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EMERGING MARKETS' SPREADS AND GLOBAL FINANCIAL CONDITIONS

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Abstract

In this article, we analyse how much of the reduction in emerging markets spreads can be ascribed to specific factors - linked to the improvement in the 'fundamentals' of a given country - rather than to common factors - linked to global liquidity conditions and agents' degree of risk aversion. By means of factor analysis, we find that a single common factor is able to explain a large part of the co-variation in emerging market economies' spreads observed in the last four years; in turn, this common factor can be traced back mainly to financial market volatility. Due to the particularly benign global financial conditions of recent years, spreads seem to have declined to below the levels warranted by improved fundamentals. As a consequence, EMEs do remain vulnerable to sudden shifts in financial market conditions.

JEL Classification numbers: C10, C22, F34, G15
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Contents

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"(...) Narrow credit spreads, like other financial market prices, may partly reflect the low overall level of volatility in financial asset prices in recent years. Any increase in actual or expected market volatility could thus lead to wider spreads by raising the risk premia demanded by investors (...)" [1]

1. Introduction [2]

Spreads between foreign-currency denominated bonds issued by emerging market economies (EMEs) and equivalent bonds issued by advanced countries have been declining over the last four years, reaching the lowest levels since the onset of the Asian banking and financial crises in 1997. Two sets of motivations have been considered to be at the root of the phenomenon under scrutiny, i.e. the favourable conditions in global financial markets and the improvement in EMEs' macroeconomic 'fundamentals'.

In this article, we seek to analyse how much of the observed reduction in EMEs' spreads can be ascribed to specific - or 'pull' - factors, linked to the improvement in the 'fundamentals' of a given country, rather than to common - or 'push' - factors, linked to developments in financial markets and global liquidity conditions. In our opinion, finding an answer to this question is relevant not only from a research perspective *per se* but also, and above all, from a policy standpoint. In fact, if the observed compression were attributed essentially to the improvement in macroeconomic 'fundamentals', it could be regarded - in some sense - as structural and permanent, therefore implying a generalised lower probability of default throughout the EMEs. Alternatively, if this reduction were determined essentially by the favourable conditions in global capital markets, swift and unexpected variations in these conditions – such as an abrupt

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[1] Excerpt from 'Sources of Potential Vulnerability in the International and Regional Financial Systems", Financial Stability Forum, Latin American Regional Meeting, 16 November 2005.

[2] We are greatly indebted to Paola Paiano for her valuable research assistance. The paper benefited from the useful comments given by the members of the International Relations Committee of the ESCB, the participants at a lunch seminar held at the Bank of Italy's Economic Research Department as well as two anonymous referees. The opinions expressed here do not reflect those of the Bank of Italy. Any errors and omissions remain our responsibility. E-mail addresses: alessio.ciarlone@bancaditalia.it paolo.piselli@bancaditalia.it giorgio.trebeschi@bancaditalia.it

increase in international investors' risk aversion - could seriously endanger the seemingly higher creditworthiness of EMEs.

In the literature, global factors are often proxied by a large set of variables, individually or jointly assessed in different econometric specifications. We refer specifically to the level of short- and long-term interest rates in advanced economies (mainly the US), as a measure of global liquidity conditions (Eichengreen and Mody, 1998a and 1998b; Kamin and Kleist, 1999; Arora and Cerisola, 2001; Ferrucci, 2003; Garcia-Herrero and Ortiz, 2005; Rozada and Levy Yeyati, 2005; Hoggarth and Yang, 2006); their volatility, as a measure of the uncertainty surrounding the path of monetary policy in advanced economies (Arora and Cerisola, 2001; Culha *et al.*, 2006); the yield spread between low and high rated corporate bonds or US long-term bonds, as a measure of international investors' appetite for risk (Ferrucci, 2003; Garcia-Herrero and Ortiz, 2005; Rozada and Levy Yeyati, 2005; Culha *et al.*, 2006); the US stock market index, as a measure of a general market risk (Ferrucci, 2003) and the OECD leading indicator of economic activity, as a measure of growth prospects in advanced economies (Garcia-Herrero and Ortiz, 2005). The overall conclusion is that these global factors do represent economically and statistically significant explanatory variables for the dynamics of EMEs' spreads.

Moving from this result, our approach improves upon the existing literature in that we use factor analysis to find out the common force that drives the co-movement of EMEs' spreads: by doing so, we think we are able to capture more information rather than appealing to changes in US interest rates or to the other variables previously mentioned. The common factor, in fact, could ideally be thought of as a summary measure for the above variables, as well as for other less measurable events such as excess co-movement and episodes of contagion. In order to implement this general idea, we draw largely on McGuire and Schrijvers (2003), who were the first - to our knowledge - to try to link the common factor to the conditions present in global capital markets. We extend their approach in two important directions: on the one side, by giving a more robust analysis of the variables that might explain the common factor; on the other side, by using the latter as an explicit determinant of EMEs' spreads.

With regard to the first level of analysis, implementing factor analysis to a sample of EMEs' sovereign spreads reveals that a single common factor is significant in explaining the co-variation (correlation) between spreads for the whole estimation period (January 1998 - December 2006). More importantly, this single common factor can be traced back to the developments in international financial market conditions: in fact, by means of the Phillips and Hansen procedure (1990), we are able to estimate a long-run relationship between the common factor, the volatility in mature stock markets (which should capture international investors' degree of risk aversion) and an index for commodity prices.

As regards the second level of analysis, a set of idiosyncratic macroeconomic 'fundamentals' - measuring the burden of public and external indebtedness, the resources allocated to their service, the ability to generate foreign-currency revenues, the domestic monetary and financial conditions - act as significant 'pull' determinants of EMEs' spreads, largely confirming the results obtained by the empirical literature reported above. The single common factor - used here to summarise the effects stemming from global financial market conditions - turns out to play a very significant role as a 'push' factor for both the long-run equilibrium relationship and the short-run dynamics of EMEs' spreads. Moreover, the comparison between the actual spread series and the series estimated by resorting only to the idiosyncratic factors seems to suggest that financial markets have gone 'too far' in their evaluation of EMEs' creditworthiness: in fact, the former series are always significantly lower than the latter. Finally, it is shown how a shock to financial market volatility and agents' degree of risk aversion can determine - through its impact on the common factor - a significant widening in EMEs' spreads.

The main policy conclusion that can be derived from this analysis is that although the accomplishment of suitable macroeconomic policies, along with the resulting improvement in 'fundamentals', has had positive effects on the reduction of the yield differentials, EMEs do remain vulnerable to sudden shifts in global financial conditions, especially if these shifts take the form of rises in market volatility and agents' degree of risk aversion.

The paper is organized as follows: Section 2 reports the stylised facts on EMEs' sovereign spreads observed over the period 1998-2006, along with possible explanations and causes; Section 3 presents the quantitative results based on factor analysis technique, while Section 4 shows how it is possible to link the common factor to a small sample of financial variables. Taking stock of these results, Section 5 deals with the determinants of EMEs' spreads; Section 6 concludes.

2. Tendencies in EMEs' spreads

2.1 Stylised facts

During the last four years, EMEs yield differentials have followed a declining trend. By January 2007, the spread implicit in the EMBI Global Index was 170 b.p. (724 b.p. by end-2002), [3] a level last observed before the onset of the Asian financial crisis in 1997 (the record low was 174 b.p.). Moreover, this compression has been widespread in all the emerging areas and seems to be still under way (**Chart 1** in Annex I).

Two sets of causes are reported to be at the root of the phenomenon under scrutiny.

The first set of reasons relates to the favourable conditions in global financial markets, characterised by both low long-term interest rates - a result of the loose monetary policy implemented by the Federal Reserve for most of our sample period - and low volatility in advance economies' stock markets, as measured by the VIX index (**Charts 2** and **3** in Annex I). [4] The abundant liquidity in international financial markets, along with a reduced risk aversion, have been responsible for the 'search for yield', which has led to a significant increase in the global demand for EMEs' assets.

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[3] The EMBI Global index, produced by JP Morgan-Chase, tracks total returns for US-dollar-denominated debt instruments issued by emerging market sovereign and quasi-sovereign entities, such as Brady bonds, loans, Eurobonds. Currently, the EMBI Global covers 191 instruments across 32 countries.

[4] The VIX index is the Chicago Board Options Exchange Volatility Index and is a market estimate of future volatility; it is calculated as a weighted average of the implied volatilities of eight put and call options written on the S&P 500 index. The VIX index is considered a good measure of international investors' risk appetite.

The second order of reasons can be traced back to the improvement in EMEs' macroeconomic 'fundamentals' observed over the last four years, especially the widespread reduction in the weight of foreign indebtedness and the improved ability to generate the foreign currency required to service it (**Charts 4** through **10** in Annex I). The variable which is often used to measure the degree of external vulnerability, the ratio between total external debt and GDP, has decreased steadily from 54 per cent in 1998 to an estimated 33 per cent in 2006. Other macroeconomic indicators traditionally associated with the onset of financial crises (Manasse and Roubini, 2005; Ciarlone and Trebeschi, 2005), such as the ratio between international reserves and total external debt (both short- and long-term), have recorded an unbroken improvement. EMEs have benefited from the acceleration of international trade flows, recording average yearly growth rates in export volume of 13 per cent in the period 1998-2006. The increase in export volume has also led to a gradual improvement in current account balances: after the deficits that characterised the first part of the 1990s, many countries have now started recording large surpluses, averaging 2.4 per cent of GDP in 2006. Noteworthy improvements have been recorded in public finance as well: since 2002, the primary balance to GDP ratio has increased in many emerging countries, while the ratio between public debt and GDP has steadily decreased. The clear improvement in these macroeconomic variables has been translated into a lower probability of default and, consequently, into a more favourable evaluation of creditworthiness: **Chart 11** in Annex I shows how, between 2002 and 2006, many EMEs were upgraded by rating agencies. Observations on the 45 degree line show all the events in which the rating did not change in the period under analysis: many countries in the sample are, indeed, located below that line, indicating that their respective ratings improved throughout the period.

2.2 Spreads and ratings: the contribution of global financial market conditions

The combined effect of both the push and pull factors mentioned above can be observed in **Chart 12** in Annex I, which displays the relationship between sovereign spreads and ratings on foreign-denominated long-term debt. More precisely, the chart shows the spread-rating pair, for each country in the sample, recorded in 2002 and

2006; the two curves are tendency lines that minimise the mean square error. [5] First of all, it is easy to see how the sample observations shifted towards the lower left-hand side of the scatter plot, confirming that EMEs have witnessed a series of rating upgrades alongside a contemporaneous compression in sovereign spreads. Most importantly, the graph also shows that the tendency curve underwent a downward shift between December 2002 and January 2007: this suggests that international investors' risk aversion may have declined during the last four years, and that this phenomenon may have contributed to a further compression of sovereign spreads beyond that granted by rating improvements. External conditions, rather than those specific to any given country, could have accounted for the fall in agents' degree of risk aversion: in fact, for a given set of 'fundamentals' - and, therefore, for a given rating - by end-2006 international capital markets were demanding a lower risk premium than that required by end-2002. The case of Colombia is illustrative: against a rating that remained unchanged at Ba2 during the sample period, the yield differential between Colombian sovereign bonds and US Treasuries decreased from 633 to 164 b.p.

3. Factor analysis

3.1 A brief overview of factor analysis

Factor analysis is a statistical technique provides a parsimonious explanation of the observed variation and co-variation (or correlation) of a set of phenomena detected amongst a given set of sample elements (Tucker and MacCallum, 1997). In our particular case, the phenomena under scrutiny are the monthly series of the (log) levels

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[5] These two dates have been chosen to capture, on the one side, the moments in which sovereign spreads reached a local maximum and, on the other side, the most recent situation, resulting from the prolonged contraction of sovereign spreads.

of sovereign spreads, [6] while the sample elements are given by the emerging economies for which such spreads were available from January 1998 onwards. [7]

Central to factor analysis is the postulate that there exist unobservable internal characteristics, or attributes, in which the sample elements may differ. These attributes are commonly referred to as 'internal factors' or 'latent variables' and are assumed to account for the variation and co-variation (or correlation) across a range of observed phenomena. The basic principle on which factor analysis is based is that these internal attributes influence the observed phenomena in a systematic fashion and this influence is assumed to be linear. It is useful to distinguish between two types of internal factors: *common*, which contemporaneously affect more than one of the observed phenomena, and *specific,* which by definition influence only one of them. Factor analysis, therefore, postulates that the variation of a given phenomenon, recorded for an *i-th* element of the sample, will be due in part to the influence of the common factors, the so-called *communality*, and in part to the influence of the specific factors, the so-called *uniqueness*; the co-variation (or correlation) recorded among the *n* elements of the sample, instead, will be due essentially to the influence of common factors.

