The correlation between FX rate volatility and stock exchange returns volatility: An emerging markets overview[1]

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Abstract

This paper examines the relationship between the volatilities of equity indexes returns and FX rates for a set of emerging countries. We study the sensitivity of sector indexes volatility to FX rates volatility of local currencies with respect to the U.S. Dollar, the British Pound, and the Japanese Yen. Our empirical results largely support the hypothesis of a positive transmission mechanism between volatilities in equity and FX rates markets. Furthermore, although Ownership Restrictions and International Capital Market Controls have significant effects on the magnitude of the relation between FX rates volatility and stock returns volatility, the type of the FX rates regime does not affect this relationship. Our findings can be exploited for portfolios international diversification and adjustment of the risk management of multinational corporations. The model can also be extended using high frequency data.

JEL classifications: F31; G15

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I- Introduction :

The purpose of this paper is to investigate the correlation between FX rates volatility and stock returns volatility. We use a GARCH model to estimate the stock return and the exchange rate volatility. The basic intuition behind this investigation is that the volatility of the stock returns is partially explained by the volatility of the FX rates. The instability observed on stock exchange market is in part due to the foreign intervention, which induces a correlation with foreign markets via FX rates and portfolios holdings of foreign investors.

The volatility of stock returns can be explained by many factors, including liquidity risk (Jun, Marathe and Shawky, 2003, Min, 2002, Lesmond, 2005), information asymmetry (Tse, Wu and Young, 2003, Attanasio, 1990), number of informed agents (Du and Wei, 2004), inventory (Thille, 2005), segmentation (Yeh, Lee and Pen, 2002, Jong and Roon, 2004), number of regulations and their imbedded costs (Green, Maggioni, and Murinde, 2000), quality of the banking system (Dellas and Hess, 2002) and the impact of investibility (i.e' the degree to which a stock can be foreign-owned on the stock return volatility') as suggested by Bae, Chan and Ng (2004). Some of these factors have a positive effect on the stock return volatility whereas others have a negative one. This large number of factors does not allow to disentangle the effect of each shock on the volatility. One way to circumvent this problem is to reduce the number of factors using fundamentals as in Fama and French (1995) or a decomposition approach of the volatility as provided recently by Caner and Önder (2005). Their study considers dividend yields and interest rates as major sources of volatility. Although, it is difficult to determine the optimal number of useful factors, one can still look for elements which are correlated either with stock returns or with the volatility.

In an international context, the variability of FX rates is clearly a potentially interesting factor that drives the level of the volatility of stock returns. With the liberalization and the reduction of barriers to international investment, foreign investors can benefit from diversifying their portfolios (Li, Sarkar, and Wang, 2003, DeSantis and Gerard, 1997)[3].

[3] ''…The integration of world equity markets reduces, but does not eliminate, the diversification benefits of investing in emerging markets subject to short-sale constraints. Our results reinforce the home bias puzzle with respect to investments in emerging markets.'' (Li, Sarkar, Wang , 2003).

As a consequence, agents are more likely to move their portfolios from a stock exchange market to another. This implies a greater sensitivity to the exchange rates and a priori a positive transmission mechanism between the stock returns volatility and the FX rates volatility. For example, sudden and bad events created in some stock exchanges will drive investors to withdraw their investment and to look for other financial markets. These investors will convert their holdings into foreign currency and shocks will subsequently affect FX markets. The south Asian crisis illustrates well this phenomenon. While, this portfolio approach explains the relation between FX rate volatility and stock return volatility, the transmission effect across both markets can also be generated by speculative investors. Furthermore, in many times the transmission mechanism turns out to be a contagion phenomenon across markets and is reinforced as the markets are getting co-integrated (Edwards and Susmel, 2001, Bekaert and Harvey[4], 2002 and 2003).

Hedging operations against foreign risk can decrease the volatility of the stocks (Allayannis and Ofek, 2001, Allayannis, Brown and Klapper, 2001)[5]. Using risk management in general can reduce the uncertainty about the financial results of the firm. This fact will thus shrink the volatility of the stock returns. Using hedging instruments can also reduce the contagion between markets. However, these operations are costly and can decrease the performance of the firms. Some investors may look for a type of firms that do not use hedging procedures. The stocks of these firms will be traded by aggressive agents looking for more growth. This statement will magnify the volatility of the stock return. Hedging operations can reduce the volatility of hedged firms and increase indirectly the volatility of the non-hedged firms. It would be interesting to study the impact of the hedging on the correlation between FX rates and stock returns. We could divide the sample of the firms following the hedging ratio. However, this question is beyond the purpose of this paper.

The volatility also tends to increase surrounding some events: earning announcements, merging, rumours displayed, etc. The effect of the liberalization on the volatility of the market is also significant (Edwards, Biscarri and Gracia, 2003, Huang and Yang, 2000,

[4] ''…. Contagion in equity markets refers to the notion that markets move more closely together during periods of crisis.'' (Bekaert and Harvey, 2003)

[5] Darden Business School Working Paper No. 01-09; World Bank Policy Research Working Paper No. 2606

Jayasuriya, 2005).[6] Bekaert and Harvey (1997) also suggest that the correlation often increases with market liberalizations[7]. It remains to see what would happen to the correlation in times of crises.

In this paper, we propose to examine the correlation between the volatility of FX rates and the volatility of the stock exchange returns in some emerging countries. We focus on emerging markets for various reasons. First, to our best knowledge, no study of this kind was undertaken on those markets. Second, the weight of these financial markets is incessantly increasing. Third, we think that emerging countries are tightly related to the major currencies in the world: American Dollar, Japanese Yen, Euro and British Pound. These latter are driving the major economic indicators of the emerging countries. The exchange rate is one of the most important elements in setting economic policies in the emerging countries. In deed, exchange rate policies play a major role to attract direct foreign investment (Bénassy-Quéré, Fontagné, and Lahrèche-Revil, 2001) and to bear the export levels. The remaining part of the work is organized as follows. In the second section, we give a theoretical framework of the relationship between FX rates and stock returns. In the third section, we give a description of the data and the methodology used. In the fourth section, we display the empirical results. Finally, the fifth section is the conclusion.

II- Theoretical Framework

We propose in this part to explore theoretically the relation between the exchange rates and the outputs of stocks. We propose to use a theoretical framework in which there are two agents: the firm and the foreign investor. We then try to determine the objectives and the behaviour of each of the two agents. The firm seeks to maximize its profit in terms of local currency and the foreign investor seeks to maximize the output of his portfolio in terms of foreign currency. We consider that the interaction between these two agents will be, mainly in charge of the relation between exchange rate risk and stock exchange

[6] ‘’…Similar to findings from previous work, we find that volatility may decrease, increase, or remain unchanged following liberalization.’’, Jayasuriya (2005).

[7] ‘’… We find that capital market liberalisations often increase the correlation between local market returns and the world market but do not drive up local market volatility.”, Bekaert and Harvey (1997).

output. It is a simple theoretical framework which enables us to study the relation between the exchange rate and the stock exchange output. In this model, we will not take into account the presence of dividends because our empirical study focus on sector indexes, which do not generally pay dividend. However, abnormal negative return should be observed on ex-dividend dates[8]. This abnormal return can, to some extent, bias the results. The generalisation of the behaviour of these two agents (firm and foreign investor) would give us a macroeconomic explanation of the relationship between FX rate and stocks returns at a country level.

1- From the firm viewpoint:

For an exporting firm, the depreciation of the local currency compared to the foreign currency will generate an increase of its income (in terms of local currency). This good news is likely to encourage investors to buy or at least to hold the stock of the firm. The quotation of the exchange rate being indirect i.e. equal to the price in foreign currency of a unit of local currency, if this rate improves, then, the price of the stock should increase. Based on this criterion, the relation is a priori negative: if the output of the local currency is negative (R_x is negative: there is a depreciation of the local currency) then there is an increase in the value of the stock. But, if the firm imports raw materials from this same foreign country or other countries, and that the foreign currencies were appreciated, the profit recorded at the time of the sales can be cancelled by the imports. It is thus necessary to check the net position in local currency of the firm. It is difficult to disentangle the effect of the increase from the effect of a decrease in the foreign currency. It is also obvious that firms are not equally affected. It depends on the geographical localization of the partners (customers and suppliers) of the firm. Profits on a currency can be cancelled by losses on other currencies.

The last decade was characterized by the multiplication of the instruments of exchange rate risk management. Futures, options, forwards and various arrangements are more and more adopted by the firms. This has as a consequence the reduction in uncertainty about

[8] At the ex-dividend date, the stock price would decrease by the same amount of the dividend distributed by the firm, as mentioned in Modigliani and Miller (1986). Since we do not take account of the dividend, we would expect to get an abnormal negative return on ex-dividend dates.

the incomes of the firm which is synonymous to less speculation. The exchange rate risk can be cancelled. Also, the presence of ADRs[9] made it possible to the American investors to invest in the emerging countries without undergoing the exchange rate risks. The rates of exchange thus have, a priori, less impact on the course of the stock than the previous decades. But, is the FX rate really an index without real importance for investors?

2- From the foreign investor viewpoint:

We propose here to expose the behaviour of the foreign investor in the stock exchanges of the emerging countries. Contrary to the local investor, the foreign investor undergoes the exchange rate risk. We will then try to determine the impact of its behaviour on the value of the stock. Even if the participation of the foreign investors in emerging stock markets is not major, it is nevertheless increasingly important. Since stocks are traded in local currency, foreign investors must translate their inflows or their outflows. The variation of the exchange rates for a foreign investor thus - in term of local currency - can either increase or decrease the output of the stock.

The following relation gives the output obtained (in the foreign currency) by a foreign investor:

$$1 + R_G = (1 + R_x)(1 + R_t) \text{ or: } R_G \approx R_x + R_t$$

With: R_G: output of the stock in foreign currency

R_t: output of the stock in local currency

R_x: output of the rates of exchange in indirect quote $R_x = \ln\left(\frac{S_{t+1}}{S_t}\right)$. In deed, it is the variation (expressed as a percentage) of the local currency compared to the foreign currency.

S_t: a number of units of the foreign currency for a unit of local currency at the date t.

So, in our case and with an indirect quotation, the rate the stock in local currency: $R_t = \ln\left(\frac{P_{t+1}}{P_t}\right)$.

P_t : Price of the sector index i in the country j at the end of the day t.

[9] ADR: American depositary receipt.

This gives the output of the local currency. If the local currency appreciated, R_x is positive. If the local currency depreciated R_x is negative.

For those who had already invested: in the case of a depreciation of the local currency compared to the foreign currency (R_x is then negative), there will be a loss of output of the stock finally obtained in foreign currency. The foreign investors, for fear of continued local currency depreciation, will seek other financial markets which may be more profitable. There is then an increase in the offer of the stock on the market. The price of the stock will drop. This assumption supports that the relation between FX rate and stock price is negative.

For those who did not invest yet: if the currency had been depreciated before they already invested, it can correspond to new possibilities of investment. For this group of investors, they will find the stocks cheap. The foreign investors, anticipating that the local currency will pursue an appreciation, will buy these stocks. Thus, the price of these stocks increases. From this point of view, the relation appears then positive between prices of the stocks and output of exchange.

There are thus two antagonistic forces taking place on the market. These two forces represent two types of foreign investors with opposite anticipations. Ones are betting on a depreciation of the local currency (contrarian strategy), others on an appreciation (momentum strategy). But, the principal difficulty on the empirical level is to be able to disentangle the effects due to the behaviour of the firm from those due to the behaviour of the foreign investor.

The two approaches exposed to explain the relation between the exchange rate risk and the stock exchange output: the approach cash-flow and the approach of supply and demand are used to explain the sources of the volatility in the stock exchange market.

3- Exchange rate regime and stock exchange markets:

The liberalization of the financial and stock exchange markets of the emerging countries lasts from the Nineties. A relatively short history for these financial markets and which is mainly characterized by the Mexican crises 1994, Asian financial crises of 1997, the

Russian crises in 1998, and the Argentinean crises in 2002. The first point to be underlined on these markets is the number of marketable quoted securities. The depth of the stock exchange markets is improving. The number of quoted securities, as well as the number of daily transactions does not cease increasing. From a financial point of view, this can lead to an efficiency improvement (i.e. a 'better' reaction of the markets). In our case, the impact of the exchange rates will be a priori more significant as the market is efficient i.e. liquid and deep. Even if the condition of efficiency remains a (theoretical) best to reach, we think that a study on an emerging but relatively well structured market, will give significant results.

