Foreign exchange market contagion: evidence of DCC and DECO Multivariate GARCH Models

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Abstract:

The goal of this study is to measure contagion phenomenon between foreign exchange markets during Subprime crisis & Euro-Zone crisis using daily data from 03/01/2005 to 03/09/2015 for twenty selected countries.

In our analysis, we use the FMI classification of exchange rate arrangements for each estimation period. We also separated an estimation period in two period's crises. estimate into two crises periods. Firstly, the US Subprime crisis period that covers the period from 17/07/2007 through 31/08/2009 (See Dungey, 2009, Celik, 2012), and secondly, the period span of the Euro-zone crisis that goes from 19.11.2009 to 31.12.2012 (See Wasim. A et al 2013).The model we use in this study is a Dynamic Equicorrelation GARCH model of Engle and Kelly (2012) and DCC-GARCH model of Engle (2002).

In summary, we conclude that all exchange rates returns series are influenced by the contagion effects come from USA and euro area over 2007-2012 periods. Moreover, we observe that the mean Dynamic conditional correlation of the multivariate GARCH increase in financial and Euro zone crises compared to the pre-crisis period. In addition to that, we conclude that persistent volatility has been high in countries adopting free floating exchange rates compare the countries they supported managed floaters, hard and soft begs exchange rate regimes.

Key word: *Contagion, Subprime and Eurozone Crises, DCC-GARCH, DECO-GARCH, Exchange Rate Regimes.*

الملخص:

الهدف من هذه الدراسة هو قياس ظاهرة انتشار العدوى بين أسواق صرف العملات الأجنبية خلال أزمة الرهن العقاري والأزمة في منطقة اليورو باستخدام البيانات اليومية من 2005/01/03 إلى 09/03/2015 حيث تم الاختيار في حدود عشرون بلد.

في تحليلنا هذا، تم استخدام تصنيف صندوق النقد الدولي في ترتيبات أسعار الصرف لكل فترات التقدير .

كما أن لدينا فترة تقدير منفصلة في أزمة لفترتين،

أولا، في فترة أزمة الرهن العقاري الأمريكي، الذي يغطي الفترة من 17/07/2007 إلى 2009/08/31 (انظر Dungey 2009 ،Celik ، 2012)، والثانية فترة أزمة منطقة اليورو الانتقال من 19.11 حيث تم استخدام نموذج الدراسة:

GARCH GARCH Dynamic Equicorrelation d'Engle et Kelly (2012) ونموذج *DCC-GARCH (2002)*.

وباختصار، فإننا نستنتج أن كل سلسلة سعر الصرف تتأثر العدوى من الولايات المتحدة ومنطقة اليورو خلال الفترات 2007-2012 .وعلاوة على ذلك، نلاحظ أن متوسط ديناميكية الارتباط مشروط بزيادة *GARCH* متعدد المتغيرات في الأزمة المالية ومنطقة اليورو مقارنة مع فترة ما قبل الأزمة .

وبالإضافة إلى ذلك، فإننا نستنتج أن التقلب المستمر كان مرتفعا في الدول تبني سعر صرف عائم مقارنة بالدول التي دعمت التعويم المدار، نظم أسعار الصرف الثابتة والمرنة.

الكلمات المفتاحية: عدوى الأزمة، الرهن العقاري ومنطقة اليورو، *DCC-GARCH*، *GARCH-DECO*، أنظمة أسعار الصرف.

- Introduction:

In recent years, particularly After July 2007, global economy has been living the worst financial crisis since the Great Depression of the 1930s, to such an extent that it affected macroeconomic variables towards a decline in GDP growth and other negative effects as unemployment rates, inflation, National and Multinational institutions collapses, stock markets crashes, etc……

In addition, world economy suffered from The U.S. Subprime mortgage crisis that hit the Eurozone from 2010 to May 2013. It had sizeable effects not only on the euro economies, but in several markets around the world.

Contagion phenomenon during Subprime crisis and Eurozone crisis is not limited to transmitting shocks on the macroeconomic and stock markets fundamentals, but to Foreign exchange market that led rapidly to massive declines of the major currencies see **Figure 1.**

The Euro and the US dollar are the major currencies used in the actual International monetary systems. As the global economy is highly vulnerable to Euro and US dollar fluctuations, we shall use euro/US dollar exchange rate as a proxy for exchange rate variation across to Subprime crisis & Eurozone crisis.

In this context, choosing an exchange rate regime by countries is an appropriate for their policy makers to affect on the macroeconomic, the monetary and capital markets. Of course, there are many classifications of the exchange rate regimes **(Levy-Yeyati and Sturzenegger, 2005; Reinhart and Rogoff, 2004; Shambaugh, 2004, Bénassy-Quéré et al 2006, Frankel and Wei, 2008, Habermeier, K et al 2009)**.

In this paper, we will follow an IMF de jure classification based on all IMF members authorities declared exchange rate regime, which listed ten categories **(**see **annual report on exchange arrangements and exchange restrictions, 2014)**

The goal of this study is to try and measure contagion phenomenon between foreign exchange markets during the U.S. subprime mortgage and Eurozone crises through an empirical analysis using DCC MGARCH methodology, the dynamic equicorrelation GARCH model and upon daily data from 03/01/2005 to 03/09/2015 for 20 countries.

The rest of the paper is organized as follows. In section 2 we present a Literature Review on Contagion phenomenon; Section 3 presents the Model and the Methodology, followed by the results and discussion showed in Section 4, and finally, Section 5 presents the main conclusion.

- **Literature Review**

The currency markets are the larger an asset market size. The trading in foreign exchange markets is averaged $5.3 trillion per day in April 2013 compared by $3.3 trillion in April 2007 **(Bank for International Settlements, 2013).** Moreover, the exchange rate volatility does increase more than proportionally with the global financial stress, when, evidence regional contagion effects is spread **(Virginie Coudert et al, 2011)**.

Several studies are classified the exchange rates regimes order to capture currencies vulnerability during crisis periods. Jean-Louis Combes (2012) rejected that intermediate regimes are more vulnerable to crises compared to the hard peg and the fully floating regimes. **Atish R. Ghosh (2010)** suggested that the growth performance for pegs was not different from that of floats during the crisis. For the recovery period 2010–11, pegs appear to be faring worse.

During the last two decades, the fixed exchange rate regimes appear to be more vulnerable and fragile with the occurrence of the crises*:* the Mexican peso crisis (1994), The Asian financial crisis (1997), the Russian and Brazilian financial crises (1998, 1999), the devaluation of the Argentinian peso (2002); **(see, Jean-Louis Combes (2012), Ahmed Atil (2008), Levy-Yeyati et al. (2006), Fischer (2001))**

Van Horen et al (2006) investigated whether the contagion is transmitted from Thailand to the other crisis countries through the foreign exchange market during the Asian crisis. Results show that there is evidence of contagion from Thailand with 13% and 21 % respectively to Indonesia and Malaysia currencies attributable to that contagion. On the Contrary, for Korea and the Philippines there is no evidence of contagion from Thailand.

Eichengreenet al. (1996) used thirty years of panel data from twenty industrialized countries for finding that is spread more easily contagion currency crises among the countries which are closely tied by international trade linkages. They suggest that trade linkages work as catalysts for contagion transmission particularly within geographic proximity. (See **Eichengreen and Rose (1998), Tornell and Velasco (1996) Huh and Kasa (1997); Rigobon (1998))**

Glick and Rose (1999) provide five episodes of currency (in 1971, 1973, 1992, 1994, and 1997) and 161 countries for the purpose of presenting the argument that trade linkages help explain cross-country correlations in exchange market pressure during crisis episodes. **Celik (2012)** presents strong evidence of contagion across foreign exchange markets for 10 emerging and 9 developed markets for the period 2005–2009 using DCC-GARCH model.

Rubén Albeiro et al (2015) found in their results that there is contagion among the Brazilian, Chilean, and Colombian and Mexican exchange rates from June 2005 through April 2012 using a regular vine copula approach.

In contrast, many studies have highlighted that contagion transmitted is not propagated when linked directly to macroeconomic fundamentals as trade links (**Eichengreen et al. (1996** but when there are down on Stock Markets (Directly) during the financial crisis **(Jawadi *et al*. (2014), Bouaziz et al., 2012, Flavin and Panopoulou, 2010, Hutchison 2009, Khan and Park, 2009; Cho and Parhizgari, 2008…..)**

Alouietall (2011) showed in their study strong evidence of time-varying correlation and persistence between stock markets of each of the BRIC (Brazil, Russia, India, China) and the US markets using daily return data for the period 2004 to 2009.

Dajcman et al. (2012) applied a Dynamic Conditional Correlation-Generalized Autoregressive Conditional Heteroskedastic (DCC-GARCH) on daily return series for the period 1997 to 2010 to examine the co-movement dynamics across the stock markets of U.K., Germany, France, and Austria and found significant evidence of contagion effects. **Kazi et al. (2013)** detected the same results by applying the same model in sixteen OECD countries 'stock markets. **Hwang et al. (2010)** used a DCC-GARCH model on 38 country's data. He found evidence of financial contagion not only in emerging markets but also in developed markets during U.S. subprime.

