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Abstract

The aim of this paper is to provide some new empirical evidence on the determinants of volatility of real exchange rates in emerging countries, focusing on the role of international financial integration in particular. A reduced-form model is estimated using the GMM method for dynamic panels over the period 1979-2004 for a sample of 39 developing countries grouped into three regions (Latin America, Asia and MENA). Our findings suggest that different types of shocks (external, real and monetary) can account for volatility of real exchange rates in emerging economies, with international financial integration being a major driving force. Therefore, financial liberalisation and integration should be pursued only gradually in emerging countries.

Keywords: Emerging economies, real exchange rate, volatility, financial integration, GMM method, dynamic panel.

JEL Classification: E31, F0, F31, C15

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1. Introduction

Since the collapse of Bretton Woods in 1973 and the switch to floating exchange rates, the volatility of the real exchange rate (RER) has increased, with significant effects on economic growth, capital movements and international trade (see Baig, 2001, and Hviding, Nowak and Ricci, 2004), especially in the developing countries, where financial liberalisation and the abolition of exchange controls have resulted in large fluctuations of real exchange rates (see, e.g., Reinhart and Smith 2001, and Corden 2002). Other authors, however, believe that financial openness can have a stabilising effect on exchange rate fluctuations (see, for example, Aguirre and Calderon, 2005; 2006), as well as lead to higher growth (see Prasad et al, 2003). Further, countries may be in a better position if they meet the challenges of financial integration, by attracting foreign investors, and hence stimulating domestic investment (see Goldstein and Turner, 2004). International financial integration can also increase liquidity and result in more effective risk diversification (see Le Fort, 2000).

The aim of this paper is to provide some new empirical evidence on the determinants of volatility of real exchange rates in emerging countries, focusing on the role of international financial integration in particular. A reduced-form model is estimated using the GMM method for dynamic panels over the period 1979-2004 for a sample of 39 developing countries grouped into three regions (Latin America, Asia and MENA). Our findings suggest that different types of shocks (external, real and monetary) can account for volatility of real exchange rates in emerging economies, with international financial integration being a major driving force. Therefore, financial liberalisation and integration should be pursued only gradually in emerging countries.

The layout of the paper is the following. Section 2 briefly reviews the literature on financial integration and real exchange rate fluctuations. Section 3 discusses the data and outlines the econometric methodology. Section 4 presents the empirical findings. Section 5 offers some concluding remarks.

2. Financial Integration on Real Exchange Rate Fluctuations

2.1 Theory

The theoretical literature on the effects of capital controls is rather limited. Moreover, only a few papers argue that financial openness reduces real exchange rate fluctuations (see Aguirre and Calderon, 2005). Prasad et al. (2003) also conclude that financial integration and liberalisation of capital flows reduce volatility as well as increase growth. Goldstein and Turner (2004) point out that financial integration is likely to attract foreign investment and stimulate domestic investment. International financial integration and liberalisation of the capital account can also increase the effectiveness of consumption smoothing and risk diversification, as well as the liquidity of financial markets (see Le Fort, 2000). Thus, as argued by Fischer (2003), emerging countries have liberalised capital flows because of the expected gains from financial globalisation. However, Eatwell and Taylor (2002) emphasise that the net benefits of liberalisation are difficult to identify, because of the costs of higher volatility. Obstfeld (1984) considers the two extreme cases of a closed capital account and of free mobility of capital. He argues that the removal of capital controls leads to an initial period of real appreciation: in the short term, an increase of the stock of net foreign assets, by boosting the demand for non-tradeable goods, generates excess demand for labour in the household goods sector and thus an appreciation of the real exchange rate, external deficits and capital inflows.

However, according to other authors, such as Le Fort (2000), the expected impact of financial integration on RER fluctuations is low, even zero, if the exchange rate system is more flexible. Indeed, the higher volatility of floating exchange rates can be offset by a high degree of capital mobility, which can help to absorb external shocks, even though it is not a guarantee against long-lived misalignments. Frankel et al. (1996) analyse the effects of taxes on capital flows by using a simple monetary model in which capital controls reduce the influence of short-term speculators on the exchange rate. Buch, Döpke and Purdziach (2002) show that introducing the Tobin tax in the Dornbusch (1976) model reduces exchange rates volatility.

The IMF (1998) takes the view that restrictions on capital movements are sometimes necessary to reduce RER volatility[1]. DeGregorio, Eichengreen, Ito and Wyplosz (2000) advocate short-term capital controls to reduce vulnerability to financial crises and contagion. However, Frankel and al. (2001) show that capital controls, in addition to reducing exchange rate volatility, increase the risk premium on domestic assets, thus increasing the domestic interest rate and reducing investment and growth. Reinhart and Smith (2001) and Corden

[1] See also Prasad et al. (2003), and Eichengreen (1998).

(2002) conclude that, owing to massive capital flows caused in the short run by the opening of the capital account, a RER appreciation is inevitable, regardless of the choice of exchange rate regime. According to Prasard et al. (2003), the transition to capital mobility should be gradual, because a premature opening could result in significant costs (see Andersen and Moreno, 2005). Jongwanich (2006) stresses that monitoring capital flows and their volatility in the short term is useful to avoid a RER appreciation. Egert, Révil and Lommatzsch (2004) show that an improvement in the net external position leads to an appreciation of the real exchange rate. Finally, Edwards and Rigobon (2005) argue that capital controls reduce the vulnerability of the nominal exchange rate to external shocks and lead to a depreciation of the real exchange rate.

2.2 Empirical Evidence

Only a few empirical studies have analysed the effects of financial integration on the dynamics of the short-term RER. Hooper and Morton (1982) found a positive correlation between net foreign assets and the RER. Obstfeld (1984) showed that the liberalisation of capital movements led to a RER appreciation in Latin America. Basurto and Ghosh (2000), using the method of Vahid and Engle (1993), confirmed the existence of a common cycle between the nominal exchange rate and the interest rate differential in the case of the Japanese Yen and Deutsch Mark exchange rates vis-à-vis the U.S. dollar, whilst the relationship was less clear for the Canadian dollar. They explained these results by pointing out that an increase in domestic interest rates leads to capital inflows, and thus an appreciation of the real exchange rate.

Chang and Velasco (2001) focused on the South-East Asia crisis of 1997-98, and the Argentine one of 2002, when panic seized foreign investors and led to bank failures and currency depreciation. Hau (2002) reported instead that, in a sample of 23 OECD countries over the 1980-1998 period, the RER was less volatile in the more open countries with more liberalised financial markets. Calderon (2003) assessed the determinants of real exchange rate volatility for 21 industrialised countries. Using quarterly data, he concluded that trade liberalisation is likely to mitigate RER volatility. Calderon (2004) studied the effect of financial openness and trade on RER volatility in a panel of industrialised and emerging economies over the period 1974-2003. Using the dynamic GMM method, he found that liberalisation reduced RER volatility. Edwards and Rigobon (2005) estimated a structural VAR for Chile and concluded that removing capital controls makes the nominal exchange rate more vulnerable to external shocks and results in a RER depreciation. Finally, Lane and Milesi-Ferretti (2005) analysed the interaction between financial globalisation and RER, by examining assets and liabilities for a panel of emerging countries. Their results indicate that the decrease in the net external position from 1990 to 1996 led to a depreciation of the real exchange rate.

Given the small number of contributions considering international financial integration as a possible driving source of RER fluctuations, we estimate below a model which enables us to evaluate the relative contribution of various shocks to the RER, including international financial integration, in a panel of emerging countries.

