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The introduction of emerging currencies into a portfolio: Towards a more complete diversification model

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Abstract. We have drawn on portfolio theory and international diversification in order to analyse strategies that help reduce emerging economy exposure to exchange-rate risk. We show that it may be efficient for an investor, by taking into account the several components of the global risk, to build up a portfolio of emerging-country assets denominated in local currency - unhedged against currency risk - compared with a strategy that includes emerging-country securities denominated in foreign currencies. This strategy would lead to a reduction in the "original sin" (i. e. the inability of emerging economies to borrow in local currency), and *de facto* to a reduction in currency mismatches in balance sheets of emerging economies.

JEL Classification: G11; E44; F34.
Keywords: International Portfolio Diversification; Original Sin; Emerging Countries; Downside Risk.

Résumé. Nous nous appuyons sur la théorie du portefeuille et de la diversification internationale afin d'analyser les stratégies permettant de réduire l'exposition des économies émergentes au risque de change. Nous montrons qu'il peut être efficient pour un investisseur, une fois prises en compte toutes les composantes du risque, de constituer un portefeuille d'actifs émergents libellés en monnaie nationale non couvert contre le risque de change par rapport à une stratégie qui inclurait dans le portefeuille des titres émergents libellés en devises. Cette stratégie conduirait à une diminution du « péché originel » (i. e. l'incapacité des économies émergentes à emprunter en monnaie nationale), et de fait à une réduction des déséquilibres en devises dans les bilans des économies émergentes.

Classification *JEL* : G11; E44; F34.
Mots-clefs : Diversification internationale des portefeuilles ; péché originel ; pays émergents ; risque asymétrique.

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1. Introduction

Balance sheet mismatches in emerging economies, particularly currency mismatches, have played a fundamental role in financial crises that have hit these economies for more than ten years. In the late 1990s, Eichengreen and Hausmann (1999) highlighted the fact that a major source of financial fragility in emerging economies was related to the currency composition of their external debt. With what they called the original sin theory, the two authors showed that emerging economies were more vulnerable to financial crises than industrialized countries because of their inability to borrow in international capital markets in their own currency. Indeed, the weight of outstanding external liabilities denominated in foreign currencies increases financial vulnerability because of the high exposure to foreign exchange and interest rate risk of these economies. It can trigger foreign exchange crises.

For Eichengreen *et al.* (2004, 2007), the original sin primarily reflects characteristics of international financial markets. In particular, the shortfall in hedging possibilities and the existence of transaction costs result in international investors giving their preference to a small number of currencies when building their portfolio. The portfolio allocation initiated by international investors is thus combined with a transfer of currency risk to emerging economies, which are ill-prepared to support this risk. Using a portfolio diversification approach we show that emerging economies might free themselves from such a risk in order to improve their resilience to shocks.

To do so, we show that a strategy consisting in including local-currency denominated emerging assets, not hedged against currency risk, in the portfolio of a foreign investor is not necessarily riskier than a foreign-currency denominated asset allocation. This is because the potential reduction of market risk (currency risk), *via* diversification of portfolios composed of emerging securities denominated in local currency, can be higher than the potential in terms of reduction in credit risk (or default risk) related to an international portfolio including foreign currency-denominated emerging securities, thereby steering the debt structure of emerging countries towards a structure in the local currency that would be more stable and less risky.

The rest of the article is as follows. Section 2 presents the theoretical model we draw upon, by justifying notably our choice to use an asymmetric measure of the portfolio's risk. Section 3 presents the methodology used while we empirically assess the various components of the portfolio's risk in Section 4. We draw our conclusions in Section 5.

2. Theoretical model

We use the portfolio diversification theory proposed by Markowitz (1952, 1959) so as to break down several components of the global risk of an internationally diversified portfolio. Initially, Markowitz's model, which is based on strong hypothesis that economic agents have a quadratic utility function, uses standard deviation (or the variance) of returns on securities to measure portfolio's risk. A first limitation of this measure is that it takes into account, without

making any distinction between them, both upward and downward deviations of returns in comparison with the average. This is inappropriate in terms of assessing the concept of risk from an investor's viewpoint because the attitude of investors varies according to the domain of the utility function, as investors are in particular more sensitive to losses they incur than to gains they make (Campbell and Kräussl, 2007) (*cf.* below). Moreover, using standard deviation as a measure of risk supposes normal distribution of returns. However, returns on emerging securities, in particular bonds, are characterized by negative skewness (Bekaert and Harvey, 1997; Bekaert, Erb, Harvey and Viskanta, 1998; Burger and Warnock, 2007).

The use of first- and second-order moments of the distribution of returns in line with the portfolio model leads, by consequence in the case of emerging securities, to a non-optimal asset allocation (Bawa and Lindenberg, 1977; Harlow and Rao, 1989; Harlow, 1991). Following Roy (1952), various measures of risk and, accordingly, various models have been proposed to take into account characteristics of the return distribution for emerging securities, as well as the behaviour of investors with respect to risk, while maintaining the initial two-dimension risk-return relationship (Hwang and Pedersen, 2004). By definition, these measures of risk, so-called downside risk measures, take into account only one part of the return distribution rather than the complete distribution. These measures isolate divergences in returns in comparison with a target return only on the left-hand side of the distribution (Harlow, 1991).