The study of **Naoui et al. (2010)** examined financial contagion using the DCC GARCH technique and a correlation test for 10 emerging markets from 1 January 2005 to 01 July 2010. Their results indicate a contagion effect during the subprime crisis from the US towards Argentina, Brazil, Korea, Honk-Kong, Malaysia, Mexico and Singapore except for the Shanghai market (China). **Yiu, Ho and Choi, (2010)** examined the dynamics of correlation between 11 Asian stock markets and the US stock market from 1993 to early 2009 within asymmetric DCC-GARCH model. Their study finds strong evidence of contagion from USA to Asian markets from late of 2007, while they found no such evidence of contagion between Asian markets during the Asian financial crisis. **Aka (2009)**investigated the transmission of the contagion from the US stock market to the West African Regional Stock Market (BRVM) from January 2, 2007, through January 30, 2009. He finds that contagion effects from the US market to the BRV. **Khallouli. W and Sandretto. R, (2012)** carried out a similar analysis for the Middle East and North African countries (MENA) and provide the evidence of mean and volatility contagion in MENA stock markets caused by the US stock market.

Model and Methodology

- **Data source**

In our analysis we try to examine contagion phenomenon among foreign exchange markets during Subprime crisis and Eurozone crisis using daily for 3896 observations. Indeed, we test contagion among exchange rate of the twenty selected countries representing American, European, Middle East, Oceania, Asian and African countries. These countries namely Algeria, Angola, Arabic Saudi, Australia, Brazil, Bulgaria, Cambodia, Canada, China, Costa Rica, Djibouti, Honduras, Hong Kong, India, Japan, Jordan, Kuwait, Norway, Salvador, UK. Our choices are largely based on the IMF de jure classification, **see Table 1**.

The sources of these exchange rates are collected from Thomson Reuters Data Stream. The return on exchange rate is defined as:

We calculate foreign exchange rate returns as:

……… (1)

Where:
: Foreign exchange rate at time t

: Foreign exchange rateat timet-1

: Return on exchange rate at time t

- **Definition of the Model**

Generalized autoregressive conditional heteroskedasticity (GARCH) of Bollerslev (1986)) suggested the generalized ARCH of Engle (1982). The GARCH model considers conditional variance to be a linear combination between squired of residual and a part of lag of conditional variance.

The mathematical representation of a GARCH (p,q):

(2)

Where ∀ i, ∀ j

Where a variance in long term is,is squired of residual andis a lag of conditional variance. In this context, there are many models called univariate GARCH used of asymmetric volatility for testing the existence of contagion during Global Financial Crisis as the exponential GARCH (EGARCH) model, Glosten, Jogannathan, and Rankle (1992) GJR-GARCH model, asymmetric power ARCH (APARCH), Zakoian (1994) threshold ARCH (TARCH) **see more Olowe, Rufus Ayodeji (2009).**

The development of the multivariate GARCH model is designed to make GARCH models more parsimonious, while its aim to find the correlation between the volatilities and co-volatilities through its conditional variance :Constant Conditional Correlation-(CCC)-GARCH model **(Bollerslev, 1990)**, the BEKK-GARCH model **(Engle and Kroner, 1995)**, and the Dynamic DCC-GARCH model **(Engle and Sheppard, 2001)**, DCC-GARCH **Lien and Tse (2002)** and the latest Dynamic Equicorrelation (DECO) approach by Engle and Kelly (2012) **Engle (2002) and Tse and Tsui (2002)** generalized the CCC model by making the conditional correlation matrix time dependent. An additional difficulty is that the time dependent conditional correlation matrix has to be positive definite ∀t.

The DCC model of **Tse and Tsui (2002**) is defined as:

$$H_t = D_t R_t D_t, \quad \text{....(3)}$$

Where D_t is defined in (3)), h_{iit} can be defined as any univariate GARCH model, and

$$R_t = (1 - \boldsymbol{\theta}_1 - \boldsymbol{\theta}_2)R + \boldsymbol{\theta}_1 \Psi_{t-1} + \boldsymbol{\theta}_2 R_{t-1}. \qquad (8.31)$$

In (4) θ_1 and θ_2 are non-negative parameters satisfying $\theta_1 + \theta_2 < 1$, R is a symmetric N × N positive definite parameter matrix with $\rho_{ii} = 1$, and Ψ_{t-1} is the N × N correlation matrix of ε_τ for $\tau = t - M, t - M + 1, \ldots, t - 1$. Its i,j-th element is given by:

$$\psi_{ij,t-1} = \frac{\sum_{m=1}^{M} u_{i,t-m} u_{j,t-m}}{\sqrt{(\sum_{m=1}^{M} u_{i,t-m}^2)(\sum_{h=1}^{M} u_{j,t-m}^2)}}, \qquad (8.32)$$

where $u_{it} = \varepsilon_{it}/\sqrt{h_{iit}}$. The matrix Ψ_{t-1} can be expressed as:

$$\Psi_{t-1} = B_{t-1}^{-1} L_{t-1} L_{t-1}' B_{t-1}^{-1}, \qquad (8.33)$$

Where B_{t-1} is a N × N diagonal matrix with i-th diagonal element given by $(\sum_{h=1}^{M} u_{i,t-h}^2)^{1/2}$ and $L_{t-1} = (u_{t-1}, \ldots, u_{t-M})$ is a N × M matrix, with $u_t = (u_{1t}\ u_{2t} \ldots u_{Nt})'$.

A necessary condition to ensure the positivity of Ψ_{t-1}, and therefore also of R_t, is that $M \geq N$. Then R_t is itself a correlation matrix if R_{t-1} is also a correlation matrix (notice that $\rho_{iit} = 1 \forall i$). Alternatively, **Engle (2002)** proposes a different DCC model (see also Engle and Sheppard, 2001).

The DCC model of **Engle (2002**) is defined :

$$R_t = diag\,(q_{11,t}^{-1/2} \ldots q_{NN,t}^{-1/2})\; Q_t\; diag\,(q_{11,t}^{-1/2} \ldots q_{NN,t}^{-1/2}), \qquad (8.34)$$

Where the N × N symmetric positive definite matrix $Q_t = (q_{ij,t})$ is given by:

$$Q_t = (1 - \alpha - \beta)\overline{Q} + \alpha u_{t-1} u_{t-1}' + \beta Q_{t-1}, \qquad (8.35)$$

With u_t as in definition Q is the N ×N unconditional variance matrix of u_t, and α and β are nonnegative scalar parameters satisfying $\alpha + \beta < 1$.

The elements of Q can be estimated or alternatively set to their empirical counterpart to render the estimation even simpler

To show more explicitly the difference between the two DCC models, we write the expression of the correlation coefficient in the bivariate case: for the DCC of **Tse and Tsui (2002),**

$$\rho_{12t} = (1-\theta_1-\theta_2)\,\rho_{12} + \theta_2\,\rho_{12,t-1} + \theta_1 \frac{\sum_{m=1}^{M} u_{1,t-m} u_{2,t-m}}{\sqrt{(\sum_{m=1}^{M} u_{1,t-m}^2)(\sum_{h=1}^{M} u_{2,t-m}^2)}}, \quad (8.36)$$

and for the DCC of Engle (2002)

$$\rho_{12t} = \frac{(1-\alpha-\beta)\,\bar{q}_{12} + \alpha\, u_{1,t-1} u_{2,t-1} + \beta\, q_{12,t-1}}{\sqrt{\left((1-\alpha-\beta)\,\bar{q}_{11} + \alpha\, u_{1,t-1}^2 + \beta\, q_{11,t-1}\right)\left((1-\alpha-\beta)\,\bar{q}_{22} + \alpha\, u_{2,t-1}^2 + \beta\, q_{22,t-1}\right)}}. \quad (8.37)$$

. The DECO model of Engle and Kelly (2012) s defined as in 3 with

$$R_t = (1-\rho_t) I_N + \rho_t J_{N\times N}, \quad (8.38)$$

$$\rho_t = \frac{1}{N(N-1)} \sum_{i\neq j} \frac{q_{ij,t}}{\sqrt{q_{ii,t} q_{jj,t}}} \quad (8.39)$$

where ρ_t is the equicorrelation, $q_{ij,t}$ is the i,jth element of Q_t in Equation (8.35), I_N denotes the N-dimensional identity matrix and $J_{N\times N}$ is an N × N matrix of ones.

According Engle and Kelly (2012) (see Lemma 2.1), R_t^{-1} exists if and only if $\rho_t \neq 1$ and $\rho_t \neq -1/(N-1)$ and R_t is positive definite if and only if $-1/(N-1) < \rho_t < 1$.

Results and Comment

- **Descriptive statistics of foreign exchange rate returns**

In this section, we shall separate the period estimate in tree periods. Firstly, US Subprime crisis period covers from 17/07/2007 through 31/08/2009**(See Dungey, 2009, Glik, 2012)**. Firstly, the US Subprime crisis period covers from 17/07/2007 through 31/08/2009 **(See Dungey, 2009, Glik, 2012)**. Secondly, the period of the Euro-zone crisis that we have covered from 19.11.2009 to 31.12.2012 **(See Wasim. A et al 2013)**.