Another point to mention is the segmentation phenomenon[10] from which suffers in general the emerging countries. The main cause of the segmentation is the lack of supply and demand. The ratios of the request over the offer on the stocks are lower than those of the developed countries. The integration of the emerging markets is also to underline (Bairoch and Kozul-Wright, 1996). We will not release in details this concept, but we will retain the impact of this phenomenon on our study. Indeed, it was noted these last years, that the emerging markets are more cointegrated. Moreover, their correlation with the developed countries markets and in particular the U.S.A does not cease being confirmed. This tendency is reinforced as the weight of the emerging countries in the world economy is increasing. The contagion between the countries is more accentuated (and unavoidable) as the economies of these countries are more cointegrated. This is the case at the financial crisis of 1997. The crisis is propagated from a country to another, almost without meeting cut fire (even though for various reasons some countries as Taiwan and China were exempted). During this period, the exchange rates were very volatile.

[10] The segmentation phenomenon: two stocks with the same characteristics have different prices relating to the market where they are quoted.

III- Methodology and data

1- Description of the data

We focus our study on the following 18 emerging countries: Argentina, Brazil, Chile, Colombia, Hungary, India, Indonesia, Malaysia, Mexico, Peru, Poland, Philippines, Russia, South Africa, South Korea, Taiwan, Thailand, and Turkey. This sample of countries is well diversified.

The source of the data is Datastream and we are using FTSE [11] indexes. The period study is variable from a country to another as mentioned in the table1. This fact is due to three reasons. First, some of the indices were created after 1994/01/01. Second, we have to work on fluctuate exchange rate regime periods. If the exchange rate is fixed with respect to one currency (generally USD), it is useless to study its impact on the stock returns. Third, the GARCH can not capture the jumps observed during crises. So we will study only post crises periods. This is particularly true for Asian countries. We also provide in table1 the type of the exchange rate regime[12].

[Insert table 1]

1.1 Exchange rates

The variables used are: exchange rates of emerging currencies with respect to U.S. dollar, British pound and Japanese yen. For some exchange rates, the dataset is missing for the quotation of JPY. We calculate the cross rate using the quotation with respect to the GBP.[13] Although, this method could imply a bias (related to the bid-ask spread and transactions costs), it is the only way to use the same index for all the countries used in

[11] FTSE indexes are created by the company FTSE. FTSE is a joint venture between The Financial Times and the London Stock Exchange.

[12] Source: IFM, Annual report 2003. "For the managed floating regime, monetary authority influences exchange rate movements through active intervention to counter the long-term trend of the exchange rate without specifying a predetermined exchange rate path or without having a specific exchange rate target. For the independently floating regime, the exchange rate is market determined, with any foreign exchange intervention aimed at moderating the rate of change and preventing undue fluctuations in the exchange rate, rather than at establishing a level for it. In these regimes, monetary policy is, in principle, independent of exchange rate policy."

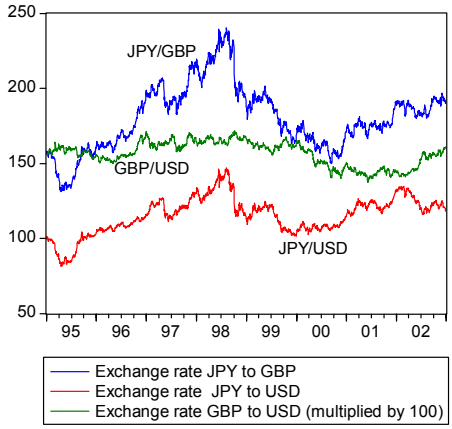
[13] 1 local currency/ 1 JPY = (1 local currency/1GBP) /(1 GBP/JPY)

the study. We give hereafter the correlation matrix of the FX rates of the emerging countries with respect to USD, GBP and JPY. [14]

[Insert table 2, 3 and 4]

Following table 2, table 3 and table 4, we can notice that the correlation of the FX rates among emerging countries is varying from -0.78 to 0.97 for the USD, from -0.85 to 0.98 for the GBP, and from -0.68 to 0.95 for the JPY. These values indicate the existence of a lot of possibilities for speculation and hedging using foreign currencies (even without using short positions). It also indicates that the emerging countries exchange rates are not behaving in the same way. The average correlation values are 0.33 for the USD, 0.47 for the GBP and 0.34 for the JPY. The variations of the local currencies with respect to the GBP are the most correlated. We give hereafter the graph of the exchange rates JPY/USD, JPY/GBP, and GBP/USD for the period spreading from 12/30/1994 to 01/01/2003.

Figure 1: The evolution of the exchanges rates:
JPY/USD, JPY/GBP and GBP/USD.



[14] See graphs of the FX rates in annex. The graphs are of local currency/USD, and local currency/GBP and local currency/JPY.

We give also, in table 5, the correlation matrix of the exchange rates JPY/USD, JPY/GBP and GBP/USD. We can notice that the JPY/USD and JPY/GBP are highly correlated. However, JPY/USD and GBP/USD are almost uncorrelated. This matrix is relevant to set up strategies for hedging or speculation.

[Insert table 5]

1.2. Sector indexes

The eleven indexes used for different countries are: FTSEW[15], Banks, Beverages, Construction and Building Materials, Cyclical Services, Financials, Food Producers and Processors, Non-Cyclical Consumer Goods, Oil and Gas, Resources, Telecom Services. These sectors represent a well balanced portfolio of the major sectors of each country. Also, we used these sectors because they are available in the majority of the countries of our study. A large literature supports the study of portfolios rather than individual stocks (Ferson and Harvey, 1991, Sunder, 1980, Collins et al., 1987). We think that this method will give more stable results. The various sector indexes also enable us to have a diversified sample. A sector index will be mainly influenced by global macroeconomic variables. As we are studying the influence of the exchange rate, we think that working on sector indices would give more significant results. However, there are also a lot of firm specific effects which are not captured by our model.

2- Methodology

2.1 Contemporaneous relationship

The first model that examines the relationship between FX rates variations and stock returns is the two factors model of Jorion (1990). It uses FX rates and market index returns to explain the stock returns. However, this model may suffer from two problems. First, using an unconditional model for large time periods could not give significant results due to structural changes. Second, the linearity of the model may be too restrictive. Others as Koutmos and Martin (2003) tried to circumvent this later problem

[15] This is the general index for each country. It can be seen as the market index.

by adding the conditional volatility of the FX rates as an explanatory variable. The adding of a squared term can capture some of the non-linearity of the relationship.

$$R_{i,t} = \beta_{i,0} + \beta_{i,1} R_{x,t} + \beta_{i,2} R_{Mt} + e_{i,t} \quad \text{[Jorion, 1990]}$$

$$R_{i,t} = \beta_{i,0} + \beta_{i,1} R_{x,t} + \beta_{i,2} R_{Mt} + \beta_{i,3} h_{x,,t} + e_{i,t} \quad \text{[Koutmos and Martin, 2003]}$$

However, our methodology would capture more non-linearity in the relationship between FX rates and stock returns. The linear model of Jorion (1990) supposes that the relationship between FX rates and stock returns is stable (same sign) throughout the sample. This is not necessarily the case. We can still have dependence between two variables, even if the linear model would give a statistically non significant coefficient. If we divide our sample into two sub samples, we can find a positive relationship for the first part and negative one for the second part. Whereas, when we run an OLS regression on the whole sample, we may not find a statistically significant coefficient.

The stock markets factors are time varying. And we could expect for example that FX rates have a positive impact on stock returns for some periods and a negative one for others. A spill-over aspect is usually observed. It depends on the currency in which the net cash flows are underwritten. Also, the use of the various derivatives instruments and short positions decrease the linearity aspect of the relationship. So using a quadratic model is more suitable to capture the dependence between FX rates and stock returns. In this model, we would be more concerned by proving the existence of dependence rather than the existence of a specific correlation.

Our hypothesis is that FX rates have an impact on stock returns. The model we propose allows us to capture this effect regardless of the sign of this relationship. We verify if any variation in FX markets would induce a variation in the stock markets. For this purpose, we use a two steps model to study the correlation between the FX rates volatility and stock returns volatility. First, we estimate the conditional volatility of each market using the GARCH (1.1) process. Second, we run an OLS regression. We use the conditional volatility of the FX rate as an explanatory variable and the conditional volatility of the sector index returns as a dependant variable.

The sector is indexed with i and the country with j. The model is as follows:

$$R_{x,j,t} = \ln\left(\frac{S_{j,t}}{S_{j,t-1}}\right) \qquad R_{i,j,t} = \ln\left(\frac{P_{i,j,t}}{P_{i,j,t-1}}\right)$$

$$\ln S_{j,t} = \ln S_{j,t-1} + \varepsilon_{x,j,t} \qquad \ln P_{i,j,t} = \ln P_{i,j,t-1} + \varepsilon_{i,j,t}$$

$$R_{x,j,t} = \varepsilon_{x,j,t} \qquad R_{i,j,t} = \varepsilon_{i,j,t}$$

$$h_{x,j,t} = a_0 + a_1 h_{x,j,t-1} + a_2 R^2_{x,j,t} \quad \textbf{(2.1)}$$

$$h_{i,j,t} = a_0 + a_1 h_{i,j,t-1} + a_2 R^2_{i,j,t} \quad \textbf{(2.2)}$$

$$h_{i,j,t} = \beta_{i,0} + \beta_{i,j,1} h_{x,j,t} + e_{i,j,t} \quad \textbf{(2.3 a)}$$

$P_{i,j,t}$: Price of the sector index i in the country j at the end of the day t.

$P_{i,j,t-1}$: Price of the sector index i in the country j at the end of day t-1.

$S_{j,t}$: Quotation of the foreign currency at the day t (One unit of foreign currency is equal to S_{jt} units of local currency).

$S_{j,t-1}$: Quotation of the foreign currency at the day t-1.

$R_{i,j,t}$: Stock exchange output of the index of sector i in the country j.

$R_{x,j,t}$: Output of the local currency (a country j) expressed in foreign currency (in American dollar, or Japanese yen or Britain Pound).

$h_{x,j,t}$: The conditional volatility of the rates of exchange in the country j.

$h_{i,j,t}$: The conditional volatility of the sector index returns i in the country j.

We estimate the equations (2.1) and (2.2). Then we run the OLS of (2.3 a). Conditional volatility is determined by the method of maximization of likelihood with a GARCH process and according to the method of optimization B.H.H.H[16].

We determine the parameters a0, a1 and a2. The expression of Log-likelihood function is as following:

[16] Algorithm of optimisation of Berndt, E.K., Hall, H.B., Hall, R.E., Hausman, J.A.

$$l(\theta; y_t, x_t) = -\frac{T}{2}\log(2\pi) - \frac{1}{2}\sum_{t=1}^{T}\log(h_t) - \frac{1}{2}\sum_{t=1}^{T}\left(\frac{y_t - x_t\beta}{h_t}\right)^2$$

The stationarity issue is important in GARCH models. It is well known that GARCH models do not capture spike and pick effects. In this case, we will have a problem of stationarity. The Asian crises and the various crises that struggle the emerging countries induces high volatility level for periods surrounding those important events. To solve this problem, we will choose to work on periods where there are no extreme values and in particular, we will work on post-crises periods.

There is a trade-off in choosing the sample size. If we choose a long period, the conditional volatilities would be well defined thanks to the large information available. Also, when we run the OLS regression we will tend to have more significant results as the period is getting larger. On the other hand, results would be more affected by noise and structural changes.

As we do not know the exact value of the volatility of each sector, and the one of the exchange rate, the use of estimated variables will give an unavoidable problem of errors in variables (error of estimation).

2.2. Measures of the foreign risk:

We give hereafter a measure of risk. This measure enables us to compare across sectors and across countries, as well. We have sector i and country j. We use equation (2.3 a):

$$h_{i,j,t} = \beta_{i,j,0} + \beta_{i,j,1} h_{x,t} + e_{i,j,t}$$

We get the estimated values of $\boldsymbol{\beta_{ij,1}}$, than we can calculate the value of the risk measure. The risk of a country j is:

$$\text{Risk}_j = \frac{1}{n_i}\sum_{i}^{11}\beta_{i,j,1}^2$$

This is the average value of the squared of significant coefficients of sectors for the county j. If the $\boldsymbol{\beta_{i,j,1}}$ of a sector i is not significant, we do not take it into account. $\mathbf{n_i}$: is the number of sectors which have significant $\boldsymbol{\beta_{i,j,1}}$.The risk of a sector i is:

$$\text{Risk}_i = \frac{1}{n_j}\sum_{j}^{18}\beta_{i,j,1}^2$$

This is the average value of the squared of significant coefficients of countries for the sector i. If the $\beta_{i,j,1}$ of a country j is not significant, we do not take it into account. n_j: is the number of countries for which $\beta_{i,j,1}$ is significant.

These are unified measures of risk that enable us to get direct comparisons between sectors within a country or within a sector. These measures do not consider the sign since we are interested only on the magnitude of the effect of the exchange rate volatility over the sector return volatility.

2.3. Lagged relationship:

We use the same methodology except for the equation **(2.3 a).**

$$h_{x,t} = a_0 + a_1 h_{x,t-1} + a_2 R^2_{x,t} \quad \textbf{(2.3 b)}$$

We can think that the volatility of the exchange rate of today will predict the volatility of the sector index of one day after. However, because of the specification of the GARCH (1.1) to estimate the volatilities, this procedure is biased.