Markowitz (1959) notably defined the semi-variance as "the most robust measure of risk from a theoretical viewpoint". This measure assesses the average squared deviations of returns below a benchmark. Formally, the author suggested evaluating the semi-variance (SV) of returns in two ways:

$$SV_m = \frac{1}{T}\sum_{t=1}^{T} Max[0,(\overline{R}_i - R_{it})]^2 \quad (1)$$

$$SV_{TC} = \frac{1}{T}\sum_{t=1}^{T} Max[0,(TC - R_{it})]^2 \quad (2)$$

where R_{it} stands for the return on security i in period t and T for all periods t. SV_m evaluates downside deviations of returns from the average of returns $\overline{R}_i$ (semi-variance in comparison with the average) while SV_{TC} determines downside deviations of returns from a benchmark rate of return or an arbitrarily chosen target rate TC.[2] According to this definition, the semi-variance expresses the fact that investors are concerned only with negative deviation from a given and arbitrarily chosen profitability threshold, *i.e.* investors care only about their potential worst-case returns.

The development of alternative measures of risk, such as semi-variance, made it possible to determine in a more general framework the lower partial moments of order n defined by (Bawa, 1975):

$$LPM(n,TC) = \frac{1}{T}\sum_{t=1}^{T} Max[0,(TC - R_{it})]^n \quad (3)$$

2. TC stands for target rate.

TC stands for the chosen target profitability rate, *T* the number of observations, *n* the degree of lower partial moment and R_{it} the return on security *i* in period *t*.

From a theoretical viewpoint, the order *n* of the measure of Lower Partial Moment (LPM_n) defines the type of investor's utility function that is consistent with his degree of risk aversion. The partial moment of order 0 is used for investors attracted by risk (positive derivative of the utility function), while the partial moment of order 1 suits all the utility functions of risk-averse investors (positive derivative of the utility function and negative second derivative). Lastly, the partial moment of order 2 concerns risk-averse investors who also have a preference for a positive asymmetrical distribution of returns[3] (positive third derivative) (Harlow, 1991; Nawrocki, 1999).

When $n = 2$ and the benchmark profitability rate is equal to the average of returns, $LPM(2,\overline{R})$ represents the previously presented traditional measure of the semi-variance. Generally speaking, the use of lower partial moments allows the restrictive hypotheses of Markowitz's initial portfolio model to be eased, on the one hand with respect to investors' preferences and, on the other hand, with respect to the properties of distribution functions of assets returns we are looking at. Ultimately, the average-lower partial moment approach is not only consistent with the attitude of investors with regard to risk but remains valid whatever return characteristics (Harlow, 1991). Recently, Jarrow and Zhao (2006) and Estrada (2007) have shown, in this respect, that the optimal mean-variance portfolio differed significantly from the optimal mean – semi-variance portfolio, notably in the case of a bond portfolio (Jarrow and Zhao, 2006). According to the authors, the mean-variance framework is effectively inappropriate with regard to the risk management inherent to this type of asset.

Lastly, we choose to model the portfolio risk by the lower partial moment of order 2 by estimating negative deviations of returns from the mean of the distribution[4] (downside risk measure via semi-standard deviation).[5]

Formally, we rely on the optimization program initially described by Bawa and Lindenberg (1977) to assess the downside risk of an international portfolio. This can be defined as follows:

$$\begin{cases} \underset{w_i}{Min}\, LPM_p^{Réf} = \sum_{i=1}^{N}\sum_{j=1}^{N} w_i w_j CoLPM_p\left(R_{it}^{dom} + \Delta e_i, R_{jt}^{dom} + \Delta e_j\right) \\ \text{under constraints } \sum_{i=1}^{N} w_i E(R_i) = E(R_p) \text{ and } \sum_{i=1}^{N} w_i = 1 \text{et } w_i > 0 \text{(Non - authorised short sales)} \end{cases}$$

3. Investors take into account the skewness of returns on securities and are generally averse to assets displaying negative skewness, i.e. unlikely but higher potential losses and probable but modest gains. In this sense, the downside risk measure is more reflective of investors' concern than the variance (Berkelaar, Kouwenberg and Post, 2004). However, for Brockett and Kahane (1992) or Brockett and Garven (1998), the hypothesis that expected utility maximizers always exhibit a preference for positive skewness is questionable.

4. According to Harlow and Rao (1989) the pertinent target profitability is the mean of the distribution of returns.

5. The semi-standard deviation is defined as the square root of semivariance.

with

$$CoLPM_p(R_{it}^{dom} + \Delta e_i, R_{jt}^{dom} + \Delta e_j) =$$

$$\sum_i w_i^2 \left[Max(0; \overline{R}_i^{dom} - R_{it}^{dom})^2 + Min(0; \overline{\Delta e}_i - \Delta e_{it})^2 + 2 \sum_t Max(0; \overline{R}_i^{dom} - R_{it}^{dom}) Min(0; \overline{\Delta e}_i - \Delta e_{it}) \right]$$

$$+ \sum_i \sum_j \left[\sum_t \begin{Bmatrix} Max(0; \overline{R}_i^{dom} - R_{it}^{dom}) Max(0; \overline{R}_j^{dom} - R_{jt}^{dom}) + Max(0; \overline{R}_i^{dom} - R_{it}^{dom}) Min(0; \overline{\Delta e}_i - \Delta e_{jt}) \\ Min(0; \overline{\Delta e}_i - \Delta e_{it}) Max(0; \overline{R}_j^{dom} - R_{jt}^{dom}) + Min(0; \overline{\Delta e}_i - \Delta e_{it}) Min(0; \overline{\Delta e}_i - \Delta e_{jt}) \end{Bmatrix} \right] \quad (4)$$

with $R_{i/jt}^{dom}$ the return of asset i/j in period t expressed in local currency (*i.e.* the borrower's) and $\Delta e_{i/jt}$ the exchange rate[6] return of the corresponding asset i/j over period t. $CoLPM_p(R_{it}^{dom} + \Delta e_i, R_{jt}^{dom} + \Delta e_j)$ represents the "co-lower partial moment" between returns on emerging-country assets denominated in local currency and exchange rate fluctuations.

