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The Effects of the European Sovereign Debt Crisis on Major Currency Markets

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Abstract

Since the European sovereign debt crisis (ESDC), the euro has been weakening, leading currency users to believe that the ESDC has impacted the major currency markets. To examine the basis of the perceptions of currency market participants, we developed a regression model using the relationship between the currency price in terms of the euro and its denominated sovereign bond price. The Australian dollar (AUD), Canadian dollar (CAD), British pound (GBP), Japanese yen (JPY), Swiss franc (CHF) and US dollar (USD) were the sample currencies used in this study. Interestingly, our findings reveal that European sovereign bond investors have three distinct views about the major currency markets: (1) JPY and USD are safe-haven currency and their denominated government bonds are better alternatives in which to invest; (2) AUD- and CAD-denominated government bonds are not trustworthy investments; and (3) GBP- and CHF-denominated bonds are not appropriate investments in the context of the ESDC. This study provides an important lesson for currency users and sovereign bond investors by indicating that the ESDC affected a limited number of currency markets rather than all major currency markets.

Keywords: European debt crisis, currency market, Lagrange Multiplier test, ARCH, GARCH
JEL Classification Codes: G15, G18

1. Introduction

Christensen (2012) states that the European sovereign debt crisis (ESDC) started at the end of 2009 and the investors raised the question of how Greece would be able to finance its growing debt. In January 2010, a European Union (EU) report condemned "severe irregularities" in Greek accounting procedures. Greece's 2009 budget deficit was revised upwards to 12.7%, from 3.7%; this was more than four times the maximum allowed by EU rules (see the Europe Crisis Timeline). In May, the EU and International Monetary Fund (IMF) led a Greek bailout. However, instead of ending the crisis, the Greek bailout was followed by bailouts in Ireland in November 2010 and Portugal in May 2011. Further, the second Greek bailout in July 2011 was finalized in February 2012. While sovereign debt has risen substantially in only a few Eurozone countries, it has become a perceived problem for the area as a whole, leading to continuous speculation of a possible breakup of the Eurozone.

The Reserve Bank of Australia (RBA) stated in its 2012 report that the euro has depreciated against most currencies since late October 2010, having previously been relatively resilient to concerns

about the prospects for a near-term resolution to the ESDC. Generally, this depreciation has been more pronounced against non-European currencies, as other European currencies have typically been affected by concerns about possible spill overs from the euro area. Since mid-2011, the euro has depreciated by between 10% and 20% against the US dollar and the Japanese yen, but by between 4% and 8% against the main Scandinavian currencies and the UK pound. In contrast, since early September, the Swiss franc has moved little against the euro as it continues to operate under a ceiling imposed by the Swiss National Bank against the euro. Overall, the euro has depreciated by 8% on a trade-weighted basis since the middle of last year. The Australian dollar has appreciated strongly against the euro, reaching its highest level in early February 2012 since the inception of the euro in 1999 and, based on historical movements in the Deutsche mark prior to the euro's introduction, its highest level against a representative European currency since early 1989.

The concurrent ESDC and depreciation of the euro against a number of currencies led us to examine the impact of the ESDC on major currency markets. To the best of our knowledge, to date, no study has been done to examine the effects of the ESDC on major currency markets. However, in contrast, Aquino (2005, 2006), Chung (2005), Yau and Nieh (2006), and Tse and Yip (2006), among others, find significant impact of foreign exchange fluctuations on the stock market around the Asian financial crisis. These studies provide evidence of a strong interrelationship between the currency market and capital market during the financial crisis, which supports the validity of this study. Our empirical results show that the euro depreciated against the US dollar and Japanese yen while the US dollar and Japanese government bond price appreciated during the ESDC. This is because investors viewed the US dollar and Japanese yen as relatively safe-haven currencies in which to invest, which led to increases in the prices of US dollar- and Japanese yen-denominated government bonds. Consequently, the demand for the US dollar and Japanese yen increased, leading to rises in their values against the euro. The present paper is organised as follows: section 2 provides a description of the data and methodology used in this study; section 3 discusses the regression results of the empirical analysis; and section 4 concludes the paper.

2. Data and Methodology

In this study, we used Australian dollar- (AUD), Canadian dollar- (CAD), British pound- (GBP), Japanese yen- (JPY), Swiss franc- (CHF) and US dollar- (USD) denominated government bonds. The data set also consisted of sample currency exchange rates against the euro (EUR). The RBA (2012) indicates that the European market sentiment deteriorated in early November 2010 due to a perceived lack of progress by European officials in dealing with the debt crisis. Our sample period, therefore, started on October 4, 2010 and continued to September 27, 2012.