We give hereafter the relationship between FX rates volatility at t-1 and the stock return volatility at t. Since $h_{i,t}$ and $h_{x,t}$ are following an autoregressive processes conditional on heteroscedasticity, it is not very useful to run this regression. We know that the coefficient of correlation between the two variables is decreasing as the lag is extended. We give hereafter an analytical answer[17]:

$$h_{i,t} = \beta_{i0} + \beta_{i1} h_{x,t} + e_{it}$$

$$h_{i,t} = \beta_{i0} + \beta_{i1}(a_0 + a_1 h_{x,t-1} + a_2 R^2_{x,t}) + e_{it}$$

$$= \beta_{i0} + \beta_{i,1}\frac{a_0}{1-a_1} + \beta_{i,1} a_1^n h_{x,t-n} + \beta_{i1} a_2 \sum_{i=0}^{i=n} a_1^i R^i_{x,t-i} + e_{i,t}$$

The coefficient related to $h_{x,t-n}$ will reach zero as n goes to infinity. The relationship between the stock return volatility and exchange rate volatility is decreasing as the lag between the two periods considered is increasing. This fact is due to the choice of the GARCH (1.1) as a model for the both volatilities (FX rates and equities returns). If the lag goes to infinity, we won't find a significant relationship between the two variables.

[17] The entire proof is given in appendix B.

However, if we increase the lag of the GARCH model, we will find a more significant lagged relationship between FX rates volatility and stock returns.

2.4. The determinants of the relationship between FX rates volatility and stock exchange volatility:

We think that the relationship between stock returns volatility and FX rates volatility is related to the characteristics of the emerging countries. We try to explain the correlation coefficient $\rho_{i,x}$ (the correlation between the FX rates volatility and stock returns volatility) using some explanatory variables. The explanatory variables are categorized into the following groups: Economic Development, Familiarity, Stock Market Development, and Capital Controls. The economic development variables are [18] : **GCI**: Growth Competitiveness index and **BCR**: Business Competitiveness Rank. When an emerging country is relatively developed, we would expect to get a higher correlation coefficient $\rho_{i,x}$. This country is supposed to be more integrated in the world economy. It would be more influenced by the variations of the FX rates. The familiarity variable used is **DIS**: Distance between the emerging country and United States, United Kingdom and Japan, respectively[19]. Coval and Moskowitz (1999) explain the regional bias and its impact on portfolio diversification. The regional bias is the fact that investors tend to overweight in their portfolios allocations the stocks traded in the closest countries to them. European investors would primarily invest in Europe and Asian Investor would do so in Asia for example. We would expect a negative relationship between the distance and the correlation coefficient. The stock market development variable is **MKTC**: Market Capitalization in 01/01/2003. If a country has a developed financial market, it will attract higher number of foreign investors. The volume of trading in this market will be linked to the FX rates variations. We would expect to get a positive relationship between the stock market development and the correlation coefficient. The capital control variables[20] are: **SUMI**: Summary Index of capital controls, **RTB**: Regulatory Trade

[18] Data are obtained from the World Economic Forum website: www.weforum.org.

[19] Data on geographical distances are obtained from www.nber.org/~wei, which calculates the bilateral distance between capital cities of countries. The data are used in Frankel and Wei (1998).

[20] Data are obtained from the Economic Freedom Network Website: www.freetheworld.com.

Barriers, **FOR**: Foreign Ownership Restrictions, **RFCME**: Restrictions in Foreign Capital Market Exchange, **ICMC**: International Capital Market Controls, **FTI**: Freedom to Trade Internationally, **AESTS**: Actual vs. Expected Size of Trade Sector, **DOBMER**: Difference between Official and Black Market Exchange Rates, and **IRC**: Interest Rate Controls. If a country has high capital control and barriers to foreign investors, it will not attract foreign investments. The need to trade in foreign currency would be less. So we would expect a negative relationship between the level of the restrictions and the correlation coefficient.

We run an OLS regression as following: the dependant variable is $\rho_{i,x}$ (the correlation coefficient between FX rate volatility and the market index Volatility) and the independent variables are those exposed above. We give hereafter the multiple regressions:

$$\rho_{j,x} = \gamma_0 + \gamma_1 \mathbf{GCI} + \gamma_2 \mathbf{BCR} + \gamma_3 \mathbf{DIS} + \gamma_4 \mathbf{MKTC} + \gamma_5 \mathbf{SUMI} + \gamma_6 \mathbf{RTB} + \gamma_7 \mathbf{FOR} + \gamma_8 \mathbf{RFCME} + \gamma_9 \mathbf{ICMC} + \gamma_{10} \mathbf{FTI} + \gamma_{11} \mathbf{AESTS} + \gamma_{12} \mathbf{DBOBMER} + .\gamma_{13} \mathbf{IRC} + \mathbf{e}_j \quad (\mathbf{2.4})$$

The multiple regression suffers from two problems. First, there is some correlation between the dependant variables which could bias the estimated coefficients. Second, since the size of the sample is not large, adding many dependent variables will not give efficient estimators. However, we will run both simple and multiple regressions. For the simple regression, we run the OLS equation for each explanatory variable separately. This method avoids the correlation bias observed on the multiple regressions. The results from the simple regression are also more efficient.

IV- Empirical results :

1. Overall results:

$$h_{ijt} = \beta_{i0} + \beta_{ij1} h_{xjt} + e_{ijt} \quad \textbf{(2.3 a)}$$

We give hereafter the results of the estimations of the coefficient $\beta_{i,j,1}$. We provide three tables: the first is for USD (table 6), the second is for GBP (table 7) and the third is for JPY (table 8). From table 6, table 7 and table 8, we can notice that the value of the coefficient $\beta_{i,j,1}$ is varying from -14.92 to 468.89 for the quotations with respect to the

USD, from -24.01to 31.77 for the GBP, and from -3.77 to 31.77 for the JPY. We give hereafter the distribution and the statistical properties of the $\beta_{i,j,1}$ in each case (USD, GBP and JPY).

[Insert table 6, 7, and 8]

Figure 2: Distribution of $\beta_{,ij,1}$ for USD.

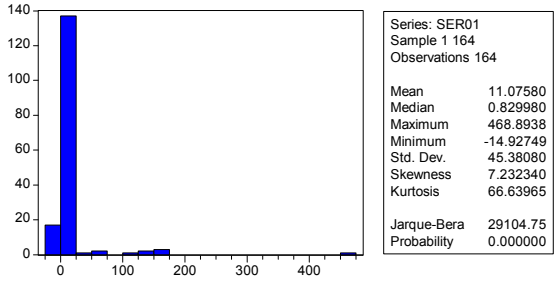


Figure 3: Distribution of $\beta_{,ij,1}$ for GBP.

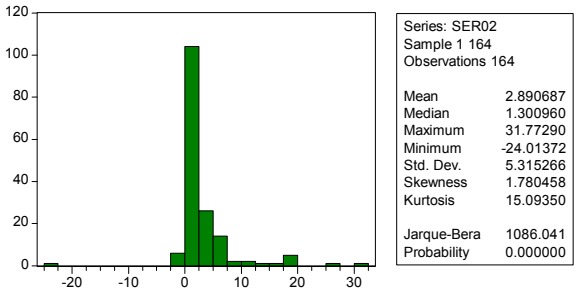
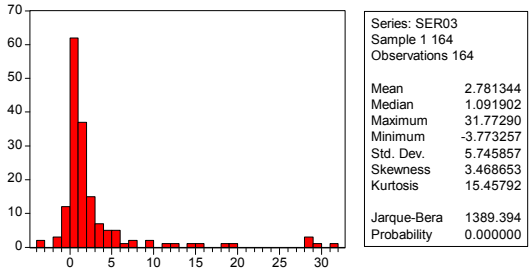


Figure 4: Distribution of $\beta_{,ij,1}$ for JPY.



The mean of $\beta_{ij,1}$ is 11.07 for USD, 2.89 for GBP, and 2.78 for JPY. The sector indexes returns volatilities are more sensitive to the fluctuations with respect to the USD. The median of $\beta_{ij,1}$ is 0.82 for USD, 1.30 for GBP, and 1.09 for the JPY. For the exchange rate

with respect to the USD, 50% of the values of $\beta_{ij,1}$ are between -1 and 1 (50% of the indexes returns are less volatile than the FX rates). This ratio is 41% and 45% for GBP and JPY respectively. As a consequence about a half of the sector indexes considered are more volatile than the FX rates.

The standard deviations of each series of $\beta_{ij,1}$ are 45.38 for USD, 5.31 for GBP and 5.74 for JPY. The exchange rates with respect to the USD are struggling with a large variability the emerging countries. From figures 2, figures 3 and figures 4, we can also notice that the distribution of $\beta_{ij,1}$ is positively skewed for USD, GBP and JPY. The values of the skewness coefficients are respectively 7.23, 1.78 and 3.46. The exchange rates volatility is evolving in the same way as the indexes returns volatility. The percentages of positive $\beta_{ij,1}$ are 89.63% for USD, 95.73% for GBP and 89.63% for JPY. This confirms our hypothesis of a positive relationship between exchange rate volatility and stock returns volatility. If the FX market is volatile, an investor is expected to observe a stock exchange market at least as much volatile. We give hereafter the p-values distributions. The proportions of P-values that are inferior to 0.1 are 73% for the USD, 73% for GBP, and 79% for the JPY. The distributions of the p-values confirm also the overall significance of the model because the p-values are highly positively skewed.

Figure 5: Distribution of P-values of $\beta_{,ij,1}$ for USD.

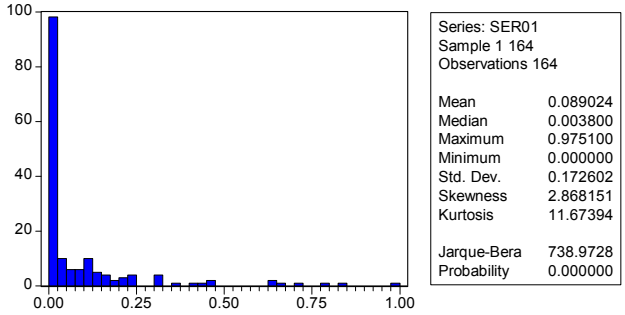


Figure 6: Distribution of P-values of $\beta_{,ij,1}$ for GBP.

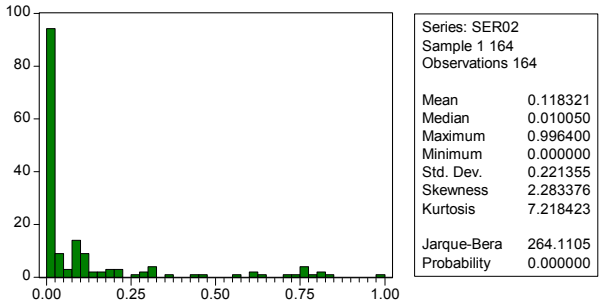
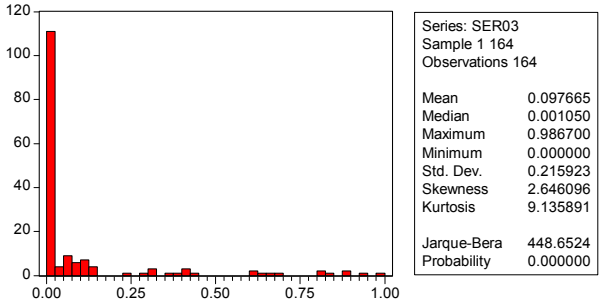


Figure 7: Distribution of P-values of $\beta_{,ij,1}$ for JPY.



2. Sectors and regions results:

In table 9, we classify our results by sector indexes. The ratios of significant sectors are ranging from 45% to 76% for the USD, from 45% to 73% for the GBP and from 50% to 83% for the JPY. The Banks Index is one of the most sensitive sectors with 76% for USD, 71% for GBP and 71% for JPY also. The overall responsiveness of this sector is 73%. The overall responsiveness of the sector indexes are ranging from 45% to 83%. The variability of the overall responsiveness is not too high.

[Insert table 9]

In table 10, we classify our results by regions: Latin America, Asia, Europe, and Africa. For each country we calculate $\mathbf{n_i}$, the number of sector indexes which have a significant relationship with the exchange rate. We calculate the ratio of significant indexes and we sum up for each region. For the impact of the USD exchange rate, we notice that Asia is the most sensitive with a ratio of significant sector indexes equal to 76%, followed by

Europe with 65 %, Latin America 61% and Africa 30%[21]. For the impact of the GBP exchange rate, we notice that Asia is the most sensitive with a ratio of significant sectors indexes equal to 71%, then Latin America with 65%, Europe 56% and Africa 20%. For the JPY exchange rate, we notice that Latin America is the most sensitive with a ratio of 82 % of significant sectors indexes, then Europe with 68%, Asia 65% and Africa 20%.