The preceding assumes that the *p* observed variables (the x_i) have been measured for each of the *n* sample elements (obviously, in our case *p*=*n* since there will be as many spreads as countries in the sample):

$$x_i = a_{i1} f_1 + \ldots + a_{im} f_m + e_i$$

The f_j (j=1, …, m) are the *m* common factors, e_i is the specific error and the a_{ij} are the so called 'factor loadings' (i.e. the effect of a given common factor on a given observed phenomenon). The f_j have mean zero and standard deviation one and are

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6 The choice of monthly data is based on two orders of motives: on the one side, it is based on a desire to circumvent problems with day-of-the-week, as well as time zone, problems; on the other side it is based on the need to reach a coherency between the time frequencies of the series of spreads and those of the macroeconomic variables used in the following econometric specifications. The choice of logged levels is coherent with the approach generally followed by the empirical literature on the subject.

7 The sample comprises the following countries: Brazil, Bulgaria, China, Colombia, Ecuador, Malaysia, Mexico, Panama, Peru, Philippines, Poland, Russia, Turkey and Venezuela.

generally assumed to be independent of each other and orthogonal to e_i. In matrix form, the preceding system can be written as:

$$\mathrm{X}_{p*1} = A_{p*m} F_{m*1} + e_{p*1}$$

from which it follows that

$$\Sigma_{p*p} = AA^T + \mathrm{cov}(e)$$

where Σ_{p*p} is the correlation matrix of X_{p*1}. Now, since the errors are assumed to be independent, cov(e) should be a p*p diagonal matrix, implying that

$$var\,(x_i) = \sum_{j=1}^{m} a_{ij}^2 + \mathrm{var}(e_i)$$

where the sum of the squares of x_i's factor loadings represents the communality (the variance it has in common with the other variables through the common factor) while the i^{th} error variance represents the uniqueness or 'specificity' (the variance determined by factors which are specific to that particular variable).

The primary objective of factor analysis is to determine the number and nature of these internal attributes. In particular, on the basis of the co-variances (or correlations) amongst the different phenomena observed on the *n* elements, factor analysis techniques will be able to: a) estimate the number of common factors; b) obtain the numerical coefficients of the factor loadings and c) estimate how much of the recorded variance in each phenomenon is accounted for by the common factors (the communality) as well as by specific factors (the uniqueness), easily calculated as the complement to one of the communality.

3.2 Factor analysis results

Table 1 hosts the correlation coefficients between the monthly (log) level of spreads for the countries comprised in our sample for the period January 1998 to

December 2006: most of the values are indeed quite high - especially if seen in a regional perspective - clearly indicating that there is some relatively strong communality in the time series properties of EMEs' spreads.

Table 1. Pair-wise correlation coefficients between EMEs' spreads

	Brazil	Bulgaria	China	Colombia	Ecuador	Malaysia	Mexico	Panama	Peru	Philippines	Poland	Russia	Turkey	Venezuela
Brazil	1													
Bulgaria	0.47	1												
China	0.41	0.93	1											
Colombia	0.82	0.64	0.51	1										
Ecuador	0.43	0.62	0.49	0.56	1									
Malaysia	0.47	0.77	0.84	0.51	0.31	1								
Mexico	0.61	0.89	0.92	0.62	0.54	0.91	1							
Panama	0.80	0.80	0.69	0.91	0.63	0.64	0.78	1						
Peru	0.83	0.79	0.67	0.90	0.53	0.65	0.76	0.94	1					
Philippines	0.50	0.56	0.51	0.72	0.21	0.60	0.53	0.73	0.72	1				
Poland	0.63	0.93	0.86	0.75	0.67	0.74	0.87	0.84	0.84	0.57	1			
Russia	0.41	0.78	0.84	0.43	0.55	0.80	0.90	0.59	0.54	0.32	0.71	1		
Turkey	0.79	0.59	0.45	0.78	0.32	0.50	0.56	0.81	0.87	0.69	0.65	0.34	1	
Venezuela	0.78	0.69	0.67	0.78	0.49	0.70	0.77	0.87	0.81	0.68	0.74	0.62	0.79	1

The first step required by factor analysis technique is to come up with an estimate of the number of factors by calculating the eigenvalues associated with the previous correlation matrix. (8) There are different methods that can be used in order to perform this task: we have chosen the 'principal factor method' (also referred to as 'principal axis factoring'). (9) This approach starts with a preliminary estimate of the communalities, which are then entered into the diagonal of the correlation matrix before factors are extracted. (10) Different estimates can be used as initial communalities, such as: a) the diagonal elements from the inverse of the correlation matrix; b) the absolute

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[8] Do not forget, in fact, that the eigenvalues can indeed be interpreted as the standardised variance associated with a particular factor.

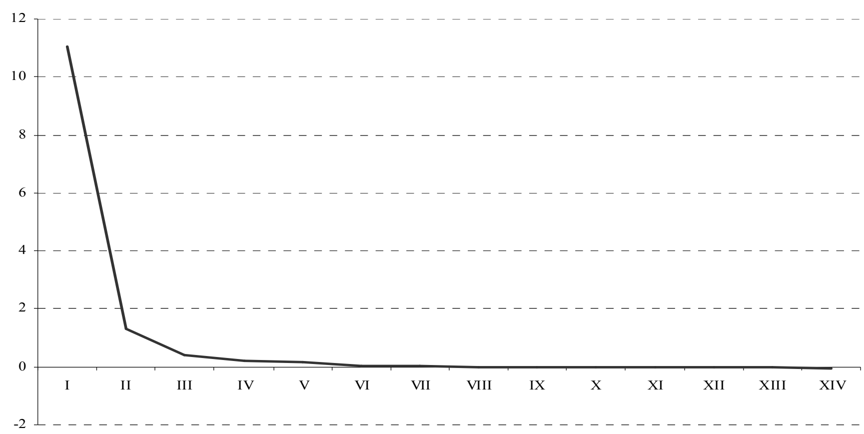
[9] Other extraction methods are: principal component, iterated principal factor, maximum likelihood, alpha factoring, image factoring, unweighted least squares and generalised least squares.

[10] Do not forget, in fact, that we are trying to explain not the whole variability of a spread series (which is, instead, the logic behind principal component analysis), but just its co-variability with all the others.

value of the maximum correlation of a variable with any others and c) the R-squared from a multiple regression of a variable onto all the others. We used the latter approach.

In order to choose the number of underlying factors - since by construction there would be as many eigenvalues as variables in the sample - the most common approach is to generate a scree-plot, i.e. a two-dimensional graph with factors on the x-axis and eigenvalues on the y-axis, [11] and then to take the number of factors corresponding to the last eigenvalue before they start to level-off. According to this procedure, the following chart suggests the existence of a single significant factor underlying the co-variation (correlation) in EMEs' sovereign spreads.

Chart 1. Factor analysis result: the scree-plot



A complementary method is to look at the percentage of the explained variance, by keeping as many factors as are required to explain 60, 70 or 80 per cent of the variance of a given spread series. Of course, there is no general consensus about the ex-ante 'optimal' amount of variance that should be explained in order to make a factor 'significant'; this problem, however, is easily overcome in our case since the first common factor alone explains almost 85 per cent of the common variation in the underlying monthly spread series, thus confirming the results obtained by the graphical analysis of the scree-plot.

[11] "Scree" is the rubble on the slope or at the bottom of the mountain.

A final approach widely used in empirical work is based on the Kaiser-Guttman criterion, which simply states that a researcher should look at the number of eigenvalues that are larger than one. Following this criterion, we would have identified two significant factors since, as clearly shown by the scree-plot, the second common factor is associated with an eigenvalue of 1.29. This value, however, is only slightly above one, which makes us suppose that adding a second factor would only complicate the analysis without providing much more information.

All these considerations lead us to conclude that, over the whole period under scrutiny, there is only a single common factor that is able to explain a significant percentage of the correlation in the underlying spreads. [(12)]

Once decided upon the number of significant common factors, factor analysis provides: a) numerical coefficients of the factor loadings, i.e. the partial correlation of a given spread series with the common factor; b) a measure of the communality, i.e. the percentage of the recorded variance in each phenomenon accounted for by the common factor and c) a measure of the uniqueness, i.e. the percentage of the recorded variance in each phenomenon accounted for by idiosyncratic factors. **Table 2**, which displays all these elements, clearly shows that for the whole period January 1998 - December 2006 the weight of the common factor was quite high for all the countries in the sample. [(13)]

[12] We have also used two other methods of factor extraction, i.e. the iterated principal factor and the maximum likelihood, which have confirmed the conclusion in the text regarding the existence of a single significant common factor. These results are available from the authors upon request.

[13] The only exception is given by Argentina. The results of factor analysis technique applied on a sample containing also this country (available from the authors upon request) show that the factor loading is negative (-0.23) and that the Argentine uniqueness is much greater than its communality (95 vs. 5 per cent). This conclusion obviously signals that the behaviour of the Argentine spread has been primarily determined by the evolution of its macroeconomic fundamentals rather than by variations in international capital markets; and it is not difficult to understand why it should be the case, given the macroeconomic evolution that lead and lagged the crisis in 2001.

Table 2. Results of principal factor analysis

Country	Factor Loading	Uniqueness	Communality
Brazil	0.90	0.19	0.81
Bulgaria	0.93	0.13	0.87
China	0.80	0.36	0.64
Colombia	0.90	0.19	0.81
Ecuador	0.79	0.37	0.63
Malaysia	0.90	0.19	0.81
Mexico	0.95	0.11	0.89
Panama	0.95	0.09	0.91
Peru	0.96	0.08	0.92
Philippines	0.71	0.50	0.50
Poland	0.91	0.17	0.83
Russia	0.91	0.18	0.82
Turkey	0.88	0.23	0.77
Venezuela	0.92	0.15	0.85
Average	*0.89*	*0.21*	*0.79*

Carrying out a year by year analysis, the empirical evidence with respect to the number of common factors is less clear-cut. In certain instances, in fact, the presence of a second common factor turns out to be stronger than it appears by looking at the whole sample, with eigenvalues significantly above the threshold suggested by the Kaiser-Guttman criterion. Nonetheless, as **Chart 13** in Annex I shows, the role played by the first common factor has always been prevailing, with a share of the explained co-variation fluctuating around 70 per cent.

In addition, **Chart 14** in Annex I is illustrative of the existence of a cyclical behaviour of both the uniqueness and the communality: more precisely, in the most recent past the contribution of idiosyncratic factors has apparently followed an upward trend, although the common factor still explains roughly 60 per cent of the variability of a given spread series.

4. The common factor

Following our previous reasoning, the common factor - despite not having a precise economic meaning - can be considered a determinant of the variability of

EMEs' sovereign spreads that is not directly linked to the specific macroeconomic characteristics of any given country but rather to the developments in the international economic and financial system. In order to give an immediate intuition regarding the above statement, we calculate the correlation coefficient between the common factor and a set of variables that reflect global conditions (**Table 3**).

Table 3. Correlation between the common factor and global financial conditions

US ten-year Treasury yield	0.35 (*)
US three-month Treasury yield	0.12
Slope yield curve [14]	0.05
VIX Index	0.90 (*)
S&P 500	-0.15
FTSE 100	0.07
Nasdaq	0.02
Commodities	-0.91 (*)
Oil price	-0.85 (*)

Note: yields on ten-year and three-month Treasuries are expressed in levels; all other variables are expressed in logs.
(*) Significantly different from zero at the 5 per cent level.