The risk of an international portfolio unhedged against currency risk is consequently composed of several components:

- the semi-standard deviation (or downside volatility) of returns emerging assets, denominated in local currency or in foreign currencies, which compose the portfolio (term [1]);
- the downside volatility of exchange rate returns (term [2]). This term disappears (no currency risk) if we consider the portfolio of foreign currencies-denominated securities;
- (intra-class) correlations between downside fluctuations in returns on emerging assets (term [3]);
- (intra-class) correlations between downside fluctuations in returns on exchange rates (term [4]). Likewise, this term disappears for a portfolio of securities issued in dollars;
- (inter-class) correlations between downside movements in returns on emerging securities and returns on corresponding exchange rates (term [5]). This term concerns only the portfolio of local currency-denominated emerging assets;
- lastly, the covariance between downside movements in returns on emerging securities and downside movements in emerging currencies (terms [6] and [7]). These covariance are generally supposed to be negligible because it is assumed that downside movements in fluctuations of currency j (term [6]) or i (term [7]) are hardly correlated to downside movements in returns of a security denominated in currency i (term [6]) or j (term [7]), for $i \neq j$.

The previously presented model enables us to assess empirically advantages of international diversification for a foreign investor.

6. Exchange rate e is defined via an uncertain quotation from the borrower's point of view, i.e. as units of the domestic currency per unit of the reference currency.

3. Methodology

The purpose of our approach is to carry out an arbitrage between two types of strategies: an investment strategy in emerging currencies compared with a strategy of investment in dollars. To do so, we use the EMBIG and ELMI+(LC) indices published by J.P. Morgan for various emerging countries. EMBI Global indicators are indices tracking the returns of sovereign assets of emerging countries (31 December 1993 = 100) issued in international markets and denominated in dollars, while the ELMI+(LC) indicators are indices tracking the returns of domestic assets of emerging economies (31 December 1993 = 100).

The ELMI+(LC) indicator corresponds more precisely to total returns of domestic money market instruments denominated in local currency (J.P. Morgan, 1997). The EMBIG indicator, for its part, refers to total returns of assets issued by sovereign or quasi-sovereign entities in emerging economies, and concerns only instruments denominated in US dollars. As for instruments included in the ELMI+(LC) indicator, assets of the EMBIG indicator have to meet minimum criteria in terms of liquidity and accessibility for foreign investors (J.P. Morgan, 1999).

These two indices, apart from their currency of denomination, are therefore not strictly comparable, as the ELMI+(LC) index covers securities with a shorter duration than instruments eligible for the EMBIG index. Maturity of instruments contained in ELMI+(LC) index are of one, two and three months, whereas the covered bonds in the EMBIG index must have at least 2 ½ years to maturity for inclusion. Once added, an instrument may remain in the EMBIG until 12 months before it matures. The duration mismatch between ELMI+(LC) and EMBIG is however impossible to evaluate precisely and therefore to take into account. The EMBIG returns are based on a composite of the issuing sovereign's and quasi-sovereign's most liquid bonds outstanding at the point of time. Accordingly, the EMBIG index displays different maturity structure over time and across sovereign issuers. It also includes both fixed and floating-rates instruments. In spite of their different interest exposure, both indices however are regularly compared as alternative investment strategies because they refer to indices that tracking profitability of emerging debt securities (Drijkoningen *et al.*, 2006) and because other indices are too partial.[7] Moreover they are available for a sample of 11 countries for a period ranging from 1 July 1997 to 31 December 2007, allowing us to compare performances of the two diversified portfolios, one denominated in dollars, the other in emerging currencies, over a relatively long period.[8] The countries included in the sample are South Africa, Argentina, Brazil, China, South Korea, Mexico, the Philippines, Poland, Thailand, Turkey and Venezuela.[9] An investor interested in exposure to emerging-country markets will therefore be able to compare two strategies: exposure to local public debt or exposure to local currency. The local debt market denominated in foreign currencies

7. Other possible indices -for example, the GBI index- are available only for recent period and for a smaller number of countries: Brazil, Mexico, Poland, South Africa and Thailand since 2002. This means they cannot be drawn upon to build a real portfolio strategy.

8. Medo *et al.* (2009) estimate that the optimal size of a portfolio is ten assets given the diversification potential.

9. Availability of data has strictly determined choices of countries and period studied, although a noteworthy point is that we wanted to include the Asian crisis.

enables investors to gain access to credit risk on emerging-country debt (as the return is determined by the risk-free rate of US debt plus a credit spread reflecting default risk), while investment in local currency in emerging-country markets exposes them to a greater extent to currency risk (in addition to credit risk on the local debt).

Our approach breaks down into three stages. Initially, we assess the downside risk of rates of return of emerging-country assets issued in local currency and of emerging-country assets issued in foreign currencies (term [1] of equation 4). Second, we calculate the downside volatility, measured by the *semi-standard deviation* of returns on emerging currencies (term [2] of equation 4). To do so, we use bilateral nominal exchange rates of quoted emerging currencies against the US dollar. Data come from J.P. Morgan with respect to the two return indicators, and from Reuters for bilateral exchange rates. Third, we look at correlations between downside movements in return rates of assets (term [3] of equation 4), between downside fluctuations in exchange rates (term [4]), as well as between cross correlations (terms [5], [6] and [7]) which correspond to the five other components of a portfolio's risk. We carry out our study on daily data.