[Insert table 10]

If we consider an overall responsiveness of each region with respect to USD, GBP and JPY, we observe that Asia is the most sensitive with 71%, then Latin America 70%, Europe 63% and Africa 23%. It could be an indicator of the integration of the emerging countries to the world economy (particularly with the developed countries). However, these emerging countries would be more affected by the economies of the developed countries. We can also observe that for the set of the emerging countries considered in our sample, the exchange rate with respect to the JPY has the most impact with 69%, then USD with 66 % and GBP with 63% of significant results.

Table 11 and 12 give the results of the estimations of the risk measure. Table 11 shows the risk measure for each sector. Table 12 gives the risk measure for each country and we sum up by regions. The results displayed in table 11 are quite mixed, and we can not draw a clear conclusion about the most risky sector with respect to all the foreign currencies (USD, GBP and JPY).

Following table 12, for the USD, Asia is the most risky region with a value of the risk measure equal to 2776.49, then Latin America with 167.25, Europe 14.90 and Africa 0.18. For the GBP, Latin America is the most risky region with a value of the risk measure equal to 61.98, then Asia with 44.79, Europe 3.33 and Africa 0.28. For the JPY, Asia is the most risky region with a value of the risk measure equal to 110.67, then Latin America with 27.40, Europe 10.85 and Africa with 1.11.

[21] We can notice that the sample of the African continent is composed of only one country. It can not give us a good idea of the responsiveness of the sector indexes for the African continent as a whole. However, South-Africa is the only African country for which there is almost an agreement to classify it as an emerging country.

[Insert table 11]

We can notice that the overall risk, for all the emerging countries, is the largest with respect to the USD. It has a value equal to 1252.04, than with respect to JPY 53.78 and GBP with 42.45. These values are different enough and allow us to state that the USD volatility affects the most the emerging countries. A small variation in the FX rate with respect to the USD will induce a high variation in stocks returns. While the results seems driven by some countries which have high risk measures as India for Asia, Peru for Latin America, Hungary for Europe, the use of an average value can reduce this problem.

The risk measure of the USD is too high in comparison to the GBP and JPY. Another explanation to this value is the fact that most of the emerging countries, while adopting a free floating or managed floating exchange rates, are trying implicitly to adjust the value of their currency around the value of the USD. The fluctuations of the exchange rates of the emerging countries with respect to USD are small relatively to those of the stock returns.

[Insert table 12]

3. Sector versus country :

Should we diversify for countries or sectors? As in Estrada, Kritzman, and Page, 2004, we examine also this question. If an investor wants to specialize, should he do it by country or sector? The answer to the question is in part given in table 13. We ranked the sectors and countries based on their risk measure. We can compare across sectors and across countries. We can notice that sectors have larger risk measure in general. These results are driven by the risk measure of India, Taiwan, Peru and Thailand. For an investor, he can specialize by country and he has to avoid these riskiest countries. Or he can specialize by sectors and he should avoid investments in the sector indexes of those riskiest countries.

[Insert table 13]

A lot of linear combinations can offer large diversification possibilities to the investor. However, barriers to international investment and transactions costs could reduce the diversification benefits. It is easier to invest in different sectors for one country than to invest for one sector in different countries.

4. Managed versus independently floating FX regime :

The last decade was characterized by the reduction of the barriers to international investment. This fact can inflate or decrease the volatility depending on the market conditions. These events also have important implications for monetary policy frameworks in the emerging market economies. The number of countries that are adopting a free float regime is increasing. Also, the number of countries that are abandoning the fixed FX rates regime is increasing. The majority of the emerging countries are adopting either a managed float regime or an independent floating FX rates regime[22]. This policy will allow for gradually adjustments of the economy and also will avoid large shocks. This also leads to fewer interventions of central banks. On the other hand, those economies would be more correlated with the other countries which could raise the sources of instability.

In table 14 and 15, we divide our results by the type of the FX regime adopted. In the panel A, we put countries which have a managed FX rates regime and in panel B the ones which have a free floating FX rates regime. In table14, we can notice that countries which have a managed FX rate regime have sector index more sensitive to FX rates. The panel A has an overall responsiveness equal to 73%, whereas it is 60% for the panel B. Also, if we analyse by currency used, we can notice a large difference for the results in the USD. For USD, the overall responsiveness is equal to 81% for panel A, and is equal to 55% for panel B. This proves that countries of panel A are more affected by USD variations.

[22] ‘’ ..among 33 major emerging market economies, the share of countries with these intermediate exchange rate regimes declined from 64% in 1991 to 18% in 2004 . Over the same period, the proportion of these 33 countries operating floating exchange rate regimes increased from 30% to 70%, while that of countries with hard pegs doubled to 12%.‘’ Source: IMF, Annual Report, 1991, 1999, and 2004.

These countries are trying to maintain their currencies in some defined intervals with respect to USD. For the GBP and JPY the results are less pronounced (even though there is a difference).

[Insert table 14]

For table 15, based on our FX risk measure, we can notice that countries of panel A are riskier than countries for panel B. The risk measure for USD is 2384.68 for panel A and 32.28 for panel B. There is a large difference between the two values which confirms that managed FX rates regime countries are more sensitive to US fluctuations. However, these results are mainly driven by India. When we exclude this country, the risk measure of panel A is equal to 34.22 (which is comparable to the one of panel B). The risk measure for GBP is 43.77 for panel A and 41.44 for panel B. For the GBP, we can notice that the risk measure is almost the same for the two groups. This is due to the fact that managed FX rates regimes are less concerned by having parity with respect to the GBP. The risk measure for JPY is 93.83 for panel A and 20.84 for panel B. Panel A is riskier than panel B. The results of JPY are mainly driven by Thailand. When we exclude this country, the risk measure of the panel A is equal to 28.09 (which is relatively comparable to the value of panel B). So, no clear conclusion can be drawn about the FX risk supported depending on the regime chosen. It seems that the FX risk with respect to USD is more important for countries following a less flexible exchange rate regime. The FX risk with respect to GBP and JPY are relatively the same for the two groups.

[Insert table 15]

5. Results of the determinants of the relationship between FX rates volatility and stock exchange volatility:

$$\rho_{j,x} = \gamma_0 + \gamma_1 GCI + \gamma_2 BCR + \gamma_3 DIS + \gamma_4 MKTC + \gamma_5 SUMI + \gamma_6 RTB + \gamma_7 FOR + \gamma_8 RFCME + \gamma_9 ICMC + \gamma_{10} FTI + \gamma_{11} AESTS + \gamma_{12} DBOBMER + \gamma_{13} IRC + e_j \quad (2.4)$$

Table 16 shows the values of the variables used in the regressions **(2.4)**. We can notice that the results of the multiple regression are not significant for any variable (for each currency also). However, when we run a simple regression for each of the explanatory variables, we notice that some of them are significant. In particular, the variables **FOR** (Foreign Ownership Restrictions) and **ICMC** (International Capital Market Controls) are significant. From table 17, we can see that the values of the coefficient associated with variable **FOR** are -0.1264 for USD, -0.08122 for the GBP and -0.09265 for JPY. For the USD, the p-value of the coefficient is 0.0011, for GBP it is 0.0223 and for the JPY it is 0.0178. In all these cases the sign of the coefficient is negative. The more restrictions we have, the weaker is the relationship between the market returns volatility and FX rates volatility. The values of the coefficient associated with variable ICMC are -0.091 for USD, -0.048 for the GBP and -0.07 for JPY. For the USD, the p-value of the coefficient is 0.002, for GBP it is 0.047 and for the JPY it is 0.0258. Also, the sign of the coefficient is always negative.

[Insert table 16 and 17]

V- Conclusion:

This work examines the relationship between sector index volatility and FX rates volatility in some emerging countries with respect to USD, GBP and JPY. We find a significant relationship between FX volatility and stocks returns volatility for a large part of the indexes studied. The number of indexes that are significantly sensitive to the FX rates is almost the same for JPY (69%), USD (66%) and GBP (63%). Moreover, we find a positive relationship between the FX rate volatility and the stock return volatility in a large part of the sector indexes studied. We also notice that the FX risk is slightly larger with respect to the USD compared to the JPY and GBP. This can be explained by the large use of the USD in commercial and financial transactions. This higher dependence to the U.S could also increase the FX risk premium (less diversification).

We compare the volatilities of the FX rates and stock returns. For FX rates with respect to the USD, 50% of the values of $\beta_{ij,1}$ are between -1 and 1 (50% of the indexes returns are less volatile than the FX rates). This ratio is 41% and 45% for

GBP and JPY respectively. As a consequence, about half of the sector indexes considered is more volatile than the FX rates.

We examine the relationship between FX risk and stock returns across countries and sectors. We find that investors or corporations that want to reduce their FX risk exposure should concentrate either their portfolios or their activities by country rather than by sector. Also, this fact is more confirmed as the correlations between countries are increasing. So the benefits from the geographical diversification are declining.

Finally, results indicate that Foreign Ownership Restrictions and International Capital Market Controls have significant effects on the magnitude of the relation between FX rates volatility and stock returns volatility. However, the type of the FX rates regime does not. In order to prevent crises and based on this criterion, corporations and investors should carry more about the flows movements rather than on the type of the FX rates.

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APPENDIX A:

Table 1: We give hereafter the list of the countries used in our study. The data from FTSE are not all available beginning from 1994:01:01. For each country the period mentioned in the table is the maximum range (for some sectors we used sub-periods). MF: managed floating FX rates regime. IF: independently free floating FX rates regime.

	Country	Period of the study		Type of FX rates regime
		begin	end	
1	**Argentina**	01/01/1994	01/01/2003	MF
2	**Brazil**	01/01/1994	01/01/2003	IF
3	**Chile**	01/01/1994	01/01/2003	IF
4	**Colombia**	12/30/1997	01/01/2003	IF
5	**Hungary**	01/01/1994	01/01/2003	MF
6	**India**	01/01/2001	01/01/2003	MF
7	**Indonesia**	12/30/1997	01/01/2003	MF
8	**Malaysia**	01/01/1994	08/27/1998	MF
9	**Mexico**	01/01/1994	01/01/2003	IF
10	**Peru**	01/01/1994	01/01/2003	IF
11	**Philippines**	12/30/1997	01/01/2003	IF
12	**Poland**	01/01/1994	01/01/2003	MF
13	**Russia**	01/01/1994	01/01/2003	MF
14	**South Africa**	12/30/1997	01/01/2003	IF
15	**South Korea**	12/30/1997	01/01/2003	IF
16	**Taiwan**	12/30/1999	01/01/2003	MF
17	**Thailand**	12/30/1999	01/01/2003	IF
18	**Turkey**	06/30/2001	01/01/2003	IF

Table 2: Correlation matrix between FX rates of emerging countries with respect to USD for the period from 12/30/1997 to 01/01/2003.

	ARG	BRA	CHI	COL	HUN	INDI	INDO	MAL	MEX	PER	PHI	POL	RUS	S_A	S_K	TAI	THA	TURK
ARGENTINA	**1.00**																	
BRAZIL	0.74	**1.00**																
CHILE	0.67	0.93	**1.00**															
COLOMBIE	0.62	0.92	0.92	**1.00**														
HUNGARY	-0.03	0.40	0.54	0.66	**1.00**													
INDIA	0.77	0.48	0.71	0.34	-0.63	**1.00**												
INDONESIA	-0.02	-0.03	0.10	-0.03	0.06	-0.48	**1.00**											
MALAYSIA	0.03	0.14	0.53	-0.13	0.22		0.49	**1.00**										
MEXICO	0.36	0.40	0.25	0.38	0.02	0.17	-0.26	0.17	**1.00**									
PERU	0.33	0.74	0.70	0.84	0.75	-0.23	-0.24	0.16	0.48	**1.00**								
PHILIPPINES	0.54	0.77	0.90	0.84	0.61	0.27	0.36	0.88	0.16	0.56	**1.00**							
POLAND	0.12	0.49	0.52	0.67	0.84	0.04	-0.25	0.42	0.20	0.83	0.44	**1.00**						
RUSSIA	0.40	0.76	0.75	0.86	0.72	0.89	-0.30	0.13	0.46	0.97	0.59	0.79	**1.00**					
SOUTH_AFRICA	0.67	0.79	0.91	0.81	0.52	0.83	0.19	0.44	0.20	0.61	0.85	0.44	0.69	**1.00**				
SOUTH_KOREA	-0.06	-0.26	-0.15	-0.36	-0.38	-0.30	0.46	0.16	-0.54	-0.67	0.05	-0.60	-0.61	-0.09	**1.00**			
TAIWAN	0.51	0.74	0.91	0.68	-0.23	0.62	0.59	#N/A	0.00	0.12	0.91	-0.49	0.76	0.85	0.81	**1.00**		
THAILAND	0.08	0.43	0.64	0.50	0.31	-0.54	0.85	#N/A	-0.17	0.24	0.89	-0.25	0.29	0.51	0.81	0.78	**1.00**	
TURKEY	0.46	0.78	0.84	0.76	-0.69	0.12	-0.48	#N/A	0.78	0.67	0.27	-0.18	0.43	-0.16	-0.78	-0.46	-0.45	**1.00**

Table 3: Correlation matrix between FX rates of emerging countries with respect to GBP for the period from 12/30/1997 to 01/01/2003.