- **Descriptive statistics**

Table 2 to 4 show descriptive statistics of, floaters, begs regimes and managed floaters exchange rate returns respectively from17.07.2007 to 31.08.2009 (financial Crisis)

The mean returns for all series are close to zero. Also, we observe the kurtosis coefficients of the foreign exchange rate returns in the last arrangements are a lower to first and secondly regime, (with a kurtosis value 3). In the first hand, these results explain the big shocks in these two foreign exchange rate markets, where the anchor hard or soft currency or basket involves country authorities' depending to external monetary policy of dollar, euro or basket countries except the small margins of less than ±1- 2% or more exercise Sterilization policies. In the contrary, floaters exchange rate regimes cannot be intervene in the market to address big volatility of exchange rates. On the other hand, kurtosis coefficients result in the last arrangement reveal with their central banks intervening in Forex markets to defend their currencies to stabilize the situation over crisis period within monetary policy targets. Whereas the previous kurtosis coefficients were confirmed by the higher standard deviation in two fist arrangement compare managed float rate exchange regime, while significant changes in the standard deviation increase after the break-point of subprime Euro-Zone crises.. Moreover, the skewness coefficients were different than zero, while, it is indicates a non-symmetric series. The Jarque-Bera test and for normality for all the currencies in Table 1 and 2 are significant, which mean the exchange returns are not normal distribution.

Tables 5 to 7 reports descriptive statistics of independently floating and managed float rate exchange rate returns respectively from 19.11.2009 to 31.12.2012 (Eurozone crisis), the kurtosis coefficients were greater than three of all series, Jarque– Bera (JB) test indicates non–normality of most of the foreign exchange rate returns.

Entire period results presented in **tables 8 to 10** shows their kurtosis of theexchange rate returns exceed 3, while, the skewness (positive or negative) and Jarque– Bera results rejects the null hypothesis and indicates non- normal distribution of series. Finally, the mean of the log exchange rate returns range from to zero.

- **Estimation results of DCC MGARCH Models**

Before illustrating the results of contagion existence and correlation during two crises, it is necessary to examine Heteroscedasticity test. The ARCH LM test proposed by **Engle (1982)** indicates the presence of ARCH effects of all foreign exchange markets returns residuals **(See figure 02).**

In the secondly examine, we make evaluates the mean and variance of DCC GARCH family, the results of are significant at 5% significance level for all currencies and for each period. This finding is reveal the role of the US dollar rates with exogenously determined to effect transmits on the other foreign exchange rates, **see table 11**

In the third test, we note in same previous table high persistence of shocks in the volatility on all currencies using tree DCC Multivariate GARCH family (equicorrelation GARCH model of **Engle and Kelly (2012),** DCC-GARCH model of **Engle (2002)** DCC-GARCH time varying of **Tse and Tsui (2002).** Therefore and Based on these model, the results shows lowest volatility, while we use DCC and DECO of Engel, but in same time we find DECO covariance estimation of Free floating exchange rate returns are the lowest. On the contrary, the DCC covariance estimation in begs and other managed arrangement appear more low than DECO model. Additionally to that, mean conditional coefficients during crises compared pre-crisis is high which is indicating that evidence of contagion phenomenon among all exchange rate regimes.

Finally, **figure 3** checks correlations between foreign exchange rates. It indicates significant correlation over time and per arrangement classification, we observed the highest correlation (55%) is documented for countries supported free floating more: Norway 85%, Australia 60%, Canada 52%, Japan 50%, India 40% and Brazil more than 30%. Thus, managed arrangement and begs regimes note lower correlation compared the free floating regimes. Algeria and Arabic Saud present the lowest correlation while the rest countries having important correlation as 15% to 40% except Bulgaria and Angola (high correlation).

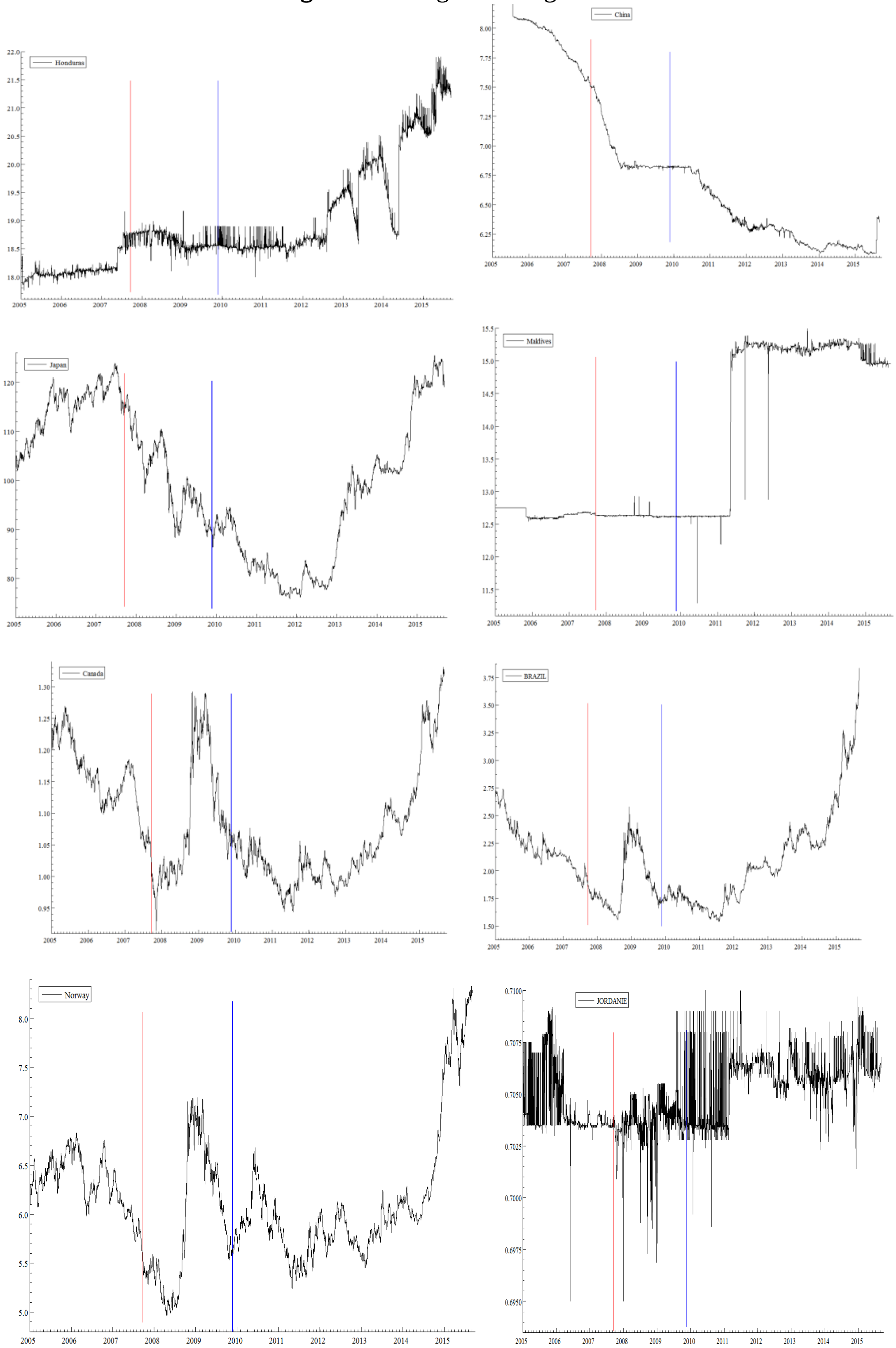
Conclusion:

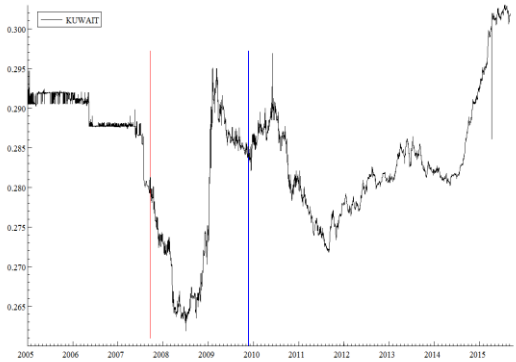
In this paper, we measure contagion phenomenon between foreign exchange markets during Subprime crisis &Eurozone crisis using daily data from 03/01/2005 to 03/09/2015 for twenty countries used different regimes exchange rate by employing DCC MGARCH model. In contrast, we concluded of all exchange rates returns series influenced by the contagion effects come from USA and euro area over 2007-2012 periods.

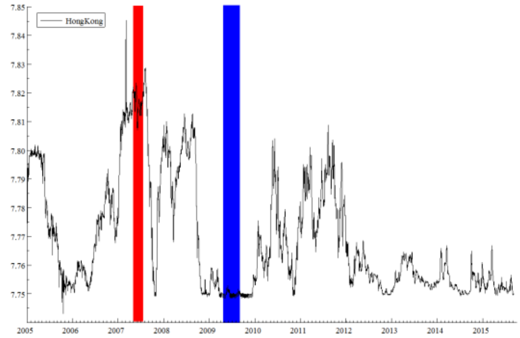
The main finding indicates that volatility persistence is higher correlation in the free exchange rate than manager and beg exchange regimes.