3. Econometric Framework

3.1 Data and Model Specification

We consider four possible types of shocks to the RER:

i) domestic real shocks affecting supply, such as productivity shocks;
ii) domestic real shocks affecting demand, such as changes in consumption and investment behaviour;
iii) external real shocks such as changes in the terms of trade;
iv) nominal shocks reflecting changes in money demand relative to supply and changes in the nominal exchange rate

Compared with the study of Hau (2002), we examine a large sample of *emerging* countries (39 of them) instead of 23 OECD countries, and over a longer time period (1979-2004, instead of 1980-1998). Also, we use panel data rather than time series methods. In comparison to Caldéron (2004), we introduce into the model additional fundamentals, such as technical progress, possibly driving RER. Moreover, we use the recent data on financial integration provided by Lane and Milesi-Feretti (2006), and the classification of exchange rate regimes of Yeyati and Sturzenegger (2005).

Our sample includes data on the real exchange rate, output, terms of trade, government expenditure, money supply, exchange rate regimes, as well as the commercial and financial openness for a sample of 39 countries, divided into three regions: 20 Latin American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Trinidad, Uruguay, Venezuela), 10 South East Asian countries (Bangladesh, China, India, Indonesia, Korea, Malaysia, Pakistan, Philippines, Sri Lanka, Thailand) and 9 countries from the MENA region (Algeria, Egypt , Iran, Israel, Jordan, Morocco, Syria, Tunisia, Turkey). The variables are calculated as follows:

* The dependent variable, RER volatility, is calculated as the standard deviation of changes in the real effective exchange rate over a period of 5 years. The RER is defined as $\frac{P}{EP^*}$ where P and P* are the domestic and foreign CPI (the US being the foreign country), and E is the nominal exchange rate taken from the IMF's International Financial Statistics (IFS) (2006). Our definition of RER implies that an increase (decrease) in RER indicates an appreciation (depreciation).

* The explanatory variables in the model are:

(i) The volatility of fundamentals, data for which are obtained from the WDI (World Development Indicators, 2006), namely:

- Output volatility, measured by the standard deviation of the growth rate of real GDP. These data have also been used by Loayza, Fajnzylber and Calderón (2004);
- Volatility of public spending (PS), calculated as the standard deviation of changes in public consumption;
- Volatility of money supply, i.e. the standard deviation of the growth rate of the monetary base.
- Volatility of terms of trade (TT6,) measured by the standard deviation of changes in the terms of trade.

(ii) Economic openness defined as:

- Trade openness, averaged over 5 years, this variable being approximated by the share of imports and exports in total household expenditure;

- International financial integration, again averaged over 5 years (from the database of Lane and Milesi-Ferretti, 2006). Three indicators are considered: the sum of stocks of FDI and portfolio investments, relative to GDP (IFI1), total liabilities and assets relative to GDP (IFI2), and the Net Foreign Assets (NFA) position, i.e. the difference between total assets and liabilities (in absolute value), which is another indicator of international financial integration. We also include a capital control variable that takes the value of 1 if there is capital liberalisation, and 0 in the case of capital restrictions. The data are from the IMF's "Exchange Arrangements and Exchange Restrictions" (2006).

iii) The foreign exchange regime, averaged over 5 years, following the classification of exchange regimes of Yeyati and Sturzenegger (2005). Finally, real GDP is taken from the WDI (2006).

Most earlier empirical studies of RER volatility are of a static nature. Only a few recent papers (Calderon, 2004; Bussiere et al., 2004, Aghion, Bacchetta, Ranciere and Rogoff, 2006, Nardis et al., 2008) adopt a dynamic approach, as we also do here. Specifically, we estimate equation (1) below, which regresses RER volatility against the volatility of fundamentals, financial integration, trade liberalisation and exchange rate regimes:

$$Y_{it} = \mu_i + \varphi Y_{it-1} + \beta X_{it} + \gamma F_{it} + \delta Z_{it} + \varepsilon_{it} \qquad (1)$$

where Y_{it} stands for RER volatility, μ_i for unobserved country-specific effects, X_{it} is a vector including the volatility of fundamentals (the standard deviation of government spending shocks, real GDP, money supply and terms of trade); F_{it} is a measure of international financial integration (IFI1, IFI2 or NFA), Z_{it} is a matrix of control variables, such as trade openness and the dummy variables taking into account changes in exchange rate regimes.

3.2 Estimation Method

In a dynamic model which includes lags of the dependent variable as explanatory variables standard econometric techniques (OLS, IV, etc.) do not yield efficient estimates of the parameters (Sevestre, 2002). The GMM method provides a solution to the problems of simultaneity bias, reverse causality and omitted variable bias (Kpodar, 2007), as well as yielding estimates of unobserved country-specific effects and dummy coefficients for which the usual methods ("within" or "difference") would be inappropriate given the dynamic nature of the regression (see Calderon et al. 2006).

There are two types of GMM estimators: the first-difference and the system one. In the former case, all variables are first-differenced to eliminate individual and time-specific effects. Variables in levels lagged twice or more are then used as instruments for the explanatory variables, assuming that the errors of the equation in levels are not autocorrelated. However, those lagged variables are weak instruments. That is why Arellano and Bover (1995) and Blundell and Bond (1998) have proposed a system GMM estimator, which is based on assumptions about the initial conditions such that the moment conditions remain valid even for persistent series. This estimator combines the equations in first differences with equations in which the level variables are instrumented by their first differences. Blundell and Bond (1998) have shown using Monte Carlo simulations that the system GMM estimator is indeed more efficient than the first-difference one, the latter yielding biased estimates in finite samples if the instruments are weak[2].

Two types of tests are usually carried out in this context: the Sargan or Hansen test for over-identifying restrictions to test the validity of the lagged variables as instruments (i.e., whether or not the instruments are exogenous), and the autocorrelation test of Arellano and Bond (1995) where the null hypothesis is no autocorrelation of second order of the errors of the equation in first differences. Appendix 1 provides more details of the GMM method.

4. Empirical Results

4.1 Descriptive and Correlation Analysis

We analyse first five-year averages over the period 1979-2004 for each country. Plots of RER volatility (see Figure 1 in Appendix 2) show a noticeable decrease in most countries in the last decade (especially in Asia and some countries in Latin America and MENA), which might reflect monetary policies aimed at reducing currency fluctuations. As for the degree of

[2] See also Kpodar (2007), p.53.

international financial integration, this appears to increase sharply in the last decade (see Figure 2 in Appendix 2).