4. Results

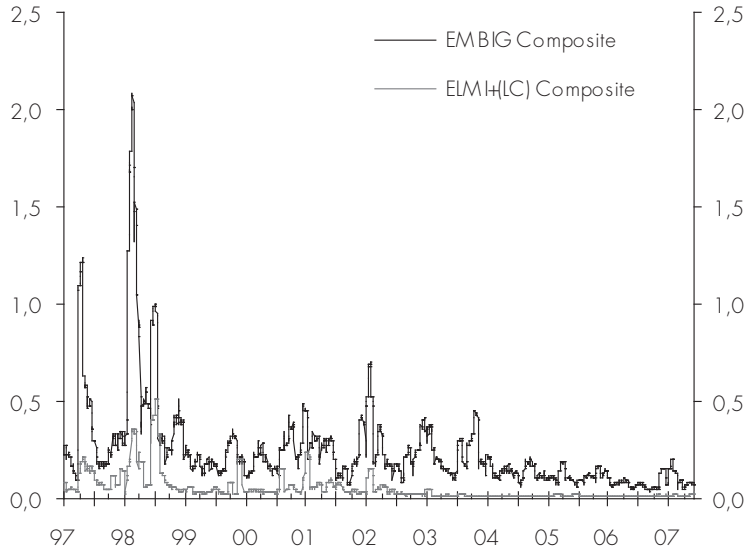
4.1. Downside volatility of returns and of emerging currencies

We carry out a comparative analysis of downside volatility of returns of the EMBIG and ELMI+(LC) indicators over the period 1 July 1997 - 31 December 2007 on daily data (*i.e.* 2,741 trading days). Figure 1 presents changes in the downside month-on-month (M/M) risk for the two composite return indicators for all 11 emerging countries. These composite indicators are calculated as the average of daily returns of each country weighted by their daily market capitalization. We can see that downside volatility of returns on domestic securities denominated in the local currency (ELMI+(LC)) is to a large extent lower than downside volatility of returns on securities traded in international markets (EMBIG), even during a crisis period.

The low volatility of the ELMI+(LC) index is not only due to its short duration (*cf.* Drijkoningen *et al.*, 2006), but, as we shall see below, also to the fact that volatilities of various currencies offset one another (low intra-class correlation). In order to back up the lower volatility of local currency assets, we can compare volatility of the EMBIG with volatility of the GBI-EM, the Government Bond Index Emerging Markets that tracks local currency government bonds issued in emerging markets. The GBI-EM closely follows the methodology of the GBI indices, and therefore might have a similar duration, but returns and statistics are only available since January 1, 2002, and for only a small number of countries. We have built two composite indexes over the 2002-2006 period, for five countries for which data were available (Brazil, Mexico, Poland, South Africa and Thailand). The downside volatility of returns of local debt in local currency (GBI-EM) is 0.11 on average, versus 0.24 for returns of bonds issued in

international markets (EMBIG). This result confirms the lower volatility of returns of emerging market local currency-denominated debt compared with the hard currency-denominated one.

Figure 1 - Downside volatility of asset return (% change, MoM)



Sources: J.P. Morgan, Reuters, author's calculation.

If we carry out a study on a country-by-country basis, we can see that economies with the highest downside volatility over the studied period here are the ones that have suffered from a financial crisis (Figure 2): Argentina, Brazil, Turkey, Thailand and Venezuela. However, downside risk of domestic securities remains lower than downside risk of international securities (except for South Korea where the two kinds of downside volatility are comparable): 0.687 percent on average *versus* 1.004 percent for Argentina, 0.424 percent *versus* 0.619 percent for Turkey, 0.270 percent *versus* 0.543 percent for Thailand over the entire period. The downside risk for the ELMI+(LC) composite indicator that covers all eleven countries for its part stood at 0.090 percent over the period *versus* 0.352 percent for the EMBIG composite index (Table 1).

Table 1 - Downside volatility calculations

	downside volatility (%) EMBIG	downside volatility (%) ELMI+(LC)	downside volatility (%) FX	downside volatility (%) ELMI+(LC) + FX
Index composite	0.352	0.089	0.268	0.358

Sources: J.P. Morgan, Reuters and Datastream authors'calculations.

Figure 2 - Downside volatility of EMBIG and ELMI+(LC) returns (M/M as %)

Figure 2a - Argentina (% change, MoM)

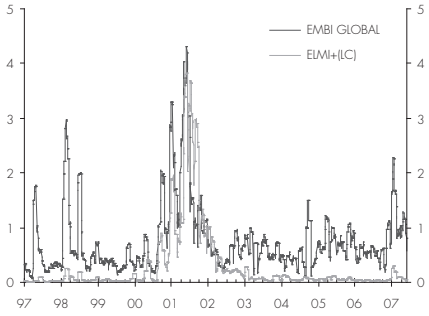


Figure 2b - China (% change, MoM)