Annex

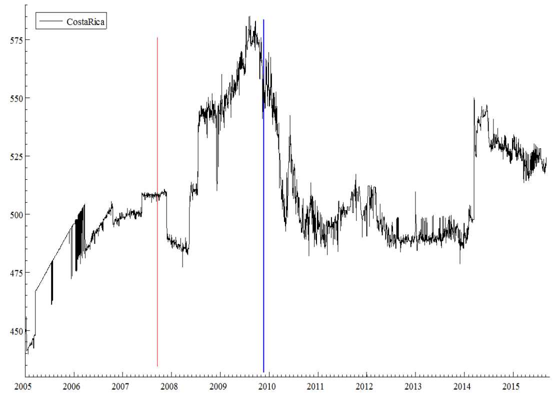
Figure 1: foreign exchange rates

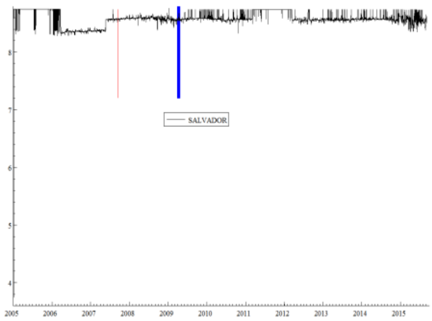


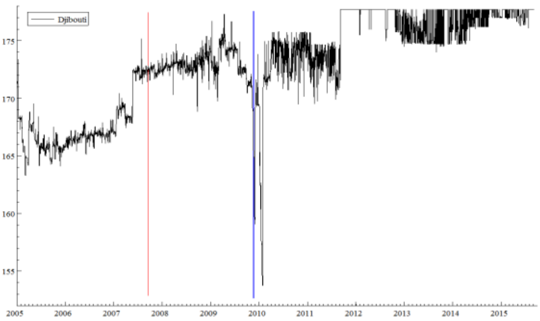

KUWAIT


HongKong

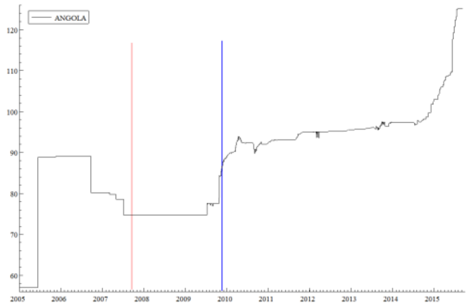

Bulgaria

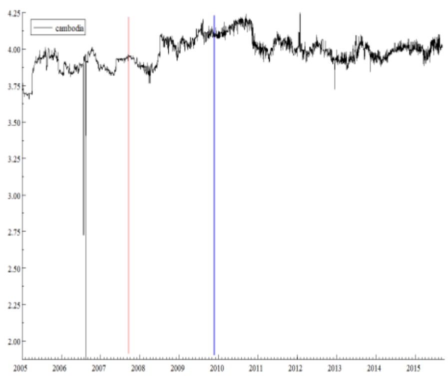

CostaRica

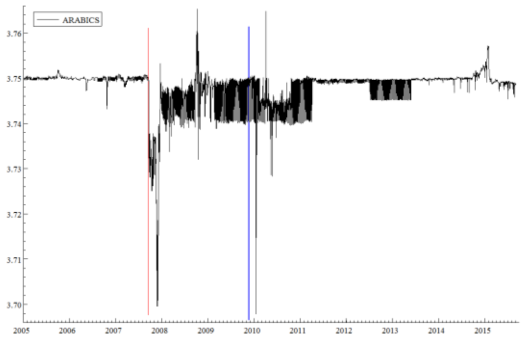

SALVADOR


Djibouti


Algeria


ANGOLA





Note

- the break-point subprime crisis
- the break-point Euro-Zone crisis

Table 1: the IMF de jure classification of exchange rates

	Exchange rate arrangement	Exchange rate anchor					Monetary aggregate target	Inflation-targeting fermework	Other
	((number of countries	U.S. dollar		Euro	compsite	other			
Hard and soft pegs	No separate legal tender	El Salvador							
	Currency board	Djibouti Hong Kong		Bulgaria		Brunei			
	Conventional peg		Jordan Saudi Arabia		Kuwait				
	Stabilized arrangement		Maldives						Angola
	Crawl-like arrangement	Honduras					China		Belarus
Other management arrangement		Cambodia			Algeria				Costa Rika
Floating	Floating							Brazil Peru	India
	Free floating							Australia Canada Japan Norway UK	United States EMU

Table2: descriptive statistics of free floating exchange regimes from 17.07.2007 to 31.08.2009 (financial Crisis)

	Mean	Maximum	Minimum	Std, Dev,	Skewness	Kurtosis	Jarque-Bera	Probability	Observations
AUS	0	0,0616	-0,0529	0,0095	0,4	10,24	1717	0	777
BRAZIL	0	0,0633	-0,063	0,0116	0,3	8,94	1152	0	777
CANADA	0,0001	0,0381	-0,0417	0,006	0,09	8,52	986	0	777
EURO	0	0,0252	-0,0346	0,005	-0,3	8,12	861	0	777
INDIA	0,0002	0,0249	-0,0322	0,005	-0,31	7,76	745	0	777
JAPAN	-0,0003	0,0284	-0,0367	0,006	-0,38	6,8	486	0	777
NORWAY	0,0001	0,045	-0,042	0,007	0,27	7,69	723	0	777
UK	0,0003	0,0401	-0,0314	0,006	0,74	10,26	1777	0	777
PERU	-0,0001	0,032	-0,0318	0,008	0,37	4,25	68	0	777

Table 03: descriptive statistics of begs exchange rate regime from 17.07.2007 to 31.08.2009 (financial Crisis)

	Mean	Std, Dev,	Skewness	Kurtosis	Jarque-Bera	Probability	Observations
ANGOLA	-0,0001	0,006	-0,61	13,35	3520	0	777
ARABICS	0,0000	0,001	-0,13	6,855	483	0	777
BELARUS	-0,0001	0,006	-0,61	13,356	3520	0	777
BULGARIA	0,0000	0,006	0,240	7,101	552	0	777
CHINA	-0,0001	0,0009	0,286	15,69	5225	0	777
DJIBOUTI	5,37E	0,004	0,495	11,28	2252	0	777
HONDURAS	0,0000	0,005	-0,32	9,388	1334	0	777
HONGKONG	0,0000	0,0002	-0,15	10,0	1634	0	777
JORDANIE	1,46E-06	0,001	0,782	23,104	13165	0	777
KAZAKHSTAN	8,16E-05	0,005	-21,06	551,5	9798275	0	777
KUWAIT	1,35E-06	0,002	0,763	12,65	3095	0	777
MALDIVES	0,0000	0,001	0,00	120,4	446705	0	777
SALVADOR	0,0000	0,0043	0,27	11,52	2363	0	777

Table 4: descriptive statistics of managed float rate regimes from 17.07.2007 to 31.08.2009 (financial Crisis)

	ALGERIA	CAMBODIA	COSTARICA
Mean	2.67E-05	0.000267	0.000157
Median	0.000000	0.000000	0.000000
Maximum	0.041916	0.048564	0.031430
Minimum	-0.041761	-0.022179	-0.049187
Std. Dev.	0.009706	0.004510	0.006024
Skewness	0.005012	2.070677	-0.378010
Kurtosis	8.299950	24.67328	14.96976
Jarque-Bera	909.3999	15762.80	4657.035
Probability	0.000000	0.000000	0.000000
Observations	777	777	777

Table 05: descriptive statistics of free floating exchange regimes from 19.11.2009 to 31.12.2012 (Eurozone crisis)

	AUS	BRAZIL	CANADA	EURO	INDIA	JAPAN	NORWAY	PERU	UK
Mean	-9,68E-05	0,00016	-4,83E-05	0,00011	0,00015	-3,07E-05	-3,69E-06	-0,00012	3,21E-05
Maximum	0,032	0,038	0,024	0,019	0,030	0,028	0,023	0,062	0,018
Minimum	-0,024	-0,034	-0,017	-0,017	-0,021	-0,022	-0,019	-0,065	-0,013
Std, Dev,	0,01	0,01	0,00	0,00	0,01	0,00	0,01	0,01	0,00
Skewness	0,37	0,21	0,38	0,26	0,09	0,87	0,37	0,03	0,28
Kurtosis	5,68	7,52	5,35	4,03	4,26	11,04	4,46	7,66	4,71
Jarque-Bera	367	980	289	63	77	3212	128	1030	155
Probability	0	0	0	0	0	0	0	0	0,00
Observations	1139	1139	1139	1139	1139	1139	1139	1139	1139

Table06: descriptive statistics of begs exchange rate regime from 19.11.2009 to 31.12.2012 (Eurozone crisis)