Panel correlations between the volatility of the real exchange rate and its fundamentals (including international financial integration) are reported in Table 1:

Table 1. RER Volatility and Financial Integration in Emerging Countries

	Total Panel		Floating		Intermediate		Fixed	
	P. Corr.	P-value	P. Corr.	P-value	P. Corr.	P-value	P. Corr.	P-value
vtt	0.450	(0.00)	0.385	(0.00)	0.442	(0.00)	0.578	(0.00)
vrgdp	0.128	(0.07)	0.243	(0.04)	0.448	(0.00)	0.087	(0.49)
vps	0.247	(0.00)	-0.185	(0.12)	0.206	(0.09)	0.487	(0.00)
vmon	0.307	(0.00)	0.087	(0.27)	0.617	(0.00)	0.373	(0.00)
Open	-0.108	(0.11)	-0.178	(0.14)	-0.380	(0.00)	-0.086	(0.50)
IFI	0.280	(0.00)	0.093	(0.44)	-0.346	(0.00)	0.282	(0.02)
NFA	0.646	(0.00)	0.030	(0.80)	-0.179	(0.11)	0.711	(0.00)
CA	-0.044	(0.54)	0.211	(0.08)	0.094	(0.45)	-0.129	(0.31)

Notes:
a) the period is 1979-2004 (five-year averages).
b) The panel correlation analysis was first performed for the 39 countries (total panel), then by exchange rate regime. To do this, for each country, a dummy variable ER was introduced taking respectively the values 0, 1, 2, if the exchange rate regime is either fixed, intermediate or flexible (following the classification of Yeyati and Sturzenegger, 2005).
c) The correlation is calculated between RER volatility and volatility of each other variable in turn. The variables vtt, vrgdp, vps, vmon, are respectively the volatility of the terms of trade, the growth rate of real GDP, government consumption and monetary base. Open stands for trade openness. The measures of financial integration are IFI2, Net Foreign Assets (NFA) and the opening of the current account (CA).

It appears that RER volatility is positively correlated with the volatility of fundamentals, such as terms of trade, real GDP growth, government consumption and money supply. This suggests that it can be attributed to various types of shocks, in particular external shocks to the terms of trade and domestic real GDP; also monetary shocks are strongly and significantly correlated with the volatility of the real exchange rate, regardless of the exchange rate regime. Moreover, trade openness is negatively correlated with RER volatility, whilst international financial integration is positively correlated. However, the latter correlation is negative in the case of intermediate exchange rate regimes.

Table 2 presents correlations for countries grouped by region.

Table 2. RER Volatility and Financial Integration in Emerging Countries by Region

	Total of Panel		Floating		Intermediate		Fixed	
	P. Corr.	P-value	P. Corr.	P-value	P. Corr.	P-value	P. Corr.	P-value
Latin America								
vtt	0.577	(0.00)	0.288	(0.09)	0.513	(0.00)	0.647	(0.00)
vrgdp	0.102	(0.31)	0.379	(0.02)	0.410	(0.01)	0.371	(0.04)
vps	0.228	(0.02)	-0.196	(0.26)	0.126	(0.46)	0.510	(0.00)
vmon	0.323	(0.00)	0.157	(0.37)	0.606	(0.00)	0.360	(0.05)
Open	-0.174	(0.26)	-0.315	(0.06)	-0.406	(0.01)	-0.104	(0.58)
IFI	0.288	(0.00)	0.088	(0.61)	-0.441	(0.00)	0.272	(0.14)
NFA	0.698	(0.00)	0.129	(0.46)	0.126	(0.46)	0.740	(0.00)
CA	-0.129	(0.19)	-0.004	(0.97)	-0.147	(0.38)	-0.208	(0.26)
Asia								
vtt	0.010	(0.94)	0.106	(0.68)	0.212	(0.39)	0.491	(0.05)
vrgdp	0.616	(0.00)	0.491	(0.05)	0.704	(0.00)	0.332	(0.16)
vps	-0.001	(0.96)	-0.360	(0.15)	0.243	(0.33)	0.097	(0.71)
vmon	0.095	(0.26)	0.097	(0.71)	0.146	(0.56)	0.106	(0.68)
Open	-0.010	(0.94)	-0.071	(0.78)	-0.053	(0.83)	-0.271	(0.24)
IFI	0.193	(0.15)	0.364	(0.15)	0.369	(0.13)	-0.455	(0.08)
NFA	0.231	(0.10)	0.322	(0.16)	0.580	(0.01)	-0.425	(0.10)
CA	0.341	(0.01)	0.503	(0.03)	0.375	(0.12)	0.108	(0.70)
MENA								
vtt	0.552	(0.00)	0.181	(0.48)	0.597	(0.05)	0.659	(0.00)
vrgdp	0.205	(0.17)	0.003	(0.98)	-0.162	(0.63)	0.267	(0.29)
vps	0.480	(0.00)	0.196	(0.44)	0.250	(0.45)	0.574	(0.01)
vmon	0.415	(0.00)	0.160	(0.53)	0.903	(0.00)	0.748	(0.00)
Open	-0.479	(0.00)	-0.337	(0.18)	-0.548	(0.08)	-0.568	(0.01)
IFI	-0.390	(0.00)	-0.275	(0.28)	-0.614	(0.04)	-0.453	(0.06)
NFA	-0.259	(0.08)	-0.256	(0.31)	-0.442	(0.17)	-0.224	(0.38)
CA	-0.064	(0.67)	0.390	(0.12)	-0.411	(0.20)	-0.312	(0.22)

Notes:
a) the period is 1979-2004 (five-year averages).
b) The panel correlation analysis was first done by region (Latin America, Asia and MENA), then by exchange rate regime within each region. To do this, for each country in a given region, a dummy variable ER was introduced taking respectively the values 0, 1, 2, if the exchange rate regime is either fixed, intermediate or flexible (following the classification of Yeyati and Sturzenegger, 2005).
c) The correlation is calculated between the RER volatility and the volatility of each other variable in turn.
The variables vtt, vrgdp, vps, vmon, are respectively the volatility of the terms of trade, the growth rate of real GDP, government consumption and monetary base. Open stands for trade openness. The measures of financial integration are IFI2, Net Foreign Assets (NFA) and the opening of the current account (CA).

It can be seen that RER volatility in Latin America is significantly and positively correlated with the external shocks to the terms of trade and the money supply. In Asia, instead, it is significantly correlated with domestic shocks to real GDP. Note also the lack of correlation with trade openness for Latin America and Asia. Furthermore, financial integration is negatively correlated with RER volatility under the fixed exchange regime often adopted by Asian countries. Such a regime, as stressed by Ferrari (2000), and Obstfeld, Shambaugh and Taylor (2004), is not compatible with the new financial architecture, mainly characterised by international financial integration, although it might reduce RER volatility (see Figure 1 of Appendix 2). Regarding the MENA countries, we find in all cases a significant negative correlation between financial integration and RER volatility. The other shocks, including external and monetary shocks, also appear to be significantly positively correlated with RER volatility in the MENA.

4.2 GMM Estimation

The panel estimates for equation (1) using the GMM system estimator of Arellano and Bover (1995) are reported in Table 3.

Table 3. RER Volatility and Financial Integration in Emerging Countries

	[I]	[II]
Volatility of RER $_{t-1}$	1.73***	1.05***
	(0.00)	(0.00)
Volatility of Terms of Trade	1.54***	0.85***
	(0.00)	(0.00)
Volatility of real GDP	0.75*	1.32*
	(0.10)	(0.09)
Volatility of Public Expenditure	0.49	0.39
	(0.14)	(0.17)
Volatility of Money Supply	0.94*	
	(0.08)	
Trade Opening	-0.16***	-0.15***
	(0.01)	(0.00)
IFI2	0.06***	
	(0.00)	

CA		0.09^{***}
		(0.00)
Number of countries	39	39
Number of obs.	185	185
R^2	0.42	0.51
Specification Tests (p- values)		
- Sargan Test	0.19	0.29
- 2nd Order Autocorrelation	0.12	0.42

Notes:
a) The panel includes 39 countries and five-year averages over the period 1979-2004.
b) Numbers in parentheses are p-values.
c) *, ** and *** correspond to the 10%, 5% and 1% significance levels respectively. Two sets of estimates were produced using IFI2 (or NFA) (see [I]), or the policy measure for international financial integration (see [II]).

