A VOLATILITY ANALYSIS OF THE EURO CURRENCY AND THE BOND MARKET

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Abstract

This paper aims to study the dynamics of the volatilities of euro currency pairs and bond markets and seeks to determine the possible connections between the two. For this purpose the methodology involves three types of GARCH models calibrated on series of six euro currency pairs and on 10–year maturity government bonds from the corresponding countries. The results indicate that the volatilities of the currency returns are connected to the corresponding governmental bond returns. Taking into account the fact that these bonds react mostly to macroeconomic events, we can conclude that new events impacts the volatility of currency returns at the daily frequency.

Keywords: volatility, currency markets, bond markets

JEL Classification: G15, G17

1. Introduction

The European Monetary Union represents the most relevant project that impacted the international financial system since the demise of the Bretton-Woods system. A detailed presentation of the European monetary integration process is made by Criste (2012) and Criste and Lupu (2015). The prospect of a financial market at continental proportions that is not subjected to exchange rate risk represented a key move to a complete financial integration. The relevance of the monetary union for bond markets is obvious and has been highlighted in studies like Bernoth et al. (2004). A powerful literature investigates the benefits and the capital role played by the euro in the evolution of bond markets and the international financial contagion is presented in Lupu (2012).

The purpose of this paper is to scrutinize the volatility of the euro currency and to search for linkages with the volatilities of several European and international bond markets. In order to achieve this objective the modeling context incorporates three models belonging

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to the GARCH class. The study thus gravitates around six currency pairs: EUR - AUD, EUR - CAD, EUR - CHF, EUR - GBP, EUR - JPY and EUR - USD and the 10 year government bonds of the states corresponding to the currency pairs (Australia, Canada, Switzerland, United Kingdom, Japan and United States).

The reminder of this paper is structured in the following manner. Section II provides a brief glimpse into similar scientific investigations. Section III describes the data and the methodology on which the study is based. Section IV covers the results obtained and their interpretation and the last section concludes.

2. Literature review

During the past decades the literature aiming at observing the linkages of different financial components has flourished into a powerful block of academic consideration. The present research relates to several areas of this literature.

Seminal research conducted by Engle, Ito and Lin (1990) and Andersen and Bollerslev (1998) generated key contributions in the investigation of the volatility of foreign exchange markets. Both studies document on spillover effects.

Ehrman et al (2011) bring forth a study that focuses on the relations between several financial sectors such as the exchange rates, bond, equity and money markets for the US and the euro zone. They report that asset prices tend to react in a powerful way to the shifts of the prices of other domestic assets. Another conclusion of the study is that before the EMU the level of international spillovers was significantly smaller. Albu et al (2014a) and Albu et al (2014b) focus on the reaction of European sovereign CDSs to certain events of quantitative easing. Similar investigations are present in Lupu and Călin (2014b) and Lupu and Călin (2014c).

Albu et al (2014c) study the relation between market capitalization and GDP per capita by using a nonlinear model that translates into a convergence based approach.

Ulrich and Wachtel (1981), Goldberg and Leonard (2003) and Ehrmann and Fratzscher (2004) demonstrate that bond markets are sensitive to news about macroeconomic fundamentals while Ito and Roley (1987) and Almeida et al. (1998) advocate the same for currency markets.

Lupu and Calin (2014a) use the MIDAS method in order to exhibit the linkages between macroeconomic growth and the stock market for a series of countries in Central and Eastern Europe. The authors report only slight dependences between the two investigated

variables, while in Lupu and Lupu (2009) is investigated the issue of contagion across Central and Eastern European stock markets using a dynamic conditional correlation test.

The literature considering exchange rate volatility is also extensive. De Grauwe et al. (1985) document on the relation between the oscillations of exchange rates and the variability of monetary shocks.

Flood and Rose (1995) investigate the impact of macroeconomic fundamentals on exchange rates focusing on both fixed and floating ones. They report a lack of influence from the macroeconomic variables.