	ARG	BRA	CHI	COL	HUN	INDI	INDO	MAL	MEX	PER	PHI	POL	RUS	S_A	S_K	TAI	THA	TURK
ARGENTINA	**1.00**																	
BRAZIL	0.69	**1.00**																
CHILE	0.65	0.95	**1.00**															
COLOMBIE	0.75	0.97	0.95	**1.00**														
HUNGARY	-0.84	-0.65	-0.57	-0.70	**1.00**													
INDIA	0.88	0.86	0.88	0.91	-0.78	**1.00**												
INDONESIA	-0.37	-0.06	-0.04	-0.08	0.36	-0.20	**1.00**											
MALAYSIA	0.78	0.92	0.93	0.96	-0.73	0.97	-0.16	**1.00**										
MEXICO	0.80	0.95	0.93	0.97	-0.75	0.95	-0.17	0.98	**1.00**									
PERU	0.77	0.94	0.95	0.97	-0.68	0.94	-0.15	0.98	0.97	**1.00**								
PHILIPPINES	0.62	0.95	0.91	0.96	-0.65	0.84	0.03	0.93	0.93	0.93	**1.00**							
POLAND	0.59	0.78	0.84	0.80	-0.35	0.74	-0.22	0.80	0.78	0.86	0.74	**1.00**						
RUSSIA	0.96	0.63	0.59	0.70	-0.85	0.84	-0.26	0.72	0.73	0.69	0.57	0.46	**1.00**					
SOUTH_AFRICA	0.47	0.13	0.20	0.23	-0.35	0.40	0.08	0.24	0.20	0.23	0.10	0.06	0.64	**1.00**				
SOUTH_KOREA	0.12	0.41	0.39	0.37	-0.05	0.30	0.24	0.34	0.31	0.33	0.41	0.21	0.19	0.23	**1.00**			
TAIWAN	0.72	0.94	0.90	0.96	-0.70	0.90	-0.06	0.94	0.94	0.94	0.95	0.72	0.70	0.26	0.56	**1.00**		
THAILAND	0.36	0.88	0.84	0.85	-0.41	0.65	0.11	0.79	0.80	0.81	0.92	0.66	0.30	-0.12	0.57	0.87	**1.00**	
TURKEY	0.63	0.87	0.95	0.89	-0.55	0.88	-0.08	0.92	0.91	0.91	0.85	0.80	0.55	0.19	0.23	0.82	0.73	**1.00**

Table 4: Correlation matrix between FX rates of emerging countries with respect to JPY for the period from 12/30/1997 to 01/01/2003.

	ARG	BRA	CHI	COL	HUN	INDI	INDO	MAL	MEX	PER	PHI	POL	RUS	S_A	S_K	TAI	THA	TURK
ARGENTINA	**1.00**																	
BRAZIL	0.04	**1.00**																
CHILE	0.57	0.05	**1.00**															
COLOMBIE	0.52	0.05	0.95	**1.00**														
HUNGARY	-0.07	0.02	0.64	0.74	**1.00**													
INDIA	0.38	0.54	0.63	0.71	0.02	**1.00**												
INDONESIA	-0.16	-0.05	0.04	0.06	0.15	-0.12	**1.00**											
MALAYSIA	-0.16	0.02	0.30	0.41	0.67	0.88	-0.12	**1.00**										
MEXICO	0.09	0.03	0.47	0.58	0.64	0.87	-0.22	0.83	**1.00**									
PERU	0.12	0.04	0.70	0.79	0.87	0.84	-0.10	0.81	0.89	**1.00**								
PHILIPPINES	0.52	0.01	0.73	0.66	0.32	-0.02	0.39	-0.25	-0.10	0.15	**1.00**							
POLAND	0.17	0.03	0.75	0.80	0.90	0.04	0.08	0.53	0.55	0.81	0.44	**1.00**						
RUSSIA	0.44	0.06	0.88	0.89	0.71	0.15	-0.05	0.31	0.54	0.77	0.59	0.79	**1.00**					
SOUTH_AFRICA	0.64	0.04	0.87	0.80	0.47	-0.03	0.10	-0.01	0.19	0.44	0.82	0.64	0.84	**1.00**				
SOUTH_KOREA	-0.29	-0.02	-0.10	-0.10	0.07	0.19	-0.02	0.35	0.08	0.05	-0.16	-0.09	-0.24	-0.29	**1.00**			
TAIWAN	-0.10	0.13	0.29	0.51	0.51	0.81	-0.03	0.77	0.80	0.80	-0.32	0.52	-0.39	-0.37	0.38	**1.00**		
THAILAND	-0.48	-0.16	0.03	0.30	0.78	0.48	0.55	0.60	0.54	0.65	-0.12	0.59	-0.68	-0.54	0.63	0.70	**1.00**	
TURKEY	0.46	0.82	0.95	0.86	-0.15	0.90	-0.05	0.86	0.91	0.90	0.26	-0.10	0.32	0.01	0.11	0.81	0.56	**1.00**

Table 5: the correlation matrix of the FX rates: JPY/USD, JPY/GBP and GBP/USD.

	JPY/GBP	JPY/USD	GBP/USD
JPY/GBP	1		
JPY/USD	0.89166	1	
GBP/USD	0.44415	- 0.00804	1

Table 6: Contemporaneous relationship between stock outputs of sector i and the variation of the FX rate with respect to the USD. The table shows the values of the coefficient (first raw) and its P-value (second raw). P-values and t-statistics are adjusted with Newey-West procedure which is robust for serial correlation and heteroscedasticity.

	Country	FTSE W	BANKS	BEVERAGES	CON.& BLDG.MAT	CYCLICAL SVS	FINANCIALS	FOOD PRODUCERS	NON-CYC.CN. GDS	OIL& GAS	RESOUR-CES	TELECOM. SVS
1	**Argentina**	**0.093**	**1.064**	**-0.689**	**1.015**	#N/A	**0.719**	**0.283**	#N/A	**0.797**	**0.797**	**2.052**
		0.112	0.000	0.000	0.717	#N/A	0.000	0.002	#N/A	0.000	0.000	0.000
2	**Brazil**	**0.868**	**0.453**	**0.399**	**0.815**	**2.800**	**0.453**	#N/A	**0.394**	**0.845**	**0.766**	**1.577**
		0.137	0.003	0.130	0.000	0.000	0.000	#N/A	0.137	0.055	0.107	0.136
3	**Chile**	**0.274**	**-0.935**	**0.199**	**0.159**	**-0.301**	**-0.842**	**3.121**	**0.165**	**0.366**	**0.366**	**0.920**
		0.228	0.004	0.650	0.221	0.405	0.002	0.033	0.629	0.457	0.457	0.114
4	**Colombia**	**0.566**	**0.901**	**0.379**	**0.931**	**0.331**	**0.489**	**1.119**	#N/A	#N/A	#N/A	#N/A
		0.121	0.173	0.307	0.044	0.150	0.224	0.034	#N/A	#N/A	#N/A	#N/A
5	**Hungary**	**-2.839**	**-3.944**	#N/A	**-14.927**	**-13.128**	**-3.944**	**3.280**	**-6.125**	**-2.836**	**-2.836**	**2.841**
		0.042	0.008	#N/A	0.000	0.361	0.008	0.657	0.001	0.001	0.051	0.009
6	**India**	**127.244**	**145.970**	#N/A	**152.671**	**468.894**	**74.043**	**40.117**	**67.569**	**152.610**	**152.610**	**113.535**
		0.000	0.020	#N/A	0.001	0.059	0.001	0.008	0.023	0.002	0.002	0.014
7	**Indonesia**	**0.309**	**0.257**	#N/A	**0.278**	**0.522**	**0.167**	**0.932**	**0.708**	**2.437**	**0.045**	**0.487**
		0.000	0.012	#N/A	0.000	0.000	0.001	0.000	0.000	0.000	0.975	0.000
8	**Malaysia**	**1.906**	**4.744**	**1.120**	**3.469**	**1.925**	**3.896**	**0.387**	**0.415**	**0.005**	**0.208**	**3.804**
		0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.434	0.004	0.000
9	**Mexico**	**0.255**	**0.802**	**1.595**	**0.890**	**0.228**	**-0.001**	**0.343**	**0.674**	#N/A	**1.741**	**0.093**
		0.000	0.001	0.000	0.000	0.000	0.787	0.000	0.000	#N/A	0.004	0.004
10	**Peru**	**11.450**	**14.581**	**7.974**	**5.452**	**6.504**	**5.757**	**24.626**	**8.542**	#N/A	**6.726**	**18.582**
		0.000	0.004	0.000	0.000	0.023	0.002	0.001	0.000	#N/A	0.007	0.002
11	**Philippines**	**0.945**	**1.138**	**0.887**	**15.337**	**2.062**	#N/A	**3.954**	#N/A	**1.788**	**1.788**	**0.638**
		0.003	0.002	0.244	0.091	0.115	#N/A	0.027	#N/A	0.000	0.000	0.105
12	**Poland**	**1.786**	**1.245**	**2.183**	**1.896**	**1.678**	**1.555**	**6.057**	**2.114**	**-0.150**	**-0.150**	**1.052**
		0.037	0.117	0.159	0.048	0.112	0.094	0.100	0.065	0.314	0.314	0.093
13	**Russia**	**0.148**	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	**0.186**	**0.136**	**0.239**
		0.002	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.000	0.001	0.000
14	**South Africa**	**0.058**	**0.358**	**0.688**	#N/A	**0.221**	**0.175**	**0.233**	**0.220**	**0.613**	**0.144**	**-0.408**
		0.176	0.116	0.157	#N/A	0.195	0.221	0.114	0.099	0.001	0.044	0.047
15	**South Korea**	**5.131**	**0.488**	#N/A	**0.332**	**1.425**	**0.322**	#N/A	**0.608**	**0.540**	**0.540**	#N/A
		0.000	0.022	#N/A	0.313	0.000	0.021	#N/A	0.005	0.067	0.067	#N/A
16	**Taiwan**	**15.809**	**9.162**	#N/A	#N/A	**-1.480**	**9.077**	**5.341**	**5.341**	#N/A	#N/A	#N/A
		0.036	0.137	#N/A	#N/A	0.827	0.080	0.229	0.229	#N/A	#N/A	#N/A
17	**Thailand**	**7.519**	**7.396**	#N/A	**14.538**	**8.648**	**6.551**	#N/A	**8.591**	**14.593**	**14.029**	**5.473**
		0.000	0.002	#N/A	0.000	0.002	0.002	#N/A	0.004	0.000	0.000	0.002
18	**Turkey**	**0.741**	**1.136**	**0.688**	**1.067**	**0.268**	**1.103**	#N/A	#N/A	**0.541**	**0.541**	**0.212**
		0.000	0.000	0.001	0.000	0.000	0.000	#N/A	#N/A	0.001	0.001	#N/A

Table 7: Contemporaneous relationship between stock outputs of sector i and the variation of the FX rate with respect to the GBP. The table shows the values of the coefficient (first raw) and its P-value (second raw) P-values and t-statistics are adjusted with Newey-West procedure which is robust for serial correlation and heteroscedasticity.