To our knowledge, there is no established theory that supports the choice of the listed financial variables: we just rely on intuition and on experience drawn from both the academic literature and market participants' views in order to select the indicators that are expected to exert a significant influence on the dynamics of EMEs' spreads. The variables hosted in the previous table are, in fact, those reported in the introduction: the level of short- and long-term interest rates in advanced economies as a measure of global liquidity conditions; the slope of the yield curve as a measure of growth prospects in the US; the VIX index as a measure of international investors' appetite for risk and the stock market indices as a measure of a general market risk. Since many indebted EMEs are commodity exporters, we add two indices developed by Bloomberg,

[14] The slope of the yield curve is calculated as the difference between the daily yields on ten-year and three-month Treasuries. It is often used as a proxy for expected future growth: an increase in the slope of the yield curve is, in fact, associated with more optimistic expectations from international investors.

the first tracking the price of a basket of commodities and the second the evolution of oil prices.

The results shown in the previous table suggest that the common factor is statistically correlated with some of the variables reported and, for this reason, can indeed be interpreted as a summary measure of the effects that global economic and financial conditions have on the observed variation in EMEs spreads.

Very interesting patterns of influence are shown in the table. First of all, the correlation between EMEs' monthly spreads and the US long-term yield is statistically different from zero, indicating that variations in US long-term interest rates can have, through the common factor, a significant effect on spreads. [15] This result, nonetheless, should be taken with a pinch of salt, especially considering the rather inconclusive literature on the relationship between US monetary policy and developing countries' spreads (Dooley *et al.*, 1996; Kamin and Kleist, 1999; Eichengreen and Mody, 1998a; Arora and Cerisola, 2001; McGuire and Schrijvers, 2003). [16]

Secondly, variations in EMEs' spreads are negatively correlated with the indices used to measure price developments in the markets for commodities. Most EMEs are open - and export-dependent - economies, so that favourable price developments in the commodities markets go with higher foreign currency revenues, strengthened ability to repay debt obligations towards international investors and reduced price of risk required by the latter to hold EMEs' assets.

Finally, the result that we found more interesting of all is the positive correlation between the common factor and the VIX index: the latter effectively measures the expectations of international investors about the future volatility of US stock markets. Rises in the expected volatility induce agents to liquidate their positions in risky assets

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[15] The correlation between the common factor and short-term rate, though positive, does not seem to be statistically different from zero.

[16] Contrary to what is suggested by McGuire and Schrijvers (2003), we do not find a negative relationship between EMEs' spreads and the slope of the US yield curve. This inverse relationship may stem from its informational content, since it has always been used as a proxy for expected economic growth. An upward-sloping yield curve is normally associated with positive growth prospects for the US, bringing about favourable fallouts for the emerging economies, especially for the export-dependent.

in favour of more secure ones (i.e. the ‘flight to quality’). This phenomenon also explains well the positive correlation between spreads and other classes of risky assets, such as corporate bonds, as highlighted in the empirical literature reported in the introduction.

The compression of sovereign spreads witnessed during the last three years could, therefore, be viewed in relation to the reduced volatility present in international capital markets, as well as to favourable price developments in the markets for commodities. As already mentioned, these conclusions are obtained by looking at simple pair-wise correlations; a more comprehensive and thorough analysis of the common factor should resort to an explicit econometric procedure. We address the issue in the rest of this section.

As a first step, we execute both the Phillips-Perron (PP) and the Augmented Dickey-Fuller (ADF) test for unit roots on the log-levels of the common factor, the VIX index, the US 10-year yield and the commodity index: these tests show that all of the series are integrated of order one regardless of both the type of test and the specification of the deterministic component. (17)

Given that the series appear to be realisation of I(1) processes, we test for the existence of a cointegrating relationship that links the variables under study. The underlying econometric model is given by the following long-run relationship

$$(1) \qquad y_t = \alpha + \beta^T x_t + \varepsilon_t$$

where y_t is an I(1) variable and x_t is a k*1 vector of I(1) regressors that might be, as in our case, potentially endogenous. We have chosen a single equation framework, rather than a VAR approach, for a very simple reason. The common factor is an artificial series which cannot actually be observed in financial markets: the aim of the econometric analysis is, therefore, to explain this series in terms of variables that we can

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[17] We have purposely not considered the oil price since the sign of the correlation seems a little odd to us: in the sample, in fact, there are only two oil-exporting countries, i.e. Russia and Venezuela, while all the others rely heavily on oil imports to satisfy their development needs.

effectively monitor. While it seems reasonable to postulate some form of endogeneity among the regressors - since, for instance, the volatility in financial markets can influence, and be influenced by, the level of US long-term yields - it seems less reasonable to assume a feed-back relationship between, for example, the common factor and the commodity prices.

For the single equation approach, we resort to the fully-modified OLS (FM-OLS) procedure proposed by Phillips and Hansen (1990) to estimate equation (1) after testing for the existence of co-integration. [(18)] The Phillips-Hansen procedure overcomes most of the problems that might arise in a simple OLS framework. In fact, although the OLS estimators of α and β^{T} are consistent, the presence of simultaneity, unit roots and serial correlation determines an asymptotically second-order bias: the estimators' limit distributions are mislocated or shifted away from the true parameters.[(19)] By means of a semi-parametric correction - i.e. a transformation involving the long-run variance and covariance matrix of the residuals - the FM-OLS specifically deals with the presence of endogeneity in the regressors, as well as potential serial correlation in the residuals; moreover, it is asymptotically efficient and does not require the use of instruments. Finally, it gives asymptotically unbiased estimators as well as *t*-statistics that are asymptotically normal, meaning that the usual tests can be carried out in order to evaluate the significance of the explanatory variables.

Therefore, by means of the FM-OLS procedure, we estimate the following equation:

---

[18] We employ the simple Engle and Granger's two-step procedure (1987) since the FM-OLS technique requires the error term to be stationary. We obtain the following long-run relationship: $\textit{Common Factor}_t = 2.46 - 0.06\ \textit{US10}_t + 1.47\ \textit{VIX}_t - 1.37\ \textit{Commodities}_t$, where the coefficients for both the *VIXt* and $\textit{Commodities}_t$ regressors are significant at the one percent significance level (the US long-term rate turned out to be insignificant). The residuals from the previous equation turn out to be stationary, confirming the existence of a co-integrating relationship between the common factor and the financial variables. Results are available from the authors upon request.

[19] The classic assumptions are violated in our case for the following reasons: a) variables such as the VIX index, the long-term bond yield and the commodity index might be endogenous, i.e. simultaneously determined; b) because all the listed variables have unit roots, the asymptotic distribution of their estimators is no longer Gaussian and c) the residuals in the equation might be serially correlated.

$$(2) \qquad \textit{common factor} = \alpha + \beta_1\ VIX_t + \beta_2\ commodities_t + \beta_3\ US10_t + \varepsilon_t$$

obtaining the results contained in **Table 4**.

Table 4. Fully modified OLS estimates: initial model
(dependent variable: common factor)

Regressor	Coefficient	Standard error	*t*-statistics	p-value
Constant	3.60	2.59	1.39	0.17
VIX Index	1.34	0.28	4.75	0.00
Commodities	-1.49	0.28	-5.34	0.00
US10 year yield	0.04	0.42	0.11	0.92

Note: asymptotic standard errors; the FM-OLS estimates have been calculated using Bartlett weights with truncation lag k=6; we have also performed the same estimation procedure with different lag structures (i.e. with k=1 and k=12), obtaining very similar results (available from the authors upon request).

The estimation results clearly show that both the VIX and the commodity index are strongly significant in explaining the common factor. Moreover, the sign of their coefficients is as expected: an increase in the volatility of financial markets leads to an increase in the common factor - and hence in EMEs' spreads - since investors become more risk averse and look for more secure assets; favourable price developments in the markets for commodities, by augmenting the foreign-currency generating abilities of EMEs, lead to a decrease in the common factor and, through it, to a lower perceived risk of default and to the compression of the yield differentials.

As regards the coefficient of the US 10-year yield, though positive it is not statistically different from zero: once controlling for the VIX and the commodities index, the US long-term bond yields do not seem to be a significant component in the explanation of the common factor and, therefore, of spreads co-movements (Kamin and Kleist, 1999). This result suggests that the ample liquidity conditions of the last four years - proxied by the low levels of long-term bond yields in the US - have been accompanied by a compression of EMEs' spreads - as measured by the highly significant unconditional correlation hosted in Table 3 - only because global capital markets have been characterised, during the same time span, by a very low level of risk aversion. Financial market volatility, therefore, seems more closely related to the common factor and appears to be the main determinant of the observed co-movement (correlation) in EMEs' spreads. [(20)]

In accordance with a general-to-specific approach, we re-estimate equation (2) by excluding the insignificant regressor, obtaining the results displayed in the following table, which represents our final model for the common factor.

Table 5. Fully modified OLS estimates: final model

Regressor	Coefficient	Standard error	*t*-statistics	p-value
Constant	1.88	1.91	0.98	0.33
VIX Index	1.61	0.27	6.02	0.00
Commodities	-1.30	0.24	-5.53	0.00

Note: asymptotic standard errors; the FM-OLS estimates have been calculated using Bartlett weights with truncation lag k=6; we have also performed the same estimation procedure with different lag structures (i.e. with k=1 and k=12), obtaining very similar results (available from the authors upon request).

The variables VIX_t and $commodities_t$ can be thought of as capturing the long-run or permanent components of the common factor, while ε_t represents the deviations from the long-run equilibrium (*ECM*). Both short- and long-run dynamics can be combined into an error-correction model, which results directly from the Granger's representation theorem (1987). [(21)] The simplest reference model is given by the following equation:

$$(3) \quad \Delta common\ factor_t = \psi + \rho ECM_{t-1} + \theta \Delta common\ factor_{t-1} + \sum_{j=0}^{p} \beta_j \Delta VIX_{t-j} + \sum_{j=0}^{p} \lambda_j \Delta commodities_{t-j} + \xi_t$$

[20] Arora and Cerisola (2001) show that once the volatility of financial markets is controlled for in a regression of EMEs' spreads on a given set of potential explanatory variables, the US long-term bond yield ceases to be a statistically significant regressor.

[21] I.e. for any set of co-integrating variables, error correction and co-integration are equivalent representations.

Since all the variables are stationary, OLS can be used to estimate the model; by means of the conventional general-to-specific approach, we are able to reach the parsimonious representation contained in **Table 6**.

Common factor: short-run dynamics and error correction

Regressor	Coefficient	Standard error	*t*-statistics	p-value
ECM_{t-1}	-0.26	0.06	-4.11	0.00
ΔVIX	0.90	0.12	7.27	0.00
Diagnostics				
R-squared	0.38			
Adjusted R-squared	0.36			
Durbin Watson	2.20			

The negative - and statistically significant - coefficient ρ measures the adjustment speed of the common factor to the long-run equilibrium: when the common factor is above equilibrium, a negative coefficient reduces its variations and forces it back to its long-run level. More precisely, it implies that 26 per cent of the gap between the equilibrium and the observed level of the common factor is closed each month. As for the other coefficients in the short-run dynamics equation, only the changes in risk appetite - measured by the VIX index - turn out to be significant.

Another approach that can be followed to detect the existence of a co-integrating relationship is the autoregressive distributed lag modelling (ARDL) suggested by Pesaran and Shin (1999). In their work, the authors show that the traditional ARDL approach is still valid even in the presence of I(1) variables, provided there is an adequate number of lagged changes in the regressors before the estimation and tests are carried out. [22] Once an appropriate choice for the order of the ARDL is made - often the most difficult task - estimation of the long-run parameters and computation of valid standard errors can be carried out by means of the classic OLS procedure, using the ‘delta method’ to compute the estimators’ standard errors. More importantly, Pesaran

[22] This is essentially done in order to “clean” the ARDL specification of contemporaneous correlation between the error terms.

and Shin also show that the ARDL estimation procedure is directly comparable to Phillips and Hansen FM-OLS approach: they are both asymptotically valid when the regressors are I(1). This means that the results obtained by the ARDL procedure constitute a valid term of reference for the estimates obtained by means of the Phillips-Hansen approach. Annex II hosts the results obtained by implementing the former approach, confirming the robustness of the FM-OLS results. **Chart 15** in Annex I graphically tests the goodness of fit of the two approaches by reporting the actual and the two fitted series of the common factor.