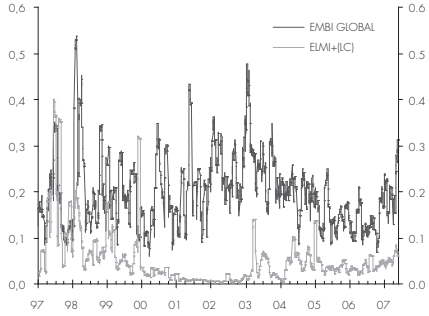


Figure 2c - Mexico (% change, MoM)

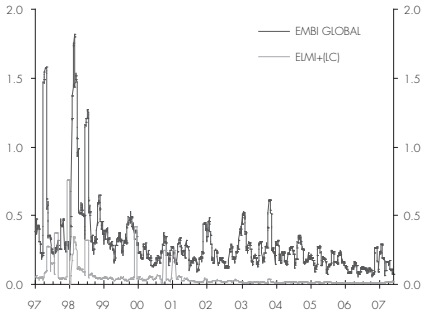


Figure 2d - Philippines (% change, MoM)

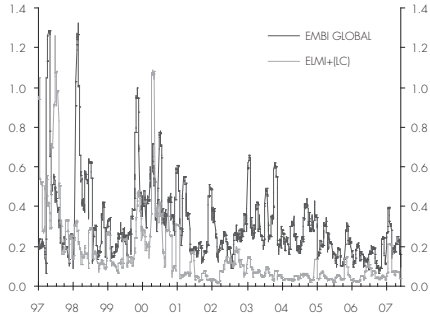


Figure 2e - Thailand (% change, MoM)

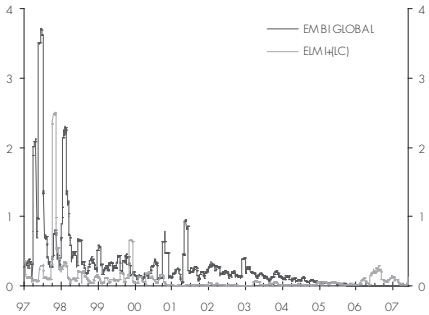
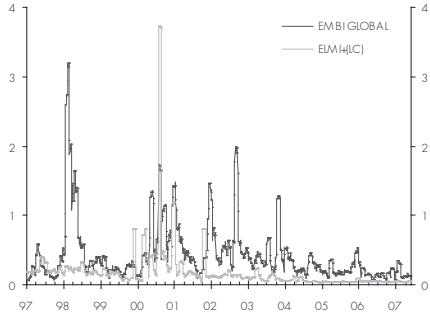


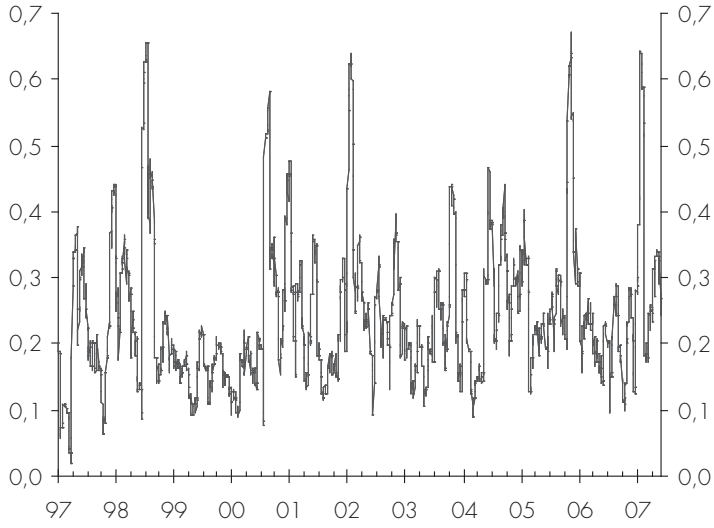
Figure 2f - Turkey (% change, MoM)



Source: Datastream.

Then we assess downside volatility of emerging currencies (FX), quoted against US dollar. After surging to all-time high levels during crisis periods (notably in 1997 during the Asian crisis or between 2001 and 2003 in Latin America and in South Africa), downside volatility of exchange rates has declined obviously in these countries since 2003 and is now below one percent in month-on-month basis (FIGURES 3a, 3b and 3c). The average downside volatility of the composite index, for its part, stands at 0.269, up slightly over the period as a whole (FIGURE 3).

Figure 3 - Downside risk FX composite (% change, MoM)



Sources: Reuters, authors' calculations.

Figure 3a - Semi-volatility FX (% change, MoM)

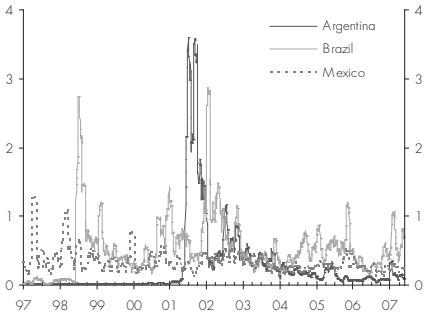


Figure 3b - Semi-volatility FX (% change, MoM)

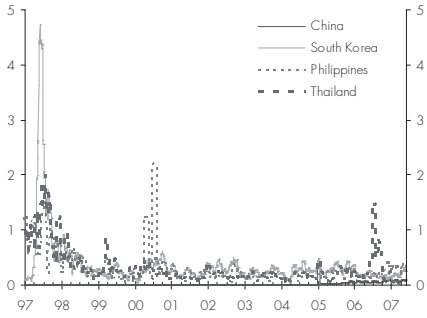
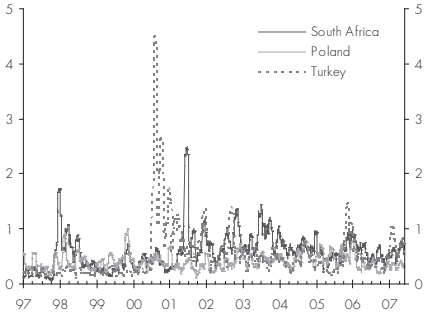


Figure 3c - Semi-volatility FX (% change, MoM)



Source: Datastream.

