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Does Emerging Market Exchange Risk Affect Global Equity Prices?

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Abstract

This paper conducts empirical tests in a conditional setting for 10 developed and 12 emerging markets to determine whether emerging market currency risk is priced and if it spills over into developed market assets. Our empirical model is based on real exchange rate measures and it allows currency risk to compete with broader economic and political risks. We find that emerging market currency risk is priced separately from other local risk factors and that it represents a significant component of equity returns in both developed and emerging markets. We also find that the spillover impact is heightened during emerging market crisis episodes and affects the expected compensation for global risks.

I. Introduction

Foreign exchange risk is one of the most important dimensions of international asset pricing. Indeed, under deviations from purchasing power parity (PPP), exchange risk should be priced. For example, in the international asset pricing models (IAPMs) of Solnik (1974) and Adler and Dumas (1983), exchange risk is a priced factor.[1] Empirically, it is now well accepted that such risk is significantly priced in major developed markets and that exchange risk premia linked to major currency fluctuations are important components of expected equity returns. [2]

Despite the occurrence of frequent currency crises and their overwhelming impact on emerging market (EM) economies and stock markets, the literature that

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[1] See Karolyi and Stulz (2003) for an excellent discussion.

[2] Early attempts to test IAPMs in an unconditional setting are inconclusive. For example, Hamao (1988) and Jorion (1991) found no evidence that exchange risk is priced on the Japanese and U.S. stock markets, respectively. More recently, using a conditional framework, Dumas and Solnik (1995), De Santis and Gerard (1998), Choi, Hiraki, and Takezawa (1998), Doukas, Hall, and Lang (1999), and Carrieri (2001) find evidence that foreign exchange risk is priced in major developed stock markets.

focuses on exchange risk premia in these markets is very sparse.[3] More importantly, we do not know whether emerging market risks affect the broader global capital market. Although theoretical models would suggest that the currency risk stemming from these markets might be of limited importance since such markets represent a small component of the world market capitalization, the issue of whether foreign exchange risk is priced and the extent of its global economic relevance is to a large extent an open empirical question.[4] Indeed, there have been numerous emerging market-related episodes, for example, the Latin American debt crisis, the tequila crisis, the Asian flu, and the Russian virus, where it is widely believed that the emerging market risks were spilling over into the broader global capital market. Clearly, emerging markets provide a generic venue for studying exchange rates and stock prices because the risks are large and colorful.

In this paper, we attempt to provide some answers to the following related questions. i) Does emerging market currency risk affect emerging market equities?[5] ii) Does emerging market currency risk earn a global risk premium, i.e., does it spill out of the emerging markets into developed markets? iii) Is the spillover impact heightened during emerging market crisis episodes?

We use a sample of 10 developed markets, including the G7 countries, and 12 emerging markets over the period 1976–2003. The base model used to test whether *EM currency risk* affects emerging market equities and whether it spills over into developed markets, is motivated by Adler and Dumas (1983).[6] In their framework, both world market risk and the risk from PPP deviations are priced. As in Dumas and Solnik (1995) and De Santis and Gerard (1998), we use the world market index but we aggregate developed market exchange risk in a composite measure. This setup is augmented with a composite measure of emerging market exchange risk as well as a unique *EM-specific risk* factor, which is constructed by orthogonalizing a composite emerging market stock index with respect to the other three factors.[7] Its inclusion is consistent with the widely accepted view that emerging markets are neither fully integrated nor completely segmented from the global market.[8] It also allows the EM currency risk to empirically compete with other local risks and may serve as a proxy for broader economic and political risks in emerging markets, albeit imperfectly. Our base four-factor model is first estimated to investigate whether EM currency risk earns

[3]See Bailey and Chung (1995) for evidence that Mexico's equity market premia are related to risk premia in the currency market.

[4]In what follows, we use the terms *EM currency risk* and *EM-specific risk* to refer to the "emerging market exchange risk" and "other emerging market-specific risks," respectively.

[5]Given that we use market-level data, i.e., one index series per country, there are limits as to how extensively we can address the issue of local pricing of EM currency risk. See Bailey and Chung (1995) and Carrieri, Errunza, and Majerbi (2006) for more detailed analyses of local pricing of assets in emerging markets.

[6]The idea of spillover used in this paper is different from the spillover tests found in previous literature. A number of papers, most notably Eun and Shim (1989) and Hamao, Masulis, and Ng (1990) look at spillover effects between financial markets. These papers use data at high frequency and investigate the issue of spillover in mean and volatility from one market to another. Our goal is to see whether emerging market events contribute to the global pricing of risk.

[7]Previous empirical studies that include both world and domestic market factors along with other risk factors to test various forms of IAPMs include Chan, Karolyi, and Stulz (1992), Choi and Rajan (1997), and Choi, Hiraki, and Takezawa (1998).

[8]See, for example, Errunza, Losq, and Padmanabhan (1992) and Bekaert and Harvey (1995).

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a global risk premium separately from other EM-specific risks. Then, to examine the spillover impact during crisis episodes in emerging markets, we use information from a crisis variable modeled after the exchange market pressure index of Eichengreen, Rose, and Wyplosz (1996). This variable is based on the exchange rates and official reserves of the constituent countries of the EM currency risk composite measure.[9] To evaluate the impact of crises episodes on the global pricing of assets, we include this variable in the conditioning information set for all four factors sequentially.

Our results can be summarized as follows. We find that the price of EM currency risk is significant and time varying for a large number of assets from developed and emerging markets. On average over the whole sample, total currency premia are negative, confirming that the hedging component in currency premia is predominant. Total currency premia are also economically significant as on average they represent about 40% of the total premium in absolute value across all global assets. Therefore, currency risk is an important risk factor in pricing both emerging and developed market assets. The EM-specific risk is also statistically significant and separately priced from the EM currency risk. Overall, emerging market risks represent over 50% of the total risk premia for emerging market assets and about 20% for developed market assets. We also find that the impact of such risks is heightened during crisis episodes when information on emerging market crises significantly affects the expected compensation for the global risk factors. This confirms the widely held belief that emerging market crises spill over into global capital markets.

The rest of the paper is organized as follows. Section II outlines the model and methodology. Section III describes the data and presents some preliminary analysis. The empirical results from tests of risk pricing and the impact of crisis episodes on the pricing of global assets are presented in Section IV. Section V concludes the paper.

II. Model and Methodology

A. The Model

The empirical model captures a number of factors that are relevant in global asset pricing. Our base model draws on the Adler and Dumas (1983) specification where expected returns are a function of a global market risk premium and inflation premia that capture risk stemming from PPP deviations. In testing the model for the four major developed countries, Dumas and Solnik (1995) and De Santis and Gerard (1998) substitute PPP deviations with the nominal exchange rate changes of three major currencies. Since our goal is to investigate whether emerging market risks are also globally priced, we modify their empirical framework in two ways.

First, we account for all sources of currency risks that arise from developed and emerging markets, and we aggregate the risk premium from both groups of

[9] Since the crisis episodes build up over time, a time-varying measure should be better than the usual dummy variables that are more suitable when precise dating is possible.

currencies into their respective composite premia.[10] We refer to these two exchange risk factors as the *major currency risk* and the *EM currency risk*. Our empirical model is thus

$$(1a) \qquad E_{t-1}(r_{i,t}) = \delta_{w,t-1}\,\mathrm{cov}_{t-1}(r_{i,t}, r_{w,t}) + \delta_{mj,t-1}\,\mathrm{cov}_{t-1}(r_{i,t}, e^r_{mj,t}) + \delta_{em,t-1}\,\mathrm{cov}_{t-1}(r_{i,t}, e^r_{em,t}),$$

where r_i and r_w are excess returns on asset i and the world market portfolio, respectively; e^r_{mj} and e^r_{em} are the changes in the two real exchange rate indices of the major currencies and the EM currencies, respectively, vis-à-vis the U.S. dollar, the reference currency; E is the expectation operator; and the δs are the time-varying prices of global risks. The covariance terms measure the exposure of asset i to world market and currency risks.

Second, the specification in (1a) contains one notable difference with respect to previous empirical work. Instead of assuming that countries' inflation rates are nonrandom and working with nominal exchange rates, we use the change in the currencies' real exchange rate as a measure of PPP deviations.[11] Intuitively, it is more appealing to approximate this risk through the real exchange risk since changes in the real exchange rate come from the combined effects of changes in the inflation differential and changes in the nominal currency value. In addition, using changes in the real exchange rate helps overcome possible complications due to fixed exchange rate regimes or discrete changes in nominal exchange rates due to devaluations or currency peg management.

To further support this claim, we plot the nominal and the real index for emerging market currencies in Graph A of Figure 1. It is evident that the nominal index reflects the steady nominal appreciation of the dollar over the last two decades. Thus, this measure is unlikely to capture changes in relative competitiveness and it might actually confound currency risk with other information. Indeed, if we find that EM currency risk is important, we could not be sure if this were due to true purchasing power deviations or instead due to other sources of EM risks. In this respect, using the real exchange rate index ensures that we are able to at least account for the adjustment from inflation. On the other hand, the real and nominal indices of developed market currencies do not exhibit such dissimilarities, but instead have very similar dynamics with mean reversion at long lags. Graph B of Figure 1 depicts this relation.

However, even with real exchange rates, equation (1a) could be misspecified because of the omission of other sources of EM risks that might be important in addition to the currency risk. For this reason, we extend the specification in (1a) to allow the EM currency risk to empirically compete with other sources of EM risks that might reflect broader types of economic risks. We measure such

[10] Among other papers that have replaced the different currency exchange rates with a composite exchange rate measure such as a trade-weighted exchange rate index, see Jorion (1991), Ferson and Harvey (1993), (1994), and Choi, Hiraki, and Takezawa (1998).

[11] Using a composite real exchange rate index would still require an assumption about inflation for the reference currency (the U.S. dollar) to be non-stochastic, which is reasonable. A proof of this claim is available from the authors.

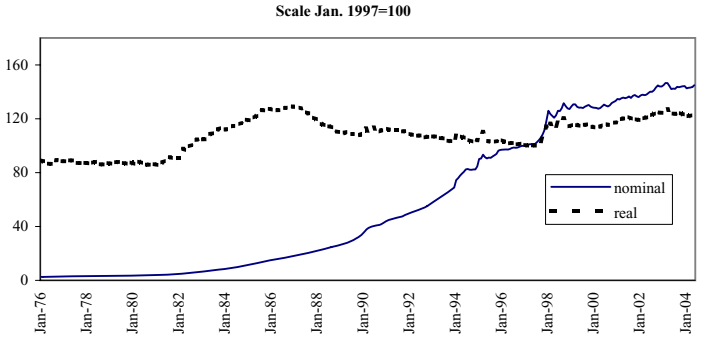
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FIGURE 1

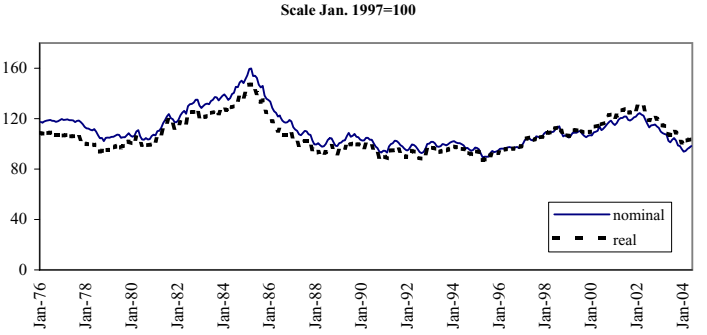
Currency Indices

Graph A shows the EM currency index in both nominal and real terms. It is a trade-weighted exchange rate index of the U.S. dollar against 19 currencies that are not heavily traded outside their respective home markets (mostly emerging markets). The major currency index reported in Graph B is the trade-weighted exchange rate index of the U.S. dollar against 16 major currencies until the introduction of the euro and seven currencies after that event. Both indices are published by the Federal Reserve Board.