5. Determinants of EMEs spreads

This section is dedicated to an empirical investigation of the 'determinants' of EMEs' spreads: this heading, of course, should comprise both domestic macroeconomic 'fundamentals' and indicators of the global conditions in financial markets. The objective we have in mind is not only to establish which variables exert a significant effect on EMEs' yield differentials, but also to work out the level of spreads that is 'coherent' with the set of macroeconomic fundamentals for a given country. By doing this, we think we can assess whether financial markets have gone 'too far' in their evaluation of EMEs' creditworthiness.

The conventional reference model for analysing the determinants of EMEs' spreads is drawn from Edwards (1984), who assumes that the spread over a risk-free interest rate can be expressed as a function of the (subjective) probability of default assigned by international investors to a given country. In turn, this (subjective) probability of default is exogenously determined, depending on a set of domestic, as well as international, macroeconomic and financial variables that influence the investors' evaluation of a given country's creditworthiness. By assuming risk-neutral banks and perfect competition, Edwards ends up with the following simple reduced form for the (log) level of sovereign spreads:

$$\text{(4)} \qquad log\ spread_i = \alpha_0 + \sum \alpha_i y_i + \xi_i$$

where $spread_i$ is the yield differential for country i, α_0 is an intercept coefficient, the α_i are slope coefficients, the y_is are a set of macroeconomic 'fundamentals' as well as domestic and international financial variables and ξ_i are i.i.d. errors.

As regards the selection of the covariates, several domestic macroeconomic and financial variables are considered as potential determinants of EMEs' spreads, drawn not only from the empirical models reported in the introduction but also from the extensive literature on financial, and particularly debt, crises (Ciarlone and Trebeschi, 2004; 2005). Since the spread is a measure of the investors' assessment of the probability that an emerging economy will default on its debt obligations, it seems natural to start with the stock and flow variables relevant for both domestic and external solvency.

Domestic solvency underscores the role played by the level of public debt (scaled to GDP), interest rates, output growth rate and government primary balances (scaled to GDP). In technical terms, in fact, fiscal sustainability requires that the current policies of the government satisfy the intertemporal budget constraint, namely the need for the discounted present value of future primary balances to be equal to the outstanding stock of debt. Consequently, a positive differential between the average interest rate and economic growth means that, all other things being equal, the higher the level of outstanding debt, the larger the future primary surpluses necessary to ensure fiscal sustainability.

External solvency, instead, highlights the importance of the stock of foreign-currency denominated debt (scaled to GDP or to exports), the current account balance (scaled to GDP) and liquidity indicators, measured by the amortisation or interest payments on external debt (both scaled to total external debt, exports or international reserves) as well as by the total debt service (scaled to exports). In addition, a rising share of external debt with a remaining maturity of less than one year can also pose serious challenges for a borrowing country. The choice of the preceding variables is justified on the grounds that financial markets are supposed to penalise emerging countries with higher spreads not only in the case of an outright default on part or all of the stock of external debt, but also in the case of increasing debt-servicing difficulties determined more by illiquidity than by insolvency. Finally, adverse developments in the exchange rate, which entail an escalating weight of external indebtedness, are expected to lead to higher spreads.

The variables measuring EMEs ability to generate foreign-currency revenues - and therefore to repay external obligations - should also be considered within the set of potential determinants of the yield differentials. From this point of view, an important role is played by variables linked to trade flows as well as by the level of international reserves (scaled to GDP, imports, long- and short-term external debt): a low degree of trade openness, for instance, might make it difficult to attain the trade surpluses necessary to meet future external debt obligations.

As recognised in the introduction, EMEs' spreads are determined not only by the evolution of the former macroeconomic 'fundamentals' specific to a given emerging economy - i.e. idiosyncratic 'pull' factors - but also by the developments in international financial markets and global liquidity conditions - i.e. common 'push' factors - summarised by the common factor worked out in Section 3.

Equation (4) is estimated by resorting again to the Phillips and Hansen FM-OLS procedure. The regressors are drawn from a large dataset of macroeconomic and financial variables recorded at monthly frequency; the variables with an original lower frequency are linearly interpolated. Although it is a widely used technique in empirical works, we recognise that it comes at the cost of imposing a (linear) model on the data generating process, which might not necessarily be the case. With this *caveat* in mind, **Table 7** contains the results of the FM-OLS estimation procedure.

Table 7: Spreads' determinants by country

Variable	Brazil	Bulgaria	China	Colombia	Ecuador	Malaysia	Mexico	Panama	Peru	Philippines	Poland	Russia	Turkey	Venezuela
Intercept	3.975 (0.30) *	1.475 (1.09)	2.056 (0.79) *	5.488 (0.23) *	5.476 (0.11) *	3.932 (0.21) *	4.070 (0.29) *	4.563 (0.14) *	7.657 (0.54) *	3.318 (0.34) *	7.494 (1.00) *	4.217 (0.234) *	6.081 (0.29) *	7.412 (0.16) *
Common factor	0.508 (0.06) *	0.559 (0.06) *	0.357 (0.04) *	0.439 (0.03) *	0.382 (0.04) *	0.324 (0.03) *	0.275 (0.02) *	0.332 (0.01) *	0.440 (0.02) *	0.290 (0.02) *	0.318 (0.06) *	0.630 (0.06) *	0.452 (0.04) *	0.240 (0.06) *
Amortization / Exports														
Amortization / International Reserves														
Amortization / Total External Debt														
Interests on external debt / Exports														
Interests on external debt / International Reserves								0.005 (0.00) *						
Interests on external debt / Total External Debt			0.051 (0.02) **			0.067 (0.02) *					0.139 (0.07) **			
Total debt service / Exports		0.035 (0.01) *										0.018 (0.01) ***		
Arrears / Total External Debt					21.182 (1.74) *									
Short term debt / Total External Debt			0.096 (0.01) *											
Total external debt / Exports								0.001 (0.00) *						
Total external debt / GDP		0.063 (0.00) *	0.169 (0.01) *									0.023 (0.00) *		
Government Primary Balance / GDP	-0.230 (0.06) *	-0.241 (0.05) *			-0.057 (0.02) *	-0.046 (0.02) **							-0.031 (0.01) *	-0.027 (0.01) *
Government Net Debt / GDP	0.047 (0.01) *			0.022 (0.00) *			0.030 (0.01) *							
Current account balance / GDP		-0.050 (0.01) *											-0.208 (0.01) **	
Exports / GDP														
Imports / GDP										0.038 (0.01) *				
Openness to trade														
Trade Balance / GDP											-0.176 (0.03) *			
International Reserves / GDP									-0.095 (0.03) *	-0.055 (0.02) *	-0.259 (0.06) *			
International Reserves / Imports			-0.012 (0.00) *											
International Reserves / Short Term Debt	-0.006 (0.00) **	-0.005 (0.00) **		-0.004 (0.00) ***										
International Reserves / Total External Debt													-0.023 (0.01) **	-0.021 (0.00) *
Inflation rate (YoY)										0.036 (0.01) *				
Interest Rate	0.009 (0.00) **					0.129 (0.02) *	0.030 (0.00) *					0.026 (0.00) *	0.003 (0.00) *	
Real GDP growth rate			-0.421 (0.07) *			-0.030 (0.01) *	-0.027 (0.01) *	-0.008 (0.00) *			-0.056 (0.02) *			
Spot Nominal Exchange Rate	0.231 (0.07) *		0.017 (a) (0.00) *		0.001 (0.00) *					0.030 (0.00) *			0.425 (0.05) *	
Adjusted R-squared	0.95	0.97	0.95	0.93	0.90	0.96	0.98	0.98	0.94	0.90	0.94	0.97	0.93	0.91
Unit root test on residuals (b)														
Augmented Dickey Fuller	-2.81 *	-3.42 *	-3.38 *	-2.18 **	-1.50	-3.83 *	-2.55 **	-3.03 *	-2.25 **	-3.92 *	-3.07 *	-2.98 *	-3.04 *	-1.90 ***
Phillips Perron	-4.14 *	-2.56 **	-6.54*	-4.03 *	-2.73 ***	-4.70 *	-5.07 *	-6.57 *	-3.91 *	-4.22 *	-4.41 *	-3.57 *	-4.02 *	-4.03 *
Error correction coefficient	-0.32 (0.1) *	-0.20 (0.07) *	-0.62 (0.11) *	-0.33 (0.07) *	-0.23 (0.14) ***	-0.46 (0.08) *	-0.34 (0.07) *	-0.63 (0.08) *	-0.28 (0.05) *	-0.22 (0.07) *	-0.39 (0.13) *	-0.19 (0.05) *	-0.30 (0.08) *	-0.24 (0.08) *

Source: World Economic Outlook Database - IMF; Bank for International Settlements; Institute for Internationa Finance, Economist Intelligence Unit.
Note: dependent variable is log of spreads. Sample period is January 1998 to December 2006. Observations are monthly. The FM-OLS estimates have been calculated using Bartlett weights with truncation lag k=6; we have also performed the same estimation procedure with different lag structures (i.e with k=1 and k=12), obtaining very similar results (available from the authors upon request). Asymptotic standard errors are reported in parenthesis. * Significant at 1% s.l.. ** Significant at 5% s.l.. *** Significant at 10% s.l.. (a) calculated as nominal effective exchange rate. (b) Being a test on residuals, we have not considered the constant nor the time trend; 4 lags have been used in order to perform the Phillips Perron test, as suggested by the Newey – West criterion; 12 lags have been used for the Augmented Dickey Fuller test, coherently with the frequency of data.

The equations in Table 8 explain relatively well the fluctuations in EMEs' sovereign spreads: the adjusted R-squared is generally above 90 per cent, higher than that obtained in most of the empirical works (see also **Chart 16** in Annex I). As expected, the common factor exerts a significant and positive effect on all the EMEs' spreads of our sample: shocks to the common factor accompany large variations in yield differentials of the same sign. Overall, this confirms that the developments in global financial markets conditions have indeed been very important in influencing the evolution of EMEs' spreads (see Table 2).

As regards the role played by macroeconomic 'fundamentals', only few turn out to be significant as 'pull' factors: nevertheless, the sign of their coefficients is always as expected. Let us consider the case of Brazil. The relevant domestic variables are essentially those linked to domestic solvency: on the one side, larger stocks of (net) public debt and soaring interest rates accompany widening spreads; on the contrary, larger primary balances and firmer growth perspectives squeeze the yield differentials. An important role is also played by the exchange rate since a significant, though decreasing, fraction of Brazil's debt has been either denominated in dollar or indexed to the dollar. Finally, Brazil's ability to generate foreign-currency revenues - measured in this particular case by the level of international reserves scaled to short-term debt - reduces its spread. These results are in line with those obtained, in a different context, by Favero and Giavazzi (2004).

Using the usual tests for unit roots on the residuals of each equation in Table 7, we cannot reject - at conventional significance levels - the null hypothesis that sovereign spreads are co-integrated with the chosen country-specific fundamentals and the common factor, [(23)] confirming other empirical results (Arora and Cerisola, 2001; Ferrucci, 2003; Hoggarth and Yang, 2006). This means that the estimated equations can be interpreted as long-run equilibrium relationships. In addition, as shown by the magnitude of the coefficients on the ECM terms displayed at the very bottom of Table 7, the adjustment to the long-run equilibrium occurs quite rapidly.

Starting from these results, it is possible to shed light on other important issues.

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[23] The only case in which this hypothesis is rejected is that of Ecuador.

First, it is possible to single out the level of EMEs' spreads that is 'coherent' with macroeconomic fundamentals for any given country in our sample. In order to answer this question, we subtract the component due to the common factor from the actual spread, obtaining a new series which we label 'idiosyncratic' spread. **Chart 17** in Annex I gives a graphical representation of our results: the comparison between the actual and the idiosyncratic spread series for each country in the sample shows that recently the latter has in all cases been higher than the former. This suggests that, in the last four years, financial markets have gone 'too far' in their evaluation of EMEs' creditworthiness, pushing the spreads below the levels consistent with macroeconomic fundamentals. The case of Colombia is illustrative: in Section 2.2, in fact, we report that from January 2002 to December 2006 this country experienced a contraction of the yield differential from 633 to 164 b.p. against a credit rating which remained unchanged at Ba2. The chart relating to Colombia gives further evidence, showing that the idiosyncratic spread did not move much from its long-run average, while the actual spread decreased substantially: this suggests that Colombian macroeconomic fundamentals did not move so enough in the sample period to justify a higher credit rating or a decrease in spread.

