Real exchange rate volatility, financial crises and exchange-rate regimes

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Abstract

This paper examines real exchange rate (RER) volatility in eighty countries around the world, during the period 1970 to 2011. Two main questions are raised: are structural breaks in RER volatility related to changes in exchange-rate regimes or financial crises? And do these two events affect the permanent and transitory components of RER volatility? To answer them, we employ two complementary procedures that consist in detecting structural breaks in the RER series and decomposing volatility into its permanent and transitory components. Our results suggest that structural breaks in RER volatility coincidence with financial crises and certain changes in nominal exchange-rate regimes. Moreover, our findings confirm that RER volatility does increase with the global financial crises and detect that the more flexible the exchange rate regime, the higher the volatility of the RER using a *de facto* exchange rate classification.

Keywords: Financial Crisis, Structural Breaks, Component-GARCH Model, Real Exchange Rates

JEL Codes: G01, C22, C54, F33

1. Introduction

An important challenge to exchange rate theory is the solution to the puzzle that real exchange rates (RERs) are more volatile than what most models can account for. Moreover, there is a great disagreement in the finance literature about the behaviour of nominal exchange rate volatility under alternative exchange rate arrangements. Flood and Rose (1995) highlight empirically a positive link between exchange rate volatility and flexible exchange rate regimes while Valachy and Kocenda (2003) find either positive or negative link according to the countries under investigation. Friedman (1953) argues that exchange rate volatility cannot be reduced by switching from floating to fixed exchange rates. Lastly, there is a strand of theoretical literature that supports that financial integration may reduce exchange rate volatility (see, for example, Obstfeld, 1984), although the empirical studies on the effects of globalization on exchange rate volatility remain non-conclusive: while Krugman and Obstfeld (2003) showed that globalization lead to exchange rate fluctuations, Hau (2002) and Calderón (2004) find a positive effect of liberalization on the reduction of the RER volatility. Moreover, Dornbusch *et al*. (1995) and De Gregorio *et al.* (2000) suggest that regardless of exchange regimes; financial integration can make countries vulnerable to the external shocks, while Coudert *et al.* (2011) show that, for most countries in their sample, exchange rate volatility increases more than proportionally with the global financial crises. This is especially relevant since, from a historical perspective, financial crises seem to be more like the rule rather than the exception (see Bordo *et al.*, 2001 and Reinhart *et al*., 2010; among others).

Since RER volatility has important implications for consumption, investment, economic growth, and trade flows (see Dellas and Zilberfarb, 1993; Campa and Goldberg, 1995; Darby *et al.*, 1999; Frankel and Rose 2002; Broda and Romalis 2013; and Viera *et al*., 2013, among others), establishing the relative importance of financial crises and exchange-rate regimes on RER volatility is a crucial question.

The majority of the existing literature investigates the effects of exchange rate volatility on a number of macroeconomic variables, e.g. growth (Bagella *et al.*, 2006) or trade (Baum and Caglayan, 2010). However, there is a lack of sufficient studies examining if changes in volatility are driven by changes in nominal exchange-rate regimes or financial crises.

Regarding previous evidence on this issue we can refer, among others, to Kocenda (2005) (who endogenously searches for the single most decisive structural break in exchange rate for a group of European transition countries, detecting breaks that are frequently associated with major changes in exchange rate regime), Balg and Mecalf (2010) (who investigate the impact of the volatility of the underlying macroeconomic fundamentals on exchange rate volatility, concluding that in the long run the volatility of the money supply is the sole determinant, whereas in the short run overshooting is found), Morales-Zumaquero and Sosvilla-Rivero (2010) (who examine the real exchange rate behaviour for a set of 22 OECD and 20 non-OECD countries during the 1960–2006 period, obtaining that there is clear evidence in favour of the non-neutrality of nominal exchange rate regime regarding real exchange rate volatility for developed countries, but not in the case of developing or emerging countries), Carrera and Vuletin (2013) (who examine a dataset for 63 countries over the period 1946–2007 finding that alternative exchange rate regimes affect short-term real exchange rate volatility differently), and Caporale *et. al* (2013) (who find that external, real and monetary shocks can account for the volatility of real exchange rates in emerging economies, with international financial integration being a major driving force).

This paper attempts to contribute to the empirical literature in this area raising two main questions: are structural breaks in RER volatility related to changes in exchange-rate regimes or financial crises? And do these two events affect the permanent and transitory components of RER volatility? To that end, we use a comprehensive data set including developed and developing countries for the 1970-2011 period, to examine whether the choice of exchange rate regime and the occurrence of a financial crisis are associated with structural breaks in RER volatility and whether they affect its permanent and transitory components.

In relation to the relevance of nominal exchange rate regimes and financial crises in explaining structural breaks in RER volatility, we use two econometric methods for testing for structural breaks: the OLS-based tests to endogenously detect multiple structural breaks, as proposed by Bai and Perron (1998, 2003), and several procedures based on Information Criterion together with the so-called sequential procedure suggested by Bai and Perron (2003). Once these structural breaks in RER volatility are detected, we examine if they are associated with major banking, currency and debt crises and whether they coincide with changes in nominal exchange rate regimes.

As for the evaluation of effects of nominal exchange rate regimes and financial crises on RER volatility, we use the component GARCH model proposed by Engle and Lee (1999) to decompose RER volatility into a permanent long-run trend component and a transitory short-run component that is mean-reverting towards the long-run trend.

Our results suggest that structural breaks in RER volatility coincide with financial crises and certain changes in nominal exchange-rate regimes. Moreover, our findings confirm that exchange rate volatility does increase with the global financial crises and suggest that the more flexible the exchange rate regime, the higher the volatility of the RER using a *de facto* exchange rate classification to capture the policies implemented by countries regardless of the regime reported by the country's authorities.

The rest of this paper is structured as follows. Section 2 describes the econometric methodology adopted in this study. Section 3 presents the data and the empirical result, and Section 4 offers some concluding remarks.

2. Econometric Methodology

2.1. Structural Breaks

Bai and Perron (1998, 2003) consider the following multiple linear regression with *m* breaks (*m*+1 regimes):

$$
\begin{aligned}
y_t &= x_t'\beta + z_t'\delta_1 + u_t, \qquad t = 1,\ldots,T_1, \\
y_t &= x_t'\beta + z_t'\delta_2 + u_t, \qquad t = T_1+1,\ldots,T_2, \\
&\vdots \\
y_t &= x_t'\beta + z_t'\delta_{m+1} + u_t, \qquad t = T_m+1,\ldots,T.
\end{aligned}
\tag{1}
$$

In this model, y_t is the observed dependent variable at time t; x_t $(p \times 1)$ and z_t $(q \times 1)$ are vectors of covariates and β and δ_j $(j = 1,...,m+1)$ are the vectors of coefficients, respectively. Finally, u_t is the disturbance at time t. The break points $(T_1,...,T_m)$ are unknown. The purpose is to estimate the unknown regression coefficients and the break points using a sample of T observations.

We consider a pure structural change model $(p = 0)$, where all the coefficients are subject to change, from the model in equation (1). In this sense, we specify each series as an AR(1) process and then, to detect multiple structural breaks in variance, we use the absolute value of the fitted residuals of the AR(1) models[1]. For this analysis we specify $z_t = \{1\}$.

To detect multiple structural breaks, we use the set of tests developed by Bai and Perron (1998, 2003): the sup *F* type test, the double maximum tests *UD*max and *WD*max and the test for ℓ versus $\ell + 1$ breaks, labelled sup $F_T(\ell + 1/\ell)$ test[2]. To run these tests it is necessary to decide the minimum distance between two consecutive breaks, *h*, that it, is obtain as the integer part of a trimming parameter, ε, multiplied by the number of observations *T* (we use $\varepsilon = 0.15$ and allow up to four breaks).

To select the dimension of the models, we follow the method suggested by Bai and Perron (1998) based on the sequential application of the sup $F_T(\ell + 1/\ell)$ test, the sequential procedure.

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[1] Similarly, Stock and Watson (2002) use the absolute value of the fitted residuals of a VAR model to analyse changes in variance. Alternatively, Valentinyi-Endrész (2004) use the squared errors from a AR(1)-GARCH(1,1) model to compute changes in variance.

[2] For further analysis see Bai and Perron (1998, 2003).

2.2. Permanent and Transitory Components

Engle and Lee (1999) proposed a “component-GARCH” (C-GARCH) model to decompose time-varying volatility into a permanent (long-run) and a transitory (short-run) component.

Consider the original GARCH model:

$$\sigma_t^2 = \omega + \alpha(\varepsilon_{t-1}^2 - \omega) + \beta(\sigma_{t-1}^2 - \omega) \tag{2}$$

As can be seen, the conditional variance of the returns here has mean reversion to some time-invariable value, ω. The influence of a past shock eventually decays to zero as the volatility converges to this value ω according to the powers of (α+β). The standard GARCH model therefore makes no distinction between the long-run and short-run decay behavior of volatility persistence.

For the permanent specification, the C-GARCH model replaces the time- invariable mean reversion value, ω, of the original GARCH formulation in equation (2) with a time variable component q_t:

$$q_t = \hat{\omega} + \rho(q_{t-1} - \hat{\omega}) + \varphi(\varepsilon_{t-1}^2 - \sigma_{t-1}^2) \tag{3}$$

where, q_t is the long-run time-variable volatility level, which converges to the long-run time-invariable volatility level $\hat{\omega}$ according to the magnitude of ρ. This permanent component thus describes the long-run persistence behaviour of the variance. The long-run time-invariable volatility level $\hat{\omega}$ can be viewed as the long-run level of returns variance for the relevant sector when past errors no longer influence future variance in any way. Stated differently, the value $\hat{\omega}$ can be seen as a measure of the 'underlying' level of variance for the respective series. The closer the estimated value of the ρ in equation (7) is to one the slower q_t approaches $\hat{\omega}$, and the closer it is to zero the faster it approaches $\hat{\omega}$. The value ρ therefore provides a measure of the long-run persistence.

The second part of C-GARCH model is the specification for the short-run dynamics, the behaviour of the volatility persistence around this long-run time-variable mean, q_t:

$$\sigma_t^2 - q_t = \gamma(\varepsilon_{t-1}^2 - q_{t-1}) + \lambda(\sigma_{t-1}^2 - q_{t-1}) \tag{4}$$

According to this transitory specification, the deviation of the current condition variance from the long-run variance mean at time t $(\sigma_t^2 - q_t)$ is affected by the deviation of the previous error from the long-run mean $(\varepsilon_{t-1}^2 - q_{t-1})$ and the previous deviation of the condition variance from the long-run mean $(\sigma_{t-1}^2 - q_{t-1})$. Therefore, in keeping with its GARCH theoretical background, the C-GARCH specification continues to take account of the persistence of volatility clustering by having the conditional variance as a function of past errors. As the transitory component describes the relationship between the short-run and long-run influence, decline rates of past shocks values of (γ+λ) closer to one imply slower convergence of the short-run and long-run influence decline rates, and values closer to zero the opposite. The value (γ+λ) is therefore a measure of how long this short-run influence decline rate is.