The comparison of [EMBIG] and [ELMI+(LC) + FX] downside volatility shows that the risk related to holding emerging securities denominated in local currency (composed of downside volatility of returns and exchange rates) is higher than the one related to holding sovereign securities issued in foreign currencies, except in China, because of currency risk. However, in several countries, the risk differential in favour of EMBIG securities remains low (Brazil, Mexico, Poland and Thailand). A striking point is that downside volatility of the weighted composite indicator [ELMI+(LC) + FX] is slightly higher than downside volatility of the EMBIG weighted composite indicator over the period (cf. the first and last columns, Table 1). The analysis, however, remains incomplete. As we have previously emphasised, the assessment of a portfolio's risk must take into account correlations between various downside movements in returns, *i.e.* opportunity to reduce risks via diversification.

4.2. Correlations between downside movements in returns (EMBIG, ELMI+(LC)) and currencies (FX)

We have analyzed correlation coefficients between downside movements in returns on EMBIG securities, in returns on ELMI+(LC) securities and in returns of exchange rates on a daily data basis. We initially assessed correlation coefficients (associated with their p-value in order to determine the significance[10] of the link) between downside movements in returns of various countries, for the two EMBIG and ELMI+(LC) indicators. To do so, we use Spearman's correlation coefficient, which is more appropriate than the standard one (or Pearson's correlation coefficient) when series are not normally distributed. We are thus able to compare average level of correlations between downside movements in EMBIG returns with correlations between downside movements in ELMI+(LC) returns (Tables 2 and 3).

10. We have set the significance threshold at one percent.

Table 2 - Correlation matrix* of downside movements in EMBIG asset returns (over the period)

EMBIG	South Africa	Argentina	Brazil	China	South Korea	Mexico	Philippines	Poland	Thailand	Turkey	Venezuela	Mean EMBIG
South Africa	1	0.125	0.169	0.285	0.246	0.315	0.184	0.416	0.236	0.256	0.19	0.242
Argentina	0.125	1	0.538	0.058	0.14	0.422	0.293	0.156	0.071	0.256	0.456	0.251
Brazil	0.169	0.538	1	0.093	0.182	0.617	0.381	0.198	0.11	0.383	0.598	0.327
China	0.285	0.058	0.093	1	0.394	0.346	0.142	0.409	0.468	0.08	0.106	0.238
South Korea	0.246	0.14	0.182	0.394	1	0.312	0.217	0.305	0.527	0.143	0.186	0.265
Mexico	0.315	0.422	0.617	0.346	0.312	1	0.378	0.382	0.261	0.343	0.518	0.389
Philippines	0.184	0.293	0.381	0.142	0.217	0.378	1	0.196	0.154	0.345	0.319	0.261
Poland	0.416	0.156	0.198	0.409	0.305	0.382	0.196	1	0.275	0.161	0.2	0.27
Thailand	0.236	0.071	0.11	0.468	0.527	0.261	0.154	0.275	1	0.09	0.127	0.232
Turkey	0.256	0.256	0.383	0.08	0.143	0.343	0.345	0.161	0.09	1	0.331	0.239
Venezuela	0.19	0.456	0.598	0.106	0.186	0.518	0.319	0.2	0.127	0.331	1	0.303
Mean EMBIG	0.242	0.251	0.327	0.238	0.265	0.389	0.261	0.270	0.232	0.239	0.303	**0.274**

* : bold characters mean significant correlation between countries at 99% confidence level.
Source: Authors' calculations.

Table 3 - Correlation matrix* of downside movements in ELMI+(LC) asset returns (over the period)

ELMI+(LC)	South Africa	Argentina	Brazil	China	South Korea	Mexico	Philippines	Poland	Thailand	Turkey	Venezuela	Mean EMBIG
South Africa	1	0.119	0.14	0.13	0.193	0.306	0.146	0.342	0.142	0.043	0.143	0.170
Argentina	0.119	1	0.115	0.037	0.04	0.154	0.056	0.129	0.056	0.05	0.11	0.087
Brazil	0.14	0.115	1	0.063	0.104	0.216	0.076	0.194	0.064	0.084	0.116	0.117
China	0.13	0.037	0.063	1	0.195	0.134	0.153	0.127	0.144	-0.002	0.042	0.102
South Korea	0.193	0.04	0.104	0.195	1	0.177	0.111	0.226	0.166	0.027	0.135	0.137
Mexico	0.306	0.154	0.216	0.134	0.177	1	0.141	0.322	0.152	0.042	0.165	0.181
Philippines	0.146	0.056	0.076	0.153	0.111	0.141	1	0.145	0.152	0.046	0.13	0.116
Poland	0.342	0.129	0.194	0.127	0.226	0.322	0.145	1	0.117	0.006	0.226	0.183
Thailand	0.142	0.056	0.064	0.144	0.166	0.152	0.152	0.117	1	-0.007	0.054	0.104
Turkey	0.043	0.05	0.084	-0.002	0.027	0.042	0.046	0.006	-0.007	1	0.107	0.040
Venezuela	0.143	0.11	0.116	0.042	0.135	0.165	0.13	0.226	0.054	0.107	1	0.123
Mean ELMI+(LC)	0.170	0.087	0.117	0.102	0.137	0.181	0.116	0.183	0.104	0.040	0.123	0.124

* : bold characters mean significant correlation between countries at 99% confidence level.
Source: Authors' calculations.