Graph A. Emerging Market Currency Index



Graph B. Major Currency Index



sources through an "orthogonal" portfolio of emerging market stocks and we call this factor the EM-specific risk. Our model is then

$$(1b) \qquad E_{t-1}(r_{i,t}) = \delta_{w,t-1}\,\mathrm{cov}_{t-1}(r_{i,t}, r_{w,t}) + \delta_{mj,t-1}\,\mathrm{cov}_{t-t}(r_{i,t}, e^{r}_{mj,t}) + \delta_{em,t-1}\,\mathrm{cov}_{t-t}(r_{i,t}, e^{r}_{em,t}) + \delta_{r,t-1}\,\mathrm{cov}_{t-t}(r_{i,t}, \hat{u}_{r,t}),$$

where the notation is the same as in the previous specification except for the addition of the risk premium from exposure to EM-specific risk. The portfolio $\hat{u}_r$ is the residual from a regression of a composite stock return index for emerging markets on the traditional sources of risk presented in equation (1a). This measure has the advantage of being purged of the shocks already explained by the world market risk and by the exchange rate risks while it contains information that is specific to the emerging markets. As a check on the information content of

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this variable, we compute the correlation with changes in the yield spread of the JP Morgan Emerging Market Bond Index (EMBI+).[12] Before orthogonalization, the EM composite stock index has its highest correlation with the EMBI+ spread changes (-0.69). In comparison, the correlation with the global factors in equation (1a) ranges from 0.64 with the world index to 0.42 with the EM currency index over the sample period.[13] After orthogonalization on the global factors of equation (1a), our EM-specific risk variable retains a very high correlation with the EMBI+ spread (-0.55).[14]

B. Empirical Methodology

We estimate the model in equation (1b) jointly in a multivariate system that comprises a country index return and the returns on the four factors.

The estimated system for each country is

$$
\begin{aligned}
(2) \qquad r_{i,t} &= \delta_{w,t-1}h_{i,w,t} + \delta_{mj,t-1}h_{i,mj,t} + \delta_{em,t-1}h_{i,em,t} + \delta_{r,t-1}h_{i,r,t} + \varepsilon_{i,t} \\
r_{w,t} &= \delta_{w,t-1}h_{w,w,t} + \delta_{mj,t-1}h_{w,mj,t} + \delta_{em,t-1}h_{w,em,t} + \varepsilon_{w,t} \\
e^r_{mj,t} &= \delta_{w,t-1}h_{mj,w,t} + \delta_{mj,t-1}h_{mj,mj,t} + \delta_{em,t-1}h_{mj,em,t} + \varepsilon_{mj,t} \\
e^r_{em,t} &= \delta_{w,t-1}h_{em,w,t} + \delta_{mj,t-1}h_{em,mj,t} + \delta_{em,t-1}h_{em,em,t} + \varepsilon_{em,t} \\
\hat{u}_{r,t} &= \delta_{r,t-1}h_{r,r,t} + \varepsilon_{r,t}, \qquad \varepsilon_t|\Omega_{t-1} \sim N(0, H_t),
\end{aligned}
$$

where $r_{i,t}$, $r_{w,t}$ are the excess returns of country i and the world portfolio measured in a common currency, $e^r_{mj,t}$, $e^r_{em,t}$ are the changes in the real exchange rate indices vis-à-vis the common currency, $\hat{u}_r$ is the residual from a regression of the EM composite stock index return on the world and currency portfolios, $\delta_{w,t-1}$ is the price of world market risk, $\delta_{mj,t-1}$ and $\delta_{em,t-1}$ are the prices of major currency risk and EM currency risk, respectively, $\delta_{r,t-1}$ is the price of EM-specific risk, Ω_{t-1} is a set of information variables available to investors at time $t-1$, and $h_{i,j,t}$ is an element of the (5×5) covariance matrix H_t.

The model in (2) allows us to investigate the importance of various factors in explaining the time variation in returns. Formally, the relevance of each factor implies testing whether the coefficients on the risk exposures, the prices of risk, are significantly different from zero.

The first equation of the system corresponds to equation (1b) where the country excess return is expressed as a function of four factors. The next three equations explain the world returns and the two currency portfolios as a function of the three factors as in (1a) since the fourth factor is orthogonal to the assets in

[12] The JP Morgan Emerging Market Bond Index tracks total returns of traded external debt instruments of EMs.

[13] Spreads in emerging market bonds are perceived to reflect market perception of default risk and, thus, by extension are viewed as a reliable proxy for economic and political risk. For a similar argument, see Bailey and Chung (1995).

[14] Although one could directly use the EMBI+ index as a better proxy for EM-wide economic and political risks, its limited time span (the series starts in 1991) would have consequences on the feasibility and the statistical reliability of our estimations.

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question.[15] The EM-specific risk in the fifth equation is explained only by its own variance.[16]

Given the evidence on predictability of international equity returns based on widely available information, the asset pricing literature exploits such a feature through the use of lagged variables. Hence, we conduct our estimation using a number of lagged conditioning variables that might convey information about the current state of financial markets. We model the prices of global risks to depend on a set of global information variables $Z_{G,t-1}$.[17] More precisely, we model the price of world market risk as an exponential function of the information variables to ensure that this price is always positive as implied by the theoretical model. The prices of currency risks are specified with a linear functional form as there is no restriction on the price of currency risk to be positive in the model.[18] A linear specification is also used for the price of the EM-specific risk factor. Since the EM-specific risk is a composite residual risk for which we do not have any a priori expectations, we do not wish to constrain it to be positive.[19]

Specifically, the pricing equations are

$$\delta_{w,t-1} = \exp(k_w' Z_{G,t-1}), \tag{3}$$

$$\delta_{j,t-1} = k_j' Z_{G,t-1}, \qquad j = r,\ em,\ mj. \tag{4}$$

We test for the significance of the prices of risk by setting the k coefficients equal to zero.

Since we want to study the effect of emerging market episodes of distress on global markets, we expand the set of the traditional global information variables by constructing the *EM crisis variable* (EMCV), similar to the index of exchange market pressure of Eichengreen et al. (1996), Sachs, Tornell, and Velasco (1996), and Kaminsky and Reinhart (1999).[20] This variable is constructed as

$$\text{EMCV}_t = \frac{1}{\sigma_e} e_t - \frac{1}{\sigma_R} R_t, \tag{5}$$

where e is the rate of change in the nominal exchange rate index, R is the rate of change in the official reserves of the countries comprising the index, and σ_e and σ_R

[15] Dumas and Solnik (1995) and De Santis and Gerard (1998) use the IAPM equation to price the deviations from uncovered interest rate parity and estimate the nominal exchange premia in (1a) through uncovered currency deposits. We focus on risk due to real exchange rate changes. By replacing nominal rates with real rates and inflation rates, we express the currency portfolio pricing equation in terms of changes in the real exchange rate.

[16] Prices of risk represent expected compensation per unit of risk. We then model the price of EM-specific risk, $\delta_{r,t-1}$, as the trade-off between the mean and variance of the risk factor.

[17] We follow Dumas and Solnik (1995) and De Santis and Gerard (1998) who use the same set of global instruments for the price of world risk and the prices of currency risk.

[18] In Adler and Dumas' (1983) theoretical model, the price of market risk is always positive as long as investors are risk averse. However, the price of currency risk can be negative if the degree of risk aversion is greater than one.

[19] From a purely statistical standpoint, De Santis and Gerard (1997) argue that imposing a positivity restriction on the price of risk might not take care of the predictability in returns. This could also be important in our case.

[20] The exchange market pressure measure is derived from the theoretical model of Girton and Roper (1977). In the literature, it is extensively used as a dependent variable in cross-sectional regressions and probit analysis to study contagion in financial and currency crises.

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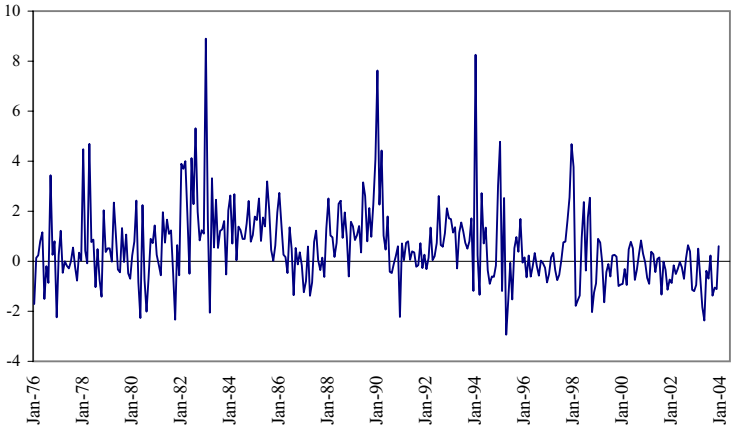
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are the respective standard deviations used as weights to equalize the contribution of each component.[21] The idea behind this variable is as follows. When facing pressure from financial markets, a government has the option of devaluing or depreciating its currency, of running down international reserves, and/or of raising interest rates.[22] Thus, any of these events or a combination of them is a sign of turbulence in the markets. Since changes in the exchange rate enter with a positive weight and changes in reserves with a negative weight, large positive readings of this variable are an indication of a crisis. To this date, the index of exchange market pressure has been used to identify the occurrence of crises and then create a binary variable.[23] For the purpose of this study, we are interested in the buildup of the pressures before the precipitation of the crisis itself. Hence, it is more appropriate to use this measure in its time-varying form. The plot in Figure 2 reveals that the EMCV is indeed helpful in identifying the timing and the building of pressure for a number of crises over our sample.

FIGURE 2

Emerging Market Crisis Variable

The EMCV used in the conditioning information set is constructed at each period as $1/\sigma_e(e) - 1/\sigma_R(R)$, where e is the rate of change in the nominal exchange rate index, R is the rate of change in official reserves of the emerging market countries comprising the index, and σ_e and σ_R are the respective standard deviations. Large positive readings of this variable are an indication of a crisis.



The system in (2) is estimated through a fully parametric approach used in De Santis and Gerard (1997), (1998). We impose a diagonal structure on the matrices of the coefficients and assume that the system is covariance-stationary

[21]The change in reserves is constructed from the reserves of each country with the same weights used for the construction of the exchange rate index.

[22]The variable should include as a third element the difference in nominal interest rates between a country and the reference country. However, as in Kaminsky and Reinhart (1999) we omit this component since comparable data on interest rates in emerging markets is not available for our full sample.

[23]Crises are defined as extreme values of the index above a specified threshold.

so that we can rewrite H_t as a function of the unconditional covariance matrix of the residuals H_0 and a reduced number of parameters,[24]

$$H_t = H_0 * (\iota\iota' - aa' - bb') + aa' * \varepsilon_{t-1}\varepsilon'_{t-1} + bb' * H_{t-1}, \quad (6)$$

where ι is a (5×1) vector of ones, a and b are (5×1) vectors of unknown parameters, and $*$ denotes the Hadamard (element by element) matrix product.[25] The system is estimated using the Broyden, Fletcher, Goldfarb, and Shanno (Shanno (1985)) and the Berndt, Hall, Hall, and Hausman (1974) algorithms, and quasi-maximum likelihood (QML) standard errors are obtained to ensure robustness of the results (see White (1982)).

Even with this parsimonious specification, a joint multi-country estimation of the model with the cross section of all countries that make up our sample would be computationally unfeasible. In addition, there are problems for the multi-country estimation due to the length of the time series, since not all countries start on the same date. One possibility would be to estimate a number of systems with a combination of different countries, but that would imply choosing arbitrary subsamples. We instead estimate the system in (2) for five assets, using one country at a time and the four benchmarks. This implies that the number of pricing tests will be equal to the number of countries that make up our sample. Hence, our overall conclusions will be based on the consistency of the evidence across the repeated tests.[26]

III. Data and Summary Statistics

This study covers the G7 countries (Canada, France, Germany, Italy, Japan, U.K., and U.S.), six emerging markets in Latin America (Argentina, Brazil, Colombia, Chile, Mexico, and Venezuela), six emerging markets in Asia (India, Korea, Malaysia, Philippines, Taiwan, and Thailand) plus Greece, Hong Kong, and Singapore. We use monthly data from January 1976 to December 2003 for a total of 336 observations, except for some emerging markets for which data is available only after 1985.[27] Country returns of emerging markets are computed from S&P/IFC national total return indices (inclusive of dividends) while the developed markets and the world market returns are computed from the MSCI total return in-

[24]This means that we assume that the variances depend only on lagged squared errors and lagged conditional variance while covariances depend on the cross-product of lagged errors and lagged conditional covariances.