Calderón (2004) studies the volatility of real exchange rates and observes that their levels can't be reduced by the increase of international trade.

An important number of exchange rate volatility studies incorporate in their methodology various types of GARCH models.

Bauwens et al. (2006) focus on the volatility of the Norwegian krone. Using an EGARCH model, the authors highlight a positive and statistically significant impact generated by new information.

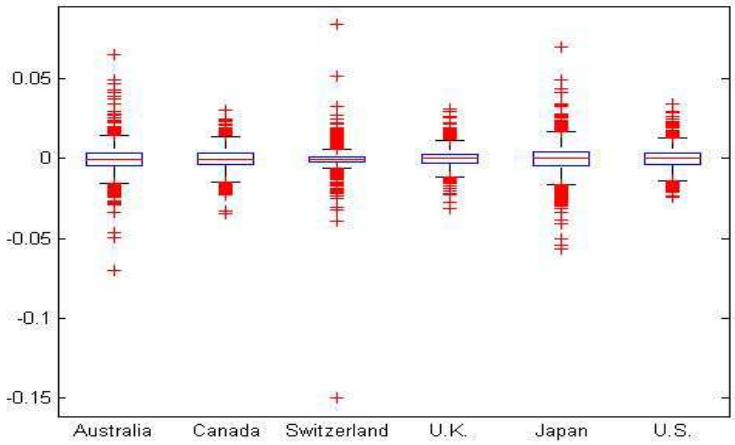
Fidrmuc and Horváth (2008) investigate the exchange rate movements for a series of recent EU member states by the means of both a GARCH and a TARCH model. The study reports high levels of volatility which come from a reduced level of credibility of local exchange rate management. Similar and more recent contributions can be found in Ahmed (2012) or Lupu et al (2014).

3. Data and Methodology

The data is provided by Bloomberg and consists in the following series of currencies: EURAUD, EURCAD, EURCHF, EURGBP, EURJPY and EURUSD. For the same time frame we also downloaded data for the 10-year maturity governmental bonds for the respective country pairs (Australia, Canada, Switzerland, United Kingdom, Japan and United States). These prices were collected with a daily frequency from January 2007 until February 2015. They cover a wide spectrum of events that encompass both the inception of the crisis and its evolvement in the following years.

The main characteristics of this series is presented in figure 1, where we show the boxplots of the log-returns for the pairs the Euro currency with all the countries mentioned above.

Figure 1: The returns of the currency pairs



We notice that they seem to have symmetrical distributions and large tails as the usual series of log-returns for financial assets in general. The largest range belongs to the distribution of the EURJPY returns as well as for the EURAUD returns.

As stated above, we are analyzing the volatility of the euro currency at the daily frequency and we study its connection with the volatilities of the bond markets.

In this respect we are using three GARCH models: the classical GARCH model, the APARCH model and the FIGARCH model for the period from January 2007 until February 2015.

The GARCH model derives from the work of Bollerslev (1986) and represents the general form of Engle's (1982) ARCH procedure. It allows the the use of passed conditional variances in the form of the present variances. The general form of the model is the following:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{m} \alpha_i a_{t-i}^2 + \sum_{j=1}^{s} \beta_j \sigma_{t-j}^2$$

where:

$\alpha_0 > 0, \alpha_i \geq 0, \beta_j \geq 0$

The Asymmetric Power ARCH (APARCH) was devised by Ding et al. (1993) and is capable of capturing the asymetry of volatilies. It's specification is the following:

$$y_t = \mu + a_t$$

$$a_t = \sigma_t \epsilon_t$$

$$\sigma_t^{\delta} = \omega + \sum_{i=1}^{m} \beta_i \sigma_{t-i}^{\delta} + \sum_{j=1}^{s} \alpha_j \left(|a_{t-j}| - \gamma_j a_{t-j} \right)^{\delta}$$