3. Data and Empirical Results

3.1. Data

We use monthly data of eighty bilateral real exchange rates against United States dollar, from January 1970 to December 2011[3], taken from the International Monetary Fund's International Financial Statistics and the Federal Reserve Board's Financial Statistics.[4] We consider six sets of countries: American countries (Canada, Mexico, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Dominican Republic, Jamaica, Trinidad and Tobago, Argentina, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela); European countries (European Union-12[5], Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Ireland, Netherlands, Portugal, Spain, Sweden, United Kingdom, Czech Republic, Hungary, Poland, Norway, Russia, Switzerland and Turkey); Middle East countries (Israel, Jordan, Kuwait, Syria, Saudi Arabia); Oceania countries (Australia and New Zealand); Asian countries (Bangladesh, India, Indonesia, Malaysia, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, China, Hong Kong, Japan, Korea and Taiwan) and African countries (Algeria, Egypt, Morocco, Tunisia, Benin, Cameroon, Congo, Cote d'Ivoire, Ghana, Kenya, Mozambique, Nigeria, Senegal, Sierra Leone, South Africa, Tanzania and Zambia).

All real exchange rate series have been corrected of outliers following the methodology developed by Gómez and Maravall (1996).[6]

[3] The sample size for Nicaragua covers the period 1988:1-2011:12.
[4] Data collected by Mathew Shane, Economic Research Service, United States Department of Agriculture.
[5] The European Union (EU) was established on 1 November 1993 with 12 Member States (Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain and United Kingdom). Their number has grown to the present 28 through a series of enlargements In our analysis we use the original EU-12 as an additional "country".
[6] We have made computations using the Program TSW.

Given that the countries in our sample present different exchange rate regimes that can change under the period studied, we have used the "natural fine classification" of Reinhart and Rogoff (2004), updated to December 2010 by Ilzetzki, Reinhart and Rogoff (2011), to distinguish between a wide range of *de facto* regimes: 1) no separate legal tender; 2) pre announced peg or currency board arrangement; 3) pre announced horizontal band that is narrower than or equal to ±2%; 4) *de facto* peg; 5) pre announced crawling peg; 6) pre announced crawling band that is narrower than or equal to ±2%; 7) *de factor* crawling peg; 8) *de facto* crawling band that is narrower than or equal to ±2%; 9) pre announced crawling band that is wider than or equal to ±2%; 10) *de facto* crawling band that is narrower than or equal to ±5%; 11) moving band that is narrower than or equal to ±2% (i.e., allows for both appreciation and depreciation over time); 12) managed floating; 13) freely floating; 14) freely falling; 15) dual market in which parallel market data is missing.

As the tables in Ilzetzki, Reinhart and Rogoff (2011) provide monthly data until December 2010, we can identify the exact date of the change of regime. For 2011, we assume that there is not modification in the exchange rate regime.

Regarding the financial crisis dates, we make use of the information provided by Laeven and Valencia (2008) and Reinhart (2010). The former covers all systemically important banking, currency and debt crises (hereafter SBC, CC and DC, respectively) for the period 1970 to 2007 for 261 countries, while the later offers the individual timeline of public and private debts, banking, sovereign domestic and external debt crises , and hyperinflation, for 70 countries, from their independence to 2010.

3.2. Empirical Results

3.2.1. Structural Breaks Results

Tables 1a-f present the detected numbers and dates of structural breaks[7] and their connection with an economic event for our examined set of countries. Recall that these breaks are searched endogenously from the data and our procedure does not rely on pre-test information to determine them, thereby avoiding the possible problem of "data mining".

To facilitate the interpretation of Tables 1a-f, we have indicated with an arrow if volatility increases (↑) or decreases (↓) after the structural break identified as crisis episodes (i.e., systematic banking crisis, SBC; currency crisis, CC and debt crisis, DC). As for the breakpoints associated with variations in the exchange rate regime (nominal exchange regime change, NERc), we have used the same convention, so an arrow pointing downwards (↓) would indicate the volatility decreases and an arrow pointing upwards (↑) would indicate the volatility decreases. Additionally, ↑* indicates the volatility increases when the nominal exchange rate goes from a more fixed regime to a more flexible one and ↓* indicates the volatility decreases when the nominal exchange rate goes from a more flexible regime to a more fixed one. Moreover, in Tables 1a-f, there is a set of breaks that can be associated with specific economic events of each examined country (that we have denoted as country specific events, CSE).

[Tables 1a-f, here]

[7] In order to save space, the numerical results of Bai and Perron's tests are not reported in Table 1 but they are available upon request.

All in all, findings from our structural breaks analysis suggest several empirical regularities[8]. First, our results seem to indicate that exchange rate regimes do really matter, as we obtain evidence in favour of nominal regimes affecting RER variation. Second, we detect, in almost all cases that the more flexible the exchange rate regime, the higher the volatility of the RER, as well as an increase in RER volatility after a financial crisis in almost all cases. Third, we document an alteration in the nominal exchange rate regime towards a more flexible one after the event of a crisis.[9] This result is in line with that of Fornaro (2011)'s, who claims the superiority of flexible exchange rate regimes compared to pegs both for the purpose of crisis times stabilization and as crises prevention devices. Finally, while two of the strongest financial crises, the Russian and Asian financial crises, have been detected using the procedure by Bai and Perron (1998, 2003), there is no evidence of a significant change in RER volatility around 2007 or 2008 capturing the recent global financial crisis. This could be related to the fact that various countries made have interfered in foreign exchange markets (using intervention and capital controls) to restrain tensions in the foreign exchange markets (see, e. g., Deutsche Bundesbank, 2010). Nevertheless, it is worth noting that institutional idiosyncrasies or major economic events are still at play, given the heterogeneity of break points detected across countries associated with country specific events. The reason for this heterogeneity is reserved for future research.

[8] We summarize the results by pointing out the main regularities. The reader is asked to browse through Tables 1a to f to find evidence for particular countries or group of countries of her/his special interest and the respective estimated break points. A more detailed account of the results by groups of countries can be found in Morales-Zumaquero and Sosvilla-Rivero (2012).

[9] Except for in Malaysia, Egypt and Senegal.

3.2.2. Permanent and Transitory Components Results

Tables 2a-f report coefficient estimates for the C-GARCH models obtained by maximum likelihood for each real exchange rate. Table 3 exhibits a summary of results with the numbers and percentages of significant coefficient estimates.

From these tables empirical results suggest a central message: evidence in favour that there exists a permanent-transitory component decomposition for our set of real exchange rates[10]. In addition, in order to evaluate the empirical relevance of our analysis, we compare the performance of the C-GARCH model to the GARCH model. It is worth noting that the C-GARCH model reduces to the GARCH (1, 1) model either $\hat{\omega} = \hat{\rho} = 0$ or $\hat{\gamma} = \hat{\lambda} = 0$. On the basis of Wald tests on these coefficients, we can see the null hypothesis is decisively rejected in almost all cases in favour of C-GARCH specification over the GARCH(1,1) specification, giving further support for our specification strategy.

[Table 2a-f, here]

[Table 3, here]

From visual inspection of figures plotting the estimated of the total conditional variance and its two components (permanent and transitory), of the monthly difference in real exchange rate for all countries under study, two regularities seem to appear[11]: (1) there is a change in volatility when a financial crisis occurs: sometimes the permanent

[10] This is the main regularity. The reader is asked to browse through Tables 2a to f and Table 3 to find evidence for particular countries or group of countries of her/his special interest. A more detailed account of the results by groups of countries can be found in Morales-Zumaquero and Sosvilla-Rivero (2012).

[11] To save space, we do not show here these figures. They are available in Morales-Zumaquero and Sosvilla-Rivero (2012).

component has smooth movements around the total GARCH volatility while the transitory component raises and other times the three volatilities (the total GARCH permanent and transitory) move together during a financial crisis; and (2) it looks that the transitory component is much more volatile, responding largely to economic events. Taken together, these findings imply that during financial crises, exchange rates are determined not only by traditional factors but also, to a major extent, by subjective perception of market participants.

Finally, and in line with Sarno and Valente (2006), a pattern seems to emerge relating countries with long periods of fixed exchange rate regimes and higher degree of persistence in RER volatility.

[Figures 1 to 6, here]

We further analyse the connection between the behaviour of the permanent-transitory components with both the occurrence of a change in the nominal exchange rate regime and the existence of a SBC and/or a CC and/or a DC. Tables 4a-e and 5a-e show the results. In the first column of Tables 4a-e we present the dating of financial crises using the information provided by Laeven and Valencia (2008) and Reinhart (2010). In the first column of Tables 5a-e we present the structural breaks associated with a change in the nominal exchange rate regime. In the second column of Tables 4 and 5, we present the results of three variance equality tests (VET): the Bartlett test, the Levene test and the Brown-Forsythe test.[12]

[12] For details see Sokal and Rohlf (1995), Levene (1960), Conover, *et al.* (1981), Brown and Forsythe (1974a, 1974b) and Neter, *et al.* (1996).

[Tables 4a-e, here]

[Tables 5a-e, here]

All in all, findings indicate that RER volatility change when there is a variation in the nominal exchange rate and after the occurrence of a financial crisis. Indeed, we observe that for almost all countries, and in almost all variations in the nominal exchange rate regime and financial crises, volatility equality tests reject the null hypothesis of equal variances. It is worth noting that for the European Union countries, there is some evidence in favour of a change in RER volatility during the recent global crisis in the cases of Belgium (a country with a high public debt to GDP ratio) and Spain (a country with a high deficit/GDP ratio).

To gain further insights in the behaviour of the permanent and transitory components of the conditional variance, we examine the correlation coefficients between each series. The results, not shown here to save space but available from the authors upon request, suggest a limited degree of co-movement for the permanent components in all countries under study (with low correlation coefficients) and a still weaker correlations between the transitory components. There is only evidence of relevant correlations between the permanent components for European Union countries, suggesting the existence of some degree of commonality between them. This could be reflecting the closer economic and monetary cooperation between European countries that formally started in 1979 with the ERM and culminated in 1999 with the introduction of a single currency and a common monetary policy.

4. Concluding Remarks

Real exchange rate (RER) volatility is an issue of great importance to both businesses and policymakers. Empirical evidence of the existence of structural breaks in financial time series made this area of research very active in the recent years. Much of attention in the literature has been given to structural breaks in volatility, which imply changes in the risk behaviour of investors due to important financial events, such as the 1987 stock market crash, the dot-com bubble in 1995-2000 and the subprime mortgage crisis.

The purpose of our paper has been to contribute to the debate on a possible relationship between structural breaks in RER volatility and changes in exchange-rate regimes or financial crises. To that end, using data for the period 1970 to 2011, we have first examined the instability in terms of multiple structural breaks in the variance in the time series of eighty countries compromising American, European, Middle East, Oceania, Asian and African countries. In particular, we have presented the results of applying two alternative procedures for searching endogenously without using a priori information: the OLS-based tests to detect multiple structural breaks, proposed by Bai and Perron (1998, 2003) and several procedures based on Information Criterion joint with the so called sequential procedure suggested by Bai and Perron (2003). We then employ the component GARCH model proposed by Engle and Lee (1999) to decompose volatility into a permanent long-run trend component and a transitory short-run component that is mean-reverting towards the long-run trend.