[25]This symmetric specification for the conditional variance-covariance matrix also has been successfully applied to emerging market data in De Santis and Imrohoroglu (1997). Moreover, modeling asymmetry for EMs returns would be very complicated as they typically show no specific pattern in terms of positive or negative asymmetry as documented in the data section.

[26]To reduce the dimensionality of the problem, Bekaert and Harvey (1995) and Hardouvelis, Malliaropoulos, and Priestley (2006) apply a two-step procedure, but their second step analysis is focused on the relevance of local risks. In our case, we are interested in pricing a number of global risks, thus a similar approach would not be appropriate.

[27]Except for Zimbabwe and Pakistan, we include all the countries of the S&P/IFC database that start in 1976 and 1985. For countries with a more limited data sample, such as Turkey or Portugal, results of the estimation are not robust across specifications.

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dices.[28] Our composite market return for emerging markets is computed from the total return on the S&P/IFCG Composite index, which is a market capitalization-weighted regional index of all emerging markets available from January 1985. We backfill the index to January 1976 with nine emerging market national indices using the same methodology based on the data available for that period from the S&P/IFCG database. All returns are expressed in U.S. dollars and computed in excess of the 30-day eurodollar deposit rate, which we use as a proxy for the risk-free rate.[29]

As mentioned in Section III, we use two trade-weighted exchange rate indices computed by the Federal Reserve Board (FRB) to separate the effects of emerging market currencies fluctuations from those of major currencies.[30] These two currency indices represent two non-overlapping sets of all the important U.S. trading partners. The emerging market currencies are those in the FRB's "other important trading partners" (OITP) index. We will refer to this as the *EM currency index*. This group includes 19 currencies that are not heavily traded outside their respective home markets.[31] The second group is summarized in the "major partners" index, which we refer to as the *major currency index*.[32] This group comprises 16 major currencies until the introduction of the euro and seven currencies after that event.[33] These two currency indices are computed on a price-adjusted basis (real exchange rate indices) and provide a measure to approximate the sum of the various real exchange rates that should be included in the model.[34] We use the log changes in these two currency indices for our measures of the EM currency risk and the major currency risk factors.

Table 1 reports summary statistics and correlations between excess market returns and the global risk factors. Compared to developed market returns characteristics, EM country returns are large in some cases but often show much higher volatility. In addition, many emerging markets show highly autocorrelated returns as indicated by the $Q(z)_{12}$ statistics, unlike the case for developed markets. There is also a high level of autocorrelation in the squared returns series for most emerging markets. The hypothesis of normally distributed returns is clearly rejected by the Bera-Jarque test for all countries except Italy and Japan. The Engle-Ng test statistics indicate the presence of negative asymmetry in four emerging markets and two developed market returns while the returns of four emerging markets suggest positive asymmetry.

[28]The MSCI world covers developed markets except for Mexico, which is included from 1981 to 1988, and Malaysia from 1993 to 1997. The MSCI All Country world index with developed and emerging markets starts only from 1988.

[29]All data we use in this study is obtained from DataStream.

[30]For more information on these indices, see the *Federal Reserve Bulletin*, October 1998.

[31]These countries are Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela in Latin America; China, Hong Kong, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan, and Thailand in Asia; Israel and Saudi Arabia in the Middle East; and Russia in Eastern Europe.

[32]Many emerging markets are quite sensitive to the change in the value of the dollar with respect to major currencies such as the Japanese yen or European currencies due to their trade patterns or currency regimes. For instance, many East Asian economies, due to their de facto peg to the dollar, are quite sensitive to the yen/U.S.$ exchange rate fluctuation. Moreover, for many East Asian countries the volume of trade with Western Europe is comparable to their trade with the U.S. and Japan.

[33]These are the currencies of the euro-area countries plus Australia, Canada, Japan, Sweden, Switzerland, and the U.K.

[34]A proof is available from the authors.

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Panel C of Table 1 reports the correlation of the countries' excess returns with the four global risk factors. The correlations between emerging market returns and the world market index are generally low (minimum of 0.07 for Venezuela and maximum of 0.41 for Malaysia) compared to developed markets (minimum of 0.49 for Italy and maximum of 0.84 for the U.S.). On the other hand, emerging markets show much higher correlations than developed markets with the EM residual stock index. Similarly, the correlations of emerging market returns with the EM currency index are generally higher than their correlations with the major currency index, while the opposite holds for developed market returns.

Panel D of Table 1 contains summary statistics for the instruments used to describe the conditioning information set of the investor. The choice of the global information variables is mainly drawn from previous empirical literature such as Dumas and Solnik (1995) and De Santis and Gerard (1998) to facilitate comparison. The set of global instruments includes a constant, the world dividend yield in

TABLE 1

Summary Statistics of Asset Excess Returns

All country returns are in U.S. dollars and in percent per month, computed in continuous time and in excess of the one-month euro-dollar interest rate. The sample period is from January 1976 to December 2003 (336 obs.) for most countries, and from January 1985 to December 2003 (228 obs.) for Colombia, Malaysia, Philippines, Taiwan, and Venezuela. All data are obtained from DataStream. B-J is the Bera-Jarque test for normality based on excess skewness and kurtosis. Q is the Ljung-Box test for autocorrelation of order 12 for the excess returns and the excess returns squared. EN-AN and EN-AP are the Engel and Ng (1993) test statistics for negative and positive asymmetry respectively. Statistics for the major currency index and the EM currency index are based on the percent (log) change in the real indices values that are used for our measures of the two currency risk factors. Data on both indices are obtained from the Federal Reserve Board. The EM residual market index refers to the residual from a regression of the S&P/IFC EM composite total return index on the world market and currency risk factors. It is used for our measure of the EM-specific risk factor.

	Obs.	Mean	Std. Dev.	B-J	$Q(z)_{12}$	$Q(z)^2_{12}$	EN-AN	EN-AP
Panel A. Summary Statistics for Developed Market Assets								
Canada	336	0.257	5.73	189.68**	13.44	11.41	−0.743	1.438
France	336	0.139	6.63	42.45**	8.69	11.71	−2.074*	0.738
Germany	336	0.276	6.39	72.38**	14.80	24.15*	−2.114*	0.003
Italy	336	0.254	7.45	3.11	18.24	10.88	−0.628	1.616
Japan	336	0.197	6.52	3.37	16.68	38.12**	−1.456	1.282
U.K.	336	0.477	5.69	40.54**	8.20	14.61	−0.453	0.788
U.S.	336	0.412	4.44	143.62**	9.89	6.42	−0.374	0.105
Greece	336	−0.166	9.46	173.74**	32.12**	51.16**	−0.335	1.678
Hong Kong	336	0.573	9.43	451.80**	18.26	3.24	−1.184	−1.070
Singapore	336	0.172	7.96	725.29**	5.63	5.72	−0.712	0.445
MSCI world index	336	0.343	4.18	66.24**	12.51	8.39	−0.164	−0.245
Major currency index	336	0.044	1.74	5.55	50.55**	9.66	0.269	0.400
Panel B. Summary Statistics for Emerging Market Assets								
Argentina	336	0.745	21.60	417.84**	10.46	56.13**	0.067	5.009**
Brazil	336	0.153	15.64	128.16**	9.58	50.29**	−1.559	0.335
Chile	336	1.166	9.65	59.28**	51.42**	49.58**	0.140	0.676
Colombia	228	0.933	8.22	58.34**	45.11**	130.44**	−1.527	7.514**
Mexico	336	0.480	12.77	1748.9**	32.55**	37.06**	−5.723**	1.300
Venezuela	228	0.168	14.25	215.39**	7.99	4.70	−0.125	1.601
India	336	0.410	7.90	10.29**	15.28	56.52**	−0.821	4.053**
Korea	336	0.276	10.67	111.81**	9.47	146.53**	−9.480**	1.027
Malaysia	228	−0.124	9.73	124.79**	34.72**	127.29**	−3.584	0.023
Philippines	228	0.626	10.39	38.26**	34.34**	13.72	−1.624	−0.202
Taiwan	228	0.455	9.64	108.34**	11.72	55.61**	−4.258**	1.305
Thailand	336	0.263	10.35	128.79**	45.91**	190.23**	−2.428*	2.160
EM residual market index	336	0.000	6.04	15.92**	33.23**	34.26**	−1.828	1.039
EM currency index	336	−0.085	1.12	370.31**	34.47**	65.02**	−6.923**	1.450

(continued on next page)

TABLE 1 (continued)

Summary Statistics of Asset Excess Returns

Panel C. Correlations of Assets with Global Risk Factors

	MSCI World Market Index	EM Residual Market Index	Emerging Market Currency Index	Major Currency Index
Canada	0.735	0.130	0.139	0.189
France	0.683	−0.021	0.142	0.255
Germany	0.651	0.056	0.114	0.197
Italy	0.497	0.085	0.104	0.182
Japan	0.691	0.004	0.094	0.329
U.K.	0.727	0.047	0.112	0.260
U.S.	0.843	−0.016	0.082	0.085
Greece	0.266	0.161	0.106	0.116
Hong Kong	0.505	0.187	0.243	0.201
Singapore	0.568	0.213	0.302	0.217
Argentina	0.089	0.311	0.123	0.000
Brazil	0.255	0.261	0.038	0.071
Chile	0.200	0.457	0.196	0.017
Colombia	0.148	0.159	0.084	0.139
Mexico	0.343	0.323	0.183	−0.066
Venezuela	0.075	0.085	0.119	0.164
India	0.110	0.226	0.172	0.105
Korea	0.351	0.136	0.137	0.091
Malaysia	0.413	0.396	0.359	0.111
Philippines	0.391	0.256	0.298	0.149
Taiwan	0.087	0.208	0.149	−0.014
Thailand	0.354	0.304	0.241	0.152
MSCI world market index	1.000	0.000	0.136	0.281
EM residual market index		1.000	0.000	0.000
EM currency index			1.000	0.194
Major currency index				1.000

Panel D. Global Information Variables

The global information set includes a constant, the world dividend yield in excess of the one-month euro-dollar interest rate (XWDY), the change in the U.S. term premium (ΔUSTP), the U.S. default premium (USDP) and the EM crisis variable (EMCV). All variables, except for the EMCV, are in percent per month, lagged one month. The EMCV is lagged three months.

	Mean	Std. Dev.	Pair-Wise Correlations			
XWDY	−0.363	0.25	1.000	0.097	0.444	0.223
ΔUSTP	0.003	0.46		1.000	0.119	0.081
USDP	1.097	0.44			1.000	0.148
EMCV	0.569	1.55				1.000

** and * denote statistical significance at the 1% and 5% levels, respectively. EM stands for emerging markets.

excess of the risk-free rate (XWDY), the change in the U.S. term premium spread (ΔUSTP), and the U.S. default premium spread (USDP). The world dividend yield is the dividend yield on the world equity index available from DataStream. The term premium spread is computed from the yield on the 10-year U.S. Treasury bond in excess of the yield on the three-month bill, both available from the FRB. The default spread is measured by the difference between Moody's Baa-rated and Aaa-rated corporate bonds also available from the FRB. These variables are used with a one-month lag relative to the equities' excess returns and the risk factors. Our information set is expanded with the EMCV described in the methodology section.

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IV. Empirical Results

A. The Base Specification

We start by estimating the international asset pricing model (2) using information variables that have been used in previous work. Indeed, most of these information variables are related to the U.S. financial markets. However, there is widespread evidence that they are important in the information set of investors worldwide and thus should be relevant also for pricing risk related to EM factors. For example, it is widely accepted that the period of high real interest rates in the U.S. in the early 1980s was one of the factors contributing to the Latin American debt crisis. Furthermore, emerging market debt is viewed as similar to U.S. corporate debt and thus EM risks should be influenced by U.S. domestic default yield spreads. In addition, using the same type of variables as Dumas and Solnik (1995) and De Santis and Gerard (1998) will help us benchmark some of the evidence in our base specification to their conclusions.