The specification tests of Sargan / Hansen and Arellano and Bover (1995) respectively suggest that the model is correctly specified (see bottom of Table 3). External shocks and volatility of real GDP appear to be the main driving forces of RER volatility. A positive shock of 1% to the terms of trade increases RER volatility by 1.54% or 0.85% based on estimation (I) and (II) respectively (see table 3). Real shocks are also an important source of volatility: a real supply shock in the form of a 1% increase in the growth rate of real GDP increases RER volatility by 0.75% or 1.32% based on model (I) and (II) respectively. In addition, an increase in government consumption by 1% increases the volatility of the real exchange rate by 0.49% or 0.39% respectively. The monetary shock also plays a role, being statistically significant at the 10% (model II), consistently with the correlation analysis. Trade openness has a statistically significant effect at the 1% level, with an increase by 1% reducing RER volatility by 16% or 15% based on model (I) or (II) respectively. As for international financial integration, a positive 1% shock to FDI stocks and portfolio investment increases RER volatility by 0.06%, whilst an increase of 1% in capital controls increases RER volatility by 0.09. This finding is consistent with those of some earlier studies (see Reinhart and Smith, 2001; Corden, 2002), and presumably reflects the fact that many emerging countries are moving towards more flexible exchange rate regimes and a higher degree of international financial integration. Finally, it should be noted that, in contrast to what suggested by the correlation analysis, the exchange rate regime has no significant effect (and is therefore not included in Table 3). This might be due to the heterogeneity of the panel in this respect.

To study the sensitivity of the previous results to geographical zones, Table 4 presents estimates of equation (1) by region, using again the GMM system-method.

Table 4. RER Volatility and Financial Integration in emerging countries classified by regions

	MENA	Asia	Latin America
Constant		-0.98^{***}	
		(0.00)	
Volatility of RER_{t-1}	1.09^{***}	0.75^{***}	1.76^{***}
	(0.00)	(0.01)	(0.00)
Volatility of Terms of Trade		0.17	2.52^{***}
		(0.19)	(0.00)
Volatility of Real GDP		1.24^{***}	
		(0.00)	
Volatility of Public Expenditure	1.37^{***}	0.27^{*}	0 .60
	(0.00)	(0.13)	(0. 17)
Volatility of Money Supply	0.32		0.785^{*}
	(0.15)		(0.10)
Trade Opening	-0.08^{**}	-0.05	-0.22
	(0.03)	(0.16)	(0.16)
Financial Integration[3]	-0.05^{**}	0.10^{**}	0.09^{***}
	(0.03)	(0.02)	(0.00)
Exchange Rate Regime	2.41^{**}	1.44	
	(0.02)	(0.15)	
Number of countries	9	10	20
Number of countries	40	45	90
R^2	0.60	0.39	0.86
Specification Tests (p-values)			
- Sargan Test	0.46	0.74	0.33
- 2nd Order Autocorrelation	0.83	0.10	0.46

[3] To measure international financial integration we use ANE for Asia, and IFI2 for the MENA region and for Latin America.

Notes:
a) The panels include in turn twenty Latin American countries, ten Asian and nine MENA countries. The period is 1979-2004 (five-year averages).
b) Numbers in parentheses are p-values.
c) *, ** and *** correspond to the 10%, 5% and 1% significance levels respectively.

Table 4 suggests that external and monetary shocks are the main sources of real exchange rate volatility in Latin America. The importance of the nominal shock is consistent with the "imbalance" approach to exchange rate fluctuations (see Mundell, 1962, Fleming, 1962) and Dornbusch, 1976). Openness increases stability of the real exchange rate, as expected. As for international financial integration, it is clearly an important source of volatility of the real exchange rate in Latin America.

In Asia, RER volatility is mainly due to domestic real shocks, which confirms the results of the correlation analysis and is consistent with "New Open Macroeconomic" models. The small role of external shocks may reflect the success of exchange rate policies implemented in several Asian countries (e.g. China, Korea, Malaysia and Thailand) to achieve exchange rate stability. Monetary shocks appear to have no effect here, whilst greater openness reduces RER volatility. As for international financial integration, it makes the RER more volatile, notwithstanding the adoption of a fixed exchange rate regime aimed at reducing fluctuations. It would appear that such exchange rate policies are not entirely compatible with the new international financial architecture. Finally, the choice of exchange rate regime seems to have a limited impact on RER volatility.

In the MENA region, monetary shocks and real demand shocks are the main determinants of RER volatility. This region is also subject to external shocks, but not to the terms of trade. Trade openness appears to have a stabilising effect on the real exchange rate, suggesting consistency between trade and exchange rate policies. Moreover, in contrast to other regions, international financial integration reduces RER volatility, consistently with the correlation analysis and other studies (e.g., Aguirre and Calderon, 2006), suggesting that the exchange rate policies adopted in this region are appropriate in the new international context. Finally, the exchange rate regime has a significant effect at the 1% level. This might reflect the monetary policies adopted by the majority of these countries (Egypt, Jordan, Morocco, Tunisia, and Turkey), whose main objective is price stability.

5. Conclusions

In this paper we have examined the determinants of RER volatility in a panel of 39 emerging countries over the period 1979-2004, paying particular attention to the role of international financial integration. The inclusion of this variable and the adoption of an appropriate econometric method, namely the GMM system-estimator of Arellano and Bover (1995) for dynamic panels enable us to obtain more reliable results and shed new light on this issue. Our findings suggest that emerging countries as a whole are subject to various types of shocks (external, real and monetary) that may explain the variability of the real exchange rate. The analysis by geographical region indicates that monetary and external shocks play a major role in both Latin America and the MENA region, whilst domestic real shocks are the main driving force in South East Asia. Trade openness helps to stabilise the RER in most countries, whereas the choice of exchange rate regime has a significant effect only in the MENA region.

Furthermore, our estimates show that international financial integration is an important source of real exchange rate variability in emerging countries, consistently with some earlier studies (Reinhart and Smith, 2001; Corden, 2002). In the Asian and Latin American countries it amplifies fluctuations of the real exchange rate, even in the presence of a fixed exchange rate regime aimed at reducing them, suggesting that such exchange rate policies are incompatible with the new international financial architecture. By contrast, in the MENA region, international financial integration is conducive to stability of the real exchange rate. A possible explanation is given by the adoption in these countries of a more flexible exchange regime, consistent with international financial integration and the new global economic environment. A gradual approach to liberalisation might, however, be necessary to reduce the difficulties possibly arising from a sudden switch to openness and flexibility.

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Appendix 1

The GMM Method

We use the Generalized Method of Moments (GMM) estimator for dynamic panels introduced by Holtz-Eakin, Newey and Rosen (1988), Arellano and Bond (1991), and Arellano and Bover (1995). It is based on, first, differencing the series to control for unobserved effects, and, second, using lagged explanatory and dependent variables as instruments, called "internal" instruments.