The main results are as follows. Firstly, we found substantial evidence of structural breaks in volatility across investigated RER. Secondly, there is high heterogeneity between series regarding the dates in which the break points are located, although major financial crises seem to coincide with most of them. Thirdly, and in line with previous empirical research, we document higher RER volatility under flexible exchange rate regimes using a de facto exchange rate classification to correct for possible inconsistencies between the commitment of the central bank and its observed behaviour. This finding could be related to the relative sluggishness in price adjustment see- e. e. g, Mussa, 1986; Baxter and Stockman 1989; Flood and Rose, 1995; Ghosh et al. 1997; Liang 1998) or could derived from a greater incidence of real and nominal shocks under flexible regimes (see Stockman 1983; Grilli and Kaminsky 1991; Clarida and Gali 1994; and Rogers 1999, among others). Finally, the decomposition of total volatility into its components suggest that the permanent component tracks total RER volatility reflecting the evolution of fundamental factors and the transitory component responds largely to market expectations, rising during the detected structural breaks.

Finally, regarding financial crisis, our results suggest that, in a context of increasing interconnectedness of financial institutions and markets, RER volatility is exacerbated during crisis periods.

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Table 1a. Structural Breaks in Volatility: Real Exchange Rates, America

Period: 1/1970-12/2011 **Specifications:** $z_t = \{1\}$ $q = 1$ $p = 0$ $\varepsilon = 0.15$ $m = 4$

	SP[a]	Dates and Explanation[b]
North		
Canada	2	Jun 1976: CSE; Nov 2002: NERc ↑*[c]
Mexico	3	Apr 1981:NERc↑*, SBC[b]↑,DC↑; Mar 1988: NERc↓; Dec 1994: NERc↑*, SBC↑
Central		
Costa Rica	2	Jul 1977: CSE; Nov 1983: NERc↓*
El Salvador	2	Sep 1984: CSE; Jun 1993: CSE
Guatemala	1	Jan 1995: CSE
Honduras	3	Aug 1980: CSE Mar 1990:NERc↑*, CC ↑; Dec 1998: NERc↓*
Nicaragua	2	Feb 1992: NERc ↓* Jul 1998: CSE
Panama	1	Dec 1992: CSE
Caribbean		
Dominican Republic	3	Jan 1985: NERc↑*, CC ↑; Aug 1991: NERc↓ *; Jan 2005: NERc↓*
Jamaica	2	Jan 1983: NERc↑*, CC↑; Jul 1996: NERc↓*, SBC↓
Trinidad Tobago	1	May 1976: NERc↓*
South		
Argentina	3	Feb 1981: NERc↑*, SBC↑; Mar 1991: NERc ↓*; Oct 2001: NERc↑*, SBC↑, DC↑
Brazil	1	Jul 1982: CC↑
Chile	2	Jun 1976: NERc↓*, SBC↓; Jan 2001: CSE
Colombia	1	Jan 1994: NERc↑*;
Ecuador	2	Mar 1982: NERc↑*, SBC↑, CC↑, DC↑; Apr 2001: NERc↓*
Paraguay	3	Mar 1985: NERc↑* ; Jan 1991: NERc ↓* ; Mar 2002: CC↑
Peru	3	Oct 1977: NERc↑* ; Aug 1986: NERc ↑* ; Jan 1990: CSE
Uruguay	1	Jun 1976: CSE
Venezuela	2	Jun 1978: SBC↑; Nov 1986: NERc↑*

Notes

a. SP: number of structural breaks selected by the sequential procedure by Bai and Perron (1998, 2003).

b. NERc: Nominal exchange rate regime change; SBC: Systematic Banking Crisis; CC: Currency Crisis; DC: Debt Crisis; CSE: Country Specific Event.

c. ↑ indicates the volatility increases and ↓ indicates the volatility decreases after the structural break identified as crisis episodes.

d. ↑* indicates the volatility increases when the nominal exchange rate goes from a more fixed regime to a more flexible one and ↓* indicates the volatility decreases when the nominal exchange rate goes from a more flexible regimen to a more fixed one.

Table 1b. Structural Breaks in Volatility: Real Exchange Rates, Europe

Period: 1/1970-12/2011 **Specifications:** $z_t = \{1\}$ $q = 1$ $p = 0$ $\varepsilon = 0.15$ $m = 4$

	SP[a]	Dates and Explanation[b]
European Union		
EU-12	2	Jan 1980: NERc↑* ; Sep 1992: EMSC
Austria	2	Jul 1980: NERc ↑ ; Sep 1992: EMSC
Belgium	2	Jan 1980: CSE; Sep 1992: EMSC
Denmark	2	Jan 1980: NERc↑ ; Sep 1992: EMSC
Finland	2	Jan 1980: CSE; Sep 1992: EMSC
France	2	Mar 1979: NERc↑; Sep 1992: EMSC
Germany	2	Jan 1980: CSE; Sep 1992: EMSC
Greece	1	Jul 1981: NERc↑*;
Italy	2	Jan 1980: CSE; Sep 1992: EMSC
Ireland	2	Mar 1979: NERc ↑* ; Sep 1992: EMSC
Netherlands	2	Jan 1980: CSE; Sep 1992: EMSC
Portugal	1	Aug 1993: NERc ↓*;
Spain	1	Apr 1978: SBC↑*;
Sweden	1	Dec 1991: SBC↑*;
United Kingdom	3	Apr 1979: CSE; Sep 1992: EMSC, NERc↑* ; Mar 2003:CSE
Central and Eastern		
Czech Republic	2	Aug 1981: NERc ↑*; Mar 1994: NERc↑*
Hungary	2	Jun 1979: NERc↓* ; Aug 2005: NERc↓*
Poland	1	Oct 1977: NERc↑*
Others		
Norway	1	Sep 1980: CSE
Russia	4	Aug 1981: CSE; Jan 1992: NERc↑*; Aug 1998: NERc↑*, RFC ↑; Aug 2005:NERc↑*
Switzerland	2	Jul 1977: CSE; Sep 1993: CSE
Turkey	2	Jun 1994: CSE; Sep 2000: SBC↑*

Notes

a. SP: number of structural breaks selected by the sequential procedure by Bai and Perron (1998, 2003).

b. NERc: Nominal exchange rate regime change; RFC: Russian Financial Crisis; SBC: Systematic Banking Crisis; CC: Currency Crisis; DC: Debt Crisis; EMSC: European Monetary System Crisis; CSE: Country Specific Event.

c. ↑ indicates the volatility increases and ↓ indicates the volatility decreases after the structural break identified as crisis episodes.

d. ↑* indicates the volatility increases when the nominal exchange rate goes from a more fixed regime to a more flexible one and ↓* indicates the volatility decreases when the nominal exchange rate goes from a more flexible regimen to a more fixed one.

Table 1c. Structural Breaks in Volatility: Real Exchange Rates, Middle East

Period: 1/1970-12/2011 **Specifications:** $z_t = \{1\}$ $q = 1$ $p = 0$ $\varepsilon = 0.15$ $m = 4$

	SP[a]	Dates and Explanation[b]		
Israel	3	Oct 1977: NERc↑*, SBC ↑;	Oct 1992: CSE;	Nov 2001: CSE
Jordan	3	Feb 1975: NERc↑*; Aug 1995: NERc↓*	Feb 1990: NERc↓*, SBC↓, CC↓, DC↓;	
Kuwait	1	Sep 1992: CSE		
Syria	1	Oct 2004: CSE		
Saudi Arabia	3	Sep 1978: CSE	Jun 1989: CSE	Dec 2003: CSE

Notes
a. SP: number of structural breaks selected by the sequential procedure by Bai and Perron (1998, 2003).
b. NERc: Nominal exchange rate regime change; SBC: Systematic Banking Crisis; CC: Currency Crisis; DC: Debt Crisis; CSE: Country Specific Event.
c. ↑ indicates the volatility increases and ↓ indicates the volatility decreases after the structural break identified as crisis episodes.
d. ↑* indicates the volatility increases when the nominal exchange rate goes from a more fixed regime to a more flexible one and ↓* indicates the volatility decreases when the nominal exchange rate goes from a more flexible regimen to a more fixed one.

Table 1d. Structural Breaks in Volatility: Real Exchange Rates, Oceania

Period: 1/1970-12/2011 **Specifications:** $z_t = \{1\}$ $q = 1$ $p = 0$ $\varepsilon = 0.15$ $m = 4$

	SP[a]	Dates and Explanation[b]
Australia	1	Nov 1982: NERc↑*
New Zealand	1	Mar 1985: NERc ↑*

Notes
a. SP: number of structural breaks selected by the sequential procedure by Bai and Perron (1998, 2003).
b. NERc: Nominal exchange rate regime change; SBC: Systematic Banking Crisis; CC: Currency Crisis; DC: Debt Crisis; CSE: Country Specific Event.
c. ↑ indicates the volatility increases and ↓ indicates the volatility decreases after the structural break identified as crisis episodes.
d. ↑* indicates the volatility increases when the nominal exchange rate goes from a more fixed regime to a more flexible one and ↓* indicates the volatility decreases when the nominal exchange rate goes from a more flexible regimen to a more fixed one.

Table 1e. Structural Breaks in Volatility: Real Exchange Rates, Asia

Period: 1/1970-12/2011 **Specifications:** $z_t = \{1\}$ $q = 1$ $p = 0$ $\varepsilon = 0.15$ $m = 4$

	SP[a]	Dates and Explanation[b]
South		
Bangladesh	3	Mar 1976: CC↑; Oct 1982: CSE; Jul 1994: CSE
India	3	Jul 1979: NERc ↓*; Jan 1999: AFC ↑ *; Dec 2004: NERc↑*
Indonesia	4	Mar 1976: CSE; Apr 1985: CSE Jul 1997: NERc↑*,AFC (SBC)↑; Aug 2003: CSE
Malaysia	2	Jul 1998: NERc↑*, AFC (CC) ↑ ; Jul 2005: CSE
Pakistan	1	Jun 1982: NERc↓
Philippines	1	Jul 1997: NERc↑*, AFC (SBC) ↑
Singapore	1	Jul 1997: AFC↑*
Sri Lanka	3	Nov 1981: NERc ↓*; Sep 1989: NERc↑, SBC↑; Dec 2004: CSE
Thailand	1	Jul 1997: NERc, AFC (SBC, CC) ↑
North		
China	4	Aug 1977: CSE; Dec 1984: CSE; Jan 1994: NERc ↓*; Jun 2005: CSE
Hong Kong	2	Jun 1977: CSE; Oct 1983: NERc↓*
Japan	2	Nov 1977: NERc ↑*; Jan 2000: CSE
Korea	2	Nov 1985: SBC ↓; Nov 1997: NERc↑*, AFC (SBC) ↑
Taiwan	1	Jul 1985: CSE

Notes

a. SP: number of structural breaks selected by the sequential procedure by Bai and Perron (1998, 2003).

b. NERc: Nominal exchange rate regime change; AFC: Asian Financial Crisis; SBC: Systematic Banking Crisis; CC: Currency Crisis; DC: Debt Crisis; CSE: Country Specific Event.

c. ↑ indicates the volatility increases and ↓ indicates the volatility decreases after the structural break identified as crisis episodes.

d. ↑* indicates the volatility increases when the nominal exchange rate goes from a more fixed regime to a more flexible one and ↓* indicates the volatility decreases when the nominal exchange rate goes from a more flexible regimen to a more fixed one.