Tables 2 and 3 report results of the multivariate systems using one country index at a time. We show the results for the group of developed markets and for the group of emerging markets separately. The tables report *p*-values for the robust Wald tests on the set of coefficients estimating the prices of each of the four risk factors. For the G7 countries, the price of world risk is significantly time varying, except for the U.S.[35] The null hypothesis that the two currency risk factors are jointly equal to zero is rejected at the 5% level or less in all instances. In contrast to Dumas and Solnik (1995) and De Santis and Gerard (1998), we provide a test in which we separate the two currency components. Consistent with previous evidence for developed markets, we find that the major currency risk is significantly priced for all countries. There is also evidence that the price of EM currency risk is statistically different from zero and significantly time varying, except in the system for Canada. The fourth risk factor, EM-specific risk, is also statistically significant, even in the presence of EM currency risk. In the same group with the G7 countries, we report the tests for three smaller markets, Greece, Hong Kong, and Singapore, which are generally considered to be in the group of developed countries. In these three cases, the global market risk is marginally significant, while the other three risk factors are priced at the 5% level or better.

Now consider Table 3 with results for emerging market assets. First, it is interesting to note that in almost all the country systems the global risk factor is significantly priced. The exceptions are Argentina and India where it is marginally significant, and Mexico where we find no significance. Although the evidence for Mexico is surprising, since it is expected to be one of the most integrated emerging markets, previously reported evidence on this issue is also conflicting.[36] With

[35] We run some checks on the system including the U.S. The results are driven by a large outlier at the end of the sample corresponding to the trough of the recession in September 2002. When we replace this observation using the sample mean, the world risk has a *p*-value of 0.012 and the significance is confirmed if we cut the sample at mid-2002.

[36] For example, Bekaert and Harvey (1995) show that the estimated degree of integration for Mexico is among the lowest, and Carrieri, Errunza, and Hogan (forthcoming) find that conditional local risk is priced while global risk is not.

TABLE 2

Hypothesis Testing of the Base Model for Developed Markets

The estimated model is

$$r_{it} = \delta_{w,t-1}\,\mathrm{cov}_{t-1}(r_{it}, r_{wt}) + \delta_{mj,t-1}\,\mathrm{cov}_{t-1}(r_{it}, e^{r}_{mjt}) + \delta_{em,t-1}\,\mathrm{cov}_{t-1}(r_{it}, e^{r}_{emt}) + \delta_{r,t-1}\,\mathrm{cov}_{t-1}(r_{it}, \hat{u}_{rt}) + \varepsilon_{it},$$

where $\delta_{w,t-1} = \exp(k'_w Z_{G,t-1})$, $\delta_{mj,t-1} = k'_{c2} Z_{G,t-1}$, $\delta_{em,t-1} = k'_{c1} Z_{G,t-1}$, $\delta_{r,t-1} = k'_r Z_{G,t-1}$, and $\varepsilon_t | \Omega_{t-1} \sim N(0, H_t)$.

r_i is the excess return on asset i, e^{r}_{em} is the change in the real EM currency index, e^{r}_{mj} is the change in the real major currency index, r_w is the excess return on the world portfolio, $\hat{u}_{r,t}$ is the EM residual market index, Z_G is a set of global information that includes a constant, the excess world dividend yield, the change in the U.S. term premium, the U.S. default premium, and $H_t = H_0 * (\iota\iota' - aa' - bb') + aa' * \varepsilon_{t-1}\varepsilon'_{t-1} + bb' * H_{t-1}$, where a and b are (5×1) vectors of parameters, and ι is a $(t \times 1)$ vector of ones.

Panel A. Specification Tests

		Canada		France		Germany		Italy		Japan		U.K.	
Null Hypothesis	df	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value
(1) Is the price of world market risk constant? $H_0 : k_{w,j} = 0\ \forall j > 1$	3	5.90	0.116	9.95	0.018	10.93	0.021	12.32	0.006	8.728	0.0331	8.45	0.037
(2) Is the price of EM-specific risk equal to zero? $H_0 : k_{r,j} = 0\ \forall j$	4	12.80	0.012	7.77	0.10	10.34	0.035	9.87	0.042	12.90	0.0117	10.76	0.029
(3) Is the price of EM-specific risk constant? $H_0 : k_{r,j} = 0\ \forall j > 1$	3	12.65	0.005	7.71	0.052	9.99	0.018	9.27	0.025	12.52	0.0058	10.67	0.013
(4) Is the price of EM currency risk equal to zero? $H_0 : k_{c1,j} = 0\ \forall j$	4	5.89	0.207	18.69	0.000	14.10	0.007	9.12	0.058	10.49	0.0328	10.74	0.029
(5) Is the price of EM currency risk constant? $H_0 : k_{c1,j} = 0\ \forall j > 1$	3	5.88	0.117	18.54	0.000	12.06	0.007	8.91	0.030	10.42	0.0182	9.35	0.024
(6) Is the price of major currency risk equal to zero? $H_0 : k_{c2,j} = 0\ \forall j$	4	14.36	0.006	16.42	0.002	12.90	0.004	13.15	0.010	14.55	0.0057	15.80	0.003
(7) Is the price of major currency risk constant? $H_0 : k_{c2,j} = 0\ \forall j > 1$	3	14.28	0.002	16.36	0.001	14.81	0.002	13.09	0.004	14.44	0.0024	15.71	0.001
(8) Are the prices of all currencies risk equal to zero? $H_0 : k_{c1,j} = k_{c2,j} = 0\ \forall j$	8	16.93	0.030	31.16	0.000	26.43	0.000	21.12	0.006	21.24	0.0065	24.03	0.002

		U.S.		Greece		Hong Kong		Singapore	
Null Hypothesis	df	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value
(1) Is the price of world market risk constant? $H_0 : k_{w,j} = 0\ \forall j > 1$	3	4.87	0.181	6.43	0.092	7.29	0.063	6.52	0.089
(2) Is the price of EM-specific risk equal to zero? $H_0 : k_{r,j} = 0\ \forall j$	4	6.90	0.141	9.89	0.042	11.35	0.023	10.96	0.027
(3) Is the price of EM-specific risk constant? $H_0 : k_{r,j} = 0\ \forall j > 1$	3	5.67	0.128	9.88	0.020	11.24	0.011	10.90	0.012
(4) Is the price of EM currency risk equal to zero? $H_0 : k_{c1,j} = 0\ \forall j$	4	9.95	0.041	26.78	0.000	17.85	0.001	11.65	0.020
(5) Is the price of EM currency risk constant? $H_0 : k_{c1,j} = 0\ \forall j > 1$	3	9.67	0.021	23.91	0.000	13.79	0.003	9.90	0.019
(6) Is the price of major currency risk equal to zero? $H_0 : k_{c2,j} = 0\ \forall j$	4	15.14	0.004	17.09	0.002	16.41	0.003	11.97	0.018
(7) Is the price of major currency risk constant? $H_0 : k_{c2,j} = 0\ \forall j > 1$	3	15.06	0.001	16.98	0.001	16.16	0.001	11.70	0.009
(8) Are the prices of all currencies risk equal to zero? $H_0 : k_{c1,j} = k_{c2,j} = 0\ \forall j$	8	22.48	0.003	36.26	0.000	31.80	0.000	20.28	0.009

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TABLE 2 (continued)

Hypothesis Testing of the Base Model for Developed Markets

Panel B. Residuals Diagnostics

	Obs.	B-J	$Q(z)$	$Q(z)^2$	EN-AN[a]	EN-AP[a]	R^2_dev	R^2_ex-EMsp	R^2_all
Canada	336	189.42**	12.14	4.78	−0.57	1.25	1.26%	1.74%	2.05%
France	336	17.14**	10.46	7.07	−1.33	−0.08	0.2	0.58	0.24
Germany	336	51.87**	14.55	8.18	−0.69	0.37	1.14	0.88	0.71
Italy	336	5.15	20.04	6.94	0.00	0.83	0.24	−0.01	0.34
Japan	336	1.86	16.36	29.96**	−1.41	0.73	3.00	2.80	2.84
U.K.	336	16.99**	5.61	7.51	−0.05	0.81	−0.37	−0.25	−0.38
U.S.	336	131.3**	12.34	5.56	0.66	−0.30	0.43	1.00	0.55
Greece	336	69.48**	29.89**	12.06	1.03	0.509	−0.14	0.54	1.17
Hong Kong	336	453.5**	17.46	3.49	−1.05	−0.85	−0.47	−0.1	−0.12
Singapore	336	1147**	7.83	2.07	0.77	0.11	1.11	1.10	1.58

[a]Engel and Ng (1993) test for negative and positive asymmetry in the residuals. * and ** denote statistical significance at the 5% and 1% levels, respectively. R^2_dev is pseudo-R^2 using world risk and major currency risk only; R^2_all is for the full model and R^2_ex-EMsp is for the full model except EM-specific risk.

respect to the other global risks, we find overwhelming evidence that all sources of currency risk are jointly significant. However, when we separate the two currency components, we find that while major currency risk is significant in all instances at any significance level, the EM currency risk component is not significant for Argentina, Colombia, Venezuela, Malaysia, Philippines, and Taiwan. Except in the case of Argentina, these are the countries with data starting only in 1985.[37] On the other hand, the significance of the EM-specific risk factor is supported across all markets. Thus, EM currency risk and EM-specific risk seem to be priced separately, although the statistical significance of the currency risk is not strongly supported in all data periods.

Since we run the system one country at a time, we have 16 estimated individual coefficients for the four time-varying prices of risk per country estimation. To save space, we do not report individual parameters, but we observe that they are consistently estimated across the country systems.[38] The GARCH parameters are of the usual size and statistically significant except for the alpha parameter of the major currency index and the beta parameter of the emerging market currency index in most system estimations.[39]

Diagnostics are provided in Panel B of Tables 2 and 3. There is evidence that GARCH effects documented for the country indices have been removed by the specification and the non-normality in the data is reduced although not eliminated. This supports our use of robust tests for inference. We also provide statistics for the presence of negative and positive asymmetry. The results indicate that for the vast majority of the countries the estimated residuals show no residual asymmetry. Finally, to gauge the additional contribution of each EM risk factor, we compute

[37]Aside from Argentina, the consistency of the evidence across these countries should not be surprising given that these systems use 32% less data in estimating the same number of coefficients.

[38]For example, the fitted values of the time-varying price of world risk range from 2.3 to 3.1 across country estimations. Estimated coefficients are available from the authors.

[39]This is not surprising given that we have weak evidence of GARCH effects for these two series.

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TABLE 3

Hypothesis Testing of the Base Model for Emerging Markets

The estimated model is

$$r_{it} = \delta_{w,t-1}\,\mathrm{cov}_{t-1}(r_{it}, r_{wt}) + \delta_{mj,t-1}\,\mathrm{cov}_{t-1}(r_{it}, e^{r}_{mjt}) + \delta_{em,t-1}\,\mathrm{cov}_{t-1}(r_{it}, e^{r}_{emt}) + \delta_{r,t-1}\,\mathrm{cov}_{t-1}(r_{it}, \hat{u}_{rt}) + \varepsilon_{it},$$

$$\text{where} \quad \delta_{w,t-1} = \exp(k'_w Z_{G,t-1}), \quad \delta_{mj,t-1} = k'_{c2} Z_{G,t-1}, \quad \delta_{em,t-1} = k'_{c1} Z_{G,t-1}, \quad \delta_{r,t-1} = k'_r Z_{G,t-1}, \quad \text{and} \quad \varepsilon_t | \Omega_{t-1} \sim N(0, H_t).$$

r_i is the excess return on asset i, e^{r}_{em} is the change in the real EM currency index, e^{r}_{mj} is the change in the real major currency index, r_w is the excess return on the world portfolio, $\hat{u}_{r,t}$ is the EM residual market index, Z_G is a set of global information that includes a constant, the excess world dividend yield, the change in the U.S. term premium, the U.S. default premium, and $H_t = H_0 * (\iota\iota' - aa' - bb') + aa' * \varepsilon_{t-1}\varepsilon'_{t-1} + bb' * H_{t-1}$, where a and b are (5×1) vectors of parameters, and ι is a (5×1) vector of ones.