Table 4 - Correlation matrix* of downside movements in FX returns (over the period)

FX	South Africa	Argentina	Brazil	China	South Korea	Mexico	Philippines	Poland	Thailand	Turkey	Venezuela	Mean FX
South Africa	1	**0.063**	**0.203**	0.001	**0.082**	**0.23**	**0.087**	**0.324**	**0.123**	**0.292**	0.032	0.144
Argentina	**0.063**	1	**0.112**	0.006	0.02	**0.06**	-0.012	0.046	-0.013	**0.057**	0.024	0.036
Brazil	**0.203**	**0.112**	1	0.008	**0.058**	**0.331**	**0.064**	**0.165**	0.035	**0.231**	0.005	0.121
China	0.001	0.006	0.008	1	**0.052**	0.004	0.035	0.005	0.036	0.02	-0.033	0.013
South Korea	**0.082**	0.02	**0.058**	**0.052**	1	**0.089**	**0.241**	**0.124**	**0.279**	**0.052**	0.029	0.103
Mexico	**0.23**	**0.06**	**0.331**	0.004	**0.089**	1	**0.075**	**0.144**	**0.104**	**0.162**	0.017	0.122
Philippines	**0.087**	-0.012	**0.064**	0.035	**0.241**	**0.075**	1	**0.104**	**0.293**	**0.056**	-0.024	0.092
Poland	**0.324**	0.046	**0.165**	0.005	**0.124**	**0.144**	**0.104**	1	**0.188**	**0.302**	0.042	0.144
Thailand	**0.123**	-0.013	0.035	0.036	**0.279**	**0.104**	**0.293**	**0.188**	1	**0.079**	0.031	0.115
Turkey	**0.292**	**0.057**	**0.231**	0.02	**0.052**	**0.162**	**0.056**	**0.302**	**0.079**	1	0.03	0.128
Venezuela	0.032	0.024	0.005	-0.033	0.029	0.017	-0.024	0.042	0.031	0.03	1	0.015
Mean FX	0.144	0.036	0.121	0.013	0.103	0.122	0.092	0.144	0.115	0.128	0.015	**0.094**

* : bold characters mean significant correlation between countries at 99% confidence level.
Source: Authors' calculations.

We then determine the matrix of correlation coefficients between downside movements in return of exchange rates of each emerging currency (TABLE 4).

The comparison of results between TABLES 2 and 3 shows a significant difference between coefficients of average intra-class correlations of these two types of return. Coefficients are close to 1 for 2.2 between downside movements in returns on securities denominated in local currency (average correlation for the ELMI+(LC) indicator of around 0.124) and downside movements in returns on securities denominated in foreign currencies (average correlation for the EMBIG indicator of around 0.274).

Another important difference is that there is no upward trend in correlations when returns decrease for ELMI indices, while crisis periods lead to contagion effects on EMBIG indices. Correlation of the EMBIG returns is 0.274 for the whole period and 0.306 for the periods of decreasing returns, whereas these correlations are respectively of 0.124 and 0.038 for the ELMI+(LC). According to J.P. Morgan (1999), investors invest to a greater extent in an asset class (debt securities) when they invest in EMBIG assets than in a local perspective (investment in a country). They will therefore be more sensitive to international events and notably to movements in the US Treasury market. On the other side, the development of local markets makes local rates more closely linked to local business cycle, in a context of more flexible exchange regime and improved external accounts. Consequently, while hard currency assets of different countries tend to move closely, various local currency assets vary strongly between countries, producing a more stable risk profile.

An in-depth study of average correlations of each country for the two indicators throughout the period shows, without any exception, the low level of coefficients associated with domestic securities in comparison with international securities. In particular, differences between correlation coefficients are significant on the entire period for Turkey (0.239 *versus* 0.040), Argentina (0.251 *versus* 0.087), Venezuela (0.303 *versus* 0.123) or Brazil (0.327 *versus* 0.117). Moreover, downside correlations of EMBIG securities are all significantly positive.

Analysis of correlation coefficients for emerging currencies (TABLE 4) shows a low average correlation between downside movements in exchange rates throughout the period (of around 0.094). In particular, downside movements in currencies in Argentina, China, the Philippines and Venezuela are close to zero over the period. Conversely, currencies with the most highly correlated exchange rates are those of South Africa and Poland with an average correlation coefficient of 0.144 over the period.

As a result, average correlations associated with emerging securities denominated in local currency, for which one also needs to take into account correlations between fluctuations in exchange rates, are lower for the period as a whole than average intra-class correlations of securities denominated in foreign currencies (0.274 *versus* 0.124+0.094 = 0.218). These results add credence to the argument calling for a greater diversification of portfolios in favour of emerging securities denominated in local currency insofar as one part of risk is minimized. However, before drawing a definitive conclusion, we need to analyse the last component of the overall risk of a portfolio unhedged against currency risk: cross correlations between

downside movements in returns of emerging-country assets and downside movements in currencies (terms [5], [6] and [7] of equation 4).