The methodology was developed based on the relationship between the sample currency exchange rate against the euro and the sample currency-denominated government bond, as in equation (1),

$$Y_t=\alpha_0+\alpha_1 X_t+\varepsilon_t \quad (1)$$

where Y_t and X_t represent the exchange rate and bond price, respectively. Under the null hypothesis, coefficients α_0 and α_1 in equation (1) should be 0 and 1, respectively, to conclude that there is a relationship between the concurrent movement of the sample currency exchange rate against the euro and the sample currency-denominated bond price. Further, the negative value of α_1 indicates that the euro depreciated against the sample currency, while the sample currency-denominated government bond price appreciated.

We addressed the unit root issue for the Y_t and X_t series, otherwise, the OLS estimates were likely to be spurious. To further accommodate potential autocorrelation and conditional heteroskedasticity, equation (1) needed to be augmented, as shown in equation (2):

$$Y_t = \alpha_0 + \alpha_1 X_t + \sum_i^{\rho} \varphi_i Y_{t-i} + \sum_i^{q} \theta_i \varepsilon_{t-i} + \varepsilon_t \quad (2)$$

Without accommodating the serial correlation and heteroskedasticity, the results would lead to biased and inconsistent inferences for α_0 and α_1. The choice of the lag order, p and q, was driven by the

results of the diagnostic tests and various information criteria. In the presence of a GARCH (r, s) error in equation (2), following Bollerlev (1986), ε_t can be decomposed as follows:

$$\varepsilon_t = \rho_t \sqrt{h_t}; \rho_t \approx iid(0,1); h_t = \omega + \sum_{i=1}^{r} \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^{s} \beta_i h_{t-i}, \quad (3)$$

with the conditions $\omega > 0$, $\alpha_i \geq 0$ and $\beta_i \geq 0$ to ensure that $h_t > 0$. Once the presence of a GARCH error was confirmed by Bollerslev's Lagrange Multiplier (LM) test, the lag order, r and s, could be determined by further diagnostic tests and various information criteria, as suggested in Bollerslev (1986).

3. Empirical Analysis

The empirical analysis began with the statistical properties of the data. The descriptive statistics of the sample data are given in Table 1. The mean and median values were very close for most of the data set. The skewness of nearly zero for several of the data series is denoted by *. The kurtosis was less than 3 for all sample data except the CHF/EUR exchange rate, indicating that the tails of the sample distribution were thinner than normal. However, the Jarque-Bera (JB) normality test rejected the approximately normal distribution assumption. This implies that the sample data used in this study were not normal.

Table 1: Descriptive Statistics

Variables	Mean	Median	Skewness	Kurtosis	Jarque-Bera
AUD Straight Bond Price	108.7588	109.7000	-0.0074*	1.5649	44.5409
AUD/EUR Rate	1.3115	1.3284	-0.4192	2.2338	27.8980
CAD Straight Bond Price	143.3130	146.2400	-0.1468	1.4993	50.5613
CAD Zero Coupon Bond Price	106.0975	106.9500	-0.4129	1.9883	36.8827
CAD/EUR Rate	1.3420	1.3483	-0.4102	2.2525	26.6362
GBP Straight Bond Price	111.2093	111.0800	0.2477	2.5590	9.5113
GBP Zero Coupon Bond Price	98.8814	99.1848	-0.5576	1.8177	57.1207
GBP/EUR Rate	0.8461	0.8498	-0.4090	2.1124	31.5094
JPY Straight Bond Price	111.1248	111.3800	-0.3657	2.2778	22.8451
JPY Zero Coupon Bond Price	84.5883	84.8000	0.1365	1.9078	27.4089
JPY/EUR Rate	107.6521	108.1700	-0.0104*	2.0295	20.0295
CHF Straight Bond Price	105.0753	105.4100	-0.1532	2.0201	22.7935
CHF/EUR Rate	1.2333	1.2152	0.2539	3.6973	16.0893
USD Straight Bond Price	128.0150	132.1406	-0.2173	1.5297	50.8337
USD Zero Coupon Bond Price	34.9188	37.3515	-.0.0095*	1.4236	53.7436
USD/EUR Rate	1.3468	1.3415	-0.0333*	2.0878	18.0875

Notes: The AUD and CHF zero coupon bonds have only been trading since mid-2012 and were excluded from the regression test due to insufficient data in the series. Therefore, there are no descriptive statistics for AUD and CHF zero coupon bond prices. The Jarque-Bera (JB) follows a chi-squared distribution with 2 degree of freedom. The critical value of the chi-squared distribution is 5.99 at the 5% level of significance.