Table 1f. Structural Breaks in Volatility: Real Exchange Rates, Africa

Period: 1/1970-12/2011 **Specifications:** $z_t = \{1\}$ $q=1$ $p=0$ $\varepsilon = 0.15$ $m=4$

	SP[a]	Dates and Explanation[b]		
North				
Algeria	2	Oct 1980: CSE;	Mar 1994: NERc↓, CC↓	
Egypt	3	Jan 1979: CC↑	May 1984: DC ↑	Oct 1991: NERc↓*, SBC↓
Morocco	0			
Tunisia	0			
Subshaharan				
Benin	1	Dec 1979: CSE		
Cameroon	2	Aug 1980: CSE;	Dec 1994: NERc↓*	
Congo	1	Mar 1976: NERc↑*, CC↑		
Cote d'Ivoire	1	Mar 1994: CC↓		
Ghana	3	Nov 1976: CSE;	Sep 1987: NERc↓ *;	Aug 2000: CC↓
Kenya	1	Dec 1978: NERc↑*;		
Mozambique	3	May 1976: CSE;	Nov 1987: SBC↑, CC↑;	Feb 1996: CSE
Nigeria	3	Sep 1984: NERc↑;	Mar 1996: NERc↓*, CC ↓;	Jul: 2005: CSE
Senegal	1	Nov 1994: NERc↓*, CC↓		
Sierra Leone	2	May 1983: CC↑ ;	Feb 1990: SBC↓, CC↓	
South Africa	2	Jan 1979: NERc↑;	Nov 1989: SBC↑	
Tanzania	2	Jan 1979: NERc↑;	May 2001: CSE	
Zambia	3	Jul 1976: NERc↑* ;	Jul 1983: NERc↑*;	Apr 1995: SBC↓, CC↓

Notes

a. SP: number of structural breaks selected by the sequential procedure by Bai and Perron (1998, 2003).

b. NERc: Nominal exchange rate regime change; SBC: Systematic Banking Crisis; CC: Currency Crisis; DC: Debt Crisis; CSE: Country Specific Event.

c. ↑ indicates the volatility increases and ↓ indicates the volatility decreases after the structural break identified as crisis episodes.

d. ↑* indicates the volatility increases when the nominal exchange rate goes from a more fixed regime to a more flexible one and ↓* indicates the volatility decreases when the nominal exchange rate goes from a more flexible regimen to a more fixed one.

Table 2a. Volatility C-GARCH Model Estimates: America

	Permanent Component				Transitory Component			Wald Tests[c]	
	$\hat{\omega}$	$\hat{\rho}$	$\hat{\varphi}$	LR half life[b]	$\hat{\gamma}$	$\hat{\lambda}$	SR half life	$\hat{\rho}=\hat{\varphi}=0$	$\hat{\gamma}=\hat{\lambda}=0$
North									
Canada	0.0009 (0.102)[a]	0.999* (165.9)	0.016 (1.529)	692	0.132* (2.118)	0.162 (0.443)	0.56	29006.13*	5.993**
Mexico	0.001*** (1.6)	0.997* (609.9)	-0.007 (-0.728)	231	0.440* (5.884)	0.366* (5.949)	3.21	523465.4*	169.03*
Central									
Costa Rica	0.0002 (1.198)	0.977* (47.292)	0.190* (3.572)	29.78	0.291* (4.263)	0.009 (0.073)	0.57	3310.08*	18.47*
El Salvador	0.0001* (3.450)	0.939* (40.917)	0.186* (4.315)	11.01	-0.014* (-2.035)	-0.976* (-61.57)	69	1674.48*	7573.22*
Guatemala	0.0002* (6.157)	0.908* (19.063)	0.118* (2.020)	7.18	0.079 (1.006)	0.112 (0.154)	0.42	460.02*	1.029
Honduras	0.00007* (3.26)	0.970* (59.382)	0.098* (3.273)	22.75	0.167* (2.766)	-0.220 (-0.819)	0.23	3840.99*	3840.99*
Nicaragua	0.0002* (2.143)	0.940* (48.728)	-0.557* (-2.742)	11.20	0.846* (5.681)	0.084 (0.173)	10	37730.76*	1138332*
Panama	0.00002* (7.76)	0.962* (42.323)	0.017 (0.969)	17.89	0.196* (2.583)	0.142 (0.653)	0.64	1878.95*	7.89**
Caribbean									
Dom. Rep.	0.006 (0.083)	0.997* (40.650)	0.272* (8.033)	231	-0.019 (-1.332)	-0.914* (-17.69)	9.84	2011.62*	785.70*
Jamaica	0.0002* (3.670)	0.754* (2.831)	0.904 (0.290)	2.45	-0.469 (-0.152)	1.063 (0.286)	1.33	109.18*	14.63*
Trinidad T.	0.0001* (3.262)	0.962* (53.658)	0.128* (2.751)	17.89	0.035 (0.571)	0.578 (0.812)	1.42	3033.75*	0.83
South									
Argentina	0.022 (0.089)	0.997* (40.598)	0.284* (6.558)	231	0.105* (1.794)	-0.521*** (-1.7)	0.79	3846.65*	17.30*
Brazil	0.001 (0.411)	0.999* (484.09)	0.159* (8.340)	692	0.075 (0.043)	0.436 (1.012)	1.03	23582.1*	4.80***
Chile	-0.001 (0.614)	0.999* (20756)	-0.004* (-24.44)	692	0.156* (11.42)	0.756* (35.39)	7.52	590000*	27941.80*
Colombia	0.004 (0.204)	0.999* (219.23)	0.119* (3.637)	692	0.472* (6.486)	0.026 (0.222)	0.99	53920*	46.94*
Ecuador	0.003 (0.742)	0.999* (2134.4)	0.221* (5.564)	692	0.241* (5.001)	-0.053 (-0.392)	0.41	4559045*	40.54*
Paraguay	0.0006* (3.523)	0.963* (50.87)	0.087* (3.365)	18.38	0.189* (3.141)	0.144 (0.671)	0.63	2638.90*	12.19*
Peru	0.004 (0.213)	0.999* (223.06)	0.321* (8.204)	692	0.353* (7.626)	0.192* (1.850)	1.14	52811.58*	116.45*
Uruguay	0.013 (0.218)	0.998* (190.84)	0.263* (9.007)	346	0.023 (1.451)	-0.932* (-18.16)	7.26	36884.18*	811.56*
Venezuela	-0.003 (-0.260)	0.999* (213.14)	0.213* (4.122)	692	0.387* (5.688)	0.111 (0.765)	0.99	55512.98*	32.49*

Notes: a. Parentheses are used to indicate z-statistics. *, **, *** indicate significance at 1%, 5% and 10%, respectively.

b. The long-run and short-run half-lives are measured using the following formulae: $LR_{HL}(\hat{\rho}) = Ln(1/2)/Ln(\hat{\rho})$ and $SR_{HL}(\hat{\gamma}+\hat{\lambda}) = Ln(1/2)/Ln(\hat{\gamma}+\hat{\lambda})$.

c. Wald tests on coefficient restrictions are Chi-square statistics with 2 degrees of freedom.

Table 2b. Volatility C-GARCH Model Estimates: Europe

	Permanent Component				Transitory Component			Wald Tests[c]	
	$\hat{\omega}$	$\hat{\rho}$	$\hat{\varphi}$	LR half life[b]	$\hat{\gamma}$	$\hat{\lambda}$	SR half life	$\hat{\rho}=\hat{\varphi}=0$	$\hat{\gamma}=\hat{\lambda}=0$
European Union									
EU-12	0.0008* (2.64)[a]	0.981* (91.89)	0.075* (3.38)	36	0.063 (1.037)	-0.209 (-0.297)	0.36	8476.96*	1.30
Austria	0.0007* (9.727)	0.980* (187.22)	-0.009 (-0.222)	34	0.053 (1.349)	0.877* (10.55)	9.55	35084.91*	112.48*
Belgium	0.0007* (6.997)	0.972* (119.90)	0.027** (1.742)	24.40	0.089 (1.352)	-0.138 (-0.349)	0.23	14718.09*	2.08
Denmark	0.0007* (6.998)	0.983* (195.02)	0.007 (0.282)	40.42	0.052*** (1.64)	0.8405* (5.222)	6	38049.57*	38.33*
Finland	0.003 (1.169)	0.999* (930.48)	0.033* (3.526)	692	0.105* (4.328)	-0.838* (-10.94)	2.24	894369.1*	254.39*
France	0.004* (3.541)	0.999* (3624.8)	0.087* (5.057)	692	0.100* (2.968)	-0.526* (2.133)	0.81	13210952*	24.34*
Germany	0.0007* (9.154)	0.980* (167.26)	-0.009 (-0.287)	34.30	0.073* (2.111)	0.844* (12.143)	8	28339.69*	150.54*
Greece	0.0007* (50.71)	0.989* (1782.5)	-0.032* (-28.12)	62.66	0.086* (2.780)	0.710* (5.452)	3	48651090*	80.59*
Italy	0.0009* (101.1)	0.992* (45802)	-0.030* (-8.193)	86.29	0.134* (3.258)	0.593* (4.415)	2.17	12400000*	106.12*
Ireland	0.0007* (2.838)	0.980* (77.84)	0.072* (3.026)	34	-0.093** (-1.74)	0.227 (0.371)	0.34	6086.87*	3.27
Netherlands	0.0007* (7.988)	0.982* (192.82)	0.003 (0.154)	38.16	0.078** (1.707)	0.763* (3.648)	4	37502.63*	52.05*
Portugal	0.0007* (7.756)	0.973* (48.32)	0.013 (0.862)	25.32	0.185* (2.755)	-0.116 (-0.594)	0.25	2335.74	7.89**
Spain	0.0008* (33.13)	0.992 (6243.3)	-0.015* (-3.29)	86.29	0.147* (2.673)	-0.020 (-0.114)	0.33	39298467*	7.17**
Sweden	0.0007* (10.55)	0.983* (263.44)	0.002 (0.331)	40	0.206* (3.624)	-0.160 (-0.947)	0.22	70547.28*	15.47*
United K.	0.0007* (4.948)	0.976* (89.56)	0.037* (1.854)	28.53	0.243* (3.656)	-0.004 (-0.020)	0.48	8200.69*	13.45*
Central and Eastern									
Czech Rep.	0.0005 (0.320)	0.999* (549.64)	0.165* (7.638)	692	0.040 (1.045)	-0.828* (-4.176)	2.9	319447.7*	45.11*
Hungary	0.005* (3.554)	0.998* (3268)	0.053* (4.615)	346	0.160* (4.485)	-0.651* (-5.207)	0.95	11139857	191.53*
Poland	0.003* (1.980)	0.999* (1174.6)	0.090* (10.733)	692	0.258* (7.496)	-0.035 (-0.228)	0.46	1380914	56.40*
Others									
Norway	0.0006* (8.443)	0.966 (84.18)	0.013 (0.643)	20	0.191* (3.415)	0.310*** (1.62)	1	7722.33*	20.79*
Russia	0.0004*** (1.6)	0.928* (23.91)	0.306* (2.073)	9.27	0.394* (4.930)	0.394* (4.930)	0.58	729.12*	25.47*
Switzerland	0.0008* (9.557)	0.975* (134.66)	0.013 (1.316)	27.37	0.057 (1.455)	-0.766* (-3.607)	2	20275.78*	28.02*
Turkey	0.001* (13.47)	0.445 (0.195)	-0.913 (-0.011)	0.85	1.194 (0.014)	-0.802 (-0.010)	0.74	3.75	3.35

