco	Panama	Peru	Philippines	Poland	Russia	South Africa	South Korea	Turkey
Brazil	0,90																
Bulgaria	0,82	0,79															
Colombia	0,37	0,38	0,41														
Croatia	0,59	0,62	0,56	0,47													
Ecuador	0,80	0,85	0,81	0,40	0,56												
Malaysia	0,19	0,31	0,14	0,28	0,24	0,29											
Mexico	0,89	0,85	0,78	0,38	0,55	0,80	0,19										
Morocco	0,86	0,82	0,77	0,32	0,59	0,74	0,13	0,72									
Panama	0,80	0,80	0,73	0,32	0,50	0,74	0,09	0,81	0,76								
Peru	0,69	0,74	0,64	0,43	0,53	0,70	0,30	0,68	0,68	0,70							
Philippines	0,53	0,51	0,48	0,30	0,35	0,52	0,38	0,52	0,49	0,48	0,47						
Poland	0,73	0,63	0,71	0,33	0,51	0,58	-0,01	0,67	0,68	0,64	0,53	0,39					
Russia	0,69	0,76	0,75	0,33	0,56	0,72	0,16	0,69	0,66	0,65	0,62	0,42	0,64				
South Africa	0,45	0,43	0,46	0,25	0,49	0,41	-0,03	0,37	0,48	0,44	0,38	0,25	0,47	0,44			
South Korea	0,45	0,43	0,39	0,24	0,22	0,35	0,22	0,34	0,41	0,39	0,20	0,46	0,29	0,29	0,15		
Turkey	0,49	0,48	0,53	0,25	0,28	0,44	-0,06	0,49	0,47	0,54	0,42	0,19	0,57	0,52	0,41	0,19	
Venezuela	0,76	0,71	0,68	0,30	0,47	0,72	0,15	0,74	0,75	0,73	0,73	0,56	0,53	0,60	0,41	0,33	0,39

$\rho_{adj} < 0$
$0 \le \rho_{adj} < 0,4$
$0,4 \le \rho_{adj} < 0,7$
$0,7 \le \rho_{adj} < 1$

1999

	Argentina	Brazil	Bulgaria	Colombia	Croatia	Ecuador	Malaysia	Mexico	Morocco	Panama	Peru	Philippines	Poland	Russia	South Africa	South Korea	Turkey
Brazil	0,75																
Bulgaria	0,41	0,49															
Colombia	0,46	0,59	0,30														
Croatia	0,25	0,25	0,49	0,19													
Ecuador	0,33	0,45	0,30	0,41	0,15												
Malaysia	0,22	0,13	0,32	-0,11	0,26	-0,04											
Mexico	0,80	0,74	0,43	0,42	0,21	0,39	0,22										
Morocco	0,54	0,54	0,60	0,32	0,35	0,23	0,31	0,53									
Panama	0,59	0,58	0,41	0,47	0,15	0,34	0,13	0,68	0,44								
Peru	0,55	0,62	0,41	0,51	0,02	0,45	0,04	0,65	0,45	0,65							
Philippines	0,36	0,42	0,36	0,18	0,29	0,29	0,40	0,45	0,42	0,30	0,35						
Poland	0,49	0,51	0,39	0,42	0,27	0,22	0,04	0,55	0,37	0,47	0,35	0,26					
Russia	0,10	0,16	0,24	0,05	0,34	0,29	0,01	0,16	0,13	0,20	0,05	0,25	0,23				
South Africa	0,25	0,19	0,34	0,26	0,14	0,11	0,06	0,25	0,23	0,26	0,12	0,11	0,33	0,03			
South Korea	0,24	0,19	0,25	-0,04	0,23	0,02	0,60	0,36	0,36	0,25	0,16	0,58	0,22	0,20	0,02		
Turkey	0,17	0,18	0,24	0,12	0,05	0,18	0,06	0,17	0,18	0,24	0,11	0,06	0,08	0,03	0,28	-0,09	
Venezuela	0,57	0,58	0,36	0,40	0,15	0,42	0,06	0,61	0,44	0,42	0,47	0,34	0,38	0,19	0,23	0,27	0,15

$\rho_{adj} < 0$
$0 \leq \rho_{adj} < 0,4$
$0,4 \leq \rho_{adj} < 0,7$
$0,7 \leq \rho_{adj} < 1$