where

$\omega > 0, \delta \geq 0$

$\beta_i \geq 0$

$\alpha_j \geq 0$

$-1 < \gamma_j < 1$

Baillie et al. (1996) introduced the Fractionally Integrated GARCH which relies on the following formulation:[1]

$$\varphi(L)(1-L)^d a_t^2 = \omega + [1 - \beta(L)]v_t$$

$$\sigma_t^2 = \frac{\omega}{1-\beta(L)} + \left\{ 1 - \frac{\alpha(L)(1-L)^d}{1-\beta(L)} \right\} a_t^2 = \frac{\omega}{1-\beta(L)} + \lambda(L) a_t^2$$

4. Results

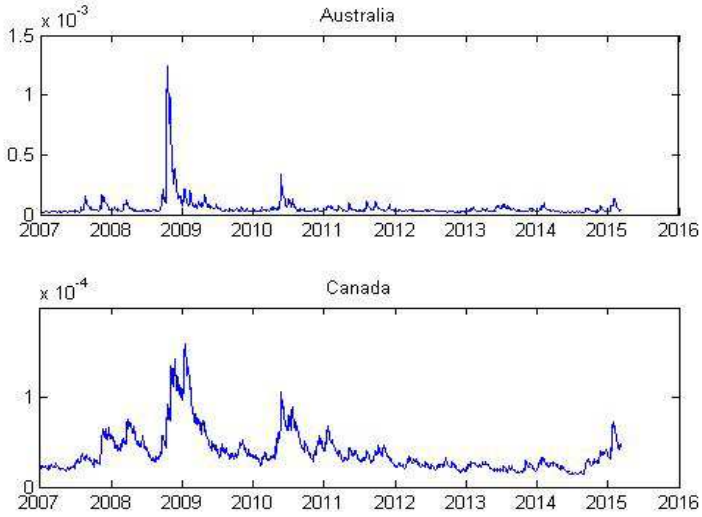
Figure 2, 3 and 4 below show the volatilities of the log-returns for the Euro currency pairs with all the counterparts from the countries in our analysis for the whole data sample. The volatilities presented here are the result of the fitting of a simple GARCH(1,1) model. Similar trends were obtained by using the other two specifications mentioned in the previous section.

For all the series, except EURCHF (due to its setting), we notice first the spike in 2008, which is consistent with the manifestation of a reaction of markets to the bankruptcies of major banks in the US, which triggered a wide range of events that were perceived at the global level. These reactions in the volatilities of currencies were clear and quite sudden, looking more like jumps in the dynamics of these log-returns, in the case of few countries (especially for Australia, Japan and to a lesser level UK) but they

[1] *For a discussion on GARCH modeling see for example Lupu and Lupu (2007) or Călin et al. (2014)*

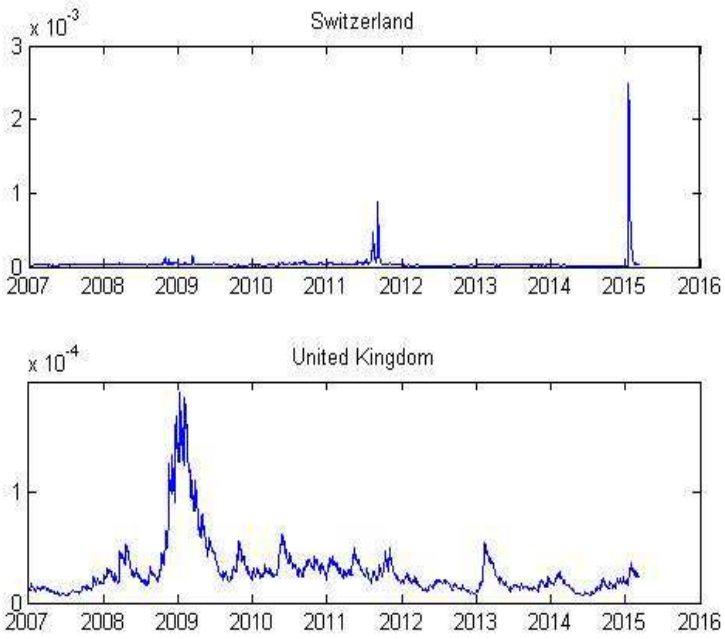
seem to have some amount of persistence in the case of US and Canada (which are known to be very correlated due to the close connection of the two economies). This persistence shows the lack of clear reaction of authorities to the manifestation of the crisis and the time needed for the generation of a strategy.