The final issue we would like to address is the likely impact on EMEs' spreads of a shock to financial market volatility, as measured by the VIX index. In order to address this issue, we need to take into account both the results of Section 4 - where we assess the link between financial market volatility and the common factor - and those of Section 5 - where we verify that the common factor is a fundamental variable underlying the dynamics of EMEs' spreads. In particular, we assess whether and how a shock to the VIX index might - through its impact on the common factor - influence the spread of an important emerging economy, namely Brazil. A first input of the simulation is given by the relationship describing the short-run dynamics of the Brazilian spread, which is hosted in the following **Table 8**. The term ECM_{t-1} is none other than the lagged residuals of the long-run equation shown in Table 7: as already mentioned, its negative - and statistically significant - coefficient measures the speed of adjustment of the spread to the long-run equilibrium. Interestingly, global market conditions are important even in the short-run, as shown by the high and significant coefficient on the changes in the common factor (*Δcommon factor* in Table 8).

Table 8. Brazil's spread: short-run dynamics and error correction

Regressor	Coefficient	Standard error	*t*-statistics	p-value
ECM_{t-1}	-0.32	0.10	-3.24	0.00
Δ*common factor*	0.59	0.04	13.38	0.00
Δ*Government net debt / GDP*	0.10	0.03	3.70	0.00
Diagnostics				
R-squared	0.79			
Adjusted R-squared	0.78			
Durbin Watson	2.03			

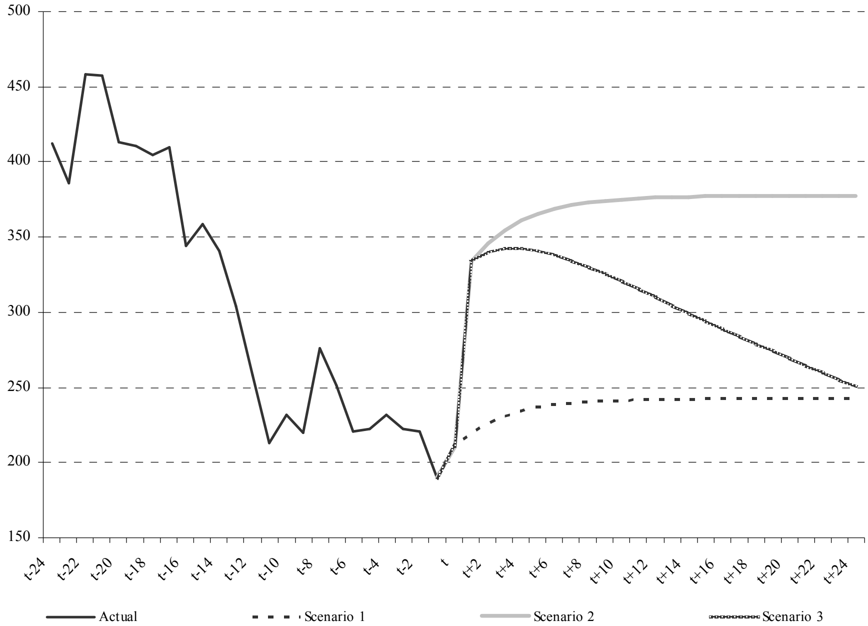
Note: OLS estimates; dependent variable is *Δspread*; only the significant variables are reported in the table.

A second input is given by the relationship describing the short-run dynamics for the common factor, hosted in Table 6.

Last but not least, the third input is to devise possible paths for the evolution of the VIX index. Three scenarios have been worked out: 1) the VIX remains at its current level; 2) the VIX permanently increase to its long-run average, rising 8 percentage points from its current level and 3) the VIX undergoes a one-time shock, increasing to its long-run average and then returning back to its current level.

These scenarios are used to forecast, by means of the short-run dynamic equation represented in Table 6, three series for the common factor over a 24-month horizon, i.e. from t to $t+24$. Each of these series is then used to forecast, by means of the short-run dynamic equation represented in Table 8, three different paths for the Brazilian spread, under each scenario (see Chart 2).

Chart 2. Brazilian spread and VIX: a scenario analysis



As the chart clearly shows, the impact of a volatility shock has significant effects on Brazil's spread: according to our model, in fact, a permanent reversion of volatility to its long-run average (scenario 2) would see the Brazilian spread widen almost 188 b.p. in a 24-month time span. This can be compared with the effect of the correction in global financial markets, experienced by end-February 2007: against an increase of almost 7 percentage points in the VIX index, the Brazilian spread widens by 20 b.p. [24]

The main conclusion of this analysis is that, notwithstanding the unquestionable improvement in macroeconomic 'fundamentals', EMEs are still vulnerable to sudden variations in financial market conditions and in agents' degree of risk aversion.

[24] The IMF in its April 2007 Global Financial Stability Report estimated that a reversion in volatility to two standard deviations above the average since 1990 would see spreads widen 225 b.p. over a 12-month time span. Such rises in volatility are by no means rare: the VIX index has breached this level 10 times since 1997.

6. Conclusions

During the last four years, financial markets have witnessed a steady compression in EMEs' sovereign spreads: both global factors, such as ample liquidity and low volatility, and specific factors, such as the improvement in fundamentals, can be cited as determinants of the reduction in yield differentials.

Our analysis suggests that a single common factor is significant in explaining the co-variation (correlation) between EMEs' sovereign spreads, and that this single common factor can be traced back to developments in international financial market conditions, especially to the volatility in stock markets and to agents' degree of risk aversion. Hence, although the accomplishment of suitable macroeconomic policies and the resulting improvement in fundamentals, had positive effects on the reduction of yield differentials, emerging economies do remain vulnerable to sudden shifts in global financial conditions, especially if the shifts take the form of rises in market volatility and increases in agents' degree of risk aversion.

Annex I

Chart 1. Yield differentials between EMEs sovereign debt and US Treasuries

(basis points; daily data)

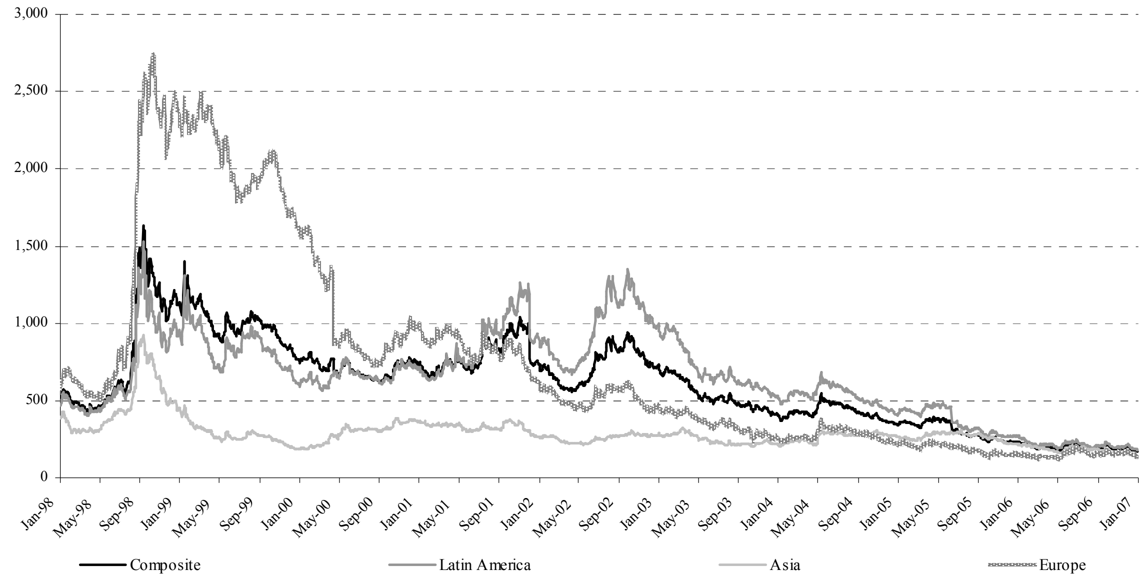


Chart 2. Long- and short-term US interest rates

(daily data)

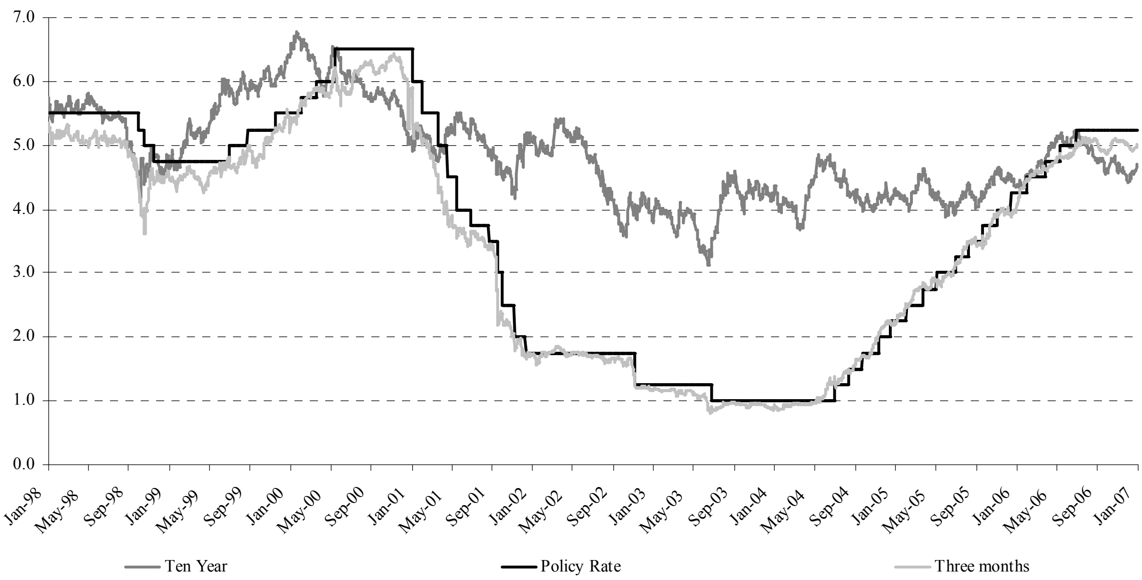
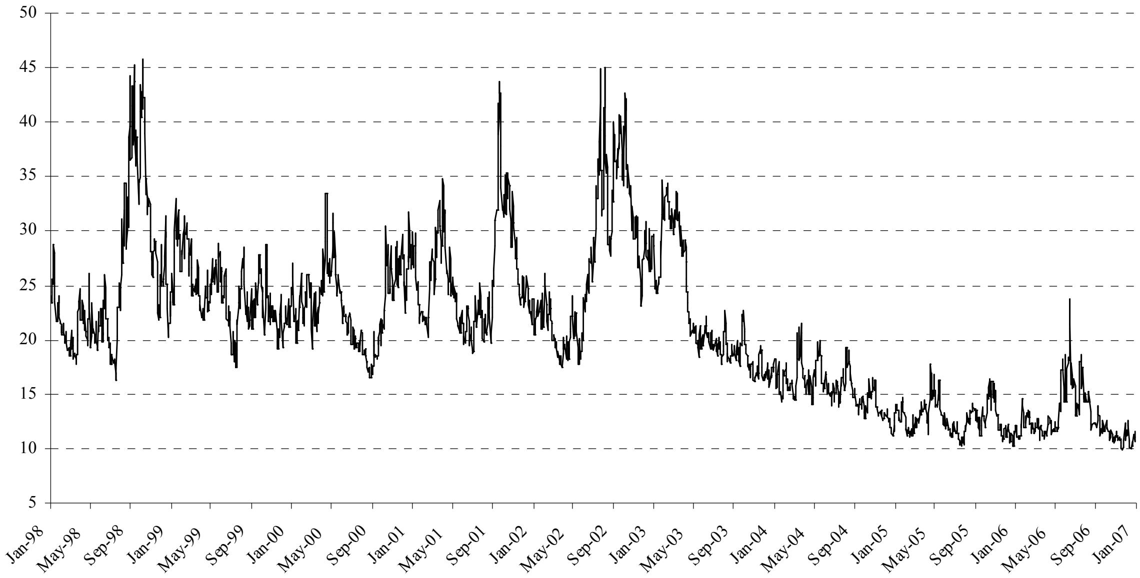


Chart 3. Implied volatility in US stock markets (VIX Index)

(daily data)



Note: The VIX index is the Chicago Board Options Exchange Volatility Index and is a market estimate of future volatility; it is calculated as a weighted average of the implied volatilities of eight put and call options written on S&P 500 index. The VIX index is considered a good measure of international investors' appetite for risk.