After accounting for time-specific effects, the set of explanatory variables *X*, we rewrite equation (1) (see section 3.1) as follows:

$$\mathbf{Y_{it}} = \boldsymbol{\alpha}\, \mathbf{Y_{i,\,t-1}} + \boldsymbol{\beta' X_{it}} + \boldsymbol{\eta_i} + \boldsymbol{\varepsilon_{it}} \qquad \textbf{(2)}$$

In order to eliminate the country- specific effect, we take first-differences of equation (2),

$$\mathbf{(Y_{it} - Y_{i,t-1}) = \boldsymbol{\alpha}\, (Y_{i,\,t-1} - Y_{i,\,t-2}) + \boldsymbol{\beta}\, (X_{it} - X_{i,\,t-1}) + (\boldsymbol{\varepsilon}_{it} - \boldsymbol{\varepsilon}_{i,\,t-1})} \qquad \textbf{(3)}$$

The use of instruments is required to deal with the likely endogeneity of the explanatory variables and the fact that, by construction, the new error term, $(e_{it} - e_{it-1})$, is correlated with the lagged dependent variable, $(y_{i,t-1} - y_{i,t-2})$.

Taking advantage of the panel nature of the data set, the instruments consist of previous observations of the explanatory and lagged dependent variables. As it relies on past values as instruments, this method only allows current and future values of the explanatory variables to be affected by the error term. Therefore, while relaxing the common assumption of strict exogeneity, it does not allow the *X variables* to be fully endogenous.

Under the assumptions that (a) the error term, ε, is not serially correlated, and (b) the explanatory variables, *X*, are weakly exogenous (i. e., they are uncorrelated with future realisations of the error term), the GMM Dynamic panel estimator uses the following moment conditions:

$$E\left[Y_{i,t-s} \quad . \quad (\varepsilon_{i,t} - \varepsilon_{i,t-1})\right] = 0 \quad \text{for } s \geq 2 \;\; ; t = s......t \qquad \textbf{(4)}$$

$$E\left[X_{i,t-s} \quad . \quad (\varepsilon_{i,t} - \varepsilon_{i,t-1})\right] = 0 \quad \text{for } s \geq 2 \;\; ; t = s......t \qquad \textbf{(5)}$$

The GMM estimator based on these conditions is known as the *difference* estimator. Notwithstanding its advantages with respect to simpler panel data estimators, it has statistical shortcomings. Alonso- Borrego and Arellano (1999) and Blundell and Bond (1998) show that when the explanatory variables are persistent over time, lagged levels of these variables are weak instruments for the regression equation in differences. Instrument weakness influences the asymptotic and small sample performance of the difference estimator. Asymptotically, the variance of the coefficients rises in small samples. In addition, the Monte Carlo experiments show that the weakness of the instruments can produce biased coefficients.

To reduce the potential biases and imprecision associated with the usual difference estimator, we use a new estimator that combines in a system the regression in differences with the regression in levels (see Arellano and Bover ,1995, and Blundell and Bond, 1998). The instruments for the regression in differences are the same as above. Those for the regression in levels are the lagged differences of the corresponding variables. These are appropriate instruments under the following additional assumptions: although there may be correlation between the levels of the right- hand side variables and the country- specific effect in equation (3), there is no correlation between the differences of these variables and the country-specific effects. This assumption results from the following stationarity property,

$$E\left[Y_{i,t+p} \quad . \quad \eta_i\right] = E\left[Y_{i,t+q} \quad . \quad \eta_i\right] \qquad \textbf{(6)}$$

$$E\left[X_{i,t+p} \quad . \quad \eta_i\right] = E\left[X_{i,t+q} \quad . \quad \eta_i\right]$$

The additional moment conditions for the regression in levels are[4]:

$$E\left[(Y_{i,t-1} - Y_{i,t-2}).(\eta_i + \varepsilon_{i,t})\right] = 0 \qquad \textbf{(7)}$$

$$E\left[(X_{i,t-1} - X_{i,t-2}).(\eta_i + \varepsilon_{i,t})\right] = 0 \qquad \textbf{(8)}$$

[4] Given that lagged levels are used as instruments in the differences specification, only the most recent difference is used as instrument in the levels specification. Using other lagged differences would result in redundant moment conditions (see Arellano and Bover, 1995).

We use the moment conditions given by equations (4), (5), (7), and (8) and employ a GMM procedure to generate consistent and efficient parameter estimates.

We employ a Generalized Method of Moments (GMM) procedure to generate consistent estimates of the parameters of interest and their asymptotic variance-covariance (Arellano and Bond, 1991; Arellano and Bover, 1995). These are given by the following formulae:

$$\hat{\sigma} = (\bar{X}' Z \hat{\Omega}^{-1} Z' \bar{X})^{-1} \bar{X}' Z \hat{\Omega}^{-1} Z' \bar{Y} \quad \textbf{(9)}$$

$$AVAR(\hat{\sigma}) = (\bar{X}' Z \hat{\Omega}^{-1} Z' \bar{X})^{-1} \quad \textbf{(10)}$$

where θ is the vector of parameters of interest (α, β), *y* is the dependent variable stacked first in differences and then in levels, *X i*s the explanatory variable matrix including the lagged dependent variable (y_{t-1}, *X*) stacked first in differences and then in levels, *Z i*s the matrix of instruments derived from the moment conditions, and **Ω̂** is a consistent estimate of the variance-covariance matrix of the moment conditions.

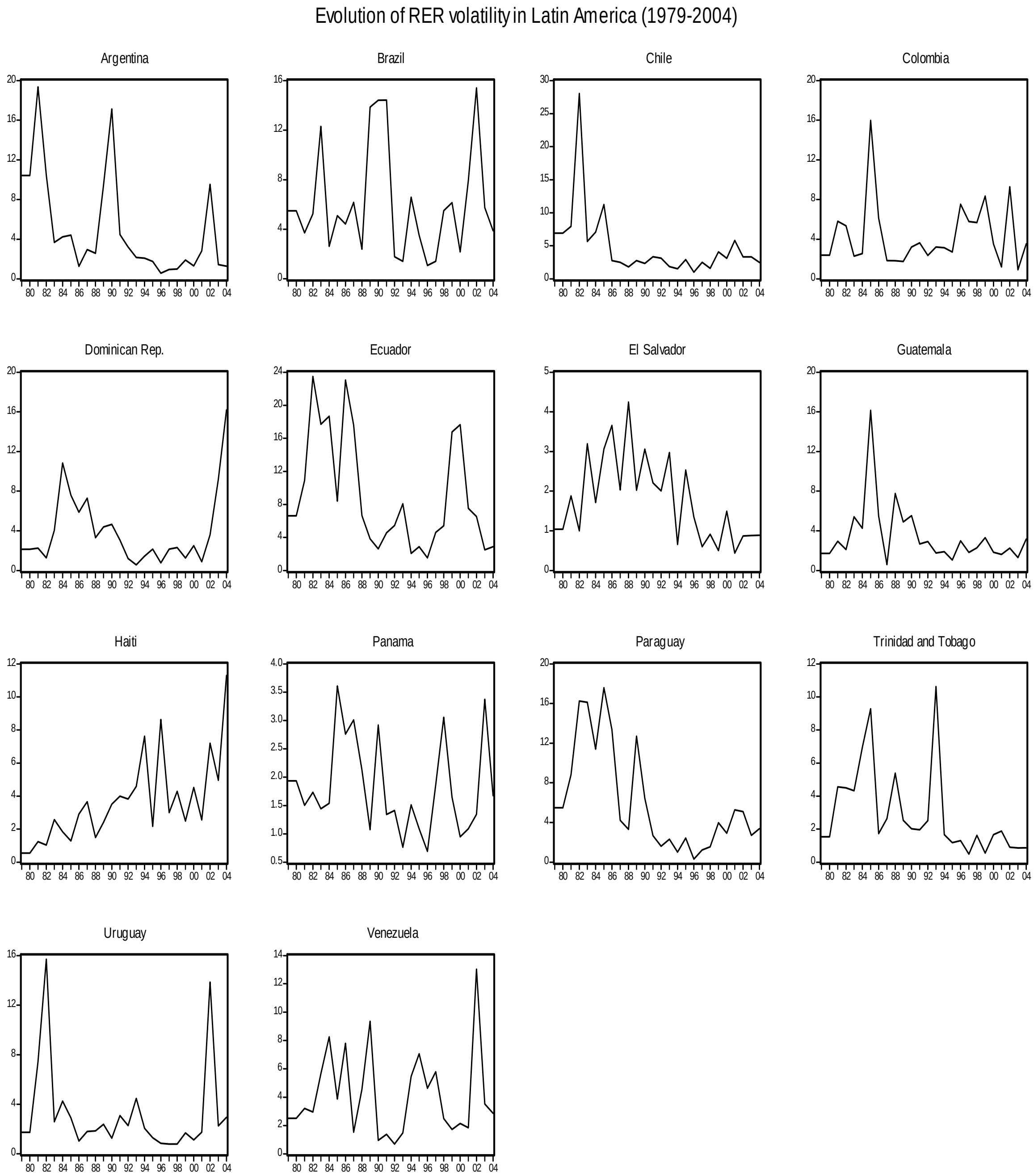
The consistency of the GMM Estimator depends on whether lagged values of the explanatory variables are valid instruments in the regression. We address this issue by considering two specification tests suggested by Arellano and Bond (1991) and Arellano and Bover (1995). The first is the Sargan test of over-identifying restrictions. It tests the overall validity of the instruments by analysing the sample analogue of the moment conditions used in the estimation process. Failure to reject the null hypothesis gives support to the model.