Figure 2: Volatilities of log-returns for EURAUD and EURCAD



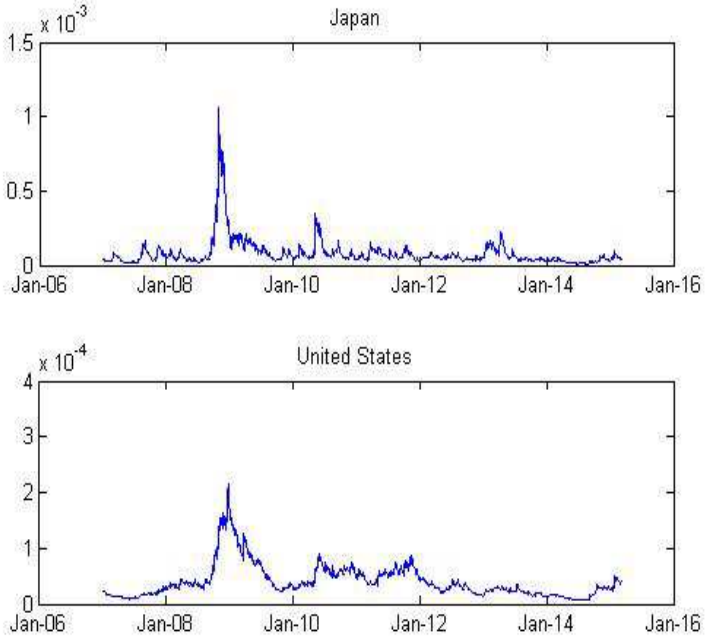
For Australia and Canada figure 2 shows a second spike (more pronounced in the case of Canada) around 2010 and beginning of 2011, which is also consistent with monetary policy reactions. The Quantitative Easing process that developed widely in the US impacted all of these countries and was clearly perceived as a clear shift in the monetary policy, with central bank officials affirming their determination to intervene in the markets in the sense that they would react as well as possible to save the economies. A close monitoring of macroeconomic statistics followed and a large dependence on the estimation of market expectations became the focus of most policy reactions.

Figure 3: Volatilities of log-returns for EURCHF and EURGBP



If for the case of Australia, Canada, UK, Japan and US we could consider the volatility dynamics as representing the result of both evolutions of the European countries and their counterparties, in the case of the EURCHF, the volatility dynamics show the results of the dynamics of Euro. We notice that the spike at the beginning of 2012 is correlated with the above mentioned shift in the monetary policy strategies and we see that the rest of the changes cover mostly low dynamics with some low reactions during the crisis in 2008. On the other hand, the large jump in 2015 reflects the well-known reaction of the Central Bank of Switzerland to relax the connection of CHF with the Euro, so this is a reaction before the large scale Quantitative Easing process to be developed in Europe.

Figure 4: Volatilities of log-returns for EURJPY and EURUSD



The volatilities of the EURJPY show both the dynamics of the European economies as well as the expectations of Kuroda's monetary policy to increase inflation in Japan as part of the well-known *Abenomics* policy. On the other hand the volatilities dynamics of the EURUSD in the second part of figure 4 shows a persistence of the large values from 2008 until 2010 and an increase during 2010 and 2012, where we could say that the monetary policies tried to identify the best strategies for the following years. Once the Quantitative Easing process was settled, the market reactions were less uncertain (as we can see smaller volatilities during this time). The increase from the end of 2014 could be associated with the uncertainty about the new Quantitative Easing program in Europe and the rate cuts of many central banks at the beginning of 2015.