Chart 4. Total External Debt

(in % of GDP)

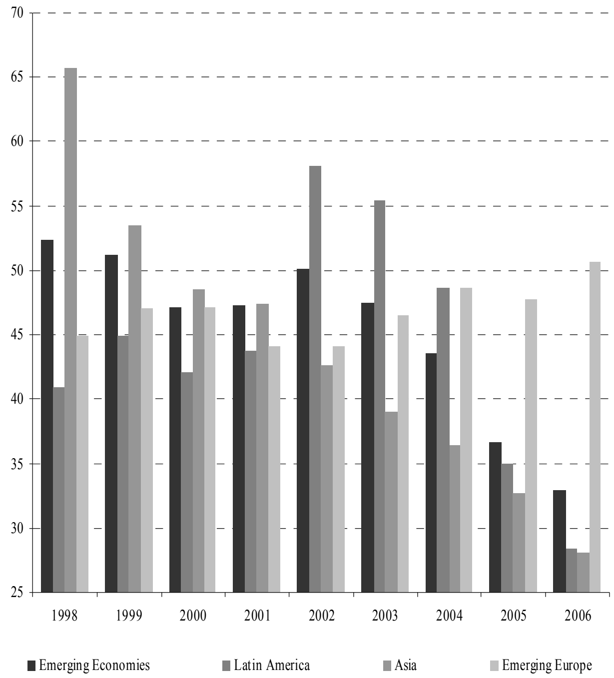


Chart 5. International Reserves / Total External Debt

(in %)

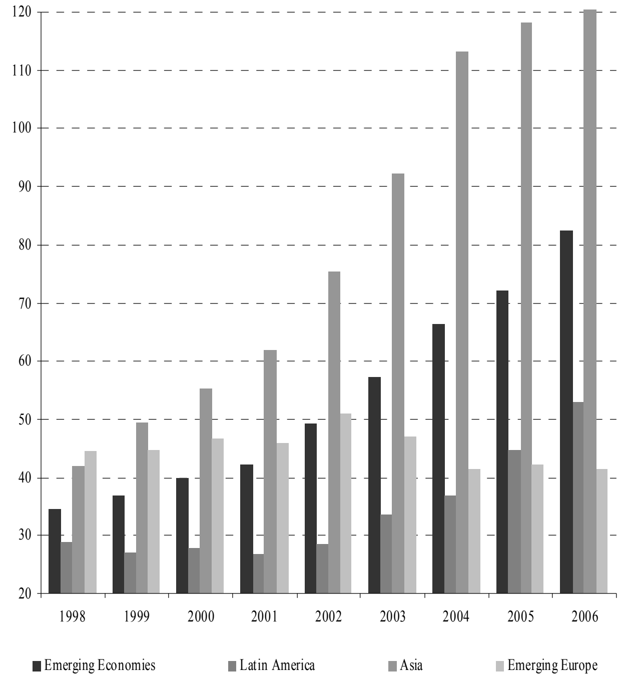


Chart 6. International Reserves / Short Term External Debt

(in %)

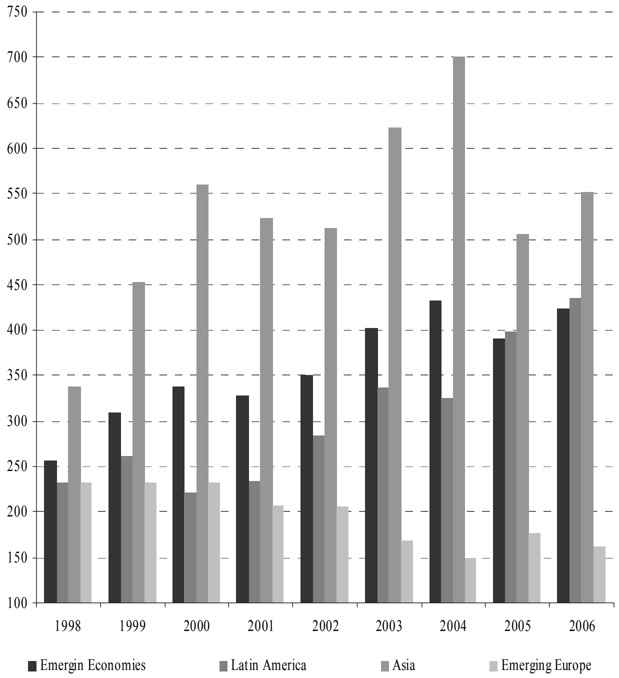


Chart 7. Exports Growth

(YoY % change)

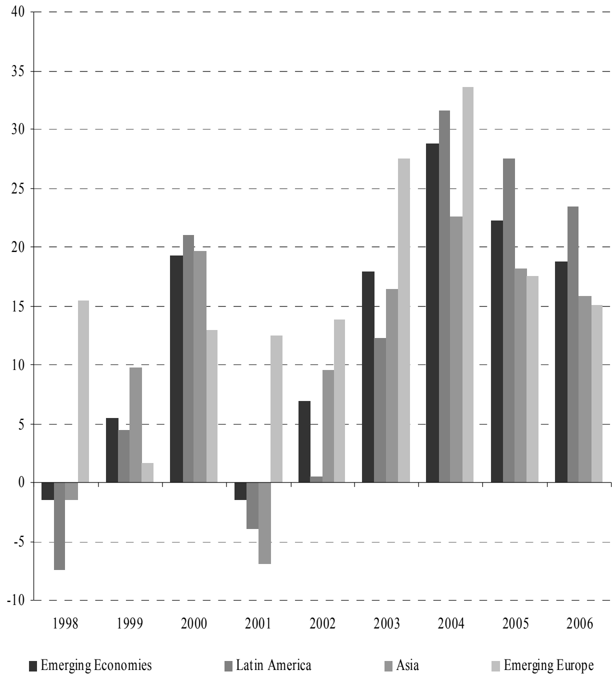


Chart 8. Current Account Balance

(in % of GDP)

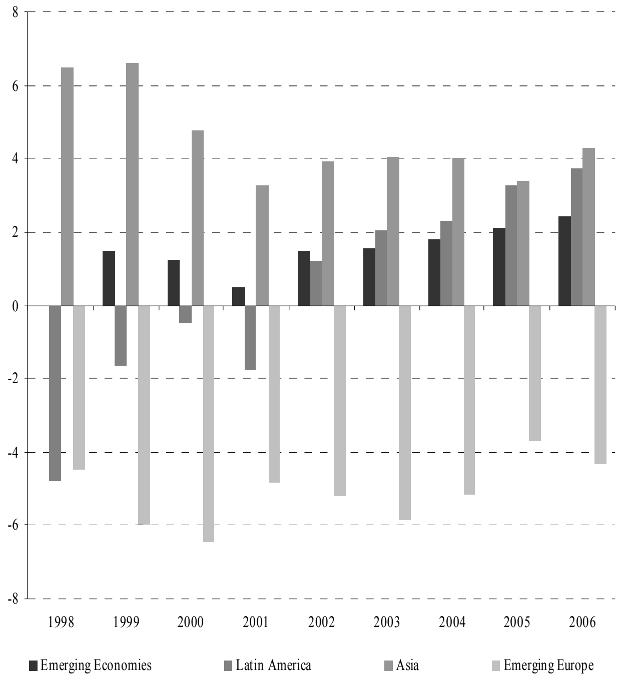


Chart 9. Primary Balance

(in % of GDP)

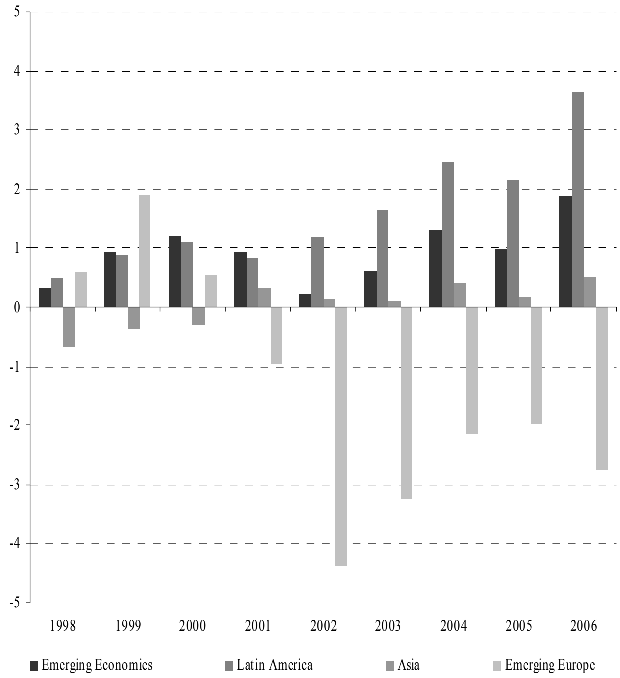


Chart 10. Public Debt

(in % of GDP)