Notes: a. Parentheses are used to indicate z-statistics. *, **, *** indicate significance at 1%, 5% and 10%, respectively.

b. The long-run and short-run half-lives are measured using the following formulae: $LR_{HL}(\hat{\rho}) = Ln(1/2)/Ln(\hat{\rho})$ and $SR_{HL}(\hat{\gamma}+\hat{\lambda}) = Ln(1/2)/Ln(\hat{\gamma}+\hat{\lambda})$.

c. Wald tests on coefficient restrictions are Chi-square statistics with 2 degrees of freedom.

Table 2c. Volatility C-GARCH Model Estimates: Middle East

	Permanent Component				Transitory Component			Wald Tests[c]	
	$\hat{\omega}$	$\hat{\rho}$	$\hat{\varphi}$	LR half life[b]	$\hat{\gamma}$	$\hat{\lambda}$	SR half life	$\hat{\rho} = \hat{\varphi} = 0$	$\hat{\gamma} = \hat{\lambda} = 0$
Israel	0.0004* (5.54)[a]	0.908* (21.74)	0.262 (1.116)	7.18	-0.238 (-1.047)	1.018* (2.949)	2.79	1365.24*	135.78*
Jordan	0.0002* (4.21)	0.977* (122.03)	0.067* (2.066)	29.78	0.046 (0.895)	0.572 (0.885)	1.44	18709.23*	3.05
Kuwait	0.0002* (5.62)	0.977* (173.33)	0.041* (2.629)	29.78	0.139* (3.602)	-0.609* (-3.682)	0.91	32396.31*	61.61*
Syria	0.0004* (17.8)	0.547 (0.268)	0.0122 (0.164)	1.15	0.134 (0.066)	-0.504* (-5.340)	0.70	1.37	272.06*
Saudi Arabia	0.00005 (1.31)	0.979* (45.98)	0.158 (1.288)	32.66	0.034 (1.288)	-0.949* (-16.34)	7.80	2223.80*	853.06*

Notes: a. Parentheses are used to indicate z-statistics. *, **, *** indicate significance at 1%, 5% and 10%, respectively.

b. The long-run and short-run half-lives are measured using the following formulae: $LR_{HL}(\hat{\rho}) = Ln(1/2)/Ln(\hat{\rho})$ and $SR_{HL}(\hat{\gamma}+\hat{\lambda}) = Ln(1/2)/Ln(\hat{\gamma}+\hat{\lambda})$.

c. Wald tests on coefficient restrictions are Chi-square statistics with 2 degrees of freedom.

Table 2d. Volatility C-GARCH Model Estimates: Oceania

	Permanent Component				Transitory Component			Wald Tests[c]	
	$\hat{\omega}$	$\hat{\rho}$	$\hat{\varphi}$	LR half life[b]	$\hat{\gamma}$	$\hat{\lambda}$	SR half life	$\hat{\rho} = \hat{\varphi} = 0$	$\hat{\gamma} = \hat{\lambda} = 0$
Australia	0.007 (0.420)[a]	0.998* (363.92)	0.152* (4.983)	346	0.154* (4.073)	-0.381* (-2.001)	0.47	132868.8*	22.86*
New Zealand	0.001* (4.512)	0.971* (92.653)	0.065* (2.410)	0.76	0.113* (1.943)	0.292 (0.873)	0.76	11852.60*	5.09***

Notes: a. Parentheses are used to indicate z-statistics. *, **, *** indicate significance at 1%, 5% and 10%, respectively.

b. The long-run and short-run half-lives are measured using the following formulae: $LR_{HL}(\hat{\rho}) = Ln(1/2)/Ln(\hat{\rho})$ and $SR_{HL}(\hat{\gamma}+\hat{\lambda}) = Ln(1/2)/Ln(\hat{\gamma}+\hat{\lambda})$.

c. Wald tests on coefficient restrictions are Chi-square statistics with 2 degrees of freedom.

Table 2e. Volatility C-GARCH Model Estimates: Asia

	Permanent Component				Transitory Component			Wald Tests[c]	
	$\hat{\omega}$	$\hat{\rho}$	$\hat{\varphi}$	LR half life[b]	$\hat{\gamma}$	$\hat{\lambda}$	SR half life	$\hat{\rho} = \hat{\varphi} = 0$	$\hat{\gamma} = \hat{\lambda} = 0$
North									
Bangladesh	0.0038 (0.108)[a]	0.998* (78.64)	0.236* (6.206)	346	0.065 (1.133)	0.205 (0.404)	0.33	6374.09*	1.33
India	0.0003* (3.734)	0.902* (21.35)	0.259* (3.925)	6.72	0.041 (1.444)	-0.867* (-8.153)	3.62	472.17*	168.47*
Indonesia	0.0007 (0.668)	0.996* (164.21)	0.100* (3.560)	173	0.472* (12.72)	0.123* (2.150)	1.33	46983.69*	197.99*
Malaysia	0.0025 (0.138)	0.999* (147.42)	0.159 (0.028)	692	0.151* (2.955)	-0.389 (-1.529)	0.48	22345.02*	42.54*
Pakistan	0.0004* (4.598)	0.971* (0.010)	0.042* (2.766)	23.55	0.336* (4.846)	0.097 (0.769)	0.77	9351.14*	25.08*
Philippines	0.0003*** (1.6)	0.971* (53.68)	0.139* (2.195)	24.40	0.318* (5.119)	0.008 (0.061)	0.62	3417.36*	26.25*
Singapore	0.0002* (8.679)	0.804* (5.118)	1.430 (0.077)	317	-1.403 (-0.076)	2.189 (0.118)	2.38	113.16*	75.86*
Sri Lanka	0.0003* (22.91)	0.970* (111.36)	-0.052* (5.131)	22.75	0.457* (5.131)	0.168*** (1.69)	1.47	76478.44*	39.70*
Thailand	0.0002*** (1.6)	0.975* (46.05)	0.161* (4.056)	23.37	0.074 (1.282)	-0.511 (-1.070)	0.84	2122.65*	9.86*
South									
China	0.0001 (1.231)	0.956* (28.78)	0.356* (3.757)	15.40	0.384* (77.18)	0.075 (0.708)	0.89	3395.64*	3056.62*
Hong Kong	0.00007* (6.36)	0.936* (11.77)	0.092 (0.345)	10.48	0.028 (0.109)	0.805 (0.974)	3.79	1123.73*	2.52
Japan	0.0008* (11.72)	0.962* (110.92)	0.012 (0.904)	17.89	0.151* (2.865)	-0.384* (-1.991)	0.47	14230.64*	17.22*
Korea	0.0002*** (1.6)	0.989* (143.71)	0.072* (3.191)	62.66	0.315* (5.291)	-0.341* (-3.549)	0.19	24982.51*	197.32*
Taiwan	0.0002* (40.58)	0.986* (1091.5)	-0.029* (-29.42)	49.16	0.149* (3.411)	0.500* (3.791)	1.60	37202054*	83.31*

Notes: a. Parentheses are used to indicate z-statistics. *, **, *** indicate significance at 1%, 5% and 10%, respectively.

b. The long-run and short-run half-lives are measured using the following formulae: $LR_{HL}(\hat{\rho}) = Ln(1/2)/Ln(\hat{\rho})$ and $SR_{HL}(\hat{\gamma}+\hat{\lambda}) = Ln(1/2)/Ln(\hat{\gamma}+\hat{\lambda})$.

c. Wald tests on coefficient restrictions are Chi-square statistics with 2 degrees of freedom.

Table 2f. Volatility C-GARCH Model Estimates: Africa

	Permanent Component				Transitory Component			Wald Tests[c]	
	$\hat{\omega}$	$\hat{\rho}$	$\hat{\varphi}$	LR half life[b]	$\hat{\gamma}$	$\hat{\lambda}$	SR half life	$\hat{\rho} = \hat{\varphi} = 0$	$\hat{\gamma} = \hat{\lambda} = 0$
North									
Algeria	0.0007* (3.81)[a]	0.979* (103.22)	0.0581* (2.686)	32.65	0.115* (1.922)	0.059 (0.460)	0.39	10655.96*	3.77
Egypt	0.029 (0.249)	0.998* (194.90)	0.474 (0.048)	346	0.187* (4.748)	-0.381* (-5.255)	0.42	38106.97*	58.91*
Morocco	0.0004* (9.73)	0.939* (24.67)	0.034* (1.814)	11	0.046* (2.535)	-0.960* (-35.14)	7.70	814.28*	3019.44*
Tunisia	0.0005* (7.639)	0.975* (147.55)	0.0007 (0.031)	27.37	0.201* (3.230)	0.579* (4.866)	2.79	23307.10	71.02*
Sub-Saharan									
Benin	0.014* (4.731)	0.999* (19760)	0.070* (5.245)	692	0.123* (3.454)	-0.690* (-4.685)	1.22	39000000*	84.92*
Cameroon	0.0008* (7.244)	0.975* (89.69)	0.018 (0.783)	27.37	0.079 (1.554)	0.610* (2.018)	1.86	8272.13*	13.13*
Congo	0.0013* (27.08)	0.981* (380.58)	-0.021* (-3.662)	36.13	0.259* (4.423)	0.226* (2.063)	0.96	149811.9*	30.07*
Cote d'Ivoire	0.0009* (8.249)	0.755* (8.648)	2.728 (0.319)	2.46	-2.665 (-0.312)	3.405 (0.399)	2.30	115.63*	89.76*
Ghana	0.018 (0.245)	0.999* (239.42)	0.269* (10.63)	692	0.317* (7.598)	-0.060 (-0.684)	0.51	62734.08*	101.72*
Kenya	0.0006* (3.928)	0.958* (50.89)	0.107* (3.814)	16.15	0.229* (4.194)	-0.219* (-2.147)	0.15	2749.57*	41.64*
Mozambique	0.0008 (0.892)	0.984* (54.90)	0.169* (3.012)	43	0.375* (6.000)	-0.073 (-0.564)	0.58	4319.73*	44.12*
Nigeria	0.001* (2.412)	0.972* (53.21)	0.103 (1.431)	24.40	0.184* (2.297)	0.557* (3.208)	0.70	2908.21*	20.81*
Senegal	0.0010* (7.345)	0.913* (20.95)	1.160* (8.480)	7.61	-1.149* (-7.689)	2.056* (19.04)	7.1	3771.02*	3535.18*
Sierra Leone	0.0032* (19.32)	0.993* (745.40)	-0.241* (-8.537)	98.67	0.651* (128.62)	0.312* (276.20)	17.9	593796.9*	100769.9*
South Africa	0.0032 (0.283)	0.997* (127.23)	0.076* (3.489)	230	0.220* (4.119)	-0.148 (-1.011)	0.26	23789.22*	22.10*
Tanzania	0.0009* (10.27)	0.951* (72.59)	0.028* (2.279)	230	0.216* (4.082)	-0.237** (-1.73)	0.18	7727.32*	40.08*
Zambia	0.003* (71.57)	0.998* (73788)	-0.038* (-99.28)	346	0.466* (8.662)	0.158*** (1.6)	1.46	5.52000000*	899.76*