Country	FTSE W	BANKS	BEVERAGES	CON.& BLDG.MAT	CYCLICAL SVS	FINANCIALS	FOOD PRODUCERS	NON-CYC.CN. GDS	OIL& GAS	RESOUR-CES	TELECOM. SVS
1 **Argentina**	**0.260**	**1.192**	**-0.403**	**5.610**	#N/A	**0.741**	**0.737**	#N/A	**0.930**	**0.930**	**1.279**
	0.000	0.000	0.000	0.271	#N/A	0.000	0.000	#N/A	0.000	0.000	0.004
2 **Brazil**	**1.150**	**0.632**	**0.545**	**1.193**	**4.020**	**0.632**	#N/A	**0.535**	**1.231**	**1.039**	**2.105**
	0.093	0.000	0.099	0.000	0.000	0.000	#N/A	0.108	0.014	0.062	0.088
3 **Chile**	**1.355**	**-1.503**	**2.162**	**0.481**	**-0.030**	**-1.309**	**5.271**	**2.049**	**2.104**	**2.104**	**3.024**
	0.086	0.000	0.086	0.004	0.841	0.000	0.001	0.087	0.075	0.075	0.005
4 **Colombia**	**0.983**	**1.458**	**1.153**	**1.305**	**0.358**	**0.763**	**2.418**	#N/A	#N/A	#N/A	#N/A
	0.098	0.141	0.122	0.177	0.280	0.198	0.017	#N/A	#N/A	#N/A	#N/A
5 **Hungary**	**3.888**	**3.394**	#N/A	**2.299**	**-24.014**	**3.394**	**3.547**	**1.262**	**3.413**	**3.413**	**4.625**
	0.099	0.303	#N/A	0.731	0.181	0.303	0.764	0.713	0.001	0.115	0.012
6 **India**	**3.175**	**27.483**	#N/A	**18.015**	**0.307**	**6.953**	**5.998**	**3.016**	**2.689**	**2.689**	**7.116**
	0.562	0.031	#N/A	0.287	0.996	0.203	0.319	0.625	0.759	0.759	0.368
7 **Indonesia**	**0.308**	**0.254**	#N/A	**0.276**	**0.525**	**0.162**	**0.945**	**0.717**	**2.219**	**0.745**	**0.484**
	0.000	0.013	#N/A	0.000	0.000	0.000	0.000	0.000	0.000	0.633	0.000
8 **Malaysia**	**1.906**	**4.744**	**1.120**	**3.469**	**1.925**	**3.896**	**0.387**	**0.415**	**0.005**	**0.208**	**3.804**
	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.434	0.004	0.000
9 **Mexico**	**0.299**	**0.907**	**1.819**	**0.995**	**0.271**	**-0.001**	**0.386**	**0.751**	#N/A	**1.474**	**0.117**
	0.000	0.001	0.000	0.000	0.000	0.790	0.000	0.000	#N/A	0.002	0.005
10 **Peru**	**14.518**	**17.886**	**8.525**	**3.834**	**4.660**	**12.322**	**18.185**	**7.341**	#N/A	**6.942**	**31.773**
	0.000	0.001	0.000	0.000	0.114	0.000	0.008	0.000	#N/A	0.000	0.000
11 **Philippines**	**1.197**	**1.514**	**1.438**	**16.837**	**2.898**	#N/A	**4.314**	#N/A	**2.255**	**2.255**	**0.654**
	0.000	0.000	0.136	0.108	0.035	#N/A	0.001	#N/A	0.000	0.000	0.050
12 **Poland**	**2.257**	**1.551**	**2.702**	**2.064**	**2.017**	**2.024**	**7.154**	**2.592**	**0.034**	**0.034**	**1.296**
	0.014	0.083	0.117	0.039	0.091	0.048	0.062	0.041	0.822	0.822	0.094
13 **Russia**	**0.213**	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	**0.254**	**0.222**	**0.217**
	0.001	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.000	0.005	0.001
14 **South Africa**	**0.072**	**0.436**	**0.806**	#N/A	**0.245**	**0.222**	**0.273**	**0.257**	**0.736**	**0.164**	**-0.401**
	0.170	0.124	0.164	#N/A	0.213	0.220	0.120	0.106	0.002	0.040	0.052
15 **South Korea**	**6.282**	**0.631**	#N/A	**0.235**	**1.617**	**0.451**	#N/A	**0.615**	**0.697**	**0.697**	#N/A
	0.000	0.018	#N/A	0.620	0.000	0.013	#N/A	0.001	0.042	0.042	#N/A
16 **Taiwan**	**1.900**	**0.524**	#N/A	#N/A	**4.215**	**0.923**	**5.668**	**5.668**	#N/A	#N/A	#N/A
	0.313	0.768	#N/A	#N/A	0.088	0.462	0.000	0.000	#N/A	#N/A	#N/A
17 **Thailand**	**5.643**	**5.133**	#N/A	**10.522**	**8.757**	**4.767**	#N/A	**5.482**	**19.376**	**18.504**	**3.761**
	0.000	0.013	#N/A	0.000	0.000	0.011	#N/A	0.000	0.000	0.000	0.003
18 **Turkey**	**0.980**	**1.560**	**1.094**	**1.436**	**0.314**	**1.494**	#N/A	#N/A	**0.644**	**0.644**	**0.351**
	0.000	0.000	0.001	0.000	0.009	0.000	#N/A	#N/A	0.017	0.017	0.014

Table 8: Contemporaneous relationship between stock output of sector i and the variation of the FX rate with respect to the JPY. The table shows the values of the coefficient (first raw) and its P-value (second raw). P-values and t-statistics are adjusted with Newey-West procedure which is robust for serial correlation and heteroscedasticity.

Country	FTSE W	BANKS	BEVERAGES	CON.& BLDG.MAT	CYCLICAL SVS	FINANCIALS	FOOD PRODUCERS	NON-CYC.CN.GDS	OIL& GAS	RESOUR-CES	TELECOM. SVS
1 **Argentina**	**0.57135**	**2.55491**	**-0.98891**	**7.25474**	#N/A	**1.59353**	**1.55589**	#N/A	**1.97663**	**1.97663**	**2.67721**
	0.00000	0.00000	0.00000	0.00770	#N/A	0.00000	0.00000	#N/A	0.00000	0.00000	0.00340
2 **Brazil**	**-0.00004**	**-0.00004**	**0.00000**	**-0.00376**	**-0.00011**	**-0.00004**	#N/A	**0.00000**	**-0.00006**	**-0.00003**	**-0.00007**
	0.00000	0.00000	0.98670	0.00360	0.00000	0.44850	#N/A	0.81280	0.00000	0.00000	0.00000
3 **Chile**	**1.34727**	**0.11072**	**3.08638**	**0.48349**	**-0.05246**	**0.20974**	**5.24296**	**2.44012**	**2.02891**	**2.02891**	**4.51465**
	0.00000	0.63460	0.00000	0.00810	0.89030	0.29060	0.00000	0.00000	0.00000	0.00000	0.00000
4 **Colombia**	**1.22651**	**0.71765**	**1.66196**	**3.15083**	**0.56137**	**0.39408**	**2.31980**	#N/A	#N/A	#N/A	#N/A
	0.00870	0.11650	0.00940	0.00000	0.03320	0.14530	0.00010	#N/A	#N/A	#N/A	#N/A
5 **Hungary**	**-2.83946**	**-3.94377**	#N/A	**-14.92749**	**-13.12808**	**-3.94377**	**3.28013**	**-6.12479**	**-2.83596**	**-2.83596**	**2.84070**
	0.04190	0.00830	#N/A	0.00000	0.36060	0.00830	0.65650	0.00090	0.00060	0.05090	0.00870
6 **India**	**0.31113**	**2.62486**	#N/A	**5.83207**	**28.77427**	**2.22470**	**2.60528**	**1.30385**	**-3.77326**	**-3.77326**	**1.68448**
	0.83250	0.39520	#N/A	0.14320	0.00760	0.07050	0.06020	0.40010	0.05470	0.05470	0.41870
7 **Indonesia**	**0.34908**	**0.29614**	#N/A	**0.31483**	**0.58849**	**0.18746**	**1.04647**	**0.79954**	**2.08160**	**-0.13842**	**0.54841**
	0.00000	0.00970	#N/A	0.00000	0.00000	0.00060	0.00000	0.00000	0.00000	0.92820	0.00000
8 **Malaysia**	**1.73407**	**3.72783**	**1.06228**	**2.64295**	**1.49369**	**3.04807**	**0.56366**	**0.57672**	**0.00136**	**0.05521**	**2.43925**
	0.00000	0.00000	0.01260	0.00000	0.00000	0.00000	0.00620	0.01290	0.67740	0.82120	0.00000
9 **Mexico**	**0.36965**	**1.35242**	**1.84936**	**1.33500**	**0.36833**	**0.00125**	**0.55345**	**0.83207**	#N/A	**0.32535**	**0.14530**
	0.00000	0.00000	0.00000	0.00000	0.00000	0.88100	0.00000	0.00000	#N/A	0.08720	0.01910
10 **Peru**	**2.23880**	**5.70446**	**1.45645**	**0.96318**	**1.96546**	**3.22386**	**5.97542**	**1.34207**	#N/A	**1.94552**	**31.77290**
	0.00000	0.00000	0.00000	0.00020	0.00010	0.00000	0.00420	0.00690	#N/A	0.00000	0.00000
11 **Philippines**	0.94469	1.13787	0.88733	15.33699	2.06186	#N/A	3.95418	#N/A	1.78779	1.78779	0.63850
	0.00290	0.00180	0.24380	0.09140	0.11530	#N/A	0.02710	#N/A	0.00020	0.00020	0.10500
12 **Poland**	**1.31147**	**1.25841**	**1.80899**	**1.40062**	**0.46773**	**1.39518**	**5.77346**	**1.43891**	**0.16243**	**0.16243**	**1.48823**
	0.00000	0.00010	0.00360	0.00000	0.31880	0.00000	0.00030	0.00090	0.30010	0.30010	0.01080
13 **Russia**	**0.54973**	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	**0.62257**	**0.49559**	**0.41755**
	0.00030	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00000	0.00110	0.00050
14 **South Africa**	**0.17209**	**0.94886**	**1.62772**	#N/A	**0.52080**	**0.57142**	**0.55732**	**0.47631**	**1.47656**	**0.21582**	**-0.35109**
	0.10050	0.09100	0.10520	#N/A	0.13000	0.12810	0.08600	0.07750	0.01620	0.01840	0.07130
15 **South Korea**	**2.17070**	**0.07040**	#N/A	**0.05811**	**0.41467**	**0.03255**	#N/A	**0.44178**	**0.20848**	**0.20848**	#N/A
	0.00000	0.42450	#N/A	0.62180	0.02080	0.61930	#N/A	0.02830	0.10200	0.10200	#N/A
16 **Taiwan**	**-1.06732**	**-1.92808**	#N/A	#N/A	**3.58514**	**-1.01694**	**4.12543**	**4.12543**	#N/A	#N/A	#N/A
	0.00000	0.00000	#N/A	#N/A	0.00030	0.00000	0.00000	0.00000	#N/A	#N/A	#N/A
17 **Thailand**	**9.64731**	**12.01782**	#N/A	**18.91330**	**19.80147**	**11.16686**	#N/A	**28.23778**	**29.22973**	**28.52081**	**6.25358**
	0.00020	0.00790	#N/A	0.00000	0.00000	0.01160	#N/A	0.00000	0.00000	0.00000	0.06320
18 **Turkey**	**0.64406**	**1.12153**	**0.79082**	**1.19916**	**0.22955**	**1.06032**	#N/A	#N/A	**0.45436**	**0.45436**	**0.21576**
	0.00100	0.00020	0.00170	0.00000	0.02260	0.00010	#N/A	#N/A	0.05600	0.05600	0.08800

Table 9: We classify the results by sector indexes and also by the currency used (USD, GBP and JPY). We can notice by this table the differences in the significance level between the sectors with respect to different currencies. **nj**: number of the countries where the index is significant. Nj is the number of the indexes available for the country.

	US $			GB £			JP ¥			
Sectors:	n_j	N_j	$\frac{n_j}{N_j}$	n_j	N_j	$\frac{n_j}{N_j}$	n_j	N_j	$\frac{n_j}{N_j}$	**Total:**
FTSE W	13	18	72%	11	18	61%	15	18	83%	72%
BANKS	13	17	76%	12	17	71%	12	17	71%	73%
BEVERAGES	5	11	45%	5	11	45%	8	11	73%	55%
CON.& BLDG.MAT	11	15	73%	9	15	60%	12	15	80%	71%
CYCLICAL SVS	8	16	50%	8	16	50%	11	16	69%	56%
FINANCIALS	11	16	69%	10	16	63%	9	16	56%	63%
FOOD PRODUCERS	9	13	69%	9	13	69%	10	13	77%	72%
NON-CYC.CN.GDS	8	13	62%	8	13	62%	10	13	77%	67%
OIL& GAS	9	14	64%	10	14	71%	8	14	57%	64%
RESOURCES	10	16	63%	10	16	63%	8	16	50%	58%
TELECOM. SVS	11	15	73%	11	15	73%	10	15	67%	71%
Total:	**108**	**164**	**66%**	**103**	**164**	**63%**	**113**	**164**	**69%**	**66%**

Table 10: We classify the results by regions and also by the currency used (USD, GBP and JPY). We can notice in this table the differences in the significance level between continents. $\mathbf{n_i}$: number of the sectors which are significant. **Nj** is the number of the sector indexes available for the country.