	Mean	Maximum	Minimum	Std, Dev,	Skewness	Kurtosis	Jarque-Bera	Probability	Observations
ANGOLA	0,000106	0,23	-0,20	0,01	2,94	302	4252080	0,00	1139
ARABICS	-2,34E-08	0,01	-0,01	0,00	-1,25	57	138709	0,00	1139
BELARUS	0,000106	0,23	-0,20	0,01	2,94	302	4252080	0,00	1139
BRUNEI	-0,00011	0,02	-0,03	0,01	0,21	8	1148	0,00	1139
BULGARIA	0,000109	0,02	-0,02	0,01	0,16	4	28	0,00	1139
CHINA	-6,84E-05	0,01	-0,01	0,00	-0,09	11	2797	0,00	1139
DJIBOUTI	4,84E-05	0,10	-0,03	0,01	2,84	41	70384	0,00	1139
HONDURAS	4,26E-05	0,03	-0,03	0,01	0,27	10	2484	0,00	1139
HONGKONG	1,13E-07	0,00	0,00	0,00	-0,24	11	3242	0,00	1139
KAZAKHSTAN	6,84E-05	0,01	-0,01	0,00	0,74	18	10922	0,00	1139
JORDANIE	4,23E-06	0,01	-0,01	0,00	-0,13	11	3043	0,00	1139
KUWAIT	-1,03E-05	0,02	-0,02	0,00	-0,36	47	91758	0,00	1139
MALDIVES	0,000165	0,18	-0,15	0,01	4,11	164	1231234	0,00	1139
SALVADOR	-3,86E-06	0,03	-0,03	0,01	0,13	11	2682	0,00	1139

Table07: descriptive statistics of managed float rate regimes from 19.11.2009 to 31.12.2012 (Eurozone crisis)

	ALGERIA	CAMBODIA	COSTARICA
Mean	8.42E-05	0.000569	-0.000103
Median	0.000000	0.000000	0.000000
Maximum	0.041083	0.334541	0.037443
Minimum	-0.031958	-0.352484	-0.034771
Std. Dev.	0.005662	0.020508	0.007890
Skewness	0.133397	1.102262	0.136788
Kurtosis	11.18053	172.4365	6.968596
Jarque-Bera	3179.344	1362699.	751.0090
Probability	0.000000	0.000000	0.000000
Observations	1139	1139	1139

Table 8: descriptive statistics of free floating exchange regimes from 03.01.2005 to 16.07.2007 (Pre-Crisis)

	Mean	Maximum	Minimum	Std, Dev,	Skewness	Kurtosis	Jarque-Bera	Probability	Observations
ANGOLA	-0,00023	0,01	-0,01	0	-0,38	6,93	372	0	925
ARABICS	1,44E-07	0	0	0	-2,33	62,24	81796	0	925
BELARUS	-0,0002	0,01	-0,01	0	-0,38	6,93	372	0	925
BRUNEI	0	0,1	-0,1	0,01	-0,13	196,68	869002	0	925
BULGARIA	-0,0002	0,01	-0,02	0	-0,19	5,11	107	0	925
CHINA	-0,00012	0	0	0	-0,73	5,42	185	0	925
DJIBOUTI	6,09E-05	0,02	-0,01	0	1,38	17,64	5140	0	925
HONDURAS	7,43E-05	0,02	-0,01	0	1,16	13,45	2653	0	925
HONGKONG	1,52E-05	0	0	0	0,21	102,04	227254	0	925
JORDANIE	-8,42E-06	0,01	-0,01	0	0,06	77,09	127154	0	925
KAZAKHSTAN	4,36E-07	0	-0,01	0	-6,35	147,48	487309	0	925
KUWAIT	-3,43E-05	0,01	-0,01	0	-0,31	10,9	1453	0	925
MALDIVES	1,17E-05	0	0	0	-0,17	8,15	618	0	925
SALVADOR	-3,40E-05	0,05	-0,05	0,01	-0,18	23,84	10063	0	925

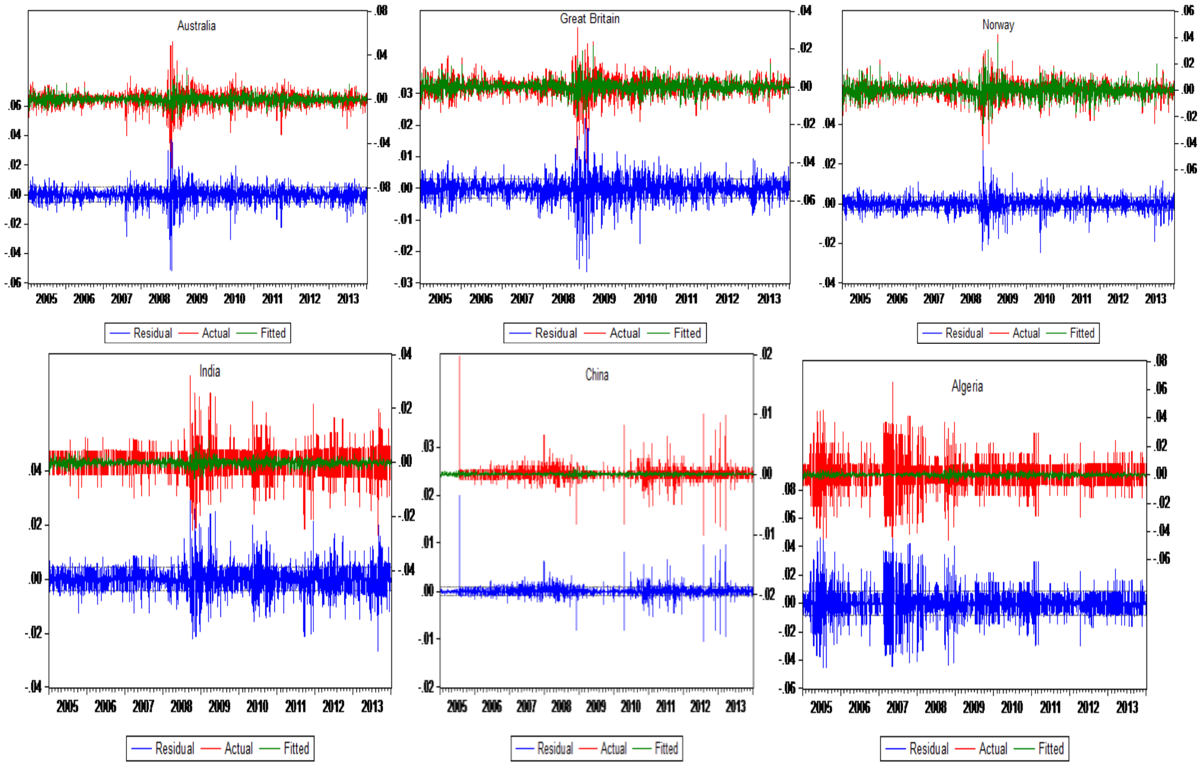
Table09: descriptive statistics of begs exchange rate regime from 03.01.2005 to 16.07.2007 (Pre-Crisis)

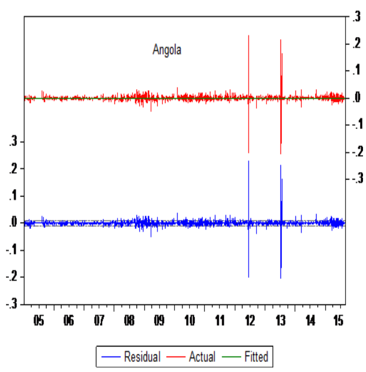
	AUS	BRAZIL	CANADA	EURO	INDIA	JAPAN	NORWAY	PERU	UK
Mean	-0,0001	-0,0004	-0,0002	0,0000	-0,0001	0,0002	-0,0001	0,0000	-0,0001
Median	0	0	0	0	0	0	-1,52E-05	0	0
Maximum	0,02	0,05	0,01	0,02	0,01	0,02	0,02	0,06	0,01
Minimum	-0,02	-0,04	-0,01	-0,02	-0,01	-0,02	-0,02	-0,06	-0,02
Std, Dev,	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,02	0,00
Skewness	0,09	1,02	0,00	-0,23	0,16	-0,39	-0,14	0,03	-0,15
Kurtosis	4,87	13,58	4,88	5,87	7,27	5,85	5,11	6,29	5,05
Jarque-Bera	136	4477	137	326	708	336	175	417	165
Probability	0	0	0	0	0	0	0	0	0
Observations	925	925	925	925	925	925	925	925	925

Table10: descriptive statistics of managed float rate regimes from 03.01.2005 to 16.07.2007 (Pre-Crisis

	ALGERIA	CAMBODIA	COSTARICA
Mean	9.78E-06	-0.000117	0.000110
Median	0.000000	0.000000	0.000000
Maximum	0.053555	0.035890	0.015542
Minimum	-0.035146	-0.032369	-0.008085
Std. Dev.	0.015263	0.004203	0.002214
Skewness	0.275152	-0.061541	1.445973
Kurtosis	4.821906	53.56342	15.87858
Jarque-Bera	28.37371	20027.28	1364.733
Probability	0.000001	0.000000	0.000000
Observations	925	925	925