Next, the standard Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) tests were employed to investigate whether a unit root was present in the data series. The ADF test accommodates serial correlation and time trends by explicitly specifying the autocorrelation structure. The PP test accommodates heteroskedasticity and autocorrelation using the non-parametric method. As shown in Phillips and Perron (1988), the PP test has better power than the ADF test under a wide range of circumstances, and hence, was more appropriate for analysing the time series data in this paper.

Both the ADF and PP unit root tests were employed for all variables and the results are given in Table 2. The results of the ADF and PP level unit root tests are presented in columns 2 and 4, respectively. The overall test results indicate that the null hypothesis of a unit root cannot be rejected at any standard level of significance. Further, columns 3 and 5 of Table 2 represent the 1st difference unit

root test results for the ADF and PP tests, respectively. These reported results suggest that the t-statistics rejected the null hypothesis of a unit root at a level of significance of less than 1%.

Table 2: Unit Root Tests

Variables	ADF Tests		PP Tests	
	Level	1st Difference	Level	1st Difference
AUD straight bond price	-0.5964	-25.4287	-0.4380	-25.5537
AUD/EUR Rate	-1.8870	-20.2726	-1.7003	-20.2433
CAD Straight Bond Price	-0.5637	-23.2985	-0.2782	-23.9808
CAD Zero Coupon Bond Price	-1.0291	-24.8691	2.0161	-26.6787
CAD/EUR Rate	-1.4640	-21.7443	-1.5240	-21.7243
GBP Straight Bond Price	-1.8857	-22.9858	-1.8961	-22.9841
GBP Zero Coupon Bond Price	-0.5064	-21.4433	-0.5637	-21.5155
GBP/EUR Rate	-1.0795	-23.5002	-0.8019	-23.9139
JPY Straight Bond Price	-1.4021	-22.8222	-1.4021	-22.8280
JPY Zero Coupon Bond Price	0.1607	-23.4452	0.2144	-23.4501
JPY/EUR Rate	-1.3619	-24.6133	-1.3196	-24.5665
CHF Straight Bond Price	0.1929	-28.4800	0.2750	-28.9797
CHF/EUR Rate	-2.2286	-15.1952	-2.0884	-21.6879
USD Straight Bond Price	-0.7382	-23.3553	-0.6147	-23.4869
USD Zero Coupon Bond Price	-0.6342	-22.3103	-0.4316	-22.7031
USD/EUR Rate	-1.4421	-23.6669	-1.4421	-23.6665

Notes: The AUD and CHF zero coupon bonds have only been trading since mid-2012 and were excluded from the regression test due to insufficient data in the series. Therefore, there are no unit root test results for AUD and CHF zero coupon bond prices. ADF and PP denoting Augmented Dickey-Fuller and Phillips-Perron, respectively. For both ADF and PP tests, -3.4428, -2.8669 and -2.5696 are critical values at 1%, 5% and 10% level of significance.

Finally, the regression analysis was conducted for the first difference in the Y_t and X_t data series, as done with equation (1), by accommodating the serial correlation and ARCH effects; the results are given in Table 3. To detect the possible presence of serial correlation problems and ARCH effects, LM tests were employed. The first column represents the short forms of the sample currency names. Columns 2 and 3 are populated with the values of the constant and slope coefficients, respectively, including their P-values in parentheses. The F-statistic with P-values for the LM test and the heteroskedasticity test are reported in columns 4 and 5, respectively.

For each currency, regression analysis was first performed between the sample currency exchange rate against the euro and the sample currency-denominated straight bond price. The results are given in the Panel A of Table 3. The P-values in the last two columns ensure that the regression analysis was done by accommodating both serial correlation and the ARCH effects. Next, the P-values in column 2 indicate that the intercepts are not statistically different from 0, in all cases. Finally, for all currency, except GBP and CHF, the P-values in column 3 confirm that there is a relationship between the sample currency exchange rate against the euro and the sample currency-denominated government bond price. The negative slope coefficient for the JPY and USD suggest that increases in JPY and USD government bond prices led to euro depreciation against the JPY and USD, respectively. For the JPY, the slope coefficient of 0.95850 suggests that there was a strong negative relationship between the JPY exchange rate against the euro and the JPY-denominated government bond price. However, this relationship was weak for the USD.