Panel A. Specification Tests

		Argentina		Brazil		Chile		Colombia		Mexico		Venezuela	
Null Hypothesis	df	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value
(1) Is the price of world market risk constant? $H_0 : k_{w,j} = 0\ \forall j > 1$	3	7.70	0.053	8.92	0.030	10.17	0.017	17.28	0.001	3.71	0.295	10.72	0.013
(2) Is the price of EM-specific risk equal to zero? $H_0 : k_{r,j} = 0\ \forall j$	4	8.21	0.084	11.16	0.025	13.83	0.008	13.92	0.008	11.51	0.021	15.68	0.004
(3) Is the price of EM-specific risk constant? $H_0 : k_{r,j} = 0\ \forall j > 1$	3	8.18	0.043	10.98	0.012	13.65	0.003	13.28	0.004	11.51	0.009	15.63	0.001
(4) Is the price of EM currency risk equal to zero? $H_0 : k_{c1,j} = 0\ \forall j$	4	4.04	0.401	34.85	0.000	8.76	0.067	79.36	0.000	16.73	0.002	3.67	0.452
(5) Is the price of EM currency risk constant? $H_0 : k_{c1,j} = 0\ \forall j > 1$	3	3.48	0.324	34.44	0.000	8.73	0.033	3.11	0.375	16.44	0.001	3.53	0.317
(6) Is the price of major currency risk equal to zero? $H_0 : k_{c2,j} = 0\ \forall j$	4	14.41	0.006	15.84	0.003	15.55	0.004	26.37	0.000	12.44	0.014	20.76	0.000
(7) Is the price of major currency risk constant? $H_0 : k_{c2,j} = 0\ \forall j > 1$	3	14.16	0.003	15.73	0.001	15.42	0.002	26.37	0.000	12.44	0.006	20.76	0.000
(8) Are the prices of all currencies risk equal to zero? $H_0 : k_{c1,j} = k_{c2,j} = 0\ \forall j$	8	16.35	0.038	48.58	0.000	23.47	0.003	106.5	0.000	25.64	0.001	27.43	0.001

		India		Korea		Malaysia		Philippines		Taiwan		Thailand	
Null Hypothesis	df	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value
(1) Is the price of world market risk constant? $H_0 : k_{w,j} = 0\ \forall j > 1$	3	6.29	0.098	7.92	0.048	10.50	0.015	9.56	0.023	12.34	0.006	10.38	0.016
(2) Is the price of EM-specific risk equal to zero? $H_0 : k_{r,j} = 0\ \forall j$	4	10.94	0.027	13.74	0.008	11.86	0.018	21.24	0.000	14.35	0.006	9.51	0.050
(3) Is the price of EM-specific risk constant? $H_0 : k_{r,j} = 0\ \forall j > 1$	3	10.93	0.012	13.74	0.003	9.82	0.020	20.64	0.000	12.97	0.005	9.46	0.024
(4) Is the price of EM currency risk equal to zero? $H_0 : k_{c1,j} = 0\ \forall j$	4	20.30	0.000	11.49	0.022	4.59	0.331	3.98	0.409	4.71	0.319	13.23	0.010
(5) Is the price of EM currency risk constant? $H_0 : k_{c1,j} = 0\ \forall j > 1$	3	20.30	0.000	11.42	0.010	3.93	0.269	3.90	0.272	4.31	0.230	12.44	0.006
(6) Is the price of major currency risk equal to zero? $H_0 : k_{c2,j} = 0\ \forall j$	4	17.05	0.002	14.79	0.005	24.78	0.000	25.28	0.000	26.12	0.000	13.43	0.009
(7) Is the price of major currency risk constant? $H_0 : k_{c2,j} = 0\ \forall j > 1$	3	16.95	0.001	14.79	0.002	24.76	0.000	25.13	0.000	26.05	0.000	13.16	0.004
(8) Are the prices of all currencies risk equal to zero? $H_0 : k_{c1,j} = k_{c2,j} = 0\ \forall j$	8	33.80	0.000	27.14	0.001	27.11	0.001	27.44	0.001	28.64	0.000	24.16	0.002

(continued on next page)

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TABLE 3 (continued)
Hypothesis Testing of the Base Model for Emerging Markets

Panel B. Residuals Diagnostics

	Obs.	B-J	$Q(z)$	$Q(z^2)$	EN-AN[a]	EN-AP[a]	R^2_dev	R^2_ex-EMsp	R^2_all
Argentina	336	214.5**	7.79	3.75	0.93	0.88	0.04%	0.01%	0.41%
Brazil	336	32.87**	5.02	13.10	−0.33	−1.05	0.04	−0.10	0.05
Chile	336	25.02**	30.99**	12.77	1.07	−0.39	−0.39	0.12	2.76
Colombia	228	21.02**	36.15**	18.08	−0.80	1.70	0.66	−1.06	−0.07
Mexico	336	367.7**	28.68**	17.31	−1.74	0.82	−0.37	1.37	2.02
Venezuela	228	247.5**	8.14	4.47	0.55	0.81	−1.30	−0.45	0.00
India	336	7.79*	10.70	16.80	0.25	2.59**	0.43	0.50	0.35
Korea	336	32.60**	11.71	6.92	−2.07*	−0.72	0.77	1.48	2.08
Malaysia	228	122.3**	15.11	9.56	−1.10	−0.23	−1.09	−1.45	0.68
Philippines	228	45.15**	26.97**	12.35	−1.85	−0.59	1.95	1.52	3.34
Taiwan	228	206.1**	13.95	14.08	−0.88	0.21	−0.30	−1.08	2.13
Thailand	336	74.54**	38.69**	20.11	0.08	0.83	1.60	1.38	1.56

[a] Engel and Ng (1993) test for negative and positive asymmetry in the residuals. * and ** denote statistical significance at the 5% and 1% levels, respectively. R^2_dev is pseudo-R^2 using world risk and major currency risk only; R^2_all is for the full model and R^2_ex-EMsp is for the full model except EM-specific risk.

the pseudo R^2.[40] The first R^2 reported is computed only with the two developed market factors of equation (1b). The second adds the contribution of the EM currency risk factor while the third statistic includes the full specification with all four factors. For eight of the 10 developed markets, there is an indication that the contribution of some of the EM risk factors to the fit of the model is relatively important. For the emerging market group, we find that accounting also for the EM-specific risk delivers a better pseudo R^2. The model with only world and major currency risks has a better fit in two of the 12 countries, Thailand and Colombia. One country, India, shows improvement with the addition of the EM currency risk factor. In all the other cases, the EM-specific risk seems very important. We take this as indication that these markets are partially segmented, since a regional benchmark contributes highly to the model fit. On the other hand, for the developed markets, we do not find that EM-specific risk is more important than the contribution of the EM currency risk factor.

As a check on our first set of results, we estimate a multi-country system. Due to the limitation of the methodology and data we cannot include all the countries that are part of Tables 2 and 3 simultaneously and thus we do not provide detailed results since our grouping could be considered arbitrary. However, we do find that qualitatively all the results of the country by country system estimations are confirmed in multi-country systems.

Overall, this evidence confirms previous results for developed stock markets and, most importantly, offers an initial indication that financial assets worldwide provide compensation not only for the risk of major currencies, but also for other global sources of risk linked to smaller financial markets.

[40] For each asset, the pseudo R^2 is the ratio between the explained sum of squares and the total sum of squares. Due to the cross-equation restrictions, there is no guarantee that the pseudo R^2 is positive for all assets.

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B. Risk Pricing under Crisis Spillover

In this section, we investigate whether the spillover impact on the factors' risk premia is heightened during emerging market crisis episodes. As markets become more global, one can conjecture that information stemming from emerging markets should have an impact on the expected compensation for risk and thus should be accounted for in the investors' information set.[41] The idea behind this test is in line with the evidence of spillover and contagion among international financial markets.[42] Hence, we refer to it as the spillover effect on risk pricing.

We reestimate the asset pricing model (2) allowing information from emerging markets in periods of crises to contribute to the repricing of all sources of risk. We measure the incremental importance of such information through the EMCV discussed in Section II. This implies that the information set $Z_{G,t-1}$ now includes one additional conditioning variable and in each country system we will have four new parameters to estimate, one for each price of risk.[43]

Each variable in $Z_{G,t-1}$ is supposed to convey the information available to investors at time $t-1$ that is used to generate the expected returns for time t. Unlike the variables of the previous test, the EMCV as measured in equation (5) is not strictly predetermined since it includes data that is disseminated with a lag. This implies that the economic series on official reserves were not actually available to investors at time $t-1$.[44] We therefore use the EMCV lagged three months to account for possible delays in data dissemination on the part of central banks of emerging markets.

Tables 4 and 5 provide the results of our new country system estimations. This time, in addition to the specification tests of the previous tables, we also separately test for the significance of the EMCV jointly on all four prices of risk. The results of this particular test are given in the last line of the tables. All the robust Wald tests for the hypothesis that the coefficients on the EMCV are jointly equal to zero have p-values that reject the null hypothesis at the 5% level or better. Although to save space we do not report the estimated parameters, the evidence on the four coefficients on an individual basis is very interesting.[45] We find consistent evidence across all our estimations that the EMCV is highly significant in explaining time variation for the price of world market risk and is very important also for the price of major currency risk. On the other hand, we find no individual significance of the EMCV for the two prices of risk stemming from emerging markets. This pattern is confirmed across the developed and emerging country groups. One way to interpret this evidence is to think that the spillover in risk is more important for the sources of developed market risks since for emerging

[41] The importance of EM information for global pricing is consistent with theoretical models that suggest herding or contagion by foreign investors; see, for example, Brennan and Cao (1997), Masson (1999), and Calvo and Mendoza (2000).

[42] Bailey, Chan, and Chung (2000) find that peso exchange rate news affects prices and trading volumes of Latin American equities.

[43] Note that there is no theory to suggest which factor premia should be affected by the crisis episodes.

[44] For a similar argument on the availability of information variables, see Dumas (1994) and Sarkissian (2003).

[45] The individual coefficients are available from the authors.

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TABLE 4

Hypothesis Testing of the Crisis Model for Developed Markets

The estimated model is

$$r_{it} = \delta_{w,t-1}\,\mathrm{cov}_{t-1}(r_{it}, r_{wt}) + \delta_{mj,t-1}\,\mathrm{cov}_{t-1}(r_{it}, e^{r}_{mjt}) + \delta_{em,t-1}\,\mathrm{cov}_{t-1}(r_{it}, e^{r}_{emt}) + \delta_{r,t-1}\,\mathrm{cov}_{t-1}(r_{it}, \hat{u}_{rt}) + \varepsilon_{it},$$

$$\text{where} \quad \delta_{w,t-1} = \exp(k'_w Z_{G,t-1}), \quad \delta_{mj,t-1} = k'_{c2} Z_{G,t-1}, \quad \delta_{em,t-1} = k'_{c1} Z_{G,t-1}, \quad \delta_{r,t-1} = k'_r Z_{G,t-1} \quad \text{and} \quad \varepsilon_t | \Omega_{t-1} \sim N(0, H_t).$$

r_i is the excess return on asset i, r_{em} is the change in the real EM currency index, r_{mj} is the change in the real major currency index, r_w is the excess return on the world portfolio, $\hat{u}_{r,t}$ is the EM residual market index, Z is a set of global information that includes a constant, the excess world dividend yield, the change in the U.S. term premium, the U.S. default premium, and the EMCV, and $H_t = H_0 * (\iota\iota' - aa' - bb') + aa' * \varepsilon_{t-1}\varepsilon'_{t-1} + bb' * H_{t-1}$, where a and b are 5×1 vectors of parameters, and ι is a (5×1) vector of ones.