The second test examines the null hypothesis that the error term $\varepsilon_{i,t}$ is not serially correlated. As in the case of the Sargan test, the model specification is supported when the null hypothesis is not rejected. In the system specification, we test whether the differenced error term (that is, the residual of the regression in differences) exhibits second-order serial correlation. First-order serial correlation of the differenced error term is expected even if the original error term (in levels) is uncorrelated, unless the latter follows a random walk. Second-order serial correlation of the differenced residual indicates that the original error term is serially correlated and follows a moving average process at least of order one. This would imply that the proposed instruments are not valid (and that higher-order lags should be used as instruments).

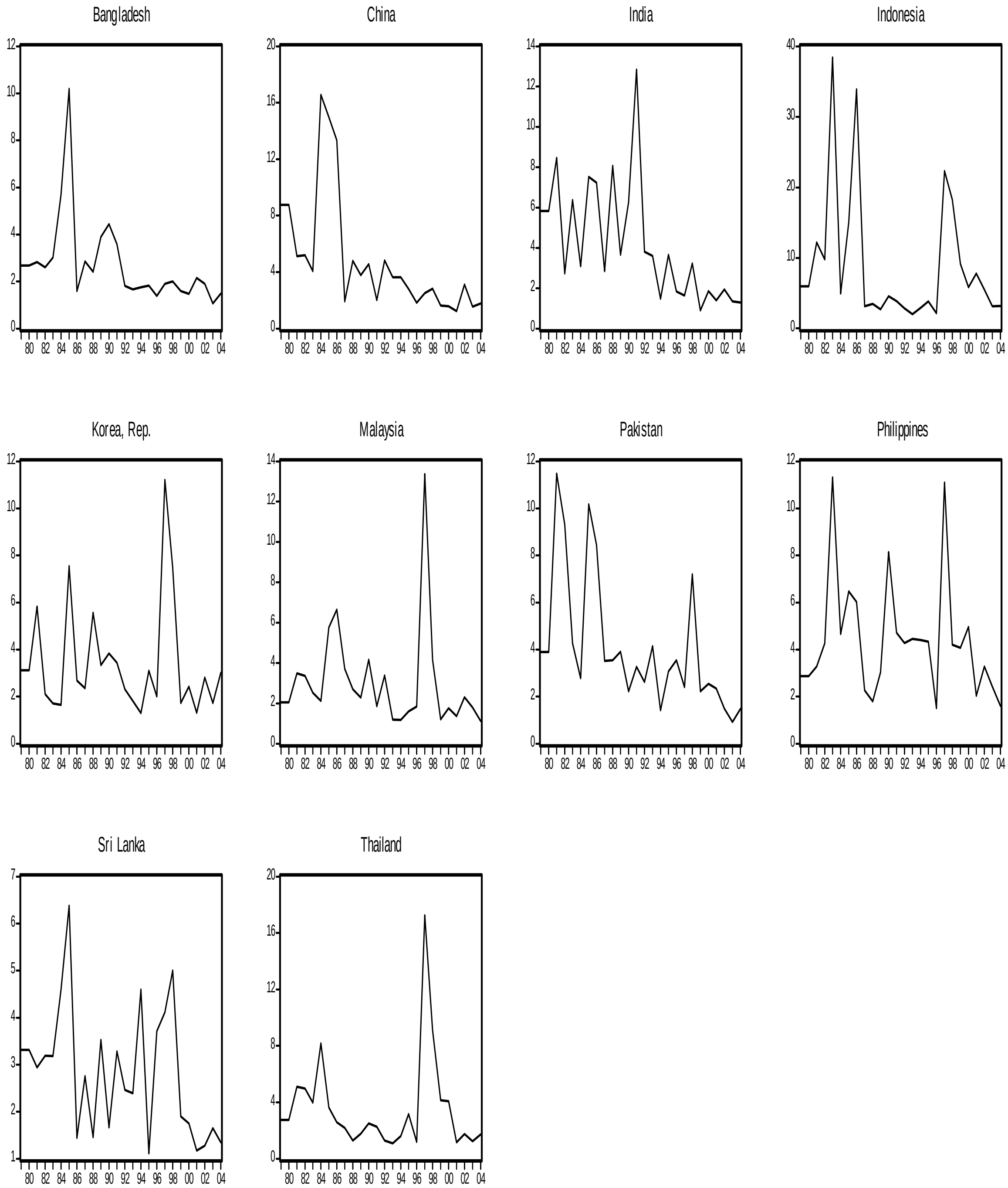
Appendix 2

Evolution of RER Volatility and International Financial Integration in Emerging Countries (1979-2004)