		US $			GB £			JP ¥			
	Country	n_i	N_i	$\frac{n_i}{N_i}$	n_i	N_i	$\frac{n_i}{N_i}$	n_i	N_i	$\frac{n_i}{N_i}$	**Total:**
	1 Argentina	7	9	78%	8	9	89%	9	9	100%	89%
	2 Brazil	4	10	40%	5	10	50%	7	10	70%	53%
Latin	3 Chile	3	11	27%	5	11	45%	8	11	73%	48%
America	5 Colombia	2	7	29%	1	7	14%	5	7	71%	38%
	10 Mexico	9	10	90%	9	10	90%	8	10	80%	87%
	11 Peru	10	10	100%	9	10	90%	10	10	100%	97%
	Total:	35	57	**61%**	37	57	**65%**	47	57	**82%**	**70%**
	7 India	9	10	90%	1	10	10%	1	10	10%	37%
Asia	8 Indonesia	9	10	90%	9	10	90%	9	10	90%	90%
	9 Malaysia	10	11	91%	10	11	91%	9	11	82%	88%
	13 Philippines	5	9	56%	7	9	78%	5	9	56%	63%
	17 South Korea	5	8	63%	7	8	88%	3	8	38%	63%
	18 Taiwan	1	6	17%	2	6	33%	6	6	100%	50%
	19 Thailand	9	9	100%	9	9	100%	8	9	89%	96%
	Total:	48	63	**76%**	45	63	**71%**	41	63	**65%**	**71%**
	20 Hungary	7	10	70%	2	10	20%	5	10	50%	47%
Europe	14 Poland	2	11	18%	4	11	36%	8	11	73%	42%
	15 Russia	4	4	100%	4	4	100%	4	4	100%	100%
	20 Turkey	9	9	100%	9	9	100%	6	9	67%	89%
	Total:	22	34	**65%**	19	34	**56%**	23	34	**68%**	**63%**
Africa	21 South Africa	3	10	30%	2	10	20%	2	10	20%	23%
	Total:	3	10	**30%**	2	10	**20%**	2	10	**20%**	**23%**
	Overall:	**108**	**164**	**66%**	**103**	**164**	**63%**	**113**	**164**	**69%**	**66%**

Table 11: We classify the results by sector indexes and also by the currency used, USD, GBP and JPY. **nj**: number of the countries where the index is significant.

	US $			GB £			JP ¥		
Sectors:	n_j	$\sum_j^{20} \beta_{i,j1}^2$	$\frac{1}{n_j}\sum_j^{20}\beta_{i,j1}^2$	n_j	$\sum_j^{20} \beta_{i,j1}^2$	$\frac{1}{n_j}\sum_j^{20}\beta_{i,j1}^2$	n_j	$\sum_j^{20} \beta_{i,j1}^2$	$\frac{1}{n_j}\sum_j^{20}\beta_{i,j1}^2$
FTSE W	13	16671.46	1282.42	11	293.48	26.68	15	114.17	7.61
BANKS	13	21618.22	1662.94	12	1134.15	94.51	12	228.41	19.03
BEVERAGES	5	68.32	13.66	5	78.60	15.72	8	23.83	2.98
CON.& BLDG.MAT	11	23791.38	2162.85	9	146.48	16.28	12	529.09	44.09
CYCLICAL SVS	8	131.07	16.38	8	108.01	13.50	11	1240.03	112.73
FINANCIALS	11	5591.99	508.36	10	198.94	19.89	9	172.31	19.15
FOOD PRODUCERS	9	2243.68	249.30	9	416.80	46.31	10	138.70	13.87
NON-CYC.CN.GDS	8	4751.37	593.92	8	124.42	15.55	10	881.88	88.19
OIL& GAS	9	23521.18	2613.46	10	400.99	40.10	8	872.50	109.06
RESOURCES	10	23539.00	2353.90	10	399.71	39.97	8	828.73	103.59
TELECOM. SVS	11	13292.78	1208.43	11	1071.15	97.38	10	1047.51	104.75
Total:	**108**	**135220.44**	**1252.04**	**103**	**4372.75**	**42.45**	**113**	**6077.17**	**53.78**

Table 12: We classify the results by regions and also by the currency used (USD, GBP and JPY). We can notice in this table the differences in the risk measure between different countries. **ni**: number of the sectors where the index is significant.

			US $			GB £			JP ¥		
		Country	n_i	$\sum_i^{11} \beta_{i,j1}^2$	$\frac{1}{n_i}\sum_i^{11}\beta_{i,j1}^2$	n_i	$\sum_i^{11} \beta_{i,j1}^2$	$\frac{1}{n_i}\sum_i^{11}\beta_{i,j1}^2$	n_i	$\sum_i^{11} \beta_{i,j1}^2$	$\frac{1}{n_i}\sum_i^{11}\beta_{i,j1}^2$
	1	Argentina	7	7.69	1.10	8	6.11	0.76	9	80.40	8.93
	2	Brazil	4	8.91	2.23	5	19.90	3.98	7	0.00	0.00
Latin	3	Chile	3	11.32	3.77	5	41.14	8.23	8	73.63	9.20
America	5	Colombia	2	2.12	1.06	1	5.85	5.85	5	19.89	3.98
	10	Mexico	9	7.71	0.86	9	8.18	0.91	8	8.32	1.04
	11	Peru	10	1582.40	158.24	9	2212.16	245.80	10	1105.67	110.57
	Total:		**35**	**1620.15**	**167.26**	**37**	**2293.33**	**61.98**	**47**	**1287.92**	**27.40**
	7	India	9	131933.58	14659.29	1	755.31	755.31	1	827.96	827.96
	8	Indonesia	9	8.08	0.90	9	7.10	0.79	9	7.06	0.78
	9	Malaysia	10	73.15	7.32	10	73.15	7.32	9	43.14	4.79
Asia	13	Philippines	5	24.22	4.84	7	41.34	5.91	5	24.22	4.84
	17	S.Korea	5	29.07	5.81	7	44.02	6.29	3	5.08	1.69
	18	Taiwan	1	249.92	249.92	2	64.26	32.13	6	52.78	8.80
	19	Thailand	9	953.79	105.98	9	1030.33	114.48	8	3577.19	447.15
	Total:		**48**	**133271.81**	**2776.50**	**45**	**2015.51**	**44.79**	**41**	**4537.43**	**110.67**
	20	Hungary	7	315.62	45.09	2	33.04	16.52	5	195.48	39.10
Europe	14	Poland	2	6.78	3.39	4	20.17	5.04	8	48.10	6.01
	15	Russia	4	0.13	0.03	4	0.21	0.05	4	1.11	0.28
	20	Turkey	9	5.37	0.60	9	9.93	1.10	6	4.91	0.82
	Total:		**22**	**327.91**	**14.91**	**19**	**63.34**	**3.33**	**23**	**249.60**	**10.85**
Africa	21	S.Africa	3	0.56	0.19	2	0.57	0.28	2	2.23	1.11
	Total:		**3**	**0.56**	**0.19**	**2**	**0.57**	**0.28**	**2**	**2.23**	**1.11**
	Overall:		**108**	**135220.44**	**1252.04**	**103**	**4372.75**	**42.45**	**113**	**6077.17**	**53.78**

Table 13: We rank the results by country and by sectors (for USD, GBP and JPY). Using the risk measure, we can notice in this table that sectors are in general more risky than countries. This fact is mainly due to India, Taiwan, Peru and Thailand. These countries will inflate the risk by sectors. For an investor who wants to reduce its FX risk, he should concentrate his investments by country. These measures do not take account of the adverse movements in FX rates. An investor could also reduce his FX risk by a well diversified portfolio. **ni**: number of the sectors where the index is significant.

	US $			GB £			JP ¥		
Country	$\frac{1}{n_i}\sum_{i}^{11}\beta_{i,j1}^2$	**Sectors:**	$\frac{1}{n_j}\sum_{j}^{20}\beta_{i,j1}^2$	**Country**	$\frac{1}{n_i}\sum_{i}^{11}\beta_{i,j1}^2$	**Sectors:**	$\frac{1}{n_i}\sum_{i}^{11}\beta_{i,j1}^2$	**Country**	$\frac{1}{n_j}\sum_{j}^{20}\beta_{i,j1}^2$	**Sectors:**	$\frac{1}{n_j}\sum_{j}^{20}\beta_{i,j1}^2$
India	14659.29	OIL& GAS	2613.46	India	755.31	TELECOM. SVS	97.38	India	827.96	TELECOM. SVS	104.75
Taiwan	249.92	RESOURCES	2353.90	Peru	245.80	BANKS	94.51	Thailand	447.15	RESOURCES	103.59
Peru	158.24	CON.& BLDG.MAT	2162.85	Thailand	114.48	FOOD PRODUCERS	46.31	Peru	110.57	OIL& GAS	109.06
Thailand	105.98	BANKS	1662.94	Taiwan	32.13	OIL& GAS	40.10	Hungary	39.10	FTSE W	7.61
Hungary	45.09	FTSE W	1282.42	Hungary	16.52	RESOURCES	39.97	Chile	9.20	FOOD PRODUCERS	13.87
Malaysia	7.32	TELECOM. SVS	1208.43	Chile	8.23	FTSE W	26.68	Argentina	8.93	FINANCIALS	19.15
S.Korea	5.81	NON-CYC.CN.GDS	593.92	Malaysia	7.32	FINANCIALS	19.89	Taiwan	8.80	CYCLICAL SVS	112.73
Philippines	4.84	FINANCIALS	508.36	S.Korea	6.29	CON.& BLDG.MAT	16.28	Poland	6.01	CON.& BLDG.MAT	44.09
Chile	3.77	FOOD PRODUCERS	249.30	Philippines	5.91	BEVERAGES	15.72	Philippines	4.84	BEVERAGES	2.98
Poland	3.39	CYCLICAL SVS	16.38	Colombia	5.85	NON-CYC.CN.GDS	15.55	Malaysia	4.79	BANKS	19.03
Brazil	2.23	BEVERAGES	13.66	Poland	5.04	CYCLICAL SVS	13.50	Colombia	3.98	NON-CYC.CN.GDS	88.19
Argentina	1.10			Brazil	3.98			S.Korea	1.69		
Colombia	1.06			Turkey	1.10			S.Africa	1.11		
Indonesia	0.90			Mexico	0.91			Mexico	1.04		
Mexico	0.86			Indonesia	0.79			Turkey	0.82		
Turkey	0.60			Argentina	0.76			Indonesia	0.78		
S.Africa	0.19			S.Africa	0.28			Russia	0.28		
Russia	0.03			Russia	0.05			Brazil	0.00		

Table 14: We divide our results in two panels: panel A is the group of the countries which have a managed FX rates regime and the panel B is the group of the countries which have an independently float FX regime. We do this for each currency used USD, GBP and JPY. We can notice in this table the differences in the significance level between different countries belonging to panel A and panel B. ni: number of the sectors which are significant. Nj is the number of the sector indexes available for the country.

Panel A:

		US $			GB £			JP ¥			
	Country	n_i	N_i	$\frac{n_i}{N_i}$	n_i	N_i	$\frac{n_i}{N_i}$	n_i	N_i	$\frac{n_i}{N_i}$	**Total:**
1	Argentina	7	9	78%	8	9	89%	9	9	100%	89%
7	India	9	10	90%	1	10	10%	1	10	10%	37%
8	Indonesia	9	10	90%	9	10	90%	9	10	90%	90%
9	Malaysia	10	11	91%	10	11	91%	9	11	82%	88%
18	Taiwan	1	6	11%	2	6	22%	6	6	67%	33%
19	Thailand	9	9	100%	9	9	100%	8	9	89%	96%
20	Hungary	7	10	70%	2	10	20%	5	10	50%	47%
15	Russia	4	4	100%	4	4	100%	4	4	100%	100%
	Overall:	**56**	**69**	**81%**	**45**	**69**	**65%**	**51**	**69**	**74%**	**73%**

Panel B:

2	Brazil	4	10	40%	5	10	50%	7	10	70%	53%
3	Chile	3	11	27%	5	11	45%	8	11	73%	48%
5	Colombia	2	7	29%	1	7	14%	5	7	71%	38%
10	Mexico	9	10	90%	9	10	90%	8	10	80%	87%
11	Peru	10	10	100%	9	10	90%	10	10	100%	97%
13	Philippines	5	9	56%	7	9	78%	5	9	56%	63%
17	South Korea	5	8	63%	7	8	88%	3	8	38%	63%
14	Poland	2	11	18%	4	11	36%	8	11	73%	42%
20	Turkey	9	9	90%	9	9	90%	6	9	60%	80%
21	South Africa	3	10	27%	2	10	18%	2	10	18%	21%
	Overall:	**52**	**95**	**55%**	**58**	**95**	**61%**	**62**	**95**	**65%**	**60%**

Table15: We divide our results in two panels: panel A is the group of the countries which have a managed FX rates regime and the panel B is the group of the countries which have an independently float FX regime. We do this for each currency used USD, GBP and JPY. We can notice in this table the differences in the risk measure between different countries belonging to panel A and panel B. ni: number of the sectors which are significant. Nj is the number of the sector indexes available for the country.