2000

	Argentina	Brazil	Bulgaria	Colombia	Croatia	Ecuador	Malaysia	Mexico	Morocco	Panama	Peru	Philippines	Poland	Russia	South Africa	South Korea	Turkey
Brazil	0,70																
Bulgaria	0,34	0,58															
Colombia	0,45	0,60	0,42														
Croatia	0,13	0,14	0,30	0,06													
Ecuador	0,20	0,31	0,21	0,18	0,02												
Malaysia	0,33	0,43	0,37	0,25	0,13	0,17											
Mexico	0,57	0,67	0,47	0,45	0,11	0,38	0,35										
Morocco	0,38	0,35	0,36	0,14	0,31	0,15	0,36	0,23									
Panama	0,46	0,67	0,50	0,51	0,09	0,27	0,27	0,56	0,15								
Peru	0,44	0,52	0,48	0,36	0,17	0,28	0,32	0,37	0,32	0,42							
Philippines	0,50	0,46	0,39	0,16	0,01	0,13	0,54	0,44	0,33	0,35	0,36						
Poland	0,45	0,46	0,31	0,33	0,08	0,37	0,25	0,45	0,35	0,39	0,36	0,30					
Russia	0,45	0,56	0,55	0,37	0,34	0,24	0,28	0,47	0,33	0,56	0,55	0,41	0,37				
South Africa	0,34	0,39	0,34	0,24	0,34	0,30	0,21	0,33	0,36	0,29	0,44	0,15	0,31	0,29			
South Korea	0,27	0,37	0,33	0,14	0,06	0,16	0,79	0,37	0,25	0,27	0,28	0,62	0,28	0,29	0,12		
Turkey	0,37	0,35	0,25	0,27	0,29	0,29	0,23	0,43	0,17	0,23	0,37	0,30	0,32	0,41	0,10	0,22	
Venezuela	0,56	0,66	0,44	0,42	0,11	0,28	0,37	0,52	0,28	0,45	0,44	0,41	0,33	0,45	0,41	0,37	0,15

$\rho_{adj} < 0$
$0 \leq \rho_{adj} < 0,4$
$0,4 \leq \rho_{adj} < 0,7$
$0,7 \leq \rho_{adj} < 1$

2001

	Argentina	Brazil	Bulgaria	Colombia	Croatia	Ecuador	Malaysia	Mexico	Morocco	Panama	Peru	Philippines	Poland	Russia	South Africa	South Korea	Turkey
Brazil	0,79																
Bulgaria	0,56	0,60															
Colombia	0,43	0,42	0,31														
Croatia	0,31	0,28	0,36	0,11													
Ecuador	0,50	0,55	0,38	0,36	0,40												
Malaysia	0,29	0,20	0,13	0,21	0,40	0,30											
Mexico	0,61	0,69	0,52	0,39	0,30	0,49	0,35										
Morocco	0,46	0,42	0,66	0,20	0,27	0,31	0,22	0,49									
Panama	0,54	0,62	0,52	0,36	0,30	0,40	0,23	0,62	0,55								
Peru	0,44	0,57	0,50	0,43	0,09	0,52	0,21	0,41	0,32	0,45							
Philippines	0,33	0,42	0,44	0,32	0,15	0,31	0,16	0,49	0,35	0,40	0,36						
Poland	0,24	0,29	0,45	0,36	0,10	0,22	0,07	0,41	0,26	0,19	0,26	0,23					
Russia	0,57	0,70	0,69	0,40	0,41	0,55	0,18	0,72	0,50	0,19	0,54	0,48	0,35				
South Africa	0,36	0,28	0,39	0,31	0,28	0,26	0,15	0,32	0,28	0,32	0,21	0,26	0,44	0,42			
South Korea	0,18	0,11	0,11	0,04	0,04	0,11	0,58	0,26	0,15	0,12	0,14	0,21	0,06	0,09	0,02		
Turkey	0,35	0,36	0,46	0,27	0,16	0,40	0,12	0,43	0,23	0,28	0,31	0,27	0,39	0,54	0,34	0,09	
Venezuela	0,64	0,66	0,51	0,40	0,30	0,56	0,12	0,64	0,50	0,67	0,44	0,40	0,17	0,70	0,30	0,16	0,28

$\rho_{adj} < 0$
$0 \le \rho_{adj} < 0,4$
$0,4 \le \rho_{adj} < 0,7$
$0,7 \le \rho_{adj} < 1$