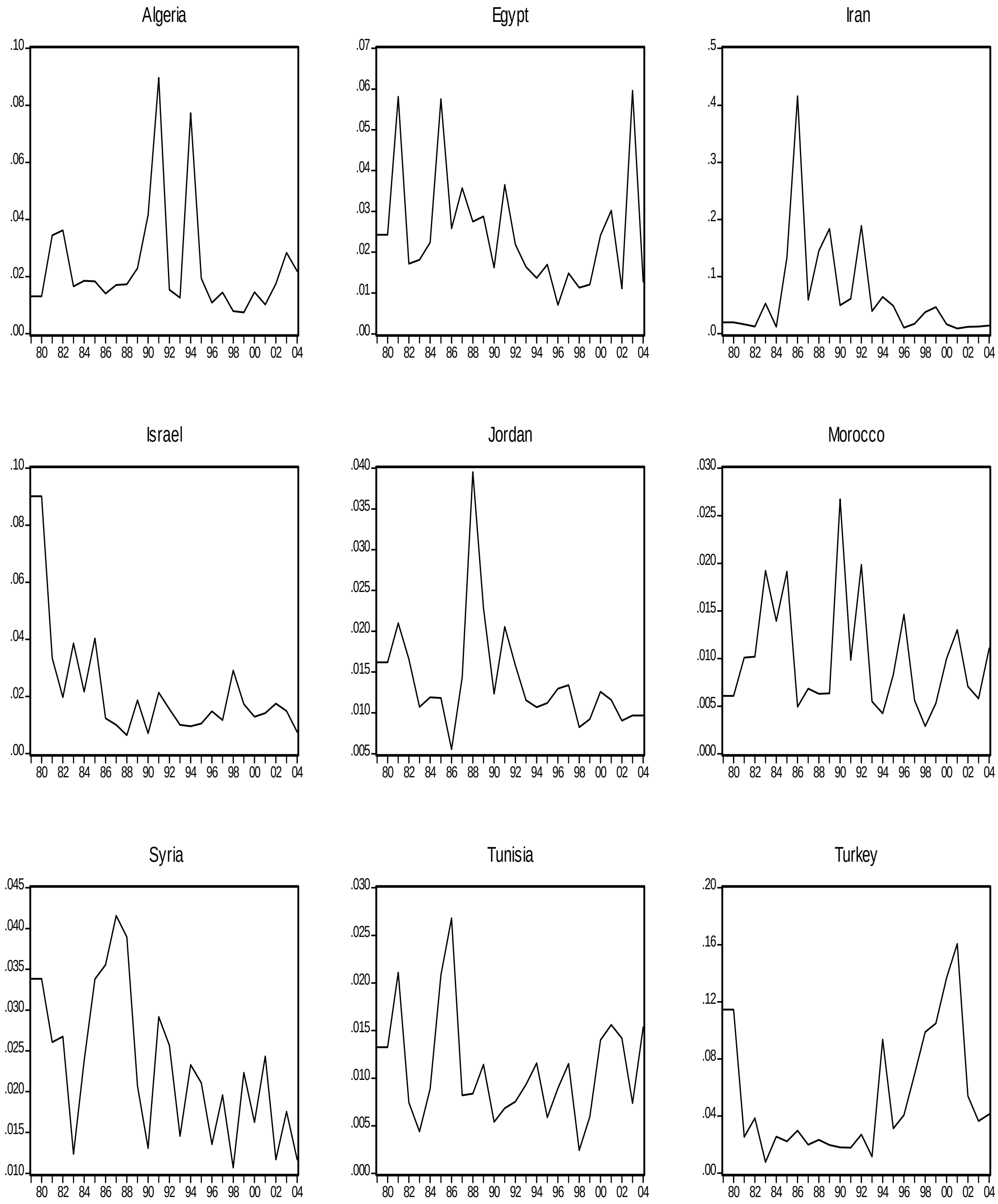
Figure 1. Evolution of RER Volatility in emerging countries, classified by region (1979-2004)



Evolution of RER volatility in Asia (1979-2004)

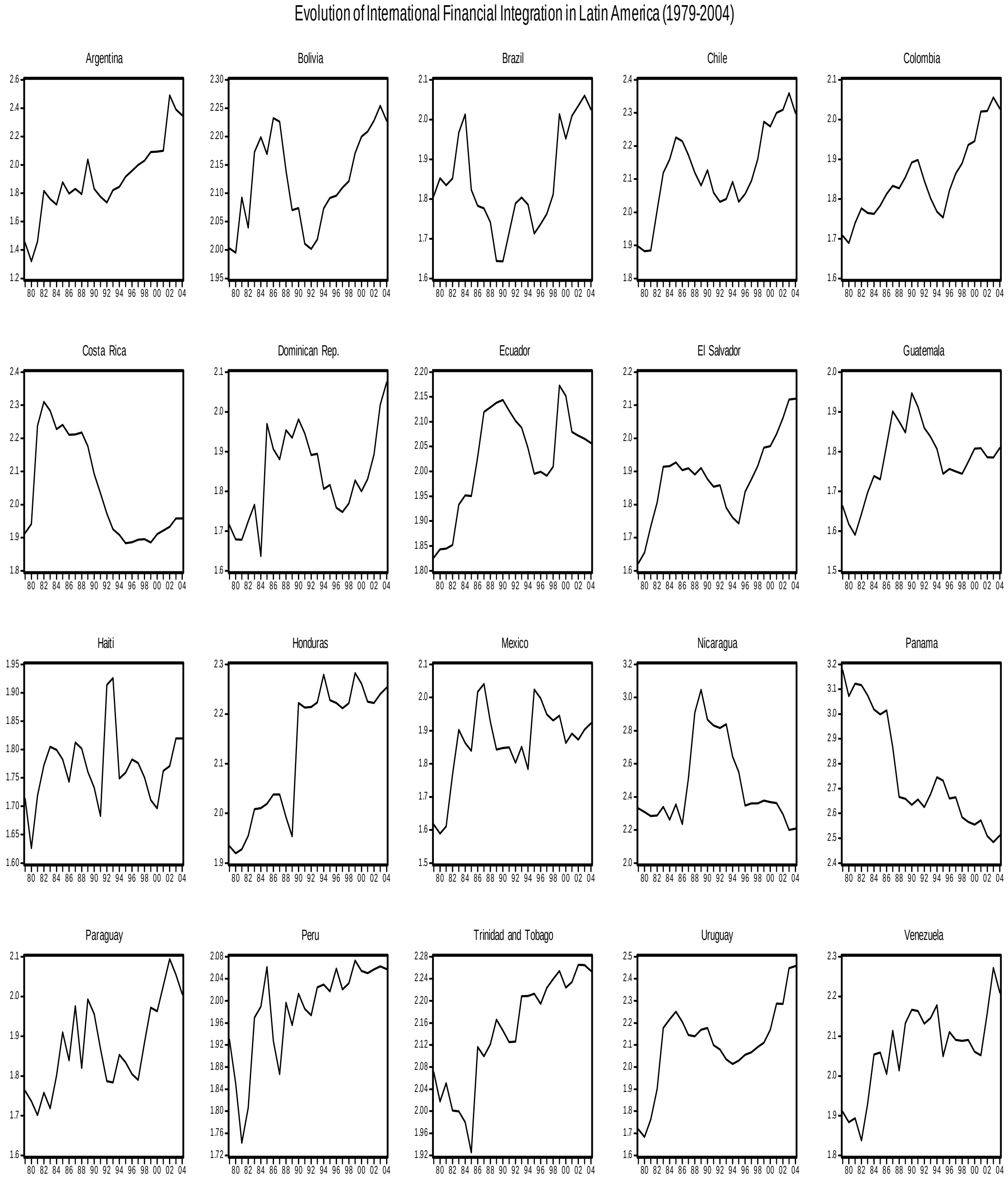


Evolution of RER volatility in MENA region (1979-2004)