Notes: a. Parentheses are used to indicate z-statistics. *, **, *** indicate significance at 1%, 5% and 10%, respectively.

b. The long-run and short-run half-lives are measured using the following formulae: $LR_{HL}(\hat{\rho}) = Ln(1/2)/Ln(\hat{\rho})$ and $SR_{HL}(\hat{\gamma}+\hat{\lambda}) = Ln(1/2)/Ln(\hat{\gamma}+\hat{\lambda})$.

c. Wald tests on coefficient restrictions are Chi-square statistics with 2 degrees of freedom.

Table 3. Summary: Number and Percentage of Significant Coefficient Estimates

	$\hat{\omega}$	$\hat{\rho}$	$\hat{\varphi}$	$\hat{\gamma}$	$\hat{\lambda}$
America (20 countries)	9/20 (45%)	20/20 (100%)	16/20 (80%)	14/20 (70%)	7/20 (35%)
Europe (EU-12+ 21 countries)	20/22 (91%)	21/22 (95%)	13/22 (60%)	16/22 (72%)	13/22 (59%)
Middle East (5 countries)	4/5 (80%)	4/5 (80%)	2/5 (40%)	1/5 (20%)	4/5 (80%)
Oceania (2 countries)	1/2 (50%)	2/2 (100%)	2/2 (100%)	2/2 (100%)	1/2 (50%)
Asia (14 countries)	10/14 (71%)	14/14(100%)	11/14 (78%)	9/14 (64%)	6/14 (43%)
Africa (17 countries)	13/17 (76%)	17/17(100%)	12/17 (70%)	15/17 (88%)	12/17 (70%)

Table 4a. Permanent and Transitory Components: America

	Financial Crisis Dates[a]	VET[b]		
		Bartlett	Levene	B-F
North				
Canada	-	-		
Mexico	SBC: 1981, 1994; CC: 1977, 1982, 1995; DC: 1982	1977: 199.81 (0.000)	8.74 (0.003)	5.28 (0.022)
		1981-82: 184.51 (0.000)	5.54 (0.018)	3.40 (0.065)
		1994-95: 241.21 (0.000)	9.69 (0.002)	4.48 (0.034)
Central				
Costa Rica	SBC: 1987, 1994; CC:1981, 1991; DC: 1981	1981: 3.97 (0.046)	6.77 (0.009)	5.79 (0.016)
		1987: 93.50 (0.000)	47.98 (0.000)	29.61 (0.000)
		1991-94: 49.26 (0.000)	24.31 (0.000)	14.67 (0.000)
El Salvador	SBC: 1989; CC: 1986	1986-89: 39.17 (0.000)	41.26 (0.000)	25.64 (0.000)
Guatemala	SBC: 2006, CC: 1986	1986: 114.7 (0.000)	39.16 (0.000)	19.58 (0.000)
		2006: 42.65 (0.000)	8.90 (0.003)	5.34 (0.021)
Honduras	CC: 1990; DC: 1981	1981: 14.52 (0.000)	2.33 (0.126)	0.707 (0.400)
		1990: 38.62 (0.000)	17.35 (0.000)	9.26 (0.025)
Nicaragua	SBC: 1996, 2000; CC:1990	1990: 618.57 (0.000)	474.45 (0.000)	413.7 (0.000)
		1996: 1630.0 (0.000)	109.11 (0.000)	32.36 (0.000)
		2000: 1415.8 (0.000)	52.09 (0.000)	15.72 (0.000)
Panama	SBC: 1988; DC: 1983	1983: 32.80 (0.000)	13.22 (0.000)	15.42 (0.000)
		1988: 11.25 (0.000)	3.63 (0.057)	5.57 (0.018)
Caribbean				
Dom. Rep.	SBC: 2003; CC: 1985, 1990, 2003; DC: 1982, 2003	1982-85: 92.26 (0.000)	36.96 (0.000)	13.59 (0.000)
		1990: 4.27 (0.038)	0.015 (0.902)	0.553 (0.457)
		2003: 1.94(0.162)	0.838 (0.360)	0.247 (0.619)
Jamaica	SBC: 1996; CC: 1978, 1983, 1991; DC: 1978	1978: 90.45 (0.000)	13.16 (0.000)	5.77 (0.016)
		1983: 153.1 (0.000)	23.88 (0.000)	10.30 (0.001)
		1991: 0.233 (0.628)	0.629 (0.428)	0.338 (0.560)
		1996: 43.3(0.000)	9.62 (0.002)	4.53 (0.033)
Trinidad T.	CC: 1986, DC: 1989	1986-89: 157.72 (0.000)	114.46 (0.000)	70.94 (0.000)

Notes: a. Financial crisis dates from Laeven and Valencia (2008) and Reinhart (2010); b. Volatility equality tests (VET): Bartlett, Levene and Brown-Forsythe tests (p-values in brackets).

Table 4a. Permanent and Transitory Components: America (cont.)

	Financial Crisis Dates[a]	VET[b]		
		Bartlett	Levene	B-F
South				
Argentina	SBC: 1980, 1989, 1995, 2001; CC: 1975, 1981, 1987, 2002; DC: 1982, 2001	1975: 134.4 (0.00)	17.99 (0.000)	6.89 (0.008)
		1980-81-82: 164. 5 (0.000)	30.17 (0.000)	11.12 (0.000)
		1987-89: 128 (0.000)	29.25 (0.000)	21.4 (0.000)
		1995		
		2001-02: 332.2 (0.000)	44.05 (0.000)	24.89 (0.000)
Brazil	SBC: 1990, 1994; CC: 1976, 1982, 1987, 1992; 1999; DC:1983	1976: 397.38 (0.000)	61.70 (0.000)	49.27 (0.000)
		1982-83: 19.43 (0.000)	25.12 (0.000)	29.83 (0.000)
		1987:16.49 (0.000)	3.91 (0.048)	8.02 (0.004)
		1990-92-94: 49.08 (0.000)	14.03 (0.000)	5.45 (0.019)
		1999: 37.4 (0.000)	9.01 (0.002)	2.65 (0.103)
Chile	SBC: 1976, 1981; CC: 1972, 1982; DC: 1983	1972: 27.6 (0.000)	0.006 (0.980)	0.188 (0.664)
		1976: 1876 (0.000)	271.8 (0.000)	130.7 (0.000)
		1981-83: 1964.09 (0.000)	131.59 (0.000)	56.41 (0.000)
Colombia	SBC: 1998	1998: 129 (0.000)	36.34 (0.000)	21.75 (0.000)
Ecuador	SBC: 1982, 1998; CC: 1982, 1999; DC: 1982, 1999	1982: 98.65 (0.000)	28.25(0.000)	18.05 (0.000)
		1998-99: 20.90 (0.000)	11.68(0.000)	11.25 (0.000)
Paraguay	SBC: 1995; CC: 1984, 1989, 2002; DC:1982	1982-84: 30.20 (0.000)	15.50(0.000)	10.94 (0.000)
		1989: 2.45 (0.117)	2.89 (0.089)	2.07 (0.150)
		1995: 5.18 (0.022)	2.45 (0.117)	1.83 (0.176)
		2002: 0.959 (0.327)	0.177(0.673)	0.161 (0.688)
Peru	SBC: 1983; CC: 1976, 1981, 1988; DC: 1978	1976-78: 937.02 (0.000)	31.49 (0.000)	10.04 (0.000)
		1981-83: 1425.35 (0.000)	57.23 (0.000)	18.56 (0.000)
		1988: 28.50 (0.000)	3.67 (0.055)	0.458 (0.498)
Uruguay	SBC: 1981, 2002; CC: 1972, 1983, 1990, 2002; DC: 1983, 2002	1972: 345.03 (0.000)	237.51(0.000)	89.08 (0.000)
		1981-83: 504.08 (0.000)	94.33 (0.000)	44.86 (0.000)
		1990:9 334.98 (0.000)	41.59 (0.000)	19.47 (0.000)
		2002: 116.19 (0.000)	9.21 (0.002)	3.88 (0.049)
Venezuela	SBC: 1994; CC: 1984, 1989, 1994, 2002; DC: 1982	1982-84: 450.6 (0.000)	112.76(0.000)	74.01 (0.000)
		1989: 2.738(0.085)	1.608 (0.205)	6.43 (0.011)
		1994: 0.908 (0.340)	6.89 (0.008)	9.605 (0.002)
		2002: 4.283 (0.004)	1.461 (0.227)	0.060 (0.805)

Notes: a. Financial crisis dates from Laeven and Valencia (2008) and Reinhart (2010); b. Volatility equality tests (VET): Bartlett, Levene and Brown-Forsythe tests (p-values in brackets).