Panel A:

		US $			GB £			JP ¥		
	Country	n_i	$\sum_i^{11} \beta_{i,j1}^2$	$\frac{1}{n_i}\sum_i^{11} \beta_{i,j1}^2$	n_i	$\sum_i^{11} \beta_{i,j1}^2$	$\frac{1}{n_i}\sum_i^{11} \beta_{i,j1}^2$	n_i	$\sum_i^{11} \beta_{i,j1}^2$	$\frac{1}{n_i}\sum_i^{11} \beta_{i,j1}^2$
1	Argentina	7	7.69	1.10	8	6.11	0.76	9	80.40	8.93
7	India	9	131933.58	14659.29	1	755.31	755.31	1	827.96	827.96
8	Indonesia	9	8.08	0.90	9	7.10	0.79	9	7.06	0.78
9	Malaysia	10	73.15	7.32	10	73.15	7.32	9	43.14	4.79
18	Taiwan	1	249.92	249.92	2	64.26	32.13	6	52.78	8.80
19	Thailand	9	953.79	105.98	9	1030.33	114.48	8	3577.19	447.15
20	Hungary	7	315.62	45.09	2	33.04	16.52	5	195.48	39.10
15	Russia	4	0.13	0.03	4	0.21	0.05	4	1.11	0.28
	Overall:	**56**	**133541.97**	**2384.68**	**45**	**1969.49**	**43.77**	**51**	**4785.12**	**93.83**
					Panel B:					
2	Brazil	4	8.91	2.23	5	19.90	3.98	7	0.00	0.00
3	Chile	3	11.32	3.77	5	41.14	8.23	8	73.63	9.20
5	Colombia	2	2.12	1.06	1	5.85	5.85	5	19.89	3.98
10	Mexico	9	7.71	0.86	9	8.18	0.91	8	8.32	1.04
11	Peru	10	1582.40	158.24	9	2212.16	245.80	10	1105.67	110.57
13	Philippines	5	24.22	4.84	7	41.34	5.91	5	24.22	4.84
17	South Korea	5	29.07	5.81	7	44.02	6.29	3	5.08	1.69
14	Poland	2	6.78	3.39	4	20.17	5.04	8	48.10	6.01
20	Turkey	9	5.37	0.60	9	9.93	1.10	6	4.91	0.82
21	South Africa	3	0.56	0.19	2	0.57	0.28	2	2.23	1.11
	Overall:	**52**	**1678.4674**	**32.28**	**58**	**2403.25**	**41.44**	**62**	**1292.05**	**20.84**

Table 16: In this table we provide the values of the data used for the cross-sectional regression. The dependent variables are COR USD: correlation between FX rates volatility with respect to USD and the sector index returns volatility, COR GBP: correlation between FX rates volatility with respect to GBP and the sector index returns volatility, COR JPY: correlation between FX rates volatility with respect to JPY and the sector index returns volatility. The independent variables are: Economic Dvpt: Economic development, Familiarity, Stock Mkt Dvpt: Stock Market development, and Capital Controls.

	Correlation between FX rates and stk mkt returns			Economic Dvpt		Familiarity			Stock Mkt Dvpt	Capital Controls								
Country	COR USD	COR GBP	COR JPY	GCI	BCR	DIS US	DIS GB	DIS JP	MKTC	SUMI	RTB	FOR	RFCME	ICMC	FTI	AESTS	DBOBMER	IRC
1 Argentina	0.073	0.218	0.232	3.56	64	2729	11141	18374	470.26	5.8	5.6	8.8	3.8	6.3	6.8	4.9	10.0	9.1
2 Brazil	0.320	0.309	-0.009	3.69	52	4362	9504	18547	395.36	5.9	5.5	8.0	4.6	6.3	6.7	5.2	9.2	5.8
3 Chile	0.044	0.197	0.375	4.91	29	6100	11684	17245	445.49	7.4	9.1	10.0	5.4	7.7	8.6	6.7	10.0	7.8
4 Colombia	0.142	0.136	0.305	3.84	57	7516	8510	14326	68.283	5.5	6.4	8.0	1.5	4.8	6.5	4.8	8.6	5.0
5 Hungary	-0.089	0.095	0.104	4.38	32	7753	1453	9055	269.55	7.4	7.6	9.6	8.5	9.0	8.4	8.2	10.0	8.0
6 India	0.530	0.027	0.024	4.04	31	8416	6717	5851	95.646	6.4	7.0	8.6	0.0	4.3	6.4	5.8	10.0	5.0
7 Indonesia	0.758	-0.093	0.756	3.53	59	8562	11722	5795	95.788	6.1	6.7	6.8	1.5	4.2	7.3	7.5	10.0	4.6
8 Malaysia	0.621	0.621	0.381	3.92	23	9019	10554	5330	159.97	6.5	7.3	8.4	0.8	4.6	7.6	10.0	10.0	3.7
9 Mexico	0.396	0.422	0.439	3.66	62	9129	8942	11312	1442.8	6.5	7.3	8.4	2.3	5.4	7.5	7.2	10.0	6.5
10 Peru	0.310	0.347	0.396	3.47	82	10518	10181	15499	182.67	6.9	7.1	8.2	8.5	8.3	7.4	3.4	10.0	8.3
11 Philippines	0.537	0.647	0.537	4	78	12003	10747	3004	81.87	6.6	5.7	6.4	0.8	3.6	7.3	9.0	10.0	7.5
12 Poland	0.254	0.330	0.254	3.53	46	12036	1448	8588	354	6.1	6.3	7.2	2.3	4.8	6.5	3.3	10.0	6.2
13 Russia	0.378	0.378	0.378	4.31	70				270.74	5.1	5.6	6.0	3.1	4.5	6.9	7.2	10.0	4.2
14 South Africa	0.094	0.101	0.198	5.07	30	13096	9033	13525	154.86	6.9	7.7	9.4	0.8	5.1	7.4	6.5	10.0	6.5
15 South Korea	0.810	0.830	0.957	4.9	24	13786	8867	1158	123.37	7.0	7.2	7.6	1.5	4.6	7.1	5.7	10.0	4.5
16 Taiwan	0.316	0.131	-0.093	5.58	15	13978	9789	2111	155.63	7.3	8.2	8.6		8.6	8.4	6.7	10.0	5.8
17 Thailand	0.510	0.484	0.458	4.5	37	14932	9542	4613	75.391	6.6	6.7	6.0	1.5	3.8	7.5	10.0	10.0	7.3
18 Turkey	0.464	0.464	0.318	3.68	51	15810	2836	8775	104.23	5.9	6.9	6.8	2.3	4.6	7.0	5.9	10.0	8.2

Table17: We give in this table the results of the regression for the correlation coefficient (as a dependent variable) with respect to some independent variables. We run a multiple regression, then for every variable we run a simple regression. We do this for each exchange rate: USD, GBP and JPY. The independent variables used are respectively: GCI: Growth Competitiveness index, BCR: Business Competitiveness rank; DIS: distance between the emerging country and United States, United Kingdom and Japan, MKTC: Market capitalization in 01/01/2003, SUMI: Summary index of the controls of capitals; RTB: Regulatory Trade Barriers; FOR: Foreign ownership restrictions; RFCME: Restrictions in Foreign Capital Market Exchange; ICMC: International Capital Market Controls; FTI: Freedom to Trade Internationally; AESTS: Actual vs. expected size of trade sector; DBOBMER: Difference between official and black market exchange rates; IRC: Interest rate controls

		Economic Dvpt		**Familiarity**	**Stock Mket Dvpt**	**Capital Controls**								
		GCI	BCR	DIS	MKTC	SUMI	RTB	FOR	RFCME	ICMC	FTI	AESTS	DBOBMER	IRC
Multiple regression	Coef. value	**0.8552**	**0.0087**	**0.0000**	**0.0005**	**-1.1505**	**0.2515**	**4.0328**	**4.4075**	**-8.6383**	**-0.0144**	**-0.0151**	**0.6241**	**-0.1977**
	P-Value	0.3257	0.3953	0.6014	0.3362	0.3467	0.3222	0.4303	0.4085	0.4158	0.9772	0.8948	0.1210	0.0797
Simple regression	Coef. value	**-0.0483**	**0.0028**	**0.0000**	**-0.0002**	**-0.0510**	**-0.0489**	**-0.1265**	**-0.0569**	**-0.0909**	**-0.0993**	**0.0361**	**0.1440**	**-0.0839**
	P-Value	0.5580	0.2488	0.0681	0.3198	0.4954	0.2799	0.0011	0.0099	0.0020	0.1374	0.0565	0.0255	0.0160
Multiple regression	Coef. value	**1.1850**	**-0.0121**	**-0.0001**	**0.0017**	**-2.0517**	**0.1160**	**13.7970**	**14.4223**	**-29.0345**	**1.4020**	**-0.3599**	**-0.0939**	**-0.0479**
	P-Value	0.5423	0.5841	0.4594	0.3743	0.5198	0.8325	0.4109	0.4089	0.4073	0.4334	0.4019	0.9148	0.8208
Simple regression	Coef. value	**-0.0028**	**0.0008**	**0.0000**	**0.0000**	**0.0055**	**-0.0478**	**-0.0812**	**-0.0173**	**-0.0477**	**-0.0274**	**0.0279**	**0.1082**	**-0.0089**
	P-Value	0.9610	0.7646	0.0885	0.7406	0.8959	0.1764	0.0223	0.1842	0.0470	0.6354	0.0498	0.0632	0.7794
Multiple regression	Coef. value	**0.6493**	**0.0170**	**0.0000**	**-0.0001**	**-0.5418**	**-0.0120**	**-2.1394**	**-2.0983**	**4.3785**	**0.2360**	**-0.0211**	**0.5243**	**-0.1542**
	P-Value	0.5308	0.2288	0.6377	0.9376	0.7372	0.9669	0.7917	0.8031	0.7954	0.7870	0.9180	0.3314	0.2584
Simple regression	Coef. value	**-0.0476**	**0.0028**	**0.0000**	**0.0000**	**-0.0067**	**-0.0154**	**-0.0926**	**-0.0237**	**-0.0703**	**-0.0180**	**0.0252**	**0.1351**	**-0.0312**
	P-Value	0.5746	0.2488	0.0681	0.7669	0.9207	0.8058	0.0178	0.1023	0.0258	0.8524	0.1239	0.2347	0.2803

Appendix B:

$$h_{i,t} = \beta_{i0} + \beta_{i1} h_{x,t} + e_{it}$$

$$h_{i,t} = \beta_{i0} + \beta_{i1}(a_0 + a_1 h_{x,t-1} + a_2 R^2_{x,t}) + e_{it}$$

$$= (\beta_{i,0} + \beta_{i,1} a_0) + \beta_{i1} a_1 h_{x,t-1} + \beta_{i1} a_2 R^2_{x,t} + e_{it}$$

$$= \beta_{i,0} + \beta_{i,1} a_0 + \beta_{i,1} a_1 (a_0 + a_1 h_{xt-2} + a_2 R^2_{x,t-1}) + \beta_{i,1} a_2 R^2_{x,t} + e_{i,t}$$

$$= (\beta_{i,0} + \beta_{i,1} a_0 + \beta_{i,1} a_1 a_0) + \beta_{i,1} a_1^2 h_{x,t-2} + \beta_{i,1} a_2 (a_1 R^2_{x,t-1} + R^2_{x,t}) + e_{i,t}$$

$$= (\beta_{i,0} + \beta_{i,1} a_0 + \beta_{i,1} a_1 a_0) + \beta_{i,1} a_1^2 (a_0 + a_1 h_{x,t-3} + a_2 R^2_{x,t-2}) + \beta_{i,1} a_2 (a_1 R^2_{x,t-1} + R^2_{x,t}) + e_{it}$$

$$= \beta_{i0} + \beta_{i,1} a_0 (1 + a_1 + a_1^2) + \beta_{i,1} a_1^3 h_{x,t-3} + \beta_{i,1} a_2 (a_1^2 R^2_{x,t-2} + a_1 R^2_{x,t-1} + R^2_{x,t}) + e_{it}$$

$$= \beta_{i0} + \beta_{i,1} a_0 (1 + a_1 + a_1^2 + \ldots + a_1^n) + \beta_{i,1} a_1^n h_{x,t-n} + \beta_{i1} a_2 (a_1^n R^n_{x,t-n} + \ldots + a_1^2 R^2_{x,t-2} + a_1 R^2_{x,t-1} + R^2_{x,t}) + e_{it}$$

$$= \beta_{i0} + \beta_{i,1} a_0 \sum_{i=0}^{i=n} a_1^i + \beta_{i,1} a_1^n h_{x,t-n} + \beta_{i1} a_2 \sum_{i=0}^{i=n} a_1^i R^i_{x,t-i} + e_{i,t}$$

$$= \beta_{i0} + \beta_{i,1} \frac{a_0}{1 - a_1} + \beta_{i,1} a_1^n h_{x,t-n} + \beta_{i1} a_2 \sum_{i=0}^{i=n} a_1^i R^i_{x,t-i} + e_{i,t}$$