For the robustness test, for each currency, except AUD and CHF, regression analysis was conducted between the sample currency exchange rate against the euro and the sample currency-denominated zero coupon bond prices. The results are presented in Panel B of Table 3. The AUD and CHF zero coupon bonds have only been trading since mid-2012 and were excluded from the regression test due to insufficient data in the series. Interestingly, the regression results based on the zero coupon bond price in Panel B are consistent with the regression results for the straight bond price, as reported in Panel A.

Table 3: Regression Analysis

Currency	Constant (P-value)	Slope (P-value)	LM Test F-statistic (P-value)	Heteroskedasticity Test F-statistic (P-value)
Panel A: Straight Bond Price				
AUD	-0.00045 (0.176)	0.00641(0.000)	4.0979 (0.0172)	2.0118 (0.1567)
CAD	-0.00058 (0.184)	0.00797 (0.000)	0.1879 (0.8288)	1.1323 (0.2878)
GBP	-0.00011 (0.528)	0.00275 (0.037)	0.3630 (0.6957)	1.6944 (0.1936)
JPY	-0.02674 (0.403)	-0.95850 (0.000)	0.0496 (0.8237)	0.8735 (0.4181)
CHF	-0.00025 (0.5373)	-0.00109 (0.864)	0.7490 (0.4733)	0.8118 (0.3680)
USD	-0.00010 (0.795)	-0.00209 (0.000)	2.0669 (0.1276)	2.2966 (0.1303)
Panel B: Zero Coupon Bond Price				
CAD	-0.00004 (0.909)	0.01254 (0.000)	0.2348 (0.7908)	1.8813 (0.1708)
GBP	-0.00018 (0.303)	0.01197 (0.011)	0.5426 (0.5816)	2.1702 (0.1413)
JPY	-0.02012 (0.532)	-0.78104 (0.000)	0.6688 (0.5128)	0.0361 (0.8493)
USD	-0.00007 (0.856)	-0.00323 (0.000)	2.0994 (0.1236)	2.3265 (0.1278)

Notes: The AUD and CHF zero coupon bonds have only been trading since mid-2012 and were excluded from the regression test due to insufficient data in the series. Therefore, there are no regression analysis results for AUD and CHF zero coupon bond prices. The Lagrange Multiplier (LM) and Heteroskedasticity tests are employed to identify and accommodate the serial correlation and ARCH (Autoregressive conditional heteroskedasticity) effects, respectively, in the regression analysis.

4. Conclusion

The ESDC began at the end of 2009 and has been spreading through Europe for more than two years without showing any signs of ending. Furthermore, the euro has been weakening against most currencies since late October 2010. The reasons for these concurrent events (the ESDC and the depreciation of the euro) are as follows: The European sovereign bond investors began to shop for better investment markets. The demand for major currency-denominated government bonds increased as European investors believed they were safe-haven currencies. Consequently, the price of the euro depreciated against major currency values. To empirically prove this obvious fact, we developed a regression model based on the relationship between major currency exchange rates against the euro and major currency- denominated bond prices. The Australian dollar (AUD), Canadian dollar (CAD), British pound (GBP), Japanese yen (JPY), Swiss franc (CHF) and US dollar (USD) were used as the major sample currencies in this study.

We found three different sets of regression results for straight bond prices. The first set of regression results shows a negative relationship between the JPY and USD exchange rates against the euro and their denominated straight bond prices. This indicates that the safe-haven currency JPY- and USD-denominated bond prices increased due to heavy demand among European bond investors, which led to appreciation in the JPY and USD in terms of the euro (i.e. a depreciating euro against the JPY and USD). The second set of regression results shows that the AUD and CAD exchange rates against the euro maintained positive relationships with their denominated straight bond prices. This suggests that European bond investors did not consider AUD and CAD trustworthy currency, and therefore, increases in these currency-denominated bond prices had no influence in appreciating the JPY and USD in terms of the euro (i.e. a depreciating euro against the JPY and USD). The final group of regression results finds no relationship between the GBP and CHF exchange rates and their denominated straight bond prices against the euro. This occurred because European bond market investors were not interested in further investments in European currency GBP- and CHF-denominated government bonds.

Next, a regression analysis was conducted for zero coupon bond prices to examine the robustness of straight bond price regression test results. Interestingly, both zero coupon bond price and straight bond price regression tests provided consistent results. The findings of this study provide great insight for global bond market investors, particularly European sovereign bond investors, in choosing a

safe-haven currency in which to capitalise their money. Further, this study confirms that the effects of the ESDC were experienced by a limited number of currency markets rather than all major currency markets.

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