Table 4b. Permanent and Transitory Components: Europe

	Financial Crisis Dates[a]	VET[b]		
		Bartlett	Levene	B-F
European Union				
EU-12	-	-		
Austria	SBC: 2008	2008: 8.05 (0.004)	1.40(0.236)	1.32 (0.250)
Belgium	SBC: 2008	2008: 13.39 (0.000)	5.31 (0.021)	6.12 (0.013)
Denmark	SBC: 2008	2008: 6.96 (0.008)	0.901 (0.342)	0.776 (0.378)
Finland	SBC: 1991; CC: 1993	1991-93: 52.31 (0.000)	29.26 (0.000)	29.56 (0.000)
France	-	-		
Germany	SBC: 2007	2007: 0.020 (0.886)	0.456 (0.499)	0.209 (0.647)
Greece	CC: 1983	1983: 43.23 (0.000)	50.19 (0.000)	44.40 (0.000)
Italy	SBC: 2008; CC: 1981	1981: 0.955 (0.328)	5.271 (0.022)	4.133 (0.042)
		2008: 0.272 (0.601)	0.028 (0.865)	0.444 (0.505)
Ireland	SBC: 2007	2007: 0.001 (0.967)	0.317 (0.573)	0.293 (0.588)
Netherlands	SBC: 2008	2008: 4.601 (0.031)	0.562 (0.453)	0.293 (0.588)
Portugal	CC: 1983	1983: 53.72 (0.000)	7.96 (0.005)	10.19 (0.001)
Spain	SBC: 1977, 2008; CC: 1983	1977: 4.183 (0.040)	2.982 (0.084)	1.763 (0.184)
		1983: 2.36 5(0.124)	3.85 (0.050)	4.671 (0.031)
		2008: 3.941 (0.047)	2.99 1(0.084)	5.384 (0.020)
Sweden	SBC: 1991; CC: 1993	1991-93: 20.27 (0.000)	1.072 (0.3000)	2.863 (0.091)
United K.	SBC: 2007	2007: 2.197 (0.138)	3.463 (0.063)	1.992 (0.158)
Central and Eastern				
Czech Rep.	SBC: 1996	1996: 347.78 (0.000)	168.88 (0.000)	118.80 (0.000)
Hungary	SBC: 1991, 2008	1991: 348.47 (0.000)	91.73 (0.000)	45.82 (0.000)
		2008: 81.92 (0.000)	92.78 (0.000)	72.37 (0.000)
Poland	SBC: 1992; DC: 1981	1981: 499.69 (0.000)	186.47 (0.000)	48.75 (0.000)
		1992: 306.27 (0.000)	58.88 (0.000)	29.62 (0.000)
Others				
Norway	SBC: 1991	1991: 6.73 (0.009)	0.027 (0.867)	0.138 (0.709)
Russia	SBC: 1998; CC: 1988; DC: 1998	1998: 372.31 (0.000)	14.26 (0.000)	3.70 (0.000)
Switzerland	-	-		
Turkey	SBC: 1982, 2000; CC: 1978, 1984, 1991, 1996, 2001; DC: 1978	1978: 0.701 (0.000)	0.028 (0.865)	0.0006 (0.980)
		1982-84: 4.94 (0.026)	0.0006 (0.978)	0.046 (0.828)
		1991: 22.20 (0.000)	1.68 (0.194)	0.376 (0.540)
		1996: 22.17 (0.000)	3.72 (0.054)	1.41 (0.234)
		2000-01: 28.35 (0.000)	6.86 (0.009)	3.93 (0.047)

Notes: a. Financial crisis dates from Laeven and Valencia (2008) and Reinhart (2010); b. Volatility equality tests (VET): Bartlett, Levene and Brown-Forsythe tests (p-values in brackets).

Table 4c. Permanent and Transitory Components: Middle East and Oceania

	Financial Crisis Dates[a]	VET[b]		
		Bartlett	Levene	B-F
Middle East				
Israel	SBC: 1977; CC: 1975, 1980, 1985	1975-77: 31.71 (0.000)	9.44 (0.000)	6.94 (0.008)
		1980: 29.30 (0.000)	8.03 (0.004)	5.28 (0.021)
		1985: 23.18 (0.000)	6.60 (0.010)	6.80 (0.009)
Jordan	SBC: 1989; CC: 1989; DC: 1989	1989: 422.4 (0.000)	266.3 (0.000)	197.2 (0.000)
Kuwait	SBC: 1982	1982: 37.09 (0.000)	25.33 (0.000)	26.62 (0.000)
Syria	CC: 1988	1988: 30.47 (0.000)	6.98 (0.000)	3.90 (0.048)
Saudi Arabia	-	-		
Oceania				
Australia	-	-	-	
New Zealand	-	-		

Notes: a. Financial crisis dates from Laeven and Valencia (2008) and Reinhart (2010); b. Volatility equality tests (VET): Bartlett, Levene and Brown-Forsythe tests (p-values in brackets).

Table 4d. Permanent and Transitory Components: Asia

	Financial Crisis Dates[a]	VET[b]		
		Bartlett	Levene	B-F
South				
Bangladesh	SBC: 1987; CC: 1976	1976: 17.82 (0.000)	9.27 (0.002)	11.93 (0.000)
		1987: 509.2 (0.000)	305.0 (0.000)	231.8 (0.000)
India	SBC: 1993	1993: 1.07 (0.300)	2.94 (0.086)	3.36 (0.067)
Indonesia	SBC: 1997; CC: 1979, 1998; DC: 1999	1979: 39.60 (0.000)	8.25 (0.004)	5.63 (0.018)
		1997-98-99: 15.50 (0.000)	0.13 (0.710)	0.030 (0.862)
Malaysia	SBC: 1997; CC: 1998	1997-98: 1.95 (0.162)	8.82 (0.003)	5.54 (0.018)
Pakistan	CC: 1972	1972: 162.08 (0.000)	62.85 (0.000)	14.21 (0.000)
Philippines	SBC: 1983, 1997; CC: 1983, 1998; DC: 1983	1983: 28.41 (0.000)	7.50 (0.006)	3.305 (0.069)
		1997-98: 16.78 (0.000)	2.45 (0.117)	0.610 (0.434)
Singapore	-		-	
Sri Lanka	SBC: 1989; CC: 1978	1978: 42.54 (0.000)	83.55 (0.000)	3.24 (0.072)
		1989: 4.57 (0.032)	0.054 (0.815)	0.024 (0.875)
Thailand	SBC: 1983, 1997; CC: 1998	1983: 72.36 (0.000)	45.13 (0.000)	32.08 (0.000)
		1997-1998: 92.68 (0.000)	74.84 (0.000)	52.87 (0.000)
North				
China	SBC: 1998	1998: 305.12 (0.000)	63.46 (0.000)	33.07 (0.000)
Hong Kong	-		-	
Japan	SBC: 1997	19.06 (0.000)	7.195 (0.007)	7.99 (0.004)
Korea	SBC: 1997; CC: 1998	180.66 (0.000)	73.74 (0.000)	47.20 (0.000)
Taiwan	-		-	

Notes: a. Financial crisis dates from Laeven and Valencia (2008) and Reinhart (2010); b. Volatility equality tests (VET): Bartlett, Levene and Brown-Forsythe tests (p-values in brackets).

Table 4e. Permanent and Transitory Components: Africa

	Financial Crisis Dates[a]	VET[b]		
		Bartlett	Levene	B-F
North				
Algeria	SBC: 1990; CC: 1988, 1994	1988: 29.90 (0.000)	24.87 (0.000)	24.26 (0.000)
		1990: 112.15 (0.000)	68.10 (0.000)	65.09 (0.000)
		1994: 119.74 (0.000)	66.64 (0.000)	61.37 (0.000)
Egypt	SBC: 1980; CC: 1979, 1990; DC: 1984	1979-80: 87.46 (0.000)	1.517 (0.218)	0.518 (0.471)
		1984: 170.10 (0.000)	6.122 (0.013)	2.060 (0.151)
		1990: 89.11 (0.000)	0.0002 (0.987)	0.084 (0.771)
Morocco	SBC: 1980; CC: 1981; DC: 1983	1980-81-83: 62.28 (0.000)	56.40 (0.000)	55.51 (0.000)
Tunisia	SBC: 1991	1991: 28.08 (0.000)	15.99 (0.000)	15.72 (0.000)
Subshaharan				
Benin	SBC: 1988; CC: 1994	1988: 41.87 (0.000)	41.73 (0.000)	42.87 (0.000)
		1994: 51.12 (0.000)	32.66 (0.000)	34.41 (0.000)
Cameroon	SBC: 1987; 1995; CC: 1994; DC: 1989	1987-89: 62.00 (0.000)	43.11 (0.000)	44.73 (0.000)
		1994-95: 112.3 (0.000)	47.20 (0.000)	48.45 (0.000)
Congo	SBC: 1983, 1991, 1994; CC: 1976, 1983; 1989, 1994, 1999; DC: 1976	1976: 8.16 (0.004)	0.121 (0.727)	0.232 (0.629)
		1983: 37.33 (0.000)	0.281 (0.596)	0.025 (0.872)
		1989-91: 77.46 (0.000)	0.858 (0.354)	0.042 (0.837)
		1994: 122.7 (0.000)	10.28 (0.001)	10.03 (0.001)
		1999: 92.42 (0.000)	7.08 (0.008)	9.098 (0.002)
Cote d'Ivoire	SBC: 1988; CC: 1994; DC: 1984, 2001	1984: 105.93 (0.000)	117.28 (0.000)	65.98 (0.000)
		1988: 90.35 (0.000)	86.17 (0.000)	50.97 (0.000)
		1994: 51.41 (0.000)	41.13 (0.000)	24.50 (0.000)
		2001: 14.24 (0.000)	12.83 (0.000)	7.25 (0.000)
Ghana	SBC: 1982; CC: 1978, 1983, 1993, 2000	1978: 134.32 (0.000)	2.48 (0.115)	0.65 (0.417)
		1982-83: 226.74 (0.000)	4.981 (0.027)	0.780 (0.377)
		1993: 1123.84 (0.000)	32.41 (0.000)	15.80 (0.000)
		2000: 1003.04 (0.000)	180.5 (0.000)	8.83 (0.000)
Kenya	SBC: 1985, 1992; CC: 1993	1985: 1.555 (0.212)	1.920 (0.166)	1.704 (0.192)
		1992-93: 32.55 (0.000)	19.11 (0.000)	13.89 (0.000)
Mozambique	SBC: 1987; CC: 1987; DC: 1984	1984: 180.32 (0.000)	57.67 (0.000)	37.10 (0.000)
		1987: 239.69 (0.000)	78.67 (0.000)	53.04 (0.000)
Nigeria	SBC: 1991; CC: 1983, 1989, 1997; DC: 1983	1983: 88.81 (0.000)	56.20 (0.000)	28.38 (0.000)
		1989-91: 0.361 (0.547)	0.010 (0.917)	0.029 (0.864)
		1997: 158.48 (0.000)	82.20 (0.000)	46.27 (0.000)

Table 4e. Permanent and Transitory Components: Africa (cont.)

	Financial Crisis Dates[a]	VET[b]		
		Bartlett	Levene	B-F
Subshaharan				
Senegal	SBC: 1988; CC: 1994; DC: 1981	1981: 40.02 (0.000)	56.13 (0.000)	52.87 (0.000)
		1988: 48.24 (0.000)	51.73 (0.000)	50.81 (0.000)
		1994: 19.05 (0.000)	19.06 (0.000)	21.72 (0.000)
Sierra Leone	SBC: 1990; CC: 1983; 1989; 1998; DC: 1977	1977: 508.95 (0.000)	24.29 (0.000)	8.79 (0.000)
		1983: 359.24 (0.000)	39.26 (0.000)	14.08 (0.000)
		1989-90: 28.85 (0.000)	0.0005 (0.995)	0.017 (0.894)
		1998: 104.35 (0.000)	12.16 (0.000)	2.37 (0.123)
South Africa	CC: 1984; DC: 1985	1984-85: 94.13 (0.000)	51.55 (0.000)	36.21 (0.000)
Tanzania	SBC: 1987; CC: 1985, 1990; DC: 1984	1984-87: 59.76 (0.000)	15.12 (0.000)	10.51 (0.000)
		1990: 39.67 (0.000)	8.46 (0.000)	5.53 (0.000)
Zambia	SBC: 1995; CC: 1983, 1989, 1996; DC: 1983	1983: 171.80 (0.000)	23.57 (0.000)	13.75 (0.000)
		1989: 108.06 (0.000)	9.10 (0.002)	3.37 (0.067)
		1995-96: 29.57 (0.000)	1.76 (0.184)	2.58 (0.108)

Notes: a. Financial crisis dates from Laeven and Valencia (2008) and Reinhart (2010); b. Volatility equality tests (VET): Bartlett, Levene and Brown-Forsythe tests (p-values in brackets).