Figure 02 : Arch effets

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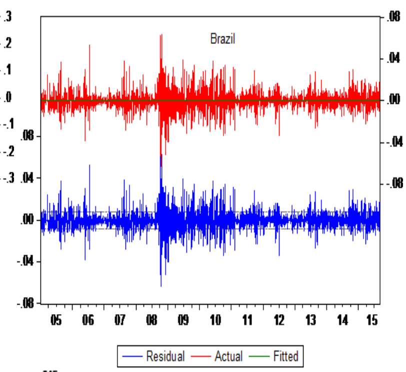
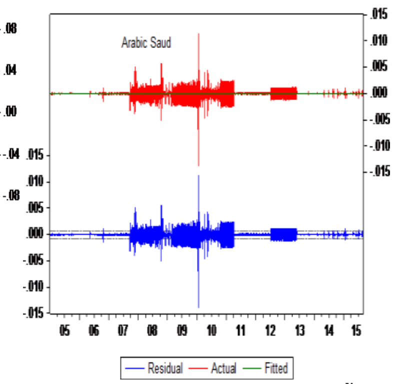

Brazil
Residual Actual Fitted


Arabic Saud
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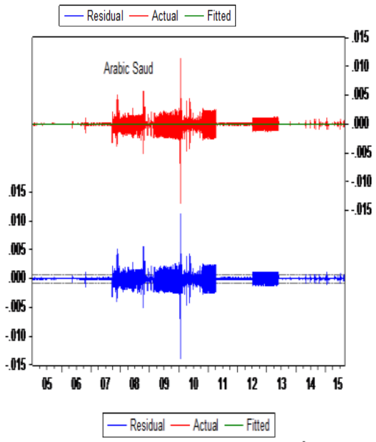
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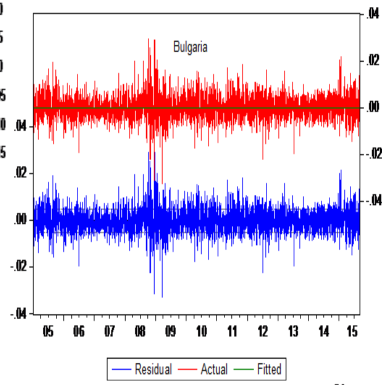
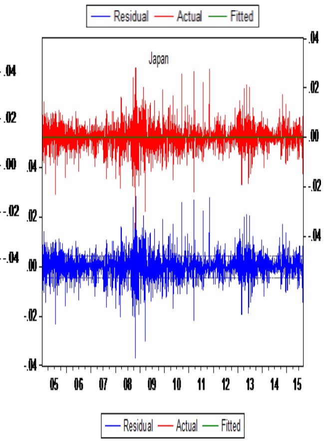
Residual Actual Fitted


Bulgaria
Residual Actual Fitted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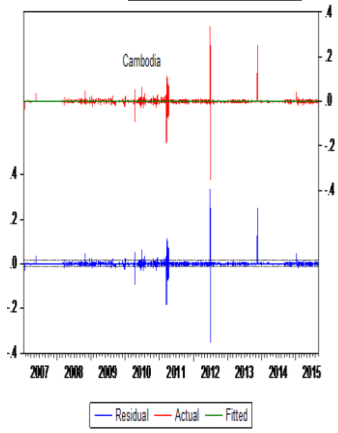
Residual Actual Fitted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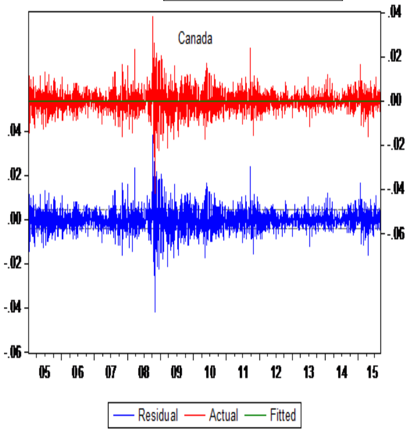
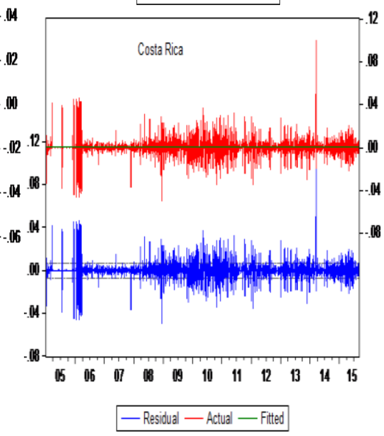
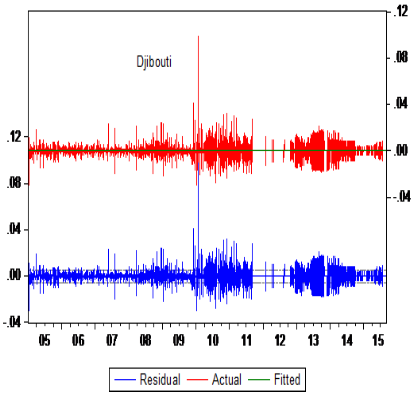
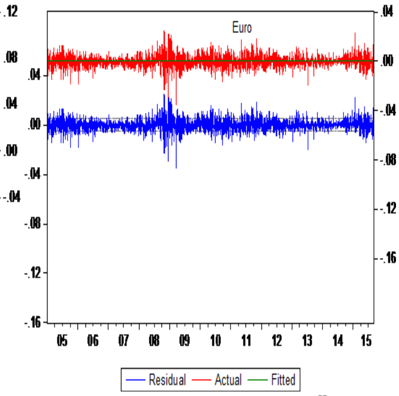
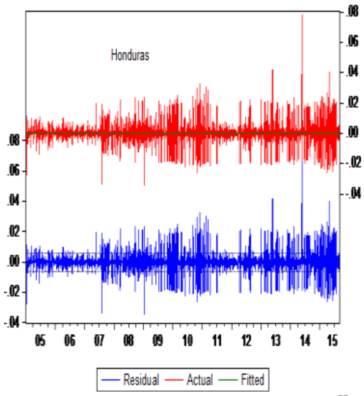
Residual Actual Fitted