Panel A. Specification Tests

		Canada		France		Germany		Italy		Japan		U.K.	
Null Hypothesis	df	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value
(1) Is the price of world market risk constant? $H_0 : k_{w,j} = 0\ \forall j > 1$	4	10.27	0.036	18.01	0.001	10.96	0.027	16.54	0.002	13.53	0.009	12.00	0.017
(2) Is the price of EM-specific risk equal to zero? $H_0 : k_{r,j} = 0\ \forall j$	5	15.02	0.010	10.21	0.070	15.98	0.007	13.68	0.018	16.84	0.005	15.18	0.010
(3) Is the price of EM-specific risk constant? $H_0 : k_{r,j} = 0\ \forall j > 1$	4	15.01	0.005	9.85	0.043	15.95	0.003	13.26	0.010	16.60	0.002	15.18	0.004
(4) Is the price of EM currency risk equal to zero? $H_0 : k_{c1,j} = 0\ \forall j$	5	14.75	0.012	11.78	0.038	10.78	0.056	10.63	0.059	11.24	0.047	12.24	0.032
(5) Is the price of EM currency risk constant? $H_0 : k_{c1,j} = 0\ \forall j > 1$	4	12.31	0.015	11.73	0.019	8.76	0.068	10.31	0.036	10.89	0.028	11.16	0.025
(6) Is the price of major currency risk equal to zero? $H_0 : k_{c2,j} = 0\ \forall j$	5	21.98	0.001	19.87	0.001	18.84	0.002	17.78	0.003	20.57	0.001	21.40	0.001
(7) Is the price of major currency risk constant? $H_0 : k_{c2,j} = 0\ \forall j > 1$	4	21.97	0.000	19.86	0.001	18.81	0.001	17.78	0.001	20.51	0.000	21.40	0.000
(8) Are the prices of all currencies risk equal to zero? $H_0 : k_{c,j} = 0\ \forall j$	10	35.41	0.000	27.33	0.002	31.07	0.001	25.46	0.005	28.46	0.002	31.09	0.001
(9) Are the EM crisis coeff. jointly equal to zero? $H_0 : k_{w,j} = k_{r,j} = k_{c1,j} = k_{c2,j} = 0,\ j = 5$	4	15.68	0.004	16.06	0.003	9.58	0.048	11.97	0.018	16.21	0.003	14.17	0.007

		U.S.		Greece		Hong Kong		Singapore	
Null Hypothesis	df	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value
(1) Is the price of world market risk constant? $H_0 : k_{w,j} = 0\ \forall j > 1$	4	10.50	0.032	9.81	0.044	15.75	0.003	20.62	0.000
(2) Is the price of EM-specific risk equal to zero? $H_0 : k_{r,j} = 0\ \forall j$	5	9.81	0.080	16.30	0.006	15.66	0.008	15.05	0.010
(3) Is the price of EM-specific risk constant? $H_0 : k_{r,j} = 0\ \forall j > 1$	4	9..81	0.043	16.08	0.003	15.58	0.004	14.98	0.005
(4) Is the price of EM currency risk equal to zero? $H_0 : k_{c1,j} = 0\ \forall j$	5	12.54	0.028	26.84	0.000	14.39	0.013	12.56	0.028
(5) Is the price of EM currency risk constant? $H_0 : k_{c1,j} = 0\ \forall j > 1$	4	12.16	0.016	26.68	0.000	11.76	0.019	11.55	0.021
(6) Is the price of major currency risk equal to zero? $H_0 : k_{c2,j} = 0\ \forall j$	5	20.64	0.000	24.45	0.000	20.94	0.001	17.78	0.003
(7) Is the price of major currency risk constant? $H_0 : k_{c2,j} = 0\ \forall j > 1$	4	20.62	0.000	24.42	0.000	20.75	0.000	17.69	0.001
(8) Are the prices of all currencies risk equal to zero? $H_0 : k_{c1,j} = k_{c2,j} = 0\ \forall j$	10	31.07	0.000	42.76	0.000	33.78	0.000	26.39	0.003
(9) Are the EM crisis coeff. jointly equal to zero? $H_0 : k_{w,j} = k_{r,j} = k_{c1,j} = k_{c2,j} = 0,\ j = 5$	5	16.34	0.002	15.41	0.004	9.45	0.051	15.83	0.003

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TABLE 4 (continued)

Hypothesis Testing of the Crisis Model for Developed Markets

Panel B. Residuals Diagnostics

	Obs.	B-J	$Q(z)$	$Q(z^2)$	EN-AN[a]	EN-AP[a]	R^2_dev	R^2_ex-EMsp	R^2_all	ΔRMSE
Canada	336	169.50**	12.90	5.32	−0.225	1.518	1.24%	1.65%	2.08%	0.000
France	336	18.69**	8.36	6.65	−1.39	−0.17	2.60	3.08	2.90	−0.090
Germany	336	60.77**	13.15	13.04	0.02	0.63	2.68	2.44	2.29	−0.050
Italy	336	5.81	19.28	5.72	0.33	1.05	1.05	0.70	0.91	−0.030
Japan	336	2.11	16.70	32.03**	−1.45	0.82	3.00	2.73	2.76	0.000
U.K.	336	19.09**	6.44	7.10	−0.38	0.62	1.55	1.75	1.62	−0.060
U.S.	336	125.24**	11.32	5.45	0.75	−0.46	0.91	1.57	0.94	−0.010
Greece	336	62.46**	29.35**	11.62	1.02	0.57	0.64	1.08	1.43	−0.013
Hong Kong	336	478.1**	16.60	2.49	−0.81	−0.89	0.38	0.60	0.50	−0.029
Singapore	336	1037.0**	8.13	2.32	0.74	−0.13	1.61	1.30	1.69	−0.005

ΔRMSE is the change in the root mean squared errors. All other notations are as in previous tables.

markets it is already captured in the exposure itself. The other sets of specification tests on the risk factors point to the same evidence as in the previous section. Across both groups of countries, we find that all four risk factors are significant and time varying except for the EM currency risk for the countries with the shorter time periods. Thus, the EMCV provides useful information for global investors to reassess their expected compensation for risk.

Diagnostics are provided in Panel B of Tables 4 and 5. As in the base case (Tables 2 and 3), GARCH effects and non-normality in the series are reduced and we find no evidence of positive or negative asymmetry. Interesting information is also conveyed by the pseudo R^2. First, when comparing the contribution of the additional factors within this specification, seven of the 10 developed markets and 11 of the 12 emerging markets show higher R^2 in the enlarged model. Second, it is useful to compare the general level of the statistics in Tables 4 and 5 with those in Tables 2 and 3. Except for Japan, the other developed markets show higher pseudo R^2, indicating that the specification with the EMCV has a better fit. For the group of emerging markets, the evidence is almost as strong with nine of the 12 markets showing better performance. Finally, in Panel B of Tables 4 and 5, we also provide the change in the root mean squared error (ΔRMSE) between the crisis specification and the base specification. Interestingly, the change in the RMSE is negative in eight of the 10 developed markets with two markets showing no change. For emerging markets, eight of the 12 markets show a negative change in the RMSE. These markets coincide with the ones showing a better fit through the pseudo R^2. Overall, we take these statistics as providing support for the model with the expanded information set that includes the EMCV.

Table 6 contains the four ex ante conditional risk premia as fractions of the total absolute premium estimated from our models. We provide averages for both specifications and for the group of developed and emerging markets.[46] Among the developed markets, we also distinguish the G7 markets from the three small developed markets. There are no major differences between the two specifications,

[46]For each country, the fraction of the conditional risk premia corresponding to the four factors at each time t is averaged over a given sample period. Then, an average across all countries is computed for each country group.

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TABLE 5

Hypothesis Testing of the Crisis Model for Emerging Markets

The estimated model is

$$r_{it} = \delta_{w,t-1}\,\mathrm{cov}_{t-1}(r_{it}, r_{wt}) + \delta_{mj,t-1}\,\mathrm{cov}_{t-1}(r_{it}, e^{r}_{mjt}) + \delta_{em,t-1}\,\mathrm{cov}_{t-1}(r_{it}, e^{r}_{emt}) + \delta_{r,t-1}\,\mathrm{cov}_{t-1}(r_{it}, \hat{u}_{rt}) + \varepsilon_{it},$$

$$\text{where} \quad \delta_{w,t-1} = \exp(k'_w Z_{G,t-1}), \quad \delta_{mj,t-1} = k'_{c2} Z_{G,t-1}, \quad \delta_{em,t-1} = k'_{c1} Z_{G,t-1}, \quad \delta_{r,t-1} = k'_r Z_{G,t-1} \quad \text{and} \quad \varepsilon_t | \Omega_{t-1} \sim N(0, H_t).$$

r_i is the excess return on asset i, r_{em} is the change in the real EM currency index, r_{mj} is the change in the real major currency index, r_w is the excess return on the world portfolio, $\hat{u}_{r,t}$ is the EM residual market index, Z is a set of global information that includes a constant, the excess world dividend yield, the change in the U.S. term premium, the U.S. default premium, and the EMCV, and $H_t = H_0 * (\iota\iota' - aa' - bb') + aa' * \varepsilon_{t-1}\varepsilon'_{t-1} + bb' * H_{t-1}$, where a and b are 5×1 vectors of parameters, and ι is a (5×1) vector of ones.

Panel A. Specification Tests

		Argentina		Brazil		Chile		Colombia		Mexico		Venezuela	
Null Hypothesis	df	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value
(1) Is the price of world market risk constant? $H_0 : k_{w,j} = 0\ \forall j > 1$	4	14.45	0.006	14.75	0.005	16.16	0.003	11.63	0.020	9.57	0.048	11.12	0.025
(2) Is the price of EM-specific risk equal to zero? $H_0 : k_{r,j} = 0\ \forall j$	5	10.40	0.065	14.50	0.013	15.90	0.007	15.37	0.009	14.89	0.011	13.60	0.018
(3) Is the price of EM-specific risk constant? $H_0 : k_{r,j} = 0\ \forall j > 1$	4	10.36	0.035	14.44	0.006	15.90	0.003	14.12	0.007	14.89	0.005	13.59	0.009
(4) Is the price of EM currency risk equal to zero? $H_0 : k_{c1,j} = 0\ \forall j$	5	9.05	0.107	28.51	0.000	14.85	0.011	7.08	0.215	20.62	0.001	4.74	0.448
(5) Is the price of EM currency risk constant? $H_0 : k_{c1,j} = 0\ \forall j > 1$	4	8.16	0.086	28.20	0.000	14.14	0.007	6.97	0.137	19.64	0.001	4.56	0.336
(6) Is the price of major currency risk equal to zero? $H_0 : k_{c2,j} = 0\ \forall j$	5	19.61	0.002	20.67	0.001	22.30	0.001	40.13	0.000	21.14	0.001	39.39	0.000
(7) Is the price of major currency risk constant? $H_0 : k_{c2,j} = 0\ \forall j > 1$	4	19.61	0.001	20.67	0.000	22.28	0.000	40.02	0.000	21.11	0.000	39.35	0.000
(8) Are the prices of all currencies risk equal to zero? $H_0 : k_{c1,j} = k_{c2,j} = 0\ \forall j$	10	27.18	0.002	52.31	0.000	33.53	0.000	46.56	0.000	39.01	0.000	44.11	0.000
(9) Are the EM crisis coeff. jointly equal to zero? $H_0 : k_{w,j} = k_{r,j} = k_{c1,j} = k_{c2,j} = 0,\ j = 5$	4	15.44	0.004	15.08	0.005	15.81	0.003	10.60	0.031	19.39	0.001	10.54	0.032

		India		Korea		Malaysia		Philippines		Taiwan		Thailand	
Null Hypothesis	df	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value	χ^2	*p*-Value
(1) Is the price of world market risk constant? $H_0 : k_{w,j} = 0\ \forall j > 1$	4	15.77	0.003	18.27	0.001	9.55	0.049	12.36	0.015	11.07	0.026	14.75	0.005
(2) Is the price of EM-specific risk equal to zero? $H_0 : k_{r,j} = 0\ \forall j$	5	13.65	0.018	14.08	0.015	10.33	0.066	20.42	0.001	14.09	0.015	13.17	0.022
(3) Is the price of EM-specific risk constant? $H_0 : k_{r,j} = 0\ \forall j > 1$	4	13.59	0.009	13.63	0.009	8.50	0.075	19.65	0.001	12.44	0.014	13.06	0.011
(4) Is the price of EM currency risk equal to zero? $H_0 : k_{c1,j} = 0\ \forall j$	5	14.15	0.015	18.66	0.002	6.75	0.240	5.34	0.376	8.17	0.147	12.55	0.028
(5) Is the price of EM currency risk constant? $H_0 : k_{c1,j} = 0\ \forall j > 1$	4	13.92	0.008	17.33	0.002	4.40	0.355	5.05	0.282	7.60	0.107	12.11	0.017
(6) Is the price of major currency risk equal to zero? $H_0 : k_{c2,j} = 0\ \forall j$	5	22.20	0.001	17.41	0.004	32.69	0.000	39.69	0.000	39.97	0.000	17.78	0.003
(7) Is the price of major currency risk constant? $H_0 : k_{c2,j} = 0\ \forall j > 1$	4	22.18	0.000	17.39	0.002	31.43	0.000	39.56	0.000	39.87	0.000	17.70	0.001
(8) Are the prices of all currencies risk equal to zero? $H_0 : k_{c1,j} = k_{c2,j} = 0\ \forall j$	10	34.77	0.000	40.20	0.000	38.57	0.000	43.78	0.000	45.10	0.000	26.58	0.003
(9) Are the EM crisis coeff. jointly equal to zero? $H_0 : k_{w,j} = k_{r,j} = k_{c1,j} = k_{c2,j} = 0,\ j = 5$	4	14.12	0.007	15.67	0.004	10.50	0.033	11.70	0.020	11.08	0.026	16.95	0.002