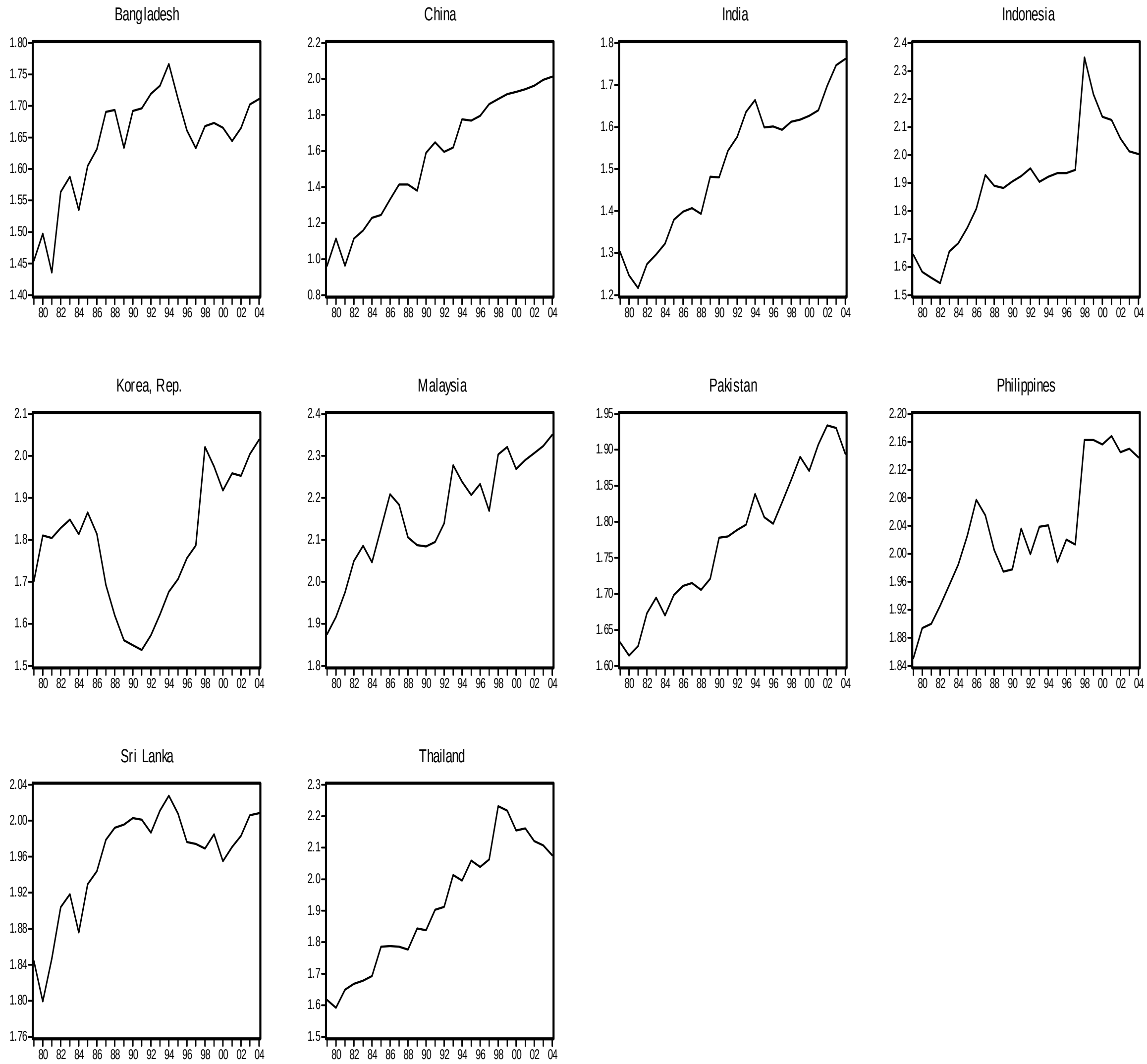


Sources: our calculations using data from the IMF's International Financial Statistics (IFS, 2006), and World Development Indicators (WDI, 2006).

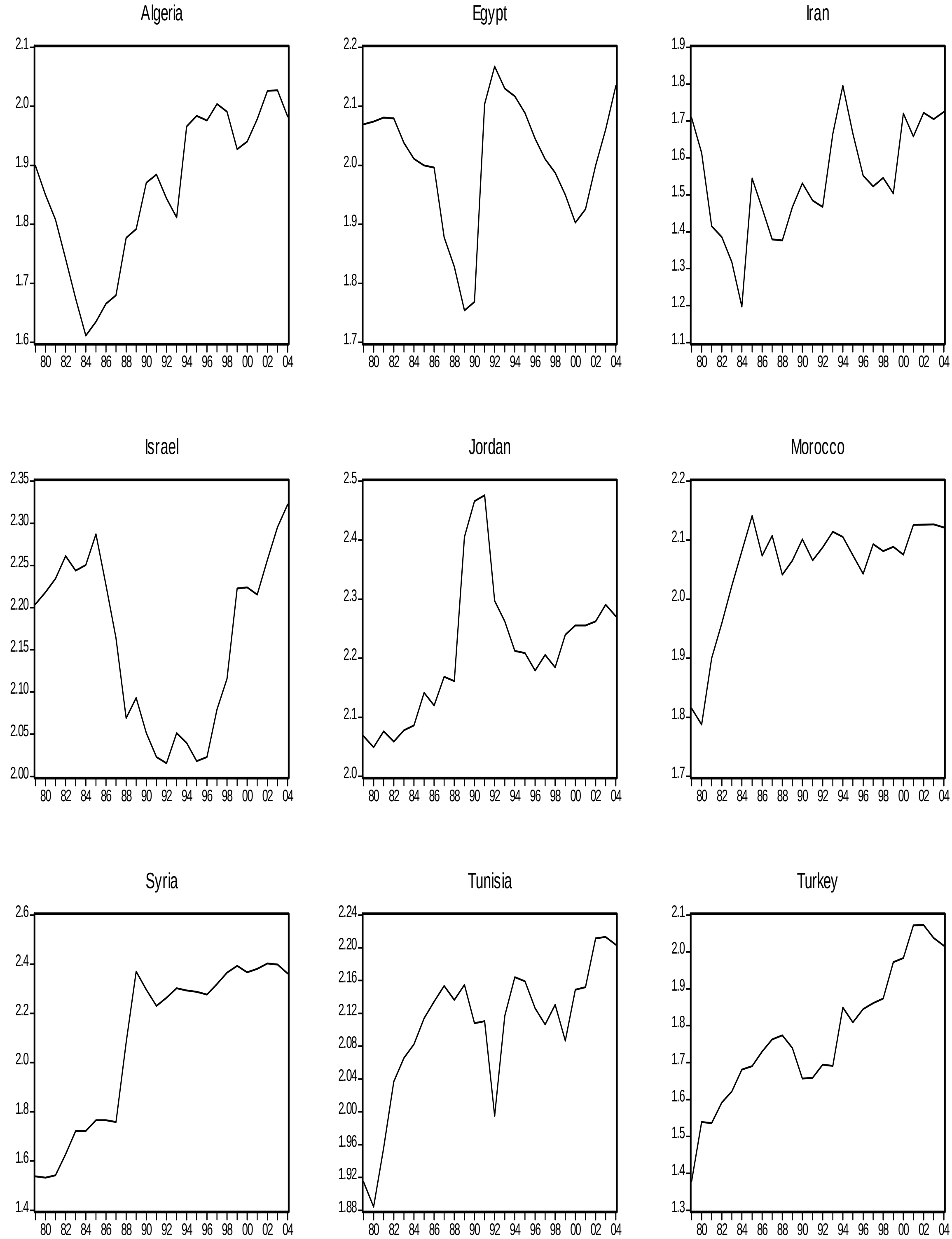
Figure 2. Evolution of International Financial Integration in Emerging Countries, classified by region (1979-2004)



Evolution of International Financial Integration in Asia (1979-2004)



Evolution of International Financial Integration in MENA region (1979-2004)



Sources: our calculations using data from the IMF's International Financial Statistics (IFS, 2006), and World Development Indicators (WDI, 2006)