Table 1

Results of regressions of volatilities of log-returns of Euro currency pairs on the dynamics of log-returns of the governmental bond markets

			Coefficients	Low 95%	High 95%
Australia	GARCH	Intercept	5.07731E-05	4.63E-05	5.52E-05
		Beta	0.030544809	0.022104	0.038986
	APARCH	Intercept	5.04095E-05	4.59E-05	5.49E-05
		Beta	0.032512893	0.024046	0.04098
	FIGARCH	Intercept	5.28084E-05	4.84E-05	5.73E-05
		Beta	0.033429343	0.025016	0.041843
Canada	GARCH	Intercept	3.75788E-05	3.65E-05	3.87E-05
		Beta	0.00322369	0.001611	0.004837
	APARCH	Intercept	3.75196E-05	3.64E-05	3.86E-05
		Beta	0.003226608	0.001623	0.00483
	FIGARCH	Intercept	3.74031E-05	3.64E-05	3.84E-05
		Beta	0.003120175	0.001594	0.004647
Switzerland	GARCH	Intercept	3.76015E-05	3.37E-05	4.15E-05
		Beta	-3.38693E-05	-4.2E-05	-2.6E-05
	APARCH	Intercept	5.14793E-05	3.92E-05	6.37E-05
		Beta	-8.27027E-05	-0.00011	-5.8E-05
	FIGARCH	Intercept	3.56542E-05	3.07E-05	4.06E-05
		Beta	-8.51695E-05	-9.5E-05	-7.5E-05
UK	GARCH	Intercept	2.88882E-05	2.77E-05	3E-05
		Beta	-0.00047788	-0.00162	0.000666
	APARCH	Intercept	2.92542E-05	2.8E-05	3.05E-05
		Beta	-0.000952045	-0.00218	0.000277
	FIGARCH	Intercept	2.85112E-05	2.75E-05	2.96E-05
		Beta	-0.000570645	-0.00161	0.000464
Japan	GARCH	Intercept	7.91036E-05	7.5E-05	8.32E-05
		Beta	0.0001112	-0.00107	0.001297
	APARCH	Intercept	7.38952E-05	7.04E-05	7.74E-05
		Beta	0.000138737	-0.00088	0.001157
	FIGARCH	Intercept	7.60432E-05	7.23E-05	7.97E-05
		Beta	9.99867E-05	-0.00097	0.001174

			Coefficients	Low 95%	High 95%
US	GARCH	Intercept	3.72542E-05	3.59E-05	3.86E-05
		Beta	0.005839648	0.004791	0.006888
	APARCH	Intercept	3.72754E-05	3.59E-05	3.86E-05
		Beta	0.005785298	0.004772	0.006799
	FIGARCH	Intercept	3.7809E-05	3.64E-05	3.92E-05
		Beta	0.005984743	0.00489	0.00708

With very few exceptions we notice that there is a clear connection between the volatilities of currency pairs and the log-returns of the bond market for governmental bonds. Taking into account the fact that usually these bonds react mostly to macroeconomic events and monetary policy decisions rather than market speculation, especially in the period covered by this sample, we can conclude that new events impacts the volatility of currency returns at the daily frequency.

5. Concluding remarks

This paper provides an analysis of the possible connections of the volatility dynamics of the main Euro currency pairs and the dynamics of the log-returns for the governmental bond market of these respective countries. The set of volatilities was obtained by the use of three GARCH models and the connections were performed using the simple regression for each series of volatilities. The results show consistence of the found volatilities with the main macroeconomic events and the existence of the dependence as mentioned seen in the regression models. We can conclude that the volatilities of the currency pairs react quite promptly to the macroeconomic events.

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