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TABLE 5 (continued)

Hypothesis Testing of the Crisis Model for Emerging Markets

Panel B. Residuals Diagnostics

	Obs.	B-J	$Q(z)$	$Q(z^2)$	EN-AN[a]	EN-AP[a]	R^2_dev	R^2_ex-EMsp	R^2_all	ΔRMSE
Argentina	336	215.0**	7.85	3.87	0.94	0.87	−0.16%	0.07%	−0.07%	0.052
Brazil	336	33.11**	4.80	13.50	−0.29	−1.06	0.25	0.18	−0.15	0.016
Chile	336	32.17**	30.83**	13.68	0.68	−0.69	−0.19	0.09	3.16	−0.019
Colombia	228	21.32**	35.72**	24.70*	−0.69	2.25*	0.78	0.10	1.07	−0.047
Mexico	336	378.6**	28.66**	16.02	−1.62	0.73	−0.3	1.16	1.82	0.013
Venezuela	228	242.7**	8.90	4.59	0.39	0.48	−0.81	0.22	0.63	−0.045
India	336	7.96*	10.88	17.08	0.25	2.66**	0.48	0.62	0.50	−0.006
Korea	336	31.69**	12.37	6.54	−1.86	−0.67	1.13	2.05	2.53	−0.025
Malaysia	228	123.1**	14.20	10.10	−0.97	−0.26	−0.4	1.18	3.15	−0.121
Philippines	228	45.71**	26.81**	12.64	−1.71	−0.50	1.60	1.55	3.44	−0.006
Taiwan	228	200.9**	14.31	14.31	−0.93	0.23	−0.48	−1.51	1.77	0.018
Thailand	336	70.92**	39.09**	20.98	0.13	0.91	1.80	1.83	1.72	−0.009

[a] Engel and Ng (1993) test for negative and positive asymmetry. * and ** denote statistical significance at the 5% and 1% levels, respectively. ΔRMSE is the change in the root mean squared errors. R^2_dev is pseudo-R^2 using world risk and major currency risk only; R^2_all is for the full model and R^2_ex-EMsp is for the full model except EM-specific risk.

which is not surprising given that they only differ based on the conditioning information set. Overall, we find that in line with the prediction of theoretical models, currency risk stemming from major currencies is equally important over all samples and across all markets.[47] Not surprisingly, the EM currency risk component is more important for the emerging countries' assets while for developed countries' assets it is not economically very relevant. The group of developed markets indeed shows the EM currency risk and the EM-specific risk as factors of equal but small importance, while the latter is substantially larger than the former in the emerging market group. This confirms the importance of disentangling the two types of risks in explaining ex ante global risk premia for all international assets. It is interesting to note that the three small developed markets show averages that are between the two other groups. For example, in comparison with the G7 countries, we find that while the importance of world risk is reduced, both EM risk factors are more relevant.

Since the conditional importance of the risk factors changes over subperiods, we also provide averages over the 1995–2001 subsample, a period characterized by a number of financial crises in emerging markets, starting with the tequila crisis in Mexico through the recent turmoil in Argentina.[48] The main difference between the base and the crisis model over this subperiod is that the total of world and major currency risks increases for the developed market group in the crisis specification. We link this finding to the evidence of spillover in risk from emerging markets into developed markets. As expected, for the emerging market group, we find that the EM risk components become more relevant in both cases, but less so in the crisis specification. Over this period, the major currency risk component is negative for all country groups, indicating its hedging value. On the other hand, the EM currency risk component is positive together with the EM-specific risk,

[47] As a comparison, Ferson and Harvey (1994) estimate the fraction of risk premium attributed to global market and currency risk as approximately 83%. Thus, our averages of the estimated premia seem reasonable.

[48] The subsample averages also indicate that, despite the lack of statistical significance, the EM currency risk component is still economically relevant for the EMs with a shorter sample period.

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TABLE 6

Estimated Risk Premia

Table 6 contains averages of the risk premia estimated for the international asset pricing models of the previous tables. The averages are percentages of the total absolute premium across three country groups. We report the world market risk premium (world RP), the major currency risk premium (major currency RP), the emerging market currency risk premium (EM currency RP), and the emerging market-specific risk premium (EM-specific RP). The individual country averages are for the 1995–2001 subperiod only. For each country, the estimated risk premia at each time t are averaged over a given sample period to compute the average conditional risk premium corresponding to the four factors. Then, for each factor, an average across all countries is computed for each country group.

	Base Specification				Crisis Specification			
	World RP	Major Currency RP	EM Currency RP	EM-Specific RP	World RP	Major Currency RP	EM Currency RP	EM-Specific RP
Panel A. Developed Markets Assets								
G7								
All sample	57.6%	25.1%	8.8%	8.6%	49.8%	28.6%	10.7%	10.8%
1995–2001	56.2	22.6	10.5	10.7	52.7	27.5	7.2	12.6
Canada	53.9	16.3	11.4	18.5	50.2	22.2	6.6	21.0
France	54.6	28.6	11.1	5.8	54.3	31.4	6.5	7.8
Germany	60.1	21.6	10.5	7.7	45.0	28.1	10.1	16.8
Italy	48.5	21.8	12.9	16.9	50.0	25.2	8.5	16.4
Japan	53.5	30.5	8.0	8.0	50.4	35.7	5.6	8.4
U.K.	54.9	29.5	9.4	6.1	51.6	35.9	5.6	6.9
U.S.	68.0	10.2	10.1	11.7	67.4	13.9	7.4	11.3
Other Developed Markets								
All sample	42.4	17.1	18.5	22.0	36.2	25.3	18.0	20.5
1995–2001	26.8	20.3	25.3	27.7	36.4	23.0	14.9	25.7
Greece	36.8	17.8	23.2	22.2	36.7	22.7	14.8	25.8
Hong Kong	19.7	22.9	26.3	31.1	36.7	23.8	13.5	26.0
Singapore	23.8	20.1	26.3	29.8	35.9	22.7	16.3	25.1
Panel B. Emerging Markets Assets								
All sample	23.7	19.4	21.0	35.8	22.4	21.4	19.9	36.3
1995–2001	21.9	15.5	22.4	40.3	22.7	19.9	17.0	40.4
Argentina	13.2	3.3	13.5	70.0	15.6	7.7	14.6	62.1
Brazil	36.5	8.8	17.3	37.3	37.6	10.8	11.8	39.8
Chile	27.1	0.6	23.4	48.9	28.3	0.3	18.7	52.7
Colombia	0.0	28.5	42.1	29.5	14.5	39.3	17.5	28.6
Mexico	44.5	7.7	14.2	33.7	35.1	13.4	12.4	39.1
Venezuela	12.0	48.2	17.4	22.4	9.8	56.8	15.1	18.3
India	11.6	12.1	26.7	49.6	14.4	15.7	18.1	51.8
Korea	36.2	12.6	20.5	30.6	40.0	9.6	17.3	33.1
Malaysia	16.7	16.8	30.6	35.9	15.1	23.7	21.6	39.6
Philippines	20.9	17.3	22.5	39.3	24.2	19.5	20.7	35.5
Taiwan	16.2	15.4	20.9	47.6	8.0	25.5	22.6	44.0
Thailand	27.6	14.6	19.3	38.4	30.0	16.0	13.5	40.5

indicating that investors worldwide required positive compensation from these types of exposures.[49]

In Figure 3, we present graphs of the estimated risk premia in the specification with the crisis variable for some representative countries in our sample. Since we want to focus on the relative importance of the EM risk factors over time, we plot the total risk premium and the two EM risks separately. Some points are noteworthy. We find that the global risk premia for the G7 developed markets in our sample are very similar. For this reason, we only report the plot for the U.S. There are substantial differences between the developed and emerging markets. As reported in Table 6, the economic importance of the two EM risks for developed markets is rather small. Consistent with past evidence on the pricing of major currency risk, exchange risk premia related to emerging market curren-

[49] Estimates of individual risk premia are available from the authors.

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cies are also often negative, confirming our belief that the hedging component in currency premia is predominant.[50] Although the graphs of six emerging markets in Figure 3 reveal more differences among the countries and similarity within regions, in general, there is a clear indication that the two EM risk components represent the largest part of the total premium. The plots for most countries reveal swings around a number of events, such as the debt crisis in 1983, the tequila crisis around 1994–1995, and the Asian crisis and the Russian default at the end of 1997 and in 1998, respectively.[51] For the three small developed markets, the plots in Figure 3 reveal interesting similarities with those documented both for developed and emerging markets as the graph for Singapore shows.[52]

The sign of the premium related to EM-specific risk from the 1990s onward could be related to the ongoing process of financial integration. Overall, we observe that this risk premium was often negative before the 1990s, while it shows up as positive thereafter. A possible explanation for this finding could be in the ongoing process of financial integration. When markets were more segmented, the EM-specific risk was likely a regional risk and thus globally it offered a sizable hedging opportunity with respect to the world market risk. In more recent periods, it seems to be an additional factor for which investors require a positive premium and thus the hedging benefits have decreased. Interestingly the break appears to have taken place at the beginning of the 1990s, a time when a large number of emerging countries had started the liberalization process.[53]

Finally, we run a number of robustness checks. First, we investigate whether the individual significance of the EMCV coefficients is really linked to the spillover effect. We reestimate the model with the EMCV affecting only the prices of EM risks. We find that the evidence is confirmed with no significance of the variable for the EM-specific risk factor and marginal significance for the EM currency risk factor in just a few cases.

Second, there could be a concern that in emerging markets the exchange rate itself reflects the broader economic and political risk of a country. We thus proceed to orthogonalize the emerging market currency index with respect to the composite emerging market stock index. We run this check for both specifications. We find that EM currency risk is almost always priced for developed and emerging markets, in most cases at the 5% level or better, together with EM-specific risk. The only exceptions are Mexico and Singapore, for which the tests are close to marginal significance. We therefore conclude that the significance of our exchange rate measure of EM currency risk is not due to it proxying for other types of risk.

In summary, the evidence reported in this section suggests that, besides the importance of EM risks as separate global factors in pricing worldwide assets,

[50] However, since total currency premia are smaller than the market premium, the total premium is positive on average.

[51] One might be concerned that this variable could pick up events other than those strictly related to EMs. One such global event is the long-term capital management (LTCM) crisis. However, note that even LTCM was partly a Russian issue. Of course, in an increasingly interdependent world, some overlap is unavoidable.

[52] Plots of the estimated risk premia for the other countries in the sample can be obtained from the authors.

[53] For an in-depth analysis, see Bekaert and Harvey (1995) and Carrieri et al. (2006).

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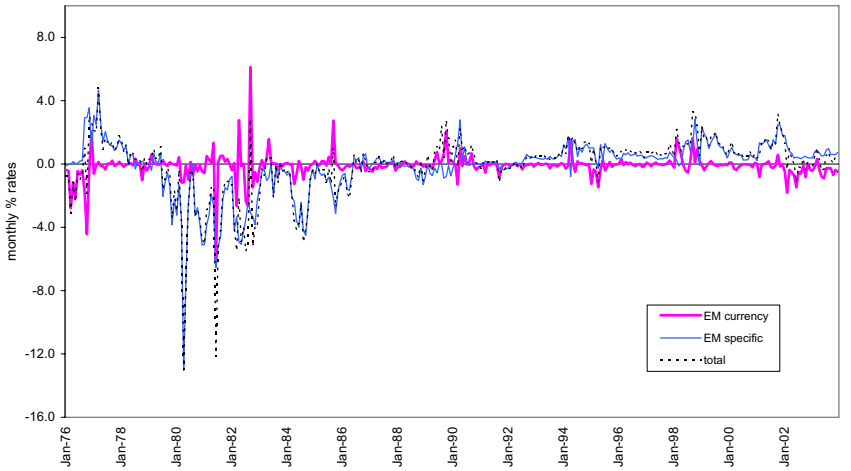
periods of distress in emerging markets impact the expected compensation for risk required by global investors.