4 3. Correlations between downside movements in returns (ELMI+(LC)) and in currencies (FX)

The last component of risk of an international portfolio is determined by the level of three cross correlations:

- cross correlation between downside movements in returns on emerging securities expressed in local currency and downside movements in the corresponding emerging currencies (term [5]),
- cross correlation between downside movements in returns on emerging securities expressed in local currency with downside movements in currencies of other emerging countries (term [6]),
- and cross correlation between downside movements in local emerging currencies and downside movements in returns of other emerging countries securities (term [7]).

We have empirically assessed the degree of correlation between these variables by calculating Spearman coefficients for each country of the sample throughout the period (July 1997-December 2007). The p-values calculated for correlation coefficients enable us to test the null hypothesis of a correlation not significantly different from zero. Coefficients in bold type show a significant correlation at the 1 percent threshold. The results are presented in the Table 5:

Table 5 - Cross correlations ELMI+(LC) - FX over the period

Cross correlations	ELMI+(LC) - FX same country (term [5])	ELMI+(LC) - FX other countries (term [6])	FX - ELMI+(LC) other countries (term [7])
South Africa	–0.035	–0.029	**–0.054**
Argentina	0.045	**–0.059**	–0.013
Brazil	–0.020	–0.026	**–0.068**
China	**0.060**	**–0.072**	–0.019
South Korea	–0.045	–0.026	–0.046
Mexico	**–0.176**	–0.039	–0.033
Philippines	**–0.167**	**–0.053**	–0.020
Poland	–0.020	–0.029	–0.035
Thailand	**–0.132**	**–0.057**	–0.035
Turkey	0.029	0.015	**–0.057**
Venezuela	–0.009	–0.020	–0.016
Mean correlation	–0.043	–0.036	–0.036

Cross correlations are the last component of the portfolio risk including local currency-denominated emerging sovereign securities. Over the period as a whole, only one country posts a significantly positive cross correlation between downside movements in returns on emerging local debt and downside movements in the corresponding currency: China. This means that a downside movement of this country asset returns is quite significantly correlated to a downside movement of its currency. Conversely, Mexico, the Philippines and Thailand post a significantly negative cross correlation that helps to lower the portfolio's overall risk. Over the period as a whole, eight countries out of eleven post a negative cross correlation. The average cross correlation is ultimately negative and stands at −0.043.

In the same way, the covariances between downside movements in returns of securities and in fluctuations of currencies of other countries are rarely significant, and when they are, are negative. Resulting negative correlations among equities and currencies markets make local currency markets an attractive tool for portfolio diversification.

All in all, we can empirically compare various levels of risks international investors face by drawing on all the results of the seven components of portfolio risk (Table 6). If risk components defined by downside volatilities of returns and of exchange rates are approximately similar for the two types of securities we have looked into (downside volatility for the EMBIG composite indicator is close to 0.352 while downside volatility for the ELMI+(LC) composite indicator + the FX composite indicator is approximately 0.358), the comparison of other components of overall risk determined by levels of correlations enables us to draw a distinction between these two types of assets.

Over the period as a whole, the correlation associated with EMBIG securities is close to 0.274 (Table 2), while for ELMI+(LC) securities unhedged against currency risk, the average correlation stands at 0.103 (0.218−0.115), *i e.* more than half lower than that of EMBIG securities.

Table 6 - Summary of risk portfolio components

	Downside volatility		Intra-class correlations		Cross correlations		Global portfolio risk	
	EMBIG	ELMI-FX	EMBIG	ELMI-FX	EMBIG	ELMI-FX	EMBIG	ELMI-FX
Composite index	0.352	0.358	0.274	0.218	-	–0.115	0.627	0.461

Source: Authors' calculations.

All in all, the overall risk of a diversified portfolio made up of emerging securities denominated in foreign currencies is higher for our sample of countries than the overall risk of a portfolio made up of emerging country sovereign bond securities denominated in local currencies unhedged against currency risk over the period July 1997-December 2007 (0.627 *versus*

0.461). By consequence, it would have been in the interest of an investor not to hedge against currency risk over the period under consideration.

In order to evaluate the robustness of our results, we have also used the standard mean-variance framework. The results are the following (TABLE 7):

Table 7 - Summary of risk portfolio components in a mean-variance framework

	Volatility		Intra-class correlations		Cross correlations		Global portfolio risk	
	EMBIG	ELMI-FX	EMBIG	ELMI-FX	EMBIG	ELMI-FX	EMBIG	ELMI-FX
Composite index	0.457	0.48	0.313	0.270	-	–0.089	0.770	0.661

Source: Authors' calculations.

Even with a mean-variance strategy, a local debt portfolio in local currencies remains less risky than a hard currency one.

5. Conclusion

At this point, portfolio and international diversification theory becomes fully meaningful: via a process of risk ranking, we can show that the downside potential for market risk, achieved by an international portfolio diversification including emerging country assets denominated in local currencies, is higher than the downside potential for credit risk supported by an investor who includes exclusively in his portfolio emerging securities denominated in foreign currencies. Such a strategy nevertheless supposes building a diversified enough portfolio, over a relatively long period. Advantages gained from diversification due to low correlations between changes in return rates of emerging securities, but also with other asset classes, should induce investors to modify structurally their asset allocations in favour of securities denominated in local currency in order to improve their portfolio efficiency. Such a strategy could reduce the "original sin" these economies are facing. However, issues of bonds denominated in hard currency can be perceived by investors as a protection against laxist monetary and exchange rate policies in emerging countries, facilitating issues of local currency-denominated debt. Therefore, these two strategies in hard and in local currencies may remains complementary for emerging countries, as for international investors.

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