Table 5a. Permanent and Transitory Components: America

	Structural breaks in nominal exchange rate regimes	VET[a]		
		Bartlett	Levene	B-F
North				
Canada	Nov 2002	66.55 (0.000)	32.72 (0.000)	28.63 (0.000)
Mexico	Apr 1981, Mar 1988, Dec 1994	1981: 184.51 (0.000)	5.54 (0.018)	3.40 (0.065)
		1988: 236.75(0.000)	3.310 (0.069)	0.773 (0.000)
		1994: 241.21 (0.000)	9.69 (0.002)	4.48 (0.034)
Central				
Costa Rica	Nov 1983	1983: 141.81 (0.000)	85.364 (0.000)	54.74 (0.000)
El Salvador	-		-	
Guatemala	-		-	
Honduras	Mar 1990, Dec 1998	1990: 38.62 (0.000)	17.35 (0.000)	9.26 (0.025)
		1998: 168.11 (0.000)	51.855 (0.000)	41.58 (0.000)
Nicaragua	Feb 1992	1992: 1651.4 (0.000)	474.46 (0.000)	120.8 (0.000)
Panama	-		-	
Caribbean				
Dom. Rep.	Jan 1985, Ago 1991, Jan 2005	1985: 92.26 (0.000)	36.96 (0.000)	13.59 (0.000)
		1991: 14.082 (0.000)	6.113 (0.013)	1.250 (0.264)
		2005: 63.57(0.000)	13.64 (0.000)	6.259 (0.012)
Jamaica	Jan 1983; Jul 1996	1983: 153.1 (0.000)	23.88 (0.000)	10.30 (0.001)
		1996: 43.3(0.000)	9.62 (0.002)	4.53 (0.033)
Trinidad T.	May 1976	122.37 (0.000)	140.0 (0.000)	124.13 (0.000)
South				
Argentina	Feb 1981, Mar 1991, Oct 2001	1981: 164. 5 (0.00)	30.17 (0.000)	11.11 (0.000)
		1991: 156.13 (0.000)	49.42 (0.000)	34.71 (0.000)
		2001: 332.2 (0.000)	44.05 (0.000)	24.89 (0.000)
Brazil	-		-	
Chile	Jun 1976, Jan 2001	1976: 1876 (0.000)	271.8 (0.000)	130.7 (0.000)
		2001: 749.7 (0.000)	26.66 (0.000)	9.20 (0.000)
Colombia	Jan 1994	212.6 (0.000)	45.63 (0.000)	28.30 (0.000)
Ecuador	Mar 1982, Apr 2001	1982: 98.65 (0.000)	28.25(0.000)	18.05 (0.000)
		2001: 179.28 (0.000)	47.76 (0.000)	31.74 (0.000)
Paraguay	Mar 1985, Jan 1991, Mar 2002	1985: 30.20 (0.000)	15.50(0.000)	10.94 (0.000)
		1991: 0.168 (0.681)	0.069 (0.791)	0.033 (0.855)
		2002: 0.959 (0.327)	0.177(0.673)	0.161 (0.688)
Peru	Oct 1977, Ago 1986	1977: 937.02 (0.000)	31.49 (0.000)	10.04 (0.000)
		1986: 1193.7 (0.000)	73.59 (0.000)	23.69 (0.000)
Uruguay	-		-	
Venezuela	Nov 1986	508.5 (0.000)	127.7 (0.000)	82.64 (0.000)

Note: a. Volatility equality tests (VET): Bartlett, Levene and Brown-Forsythe tests (p-values in brackets).

Table 5b. Permanent and Transitory Components: Europe

	Structural breaks in nominal exchange rate regimes	VET[a]		
		Bartlett	Levene	B-F
European Union				
EU-12	Jan 1980	31.86 (0.000)	31.99 (0.000)	18.64 (0.000)
Austria	Jul 1980	83.14 (0.000)	97.22 (0.000)	59.28 (0.000)
Belgium	-	-		
Denmark	Jan 1980	86.27 (0.000)	110.80 (0.000)	62.24 (0.000)
Finland	-	-		
France	Mar 1979	33.81 (0.000)	34.45 (0.000)	26.55 (0.000)
Germany	-	-		
Greece	Jul 1981	13.23 (0.000)	19.40 (0.000)	13.41 (0.000)
Italy	-	-		
Ireland	Mar 1979	9.71 (0.001)	2.07 (0.150)	2.96 (0.085)
Netherlands	-	-		
Portugal	Ago 1993	34.41 (0.000)	9.26 (0.005)	10.38 (0.001)
Spain	-	-		
Sweden	-	-		
United K.	Sep 1992	0.986 (0.320)	0.454 (0.500)	0.064 (0.799)
Central and Eastern				
Czech Rep.	Ago 1981, Mar 1994	1981: 536.37 (0.000)	190.09 (0.000)	182.35 (0.000)
		1994: 689.43 (0.000)	234.61 (0.000)	177.55 (0.000)
Hungary	Jun 1979, Ago 2005	1979: 217.29 (0.000)	34.53 (0.000)	19.21 (0.000)
		2005: 474.37 (0.000)	387.58 (0.000)	283.68 (0.000)
Poland	Oct 1977	848.21 (0.000)	37.41 (0.000)	19.38 (0.000)
Others				
Norway	SBC: 1991	1992: 1593.73 (0.000)	59.01 (0.000)	26.31 (0.000)
Russia	Jan 1992, Ago 1998, Ago 2005	1998: 372.31 (0.000)	14.26 (0.000)	3.70 (0.000)
		2005: 136.94 (0.000)	3.374 (0.000)	0.674 (0.000)
Switzerland	-	-		
Turkey	-	-		

Note: a. Volatility equality tests (VET): Bartlett, Levene and Brown-Forsythe tests (p-values in brackets).

Table 5c. Permanent and Transitory Components: Middle East and Oceania

	Structural breaks in nominal exchange rate regimes	VET[a]		
		Bartlett	Levene	B-F
Middle East				
Israel	Oct 1977	1977: 31.71 (0.000)	9.44 (0.000)	6.94 (0.008)
Jordan	Feb 1975, Feb 1990, Ago 1995	1975: 14.05 (0.000)	4.704 (0.000)	3.212(0.000)
		1990: 422.4 (0.000)	266.33 (0.000)	197.2 (0.000)
		1995: 380.12 (0.000)	212.79 (0.000)	135.6 (0.000)
Kuwait	-	-		
Syria	-	-		
Saudi Arabia	-	-		
Oceania				
Australia	Nov 1982	136.35 (0.000)	72.48 (0.000)	52.97 (0.000)
New Zealand	Mar 1985	55.84 (0.000)	70.01 (0.000)	56.21 (0.000)

Note: a. Volatility equality tests (VET): Bartlett, Levene and Brown-Forsythe tests (p-values in brackets).

Table 5d. Permanent and Transitory Components: Asia

	Structural breaks in nominal exchange rate regimes	VET[a]		
		Bartlett	Levene	B-F
South				
Bangladesh	-	-		
India	Jul 1979, Dec 2004	1979: 42.77 (0.000)	9.232 (0.002)	6.183 (0.013)
		2004: 15.27 (0.000)	4.180 (0.000)	2.031 (0.000)
Indonesia	Jul 1997	15.50 (0.000)	0.13 (0.710)	0.030 (0.862)
Malaysia	Jul 1998	1.95 (0.162)	8.82 (0.003)	5.54 (0.018)
Pakistan	Jun 1982	378.42 (0.000)	84.64 (0.000)	42.75 (0.000)
Philippines	Jul 1997	16.78 (0.000)	2.45 (0.117)	0.610 (0.434)
Singapore	-	-		
Sri Lanka	Nov 1981, Sep 1989	1981: 31.81 (0.000)	5.919 (0.015)	2.237 (0.135)
		1989: 4.57 (0.032)	0.054 (0.815)	0.024 (0.875)
Thailand	Jul 1997	92.68 (0.000)	74.84 (0.000)	52.87 (0.000)
North				
China	Jan 1994	183.63 (0.000)	46.43 (0.000)	25.35 (0.000)
Hong Kong	Oct 1983	123.90 (0.000)	73.80(0.000)	49.24 (0.000)
Japan	Nov 1977	0.747 (0.000)	0.947 (0.330)	1.315 (0.251)
Korea	Nov 1997	180.66 (0.000)	73.74 (0.000)	47.20 (0.000)
Taiwan	-	-		

Note: a. Volatility equality tests (VET): Bartlett, Levene and Brown-Forsythe tests (p-values in brackets).

Table 5e. Permanent and Transitory Components: Africa

	Structural Breaks in nominal exchange rate regimes	VET[a]		
		Bartlett	Levene	B-F
North				
Algeria	Mar 1994	119.74 (0.000)	66.64 (0.000)	61.37 (0.000)
Egypt	Oct 1991	89.11 (0.000)	0.0002 (0.987)	0.084 (0.771)
Morocco	-	-		
Tunisia	-	-		
Subshaharan				
Benin	-	-		
Cameroon	Dec 1994	112.3 (0.000)	47.20 (0.000)	48.45 (0.000)
Congo	Mar 1976	8.16 (0.004)	0.121 (0.727)	0.232 (0.629)
Cote d'Ivoire	-	-		
Ghana	Sep 1987	1493 (0.000)	54.12 (0.000)	26.06 (0.000)
Kenya	Dec 1978	56.02 (0.000)	19.55 (0.000)	12.26 (0.000)
Mozambique	-	-		
Nigeria	Sep 1984, Mar 1996	1984: 71.19 (0.000)	48.28 (0.000)	23.85 (0.000)
		1996: 179.47 (0.000)	95.41 (0.000)	53.86 (0.000)
Subshaharan				
Senegal	Nov 1994	19.05 (0.000)	19.06 (0.000)	21.72 (0.000)
Sierra Leone	-	-		
South Africa	Jan 1979	81.74 (0.000)	46.82 (0.000)	30.35 (0.000)
Tanzania	Jan 1979	5.198 (0.000)	0.079 (0.000)	0.417 (0.518)
Zambia	Jul 1976, Jul1983	1976: 212.37 (0.000)	21.87 (0.000)	14.01 (0.000)
		1983: 171.80 (0.000)	23.57 (0.000)	13.75 (0.000)

Notes: a.Volatility equality tests (VET): Bartlett, Levene and Brown-Forsythe tests (p-values in brackets).