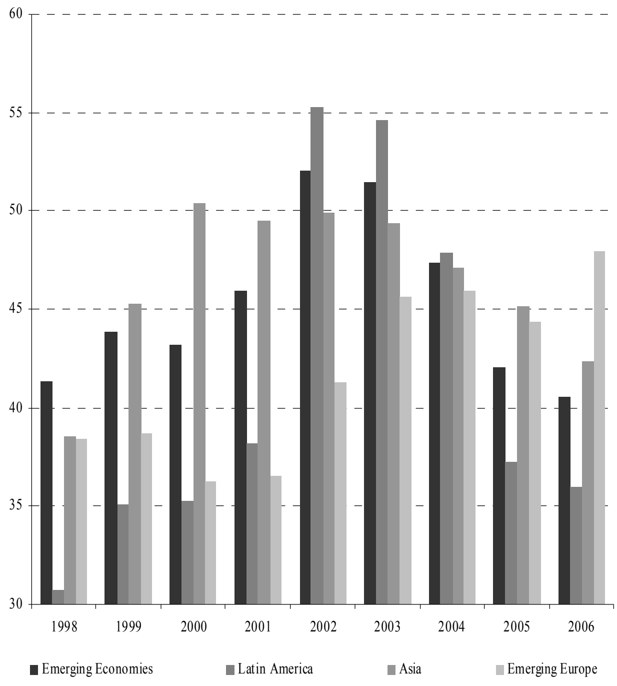
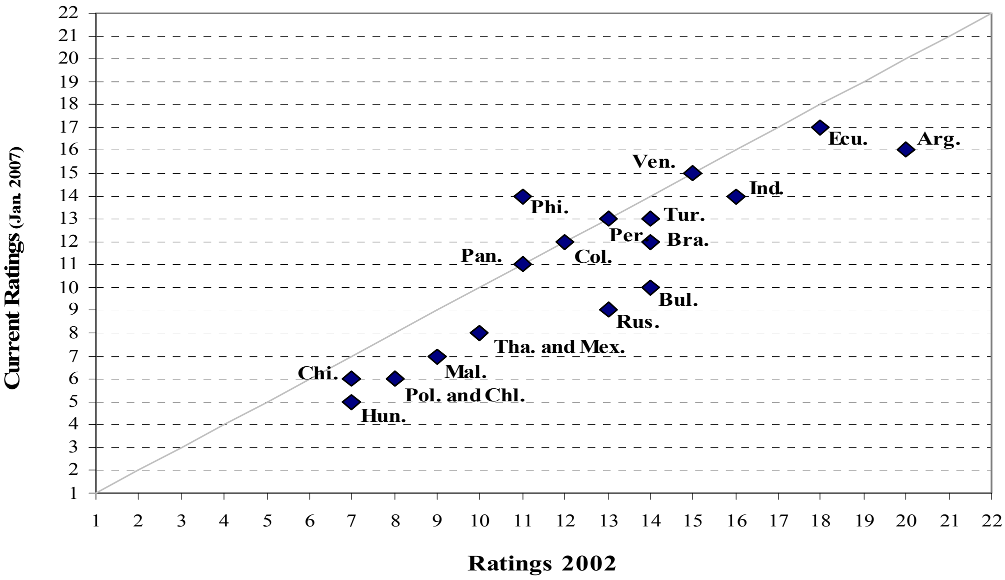
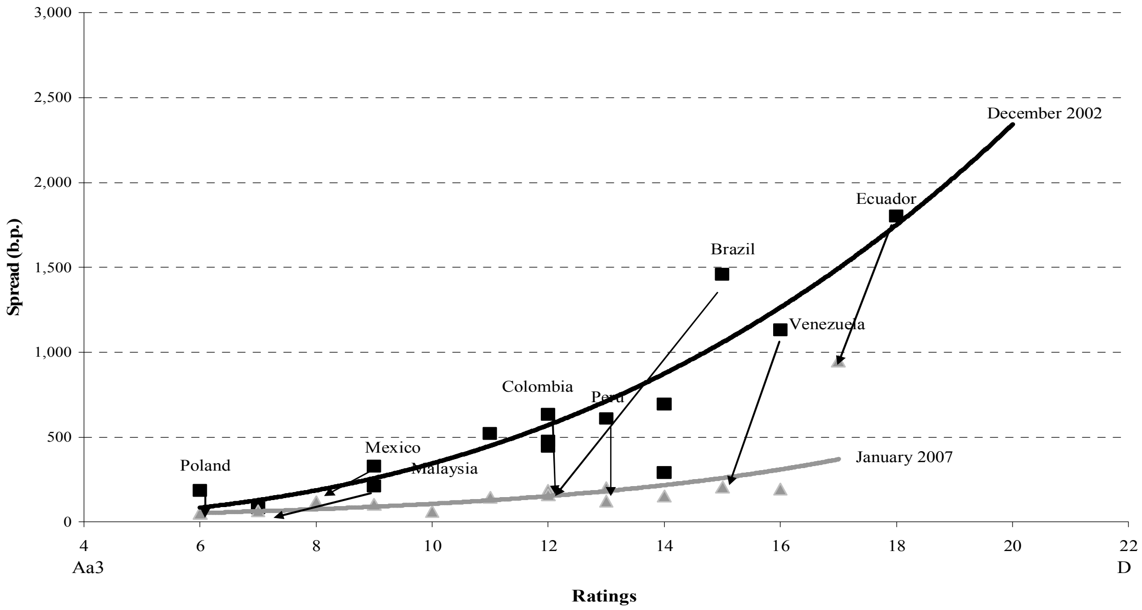


Chart 11. Emerging economies' ratings



Note: Moody's ratings have been given a numerical value from 1 (Aaa) to 22 (Default). Points below the 45° line show that an upgrading occurred between 2002 and February 2006. The countries considered in the sample are: Argentina, Brazil, Bulgaria, China, Colombia, Ecuador, Hungary, Indonesia, Malaysia, Mexico, Panama, Peru, Philippines, Poland, Russia, Thailand, Turkey and Venezuela. The 'investment' grade corresponds to a rating equal to, or better than, Baa3 (to a numerical score equal to, or lower than, 10 in the numerical scale).

Chart 12. Rating on long-term foreign currency debt and sovereign spreads



Note: Moody's ratings have been given a numerical value from 1 (Aaa) to 22 (Default). The countries considered in the sample are: Argentina, Brazil, Bulgaria, China, Colombia, Ecuador, Hungary, Indonesia, Malaysia, Mexico, Panama, Peru, Philippines, Poland, Russia, Thailand, Turkey and Venezuela. The 'investment' grade corresponds to a rating equal to, or better than, Baa3 (to a numerical score equal to, or lower than, 10 in the numerical scale).

Chart 13. Percentage of variability of spreads explained by the first two common factors

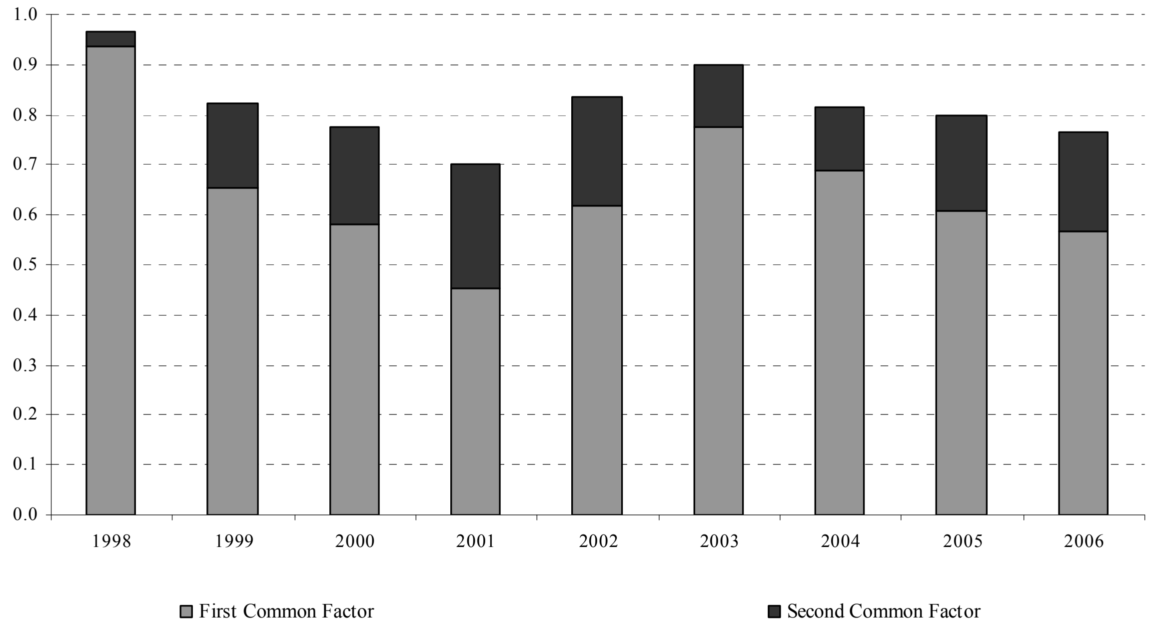


Chart 14. Average uniqueness and communality

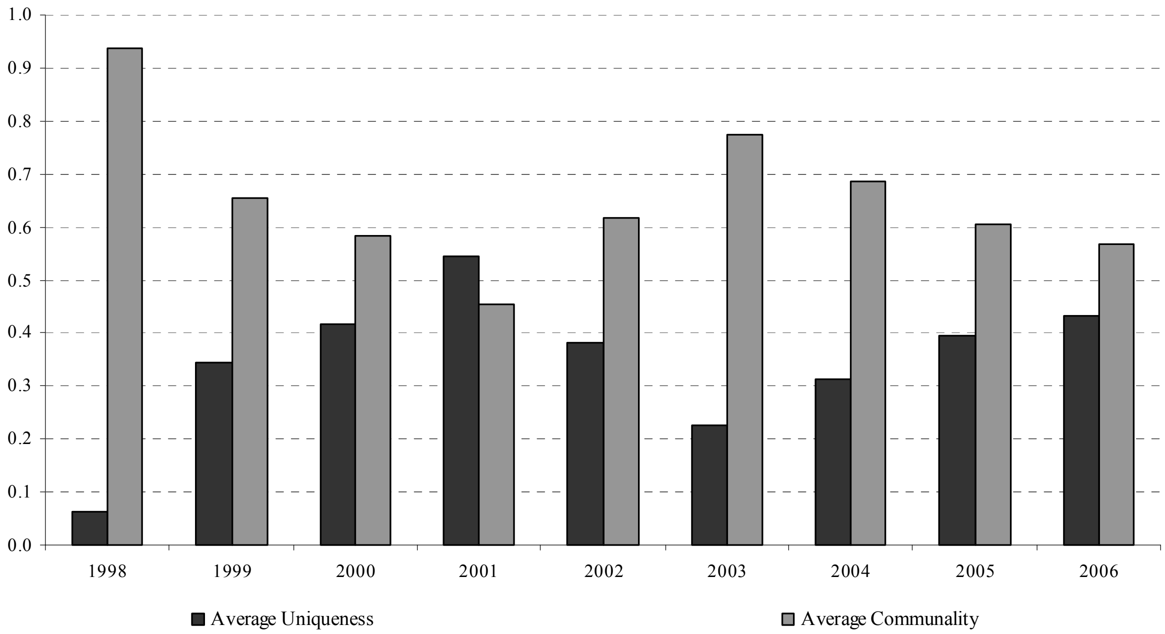


Chart 15. Common factor: actual vs. fitted values from the long-run relationship

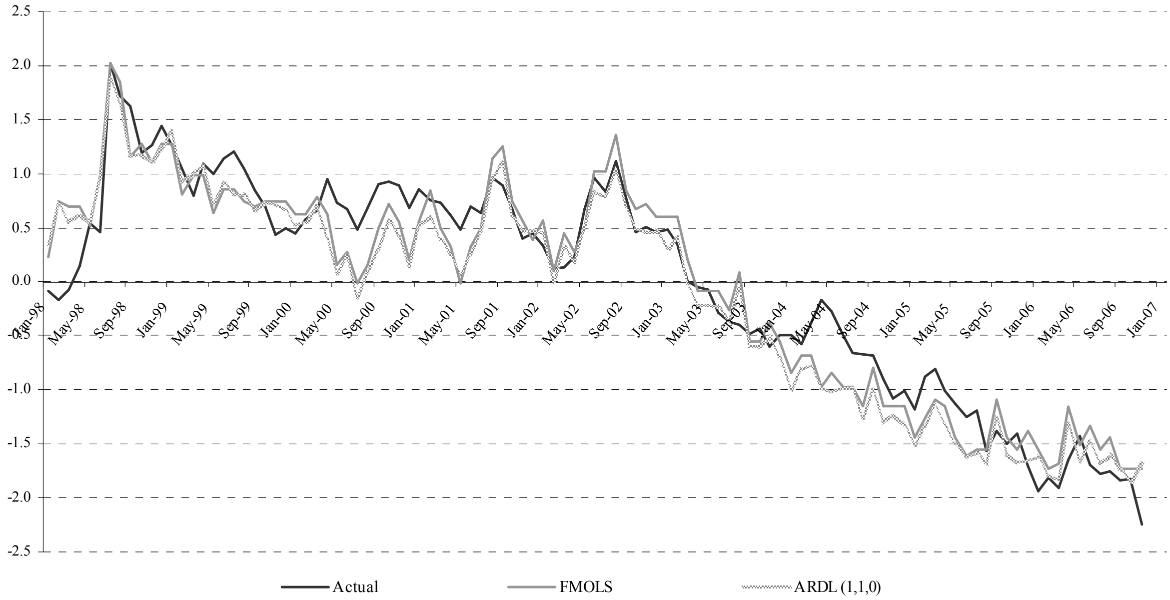


Chart 16. EMEs' Spreads: Actual vs. Fitted

(log spreads)

Brazil

Bulgaria

China

Colombia

Ecuador

Malaysia

Mexico

Panama

Peru

Philippines

Poland

Russia

Turkey

Venezuela

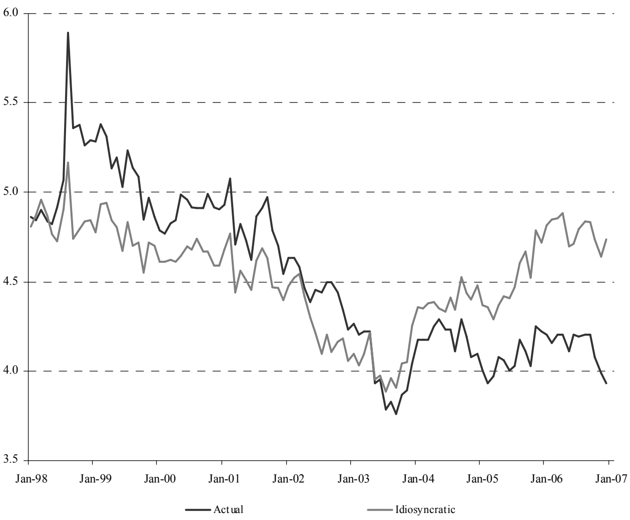
Chart 17. EMEs' Spreads: Actual vs. Idiosyncratic