V. Conclusions

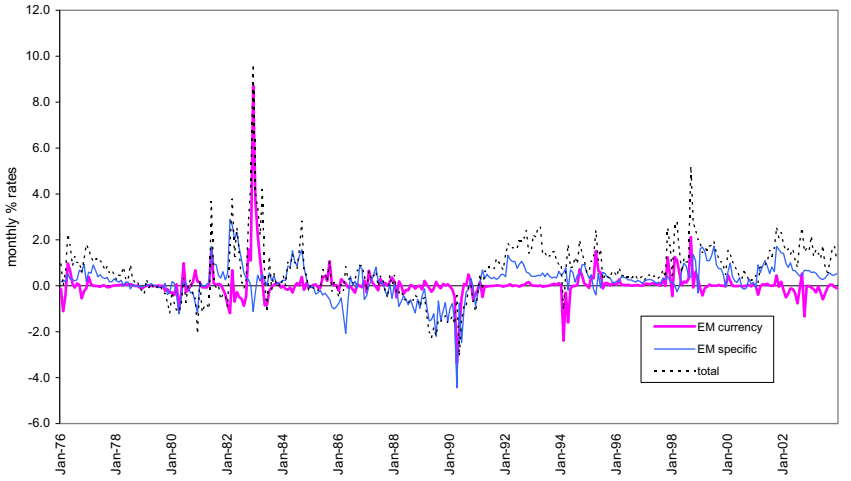
This paper investigates whether EM currency risk affects emerging market equities, if it spills over into developed markets, and whether the impact is heightened during emerging market crisis episodes. Our empirical model allows us to

FIGURE 3
Estimated Risk Premia

Graph A. Argentina



Graph B. Brazil

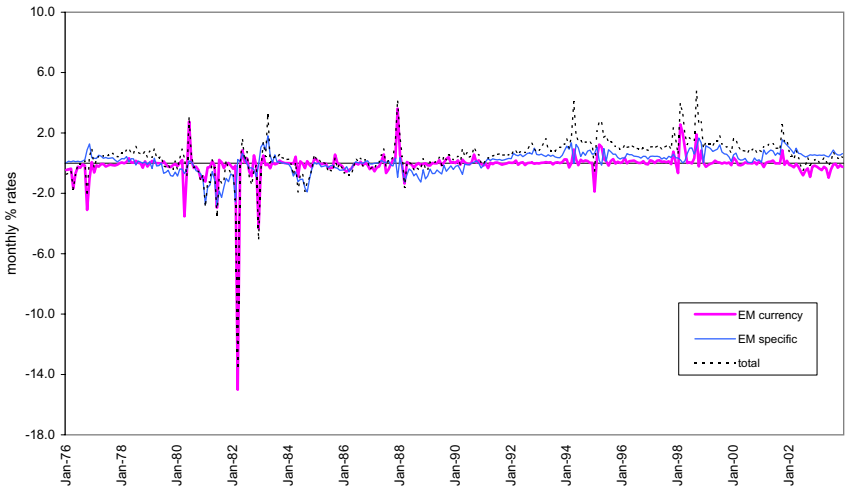


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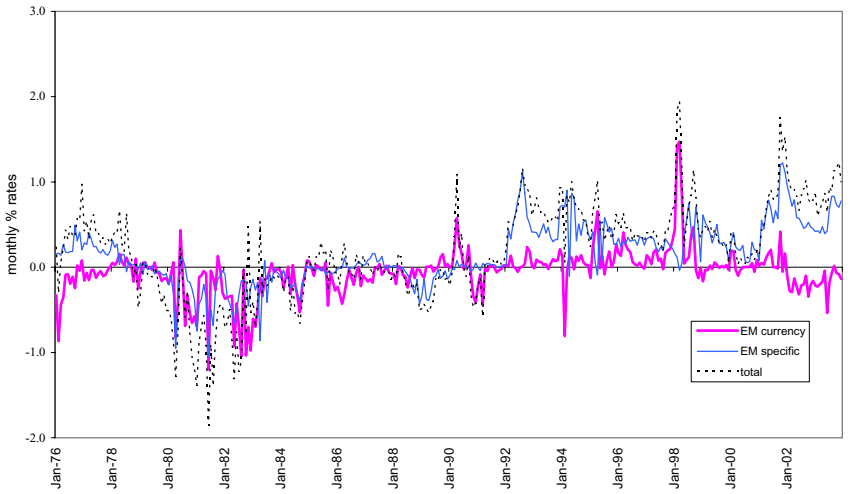
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FIGURE 3 (continued)
Estimated Risk Premia

Graph C. Mexico



Graph D. India



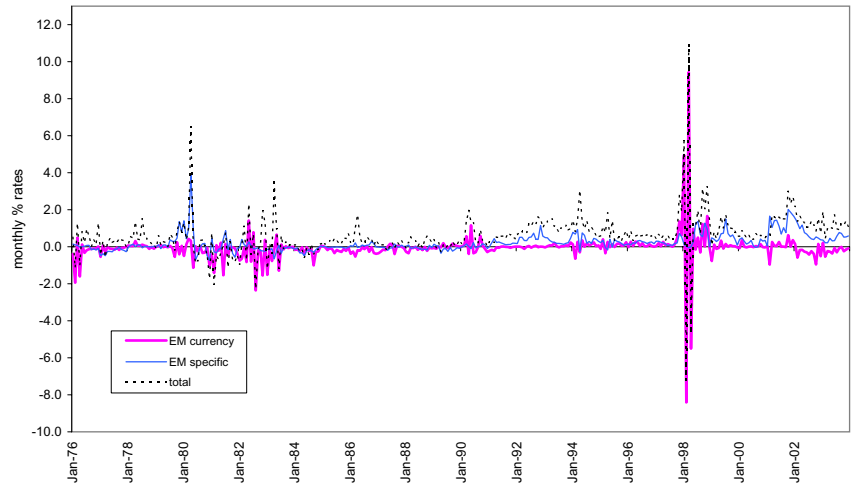
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estimate the contribution of emerging market currency risk premia in addition to major currency risk premia. Since inflation rates are often high and volatile in emerging markets, we use real exchange rate measures that provide a better proxy for PPP deviations since they capture both inflation and nominal exchange rate risk. Moreover, we allow the EM currency risk factor to empirically compete with other sources of EM-specific risks. This is important for the robustness of our conclusions because the emerging market exchange rate measure may reflect

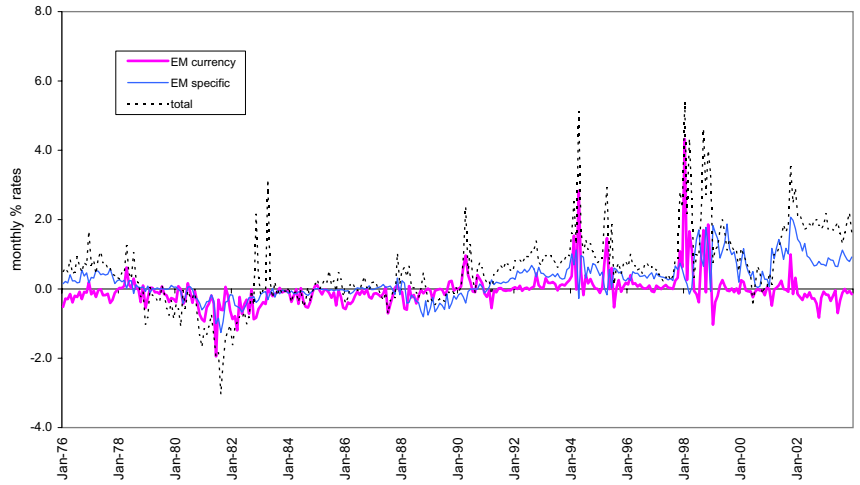
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FIGURE 3 (continued)
Estimated Risk Premia

Graph E. Korea



Graph F. Thailand



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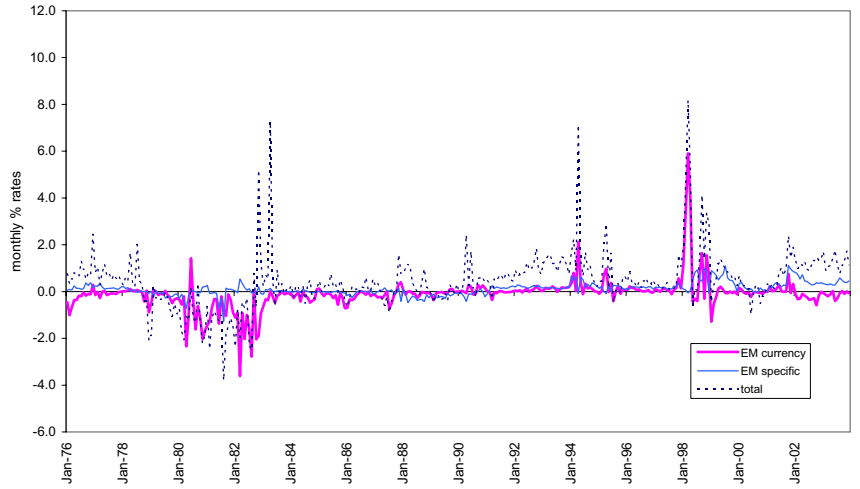
broader economic and political risks and lead to a spurious significance of EM currency risk as a global pricing factor.

Our results support the hypothesis of significant EM currency risk premia related to both emerging and developed market assets. There is also evidence that EM currency risk is priced separately from other EM-specific risks. Our measure of EM-specific risk is found to be significantly priced and time varying for all countries in the sample. Our results suggest that the total risk premium

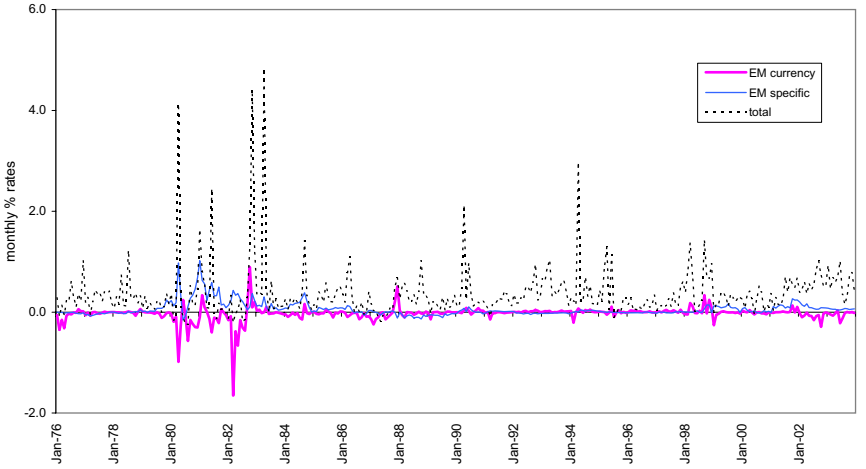
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FIGURE 3 (continued)
Estimated Risk Premia

Graph G. Singapore



Graph H. U.S.



stemming from emerging market risks is economically significant. Overall, EM risks represent over 50% of the total risk premium for emerging market assets and about 20% for developed market assets. Finally, we find that the spillover impact is heightened during emerging market crisis episodes and such information in particular affects the ex ante world market and major currency risk premia. Thus, the information about emerging market crises significantly contributes to the repricing of the global risk factors for developed market assets.

These results have important implications for investor decisions regarding global asset allocation and hedging of portfolio risks. During crisis episodes,

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investors should take into account the potential repricing of various risks that would affect their asset allocation decisions. For hedging portfolio risk, these results point to the importance of disentangling the effects of emerging market currency risk from other EM-specific risk exposures.

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