2002

	Argentina	Brazil	Bulgaria	Colombia	Croatia	Ecuador	Malaysia	Mexico	Morocco	Panama	Peru	Philippines	Poland	Russia	South Africa	South Korea	Turkey
Brazil	0,29																
Bulgaria	0,03	0,51															
Colombia	0,11	0,40	0,20														
Croatia	0,11	0,08	0,29	0,03													
Ecuador	0,17	0,59	0,32	0,36	0,31												
Malaysia	-0,04	0,11	0,05	-0,05	0,31	0,10											
Mexico	0,28	0,70	0,51	0,41	0,19	0,47	0,06										
Morocco	0,29	0,28	0,15	0,15	0,13	0,17	0,10	0,29									
Panama	0,26	0,46	0,29	0,32	0,00	0,34	0,07	0,46	0,18								
Peru	0,09	0,53	0,39	0,35	0,04	0,51	-0,02	0,45	0,18	0,40							
Philippines	0,09	0,38	0,25	0,07	0,00	0,38	0,06	0,40	0,24	0,35	0,30						
Poland	0,27	0,07	0,13	0,08	0,13	0,13	-0,15	0,16	0,18	0,10	0,12	0,04					
Russia	0,24	0,63	0,59	0,24	0,20	0,56	-0,01	0,63	0,35	0,10	0,43	0,48	0,21				
South Africa	0,26	0,18	0,18	0,12	0,10	0,21	0,09	0,26	0,19	0,19	0,18	0,08	0,36	0,39			
South Korea	0,01	0,08	-0,07	-0,05	-0,03	0,02	0,76	0,05	0,13	0,15	-0,05	0,11	-0,12	0,07	0,04		
Turkey	0,12	0,40	0,37	0,11	0,20	0,37	0,00	0,39	0,28	0,28	0,41	0,35	0,15	0,54	0,20	0,02	
Venezuela	0,24	0,53	0,27	0,31	0,10	0,39	0,06	0,40	0,28	0,36	0,34	0,22	0,08	0,43	0,14	0,11	0,37

$\rho_{adj} < 0$
$0 \le \rho_{adj} < 0,4$
$0,4 \le \rho_{adj} < 0,7$
$0,7 \le \rho_{adj} < 1$

2003

	Argentina	Brazil	Bulgaria	Colombia	Croatia	Ecuador	Malaysia	Mexico	Morocco	Panama	Peru	Philippines	Poland	Russia	South Africa	South Korea	Turkey
Brazil	0,17																
Bulgaria	0,18	0,21															
Colombia	0,11	0,60	0,15														
Croatia	0,06	0,05	0,32	0,03													
Ecuador	0,15	0,40	0,20	0,37	0,07												
Malaysia	0,02	0,07	0,15	-0,02	0,05	0,06											
Mexico	0,08	0,56	0,10	0,50	0,15	0,26	0,02										
Morocco	-0,04	0,16	0,18	0,08	0,11	-0,05	-0,01	0,13									
Panama	0,22	0,39	0,12	0,49	0,01	0,27	-0,06	0,39	0,06								
Peru	0,18	0,58	0,31	0,60	0,11	0,47	0,07	0,53	0,04	0,49							
Philippines	0,15	0,29	0,10	0,16	0,01	0,30	0,43	0,23	-0,10	0,10	0,24						
Poland	0,02	0,02	0,17	-0,11	0,12	0,11	0,01	0,22	0,13	0,06	0,01	0,03					
Russia	0,16	0,40	0,46	0,38	0,25	0,46	0,12	0,31	0,18	0,21	0,43	0,15	0,26				
South Africa	0,02	0,25	0,35	0,25	0,23	0,28	0,10	0,32	0,15	0,24	0,34	0,10	0,44	0,40			
South Korea	0,09	0,04	0,13	0,06	0,07	0,06	0,85	-0,03	0,04	-0,07	0,09	0,34	-0,05	0,08	0,12		
Turkey	-0,02	0,31	0,05	0,21	0,02	0,34	0,11	0,28	0,16	0,08	0,23	0,23	0,23	0,40	0,26	0,14	
Venezuela	-0,08	0,40	0,14	0,26	0,11	0,25	-0,04	0,34	0,08	0,10	0,21	0,11	0,08	0,27	0,12	0,00	0,42