(log spreads)

Brazil

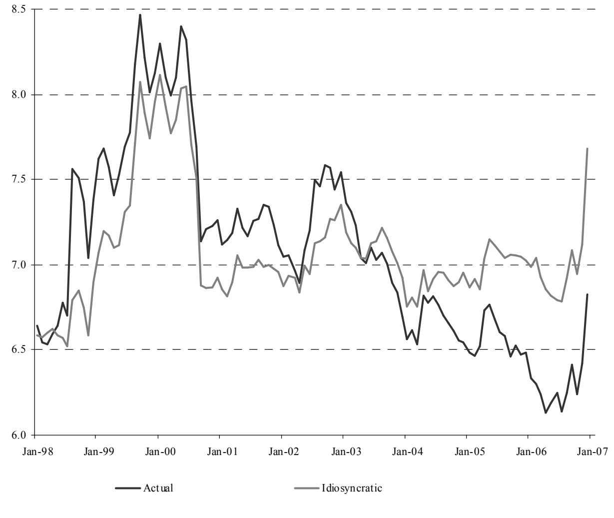
Bulgaria

China



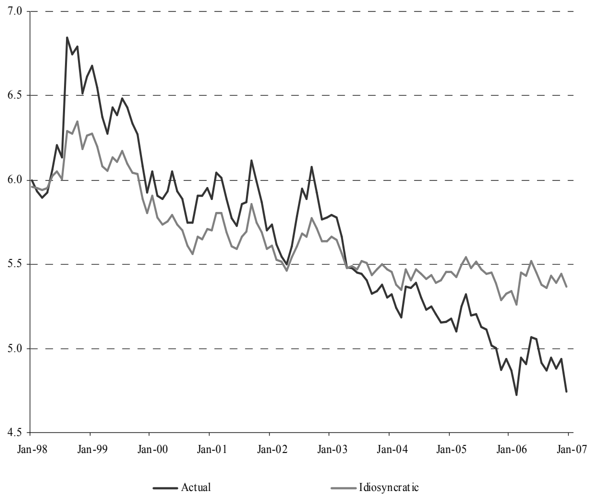
Colombia

Ecuador



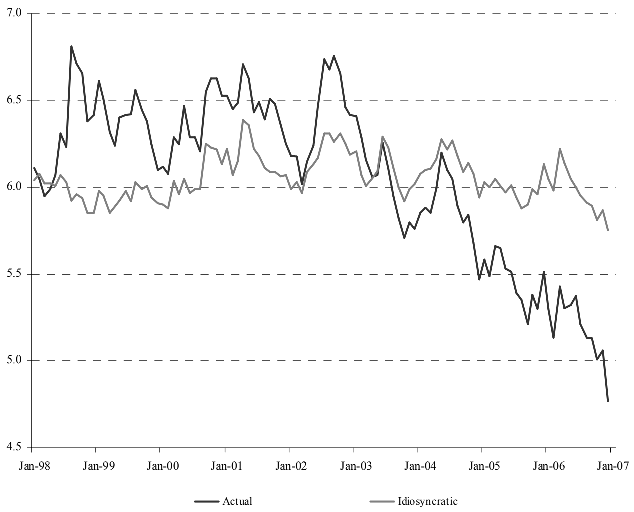
Malaysia

Mexico



Panama

Peru



Philippines

Poland

Russia

Turkey

Venezuela

Annex II

An ARDL(1,1,0) model for the common factor

The most general specification for an ARDL model is given by equation (1) assuming, for notational convenience, a fixed lag of one for both the dependent and independent variables. [25]

$$(1) \qquad y_t = c + \varphi y_{t-1} + \sum_{i=1}^{I} \beta_i x_{it} + \sum_{i=1}^{I} \delta_i x_{it-1} + \varepsilon_t$$

Equation (1), by rearranging its terms, nests the classic error-correction mechanism:

$$(2) \qquad \Delta y_t = \phi\left[y_{t-1} - \alpha - \sum_{i=1}^{I} \lambda_i x_{it} \right] - \sum_{i=1}^{I} \delta_i \Delta x_{it} + \varepsilon_t$$

where

$$\phi = -(1 - \varphi) \qquad \alpha = c/(1-\varphi) \qquad \lambda_i = (\beta_i + \delta_i)/(1-\varphi)$$

The term in square brackets in equation (2) represents the long-run relationship, while the λ_is represent the resulting elasticities. In order to estimate the long-run relationship, we employ a two-step procedure suggested by Pesaran and Shin (1999): the first step consists in choosing the appropriate lag structure of the ARDL; the second step implies estimating the long-run coefficients and their standard errors using the ARDL structure chosen at step one. Since the 'true' order of an ARDL is rarely known from the outset, we tried different complex lag configurations, and then we chose the appropriate lag order using the Schwartz Bayesian Criterion, [26] subject to a pre-specified maximum lag. According to this criterion, the 'best' structure is a simple ARDL (1;1;0) of the form:

$$(3) \qquad common\ factor_t = c + \varphi\, common\ factor_{t-1} + \beta_1 VIX_t + \delta_1 VIX_{t-1} + \beta_2 commodities_t + \varepsilon_t$$

with the estimated coefficients contained in the following table. (27)

Table 1. Autoregressive distributed lag (ARDL) model for the common factor

Regressor	Coefficient	Standard error	*t*-statistics	P-value
Constant	0.58	0.71	0.82	0.41
Common factor$_{t-1}$	0.82	0.07	12.49	0.00
VIX	0.71	0.13	5.56	0.00
VIX$_{t-1}$	-0.45	0.14	-3.26	0.00
Commodities	-0.27	0.13	-2.11	0.04
Diagnostics				
R-squared	0.97			
Adjusted R-squared	0.97			
Durbin Watson	2.09			

Note: the pre-specified maximum number of lags has been set to 8, since this is the level sufficient to make the residuals of the ARDL model white noise and asymptotically normal (results available from the authors upon request).

The coefficients of the long-run relationship stemming from the ARDL (1,1,0) model, reported in the following table, substantially confirm those obtained by applying the FM-OLS procedure in that both the VIX and the commodities index turn out to be significant explanatory variables for the common factor.

Table 2. ARDL model: implied long-run relationship

Regressor	Coefficient	Standard error	*t*-statistics	P-value
Constant	3.21	3.66	0.88	0.38
VIX Index	1.45	0.51	2.86	0.01
Commodities	-1.49	0.45	-3.35	0.00

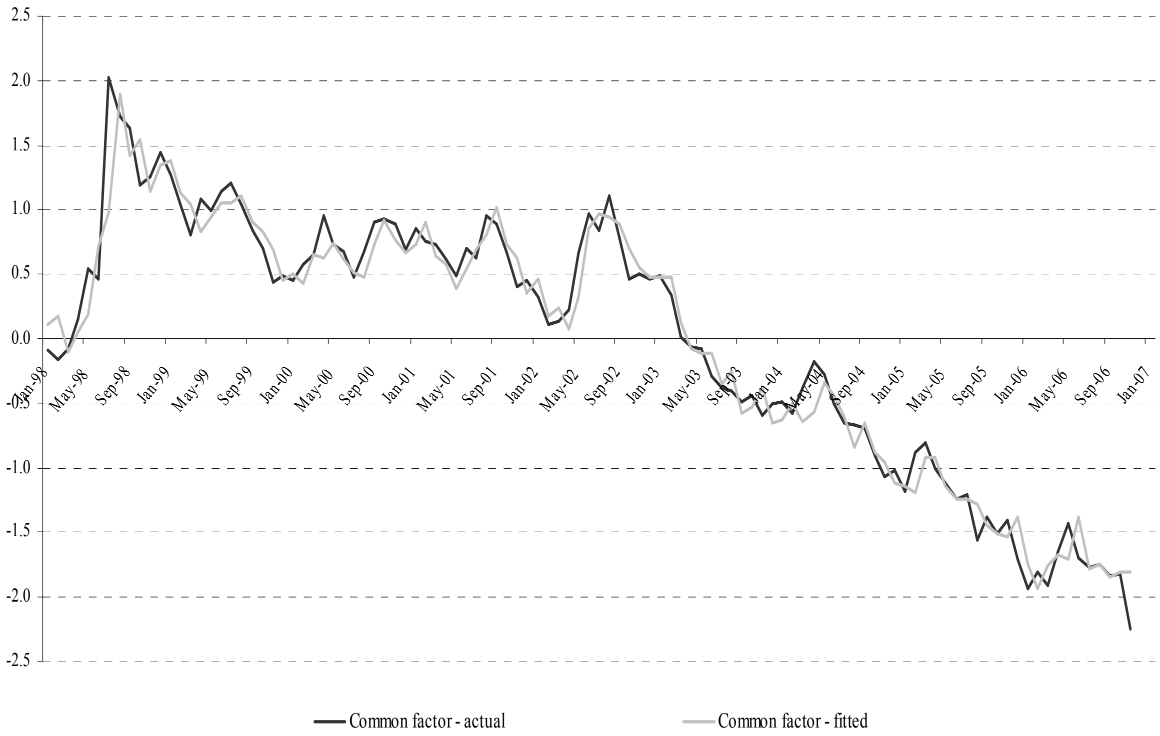
[25] In reality, the specification can be more complicated than that reported in the text because of the presence of more lagged explanatory variables.

[26] By means of Monte Carlo experiments, Pesaran and Shin (1999) demonstrate that this criterion tends to perform slightly better than the others (such as the R-bar, the Akaike or the Hannan-Quinn criteria).

[27] We purposely do not take into account the US T-bond yield since it is insignificant in the FM-OLS procedure.

The following chart graphically tests the goodness of fit of the ARDL approach by reporting the actual and the fitted series of the common factor.

Chart 1. Common factor: actual vs. fitted values – ARDL(1,1,0)



To check if variables in the model are really co-integrated we run the usual tests for nonstationarity of the residuals of the ARDL (1,1,0) long-run relationship. Again, we can safely reject the null of unit root at reasonable confidence levels.

Table 3. ARDL model: test for unit roots on the residuals of the long-run relationship

Test	Statistics	1% critical value	5% critical value	10% critical value
Augmented Dickey-Fuller	-1.74	-2.60	-1.95	-1.61
Phillips Perron	-3.85			

Note: 4 lags have been used in order to perform the Phillips Perron test (as suggested by the Newey – West criterion); 12 lags, coherently with the frequency of data, have been used for the Augmented Dickey Fuller test. Being a test on residuals, we have not considered the constant nor the time trend.

The last step of the ARDL procedure implies estimating the coefficients of the short-run relationship, hosted in **Table 4** below.

Table 4. ARDL model: short-run dynamics and error correction

Regressor	Coefficient	Standard error	*t*-statistics	P-value
Constant	0.58	0.71	0.82	0.41
ECM_{t-1}	-0.18	0.07	-2.77	0.01
ΔVIX_{t-1}	0.71	0.13	5.56	0.00
$\Delta commodities_{t-1}$	-0.27	0.13	-2.11	0.04
Diagnostics				
R-squared	0.27			
Adjusted R-squared	0.24			
Durbin Watson	2.09			

The results are in line with those obtained by means of the FM-OLS procedure. Again, the coefficient Φ, which measures the adjustment speed of the common factor to changes in the explanatory variables in equation (5), is correctly signed implying the existence of an error correction mechanism (ECM) that forces the common factor back to its long-run equilibrium. Again, although statistically significant and correctly signed, the coefficient of the EMC is relatively small, smaller than the one obtained by the FMOLS procedure: only 18 per cent of the gap between the equilibrium and the observed level of the common factor is closed each period. The conclusion that a shock to the common factor might have strong persistence is actually reinforced by what obtained in Table 11. Again, variations in investors' risk appetite, measured by changes in the VIX index, turn out to be the most significant variable in determining the short-run dynamics of the common factor.

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