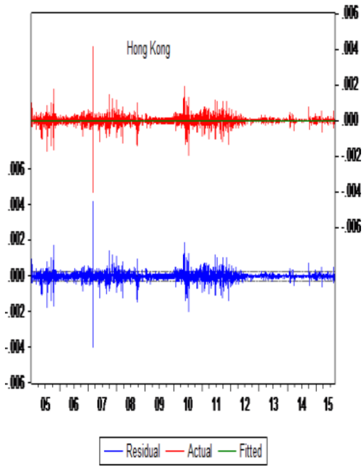

Canada
Residual Actual Fitted

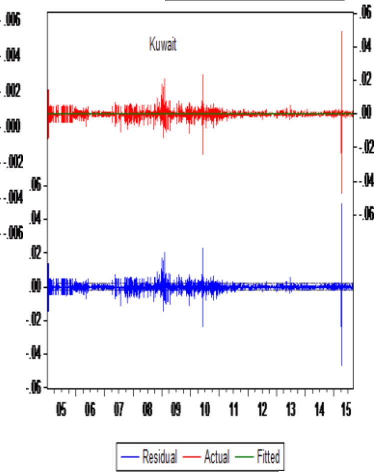

Costa Rica
Residual Actual Fitted

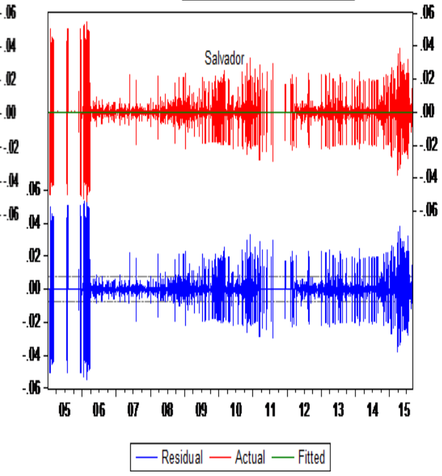


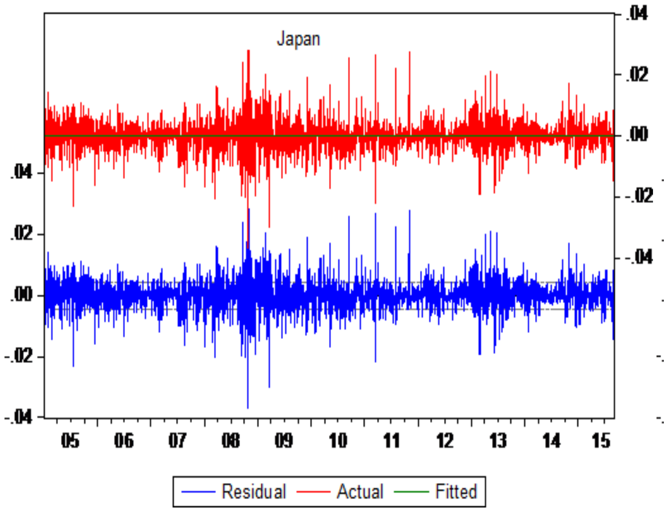












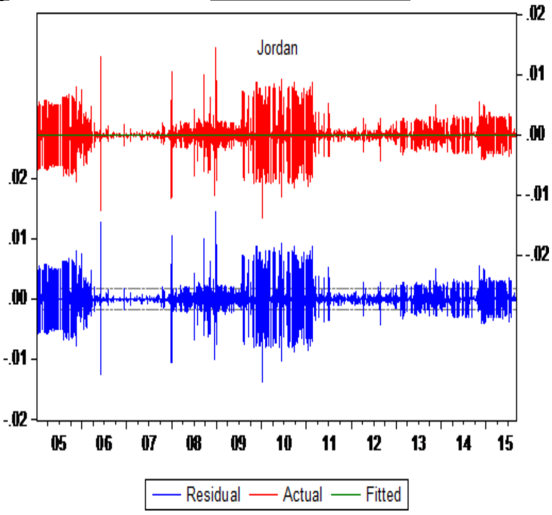
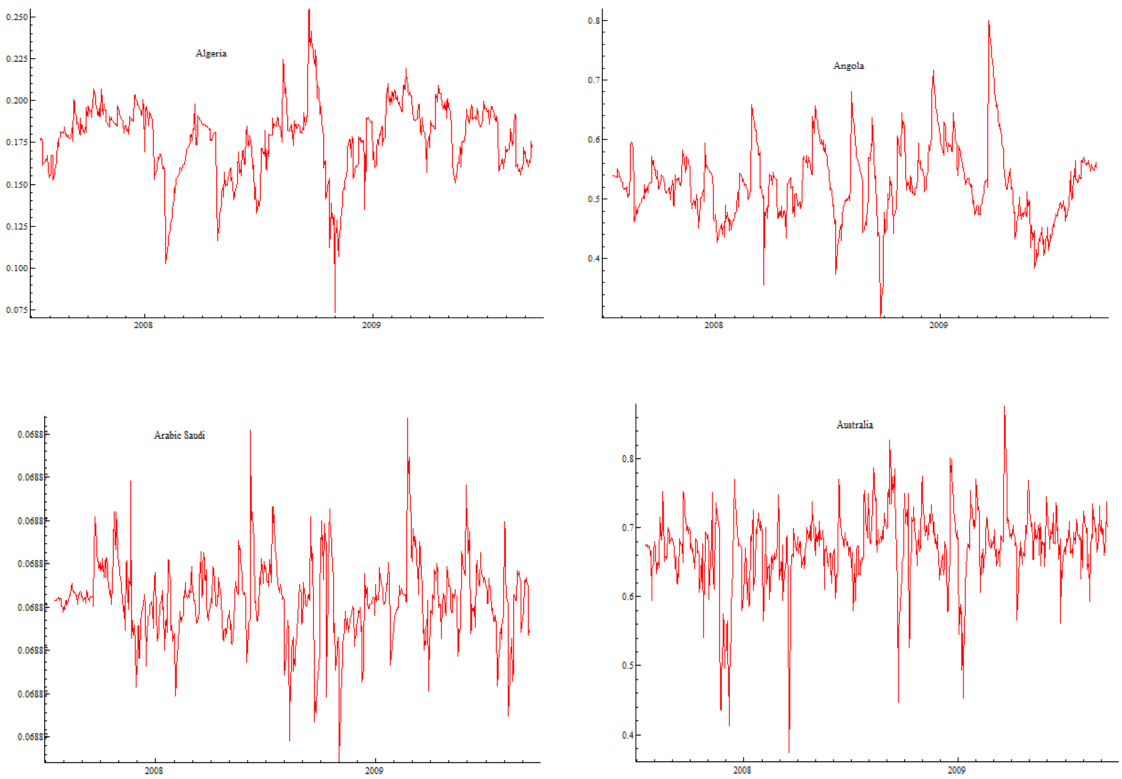


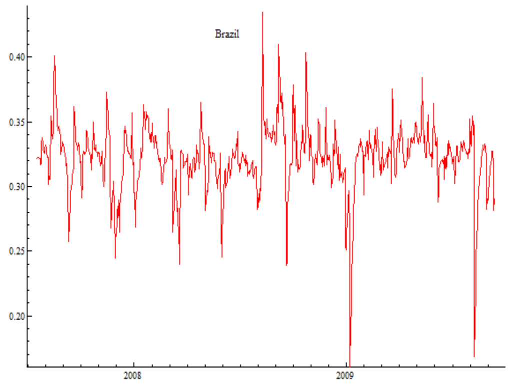
Table11: volatility of DCC MGARCH Models

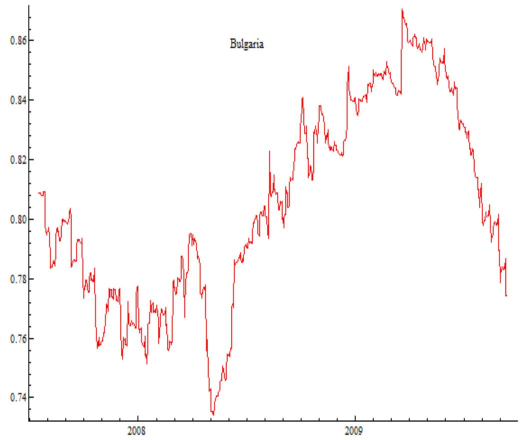
	DCC Engel	DCC Lien and Tse (2002)	(DECO)
Parameter	Volatility	Volatility	Volatility
Algeria	0,9004	0,8512	0,938
Angola	1,1	0,97	1,09
Arabic S	0,8304	0,8603	0,82
AUSTRALIA	0,8	0,8	0,76
Brazil	0,78	0,82	0,77
Bulgaria	0,987	0,97	0,98
Cambodia	0,98	0,99	0,96

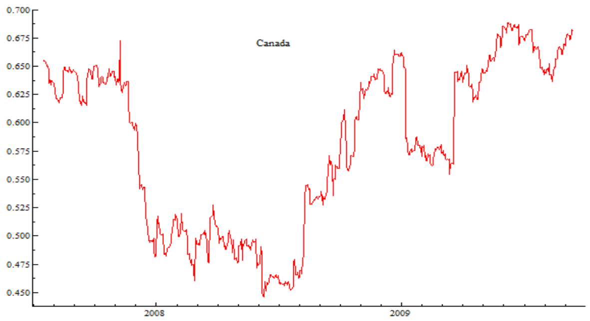
Canada	0,989	0,99	0,998
China	0,83	0,23	0,83
Costa Rica	0,948	0,92	0,94
Djibouti	0,8	0,8	0,81
Honduras	0,99	0,99	0,99
Hong Kong	0,82	0,89	0,88
India	0,9	0,91	0,89
Japan	0,95	1,6	0,95
Jordania	0,81	0,82	0,80
Kuwait	0,98	0,96	0,98
Norway	0,96	1,1	0,978
salvador	0,84	0,86	0,84
UK	0,95	0,99	0,95

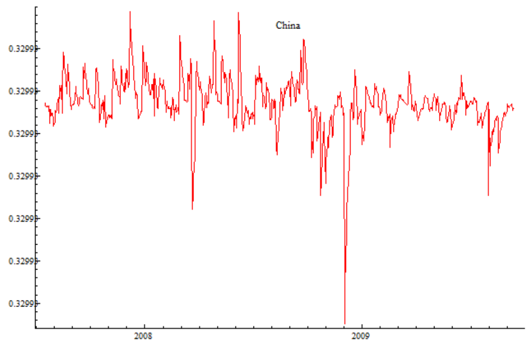
Figure03: dynamic correlation **duri,g crises**