$\rho_{adj} < 0$
$0 \leq \rho_{adj} < 0,4$
$0,4 \leq \rho_{adj} < 0,7$
$0,7 \leq \rho_{adj} < 1$

2004

	Argentina	Brazil	Bulgaria	Colombia	Croatia	Ecuador	Malaysia	Mexico	Morocco	Panama	Peru	Philippines	Poland	Russia	South Africa	South Korea	Turkey
Brazil	0,06																
Bulgaria	-0,18	0,19															
Colombia	0,19	0,66	0,40														
Croatia	0,02	0,06	-0,05	0,01													
Ecuador	-0,01	0,58	0,31	0,49	0,17												
Malaysia	-0,07	0,25	0,21	0,26	-0,09	0,20											
Mexico	0,11	0,48	0,45	0,64	-0,09	0,40	0,33										
Morocco	-0,02	0,14	0,11	0,08	-0,01	-0,02	0,07	0,13									
Panama	0,15	0,41	0,41	0,61	-0,06	0,38	0,29	0,63	0,00								
Peru	0,06	0,51	0,41	0,68	0,08	0,36	0,26	0,69	0,16	0,68							
Philippines	0,15	0,41	0,16	0,50	-0,11	0,30	0,46	0,36	0,01	0,38	0,44						
Poland	-0,18	0,10	0,44	0,11	-0,20	0,06	0,17	0,20	-0,08	0,20	0,10	0,06					
Russia	0,13	0,48	0,47	0,56	0,00	0,36	0,38	0,59	0,12	0,53	0,54	0,35	0,25				
South Africa	-0,05	0,29	0,56	0,48	-0,16	0,17	0,23	0,44	0,02	0,51	0,40	0,19	0,49	0,40			
South Korea	0,32	0,16	0,07	0,22	0,11	0,15	0,59	0,18	0,11	0,16	0,19	0,22	-0,06	0,16	0,04		
Turkey	0,18	0,52	0,36	0,52	0,13	0,43	0,29	0,39	0,09	0,43	0,49	0,42	0,09	0,55	0,33	0,11	
Venezuela	0,14	0,67	0,28	0,63	0,02	0,59	0,23	0,46	0,07	0,40	0,47	0,50	0,02	0,56	0,18	0,17	0,48

$\rho_{adj} < 0$
$0 \leq \rho_{adj} < 0,4$
$0,4 \leq \rho_{adj} < 0,7$
$0,7 \leq \rho_{adj} < 1$

2005	Argentine	Brazil	Bulgaria	Colombia	Ecuador	Malaysia	Mexico	Morocco	Panama	Peru	Philippines	Poland	Russia	South Africa	Turkey
Brazil	0,09														
Bulgaria	0,13	0,04													
Colombia	0,11	0,74	0,22												
Ecuador	-0,03	0,68	0,06	0,51											
Malaysia	0,05	0,06	-0,04	-0,03	0,31										
Mexico	0,10	0,48	0,41	0,47	0,44	0,21									
Morocco	0,24	0,13	0,08	-0,07	0,20	0,07	0,36								
Panama	0,20	0,66	0,20	0,70	0,32	0,16	0,34	-0,13							
Peru	0,06	0,68	-0,11	0,48	0,35	0,10	0,22	-0,01	0,54						
Philippines	0,22	0,09	0,00	-0,20	0,20	0,39	0,16	0,26	-0,12	0,00					
Poland	-0,10	-0,18	0,66	0,10	-0,15	-0,14	0,29	0,04	0,00	-0,18	-0,16				
Russia	0,36	0,26	0,51	0,27	0,37	0,41	0,57	0,25	0,42	-0,03	0,20	0,24			
South Africa	0,16	-0,30	0,42	-0,07	-0,23	-0,07	0,03	0,25	-0,18	-0,21	-0,21	0,63	0,13		
Turkey	0,29	0,44	0,38	0,54	0,34	0,16	0,37	0,21	0,57	0,44	0,00	0,17	0,39	0,19	
Venezuela	0,04	0,78	0,08	0,74	0,68	-0,08	0,40	0,13	0,52	0,57	-0,23	-0,10	0,13	-0,11	0,48

$\rho_{adj} < 0$

$0 \leq \rho_{adj} < 0,4$

$0,4 \leq \rho_{adj} < 0,7$

$0,7 \leq \rho_{adj} < 1$