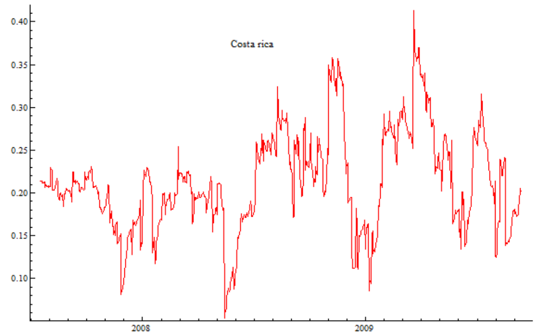


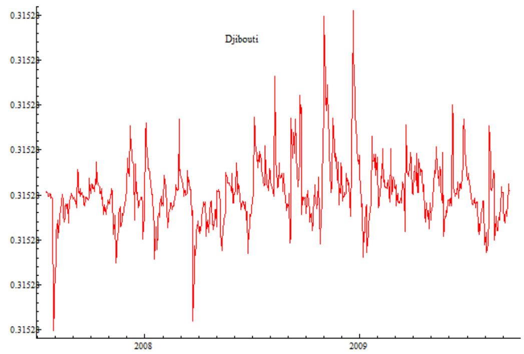

Brazil
2008
2009

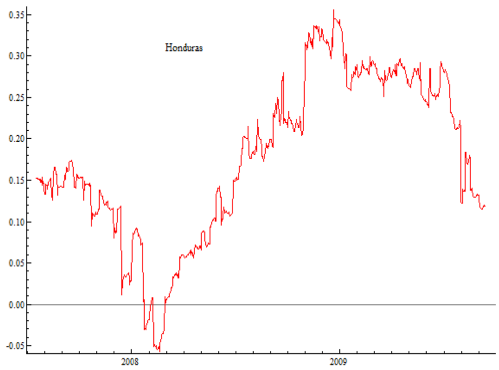

Bulgaria
2008
2009

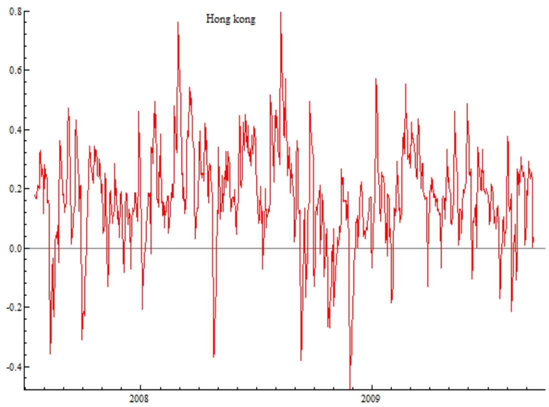

Canada
2008
2009

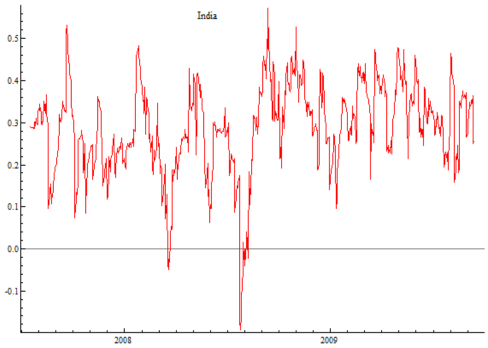

China
2008
2009


Costa rica
2008
2009


Djibouti
2008
2009


Honduras
2008
2009


Hong kong
2008
2009


India
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0.2
0.1
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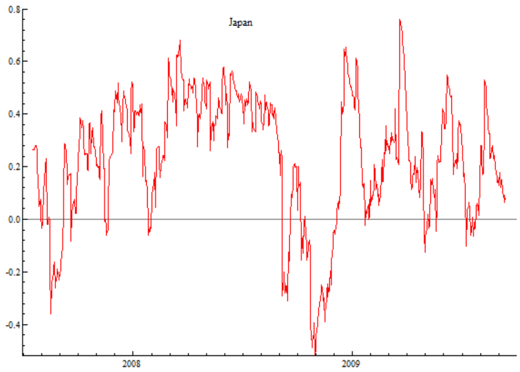
2008
2009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0.2
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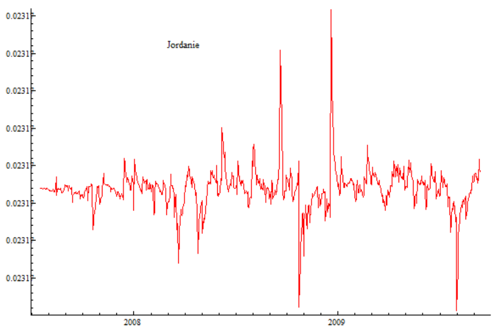
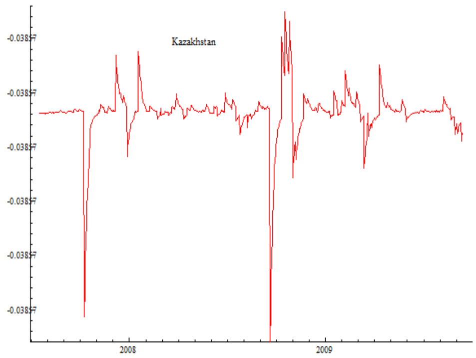
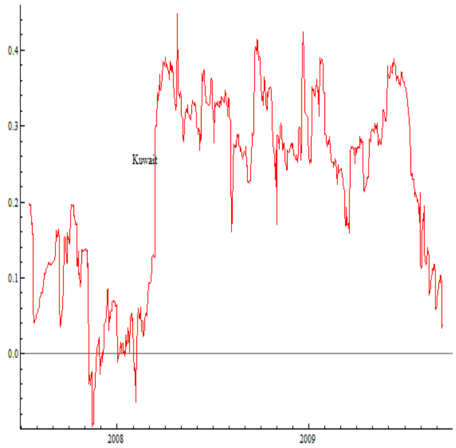
-0.4
2008
2009


Jordanie
0.0231
2008
2009


Kazakhstan
-0.038
2008
2009


Kuwait
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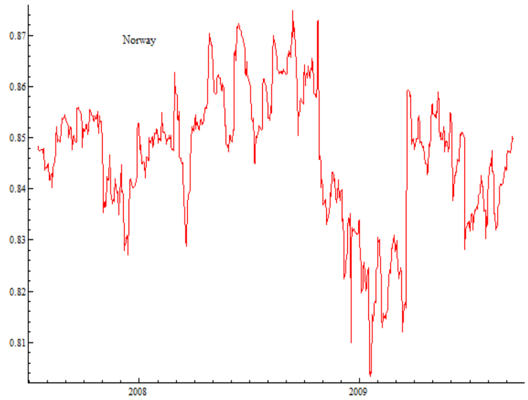
0.3
0.2
0.1
0.0
2008
2009


Norway
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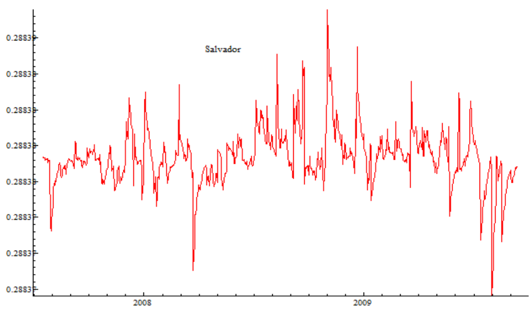
0.86
0.85
0.84
0.83
0.82
0.81
2008
2009


Salvador
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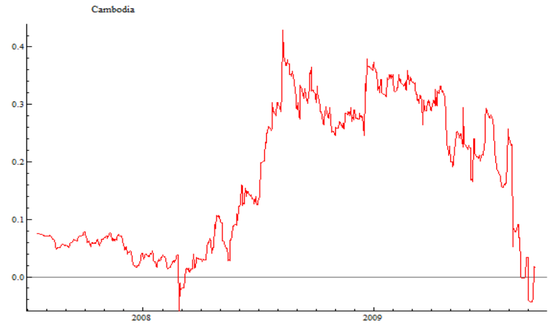
0.2883
0.2883
0.2883
0.2883
0.2883
0.2883
0.2883
2008
2009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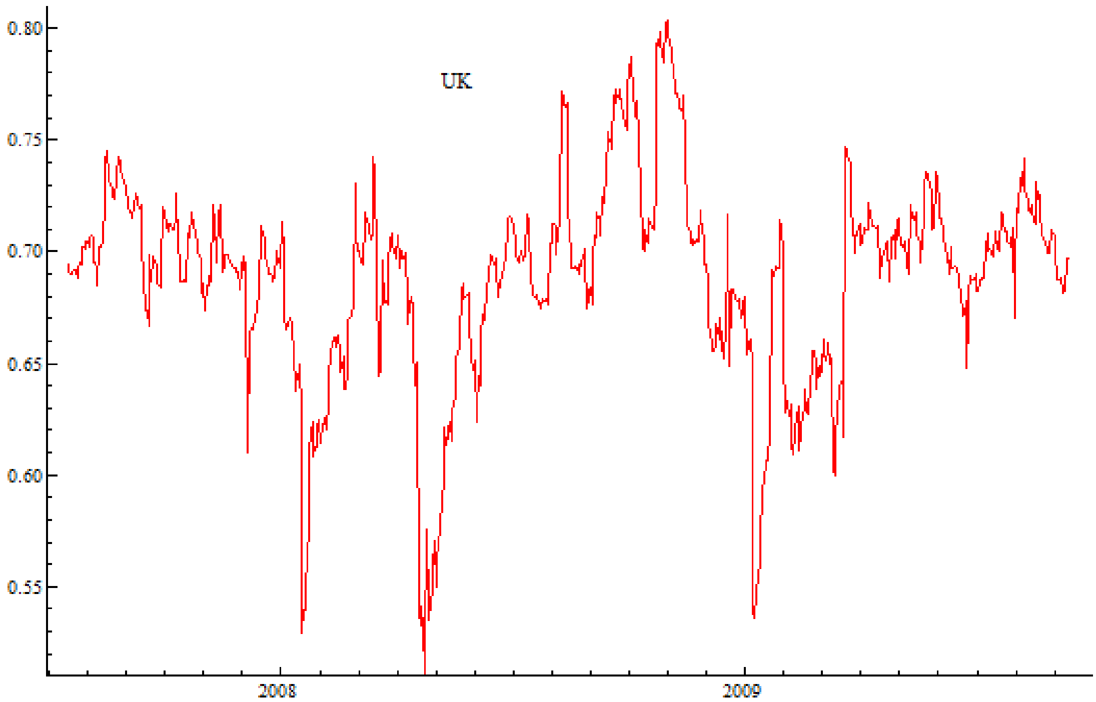
0.3
0.2
0.1
0.0
2008
2009


UK
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0.75
0.70
0.65
0.60
0.55
2008
2009