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Determining the EUR/USD exchange rate with U.S. and German government bond yields in the post-crisis period

Natalja Lace[a], Irena Mačerinskienė[b], Andrius Balčiūnas[b,*]

[a] *Department of Corporate Finance and Economics, Faculty of Engineering Economics and Management, Riga Technical University, 6 Kalnciema Street, LV-1048 Riga, Latvia*

[b] *Department of Banking and Investments, Faculty of Economics and Finance Management, Mykolas Romeris University, Ateities g. 20, LT-08303 Vilnius, Lithuania*

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Abstract

This research shows how U.S. and German government bond yields can determine the EUR/USD exchange rate in the short run. After presenting the discussion on fundamental, technical and microstructure approach exchange rate determination models, a conclusion is made that out of the components of fundamental models the interest rates could be the best determinants for explaining exchange rate fluctuations in the short term. For the research the mostly traded currency pair, the EUR/USD, was chosen and 2-year, 10-year U.S. and German government bond yields were selected as determinants of the exchange rate. After performing the linear regression procedure it has shown that the model can determine 5 per cent of the daily EUR/USD fluctuations with a change in 2-year U.S. government debt yield being the greatest determinant in the model. It affects the exchange rate as it is stated in the uncovered interest rate parity model – when the yield increases, the USD declines against the euro and vice versa. Another finding is that an increase in the German 10-year government bond yield increases the price of the euro and the increase in the U.S. 10-year debt yield leads to an appreciation of the USD.

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1. Introduction

The foreign exchange market is the largest market in the world with rapidly increasing trading volumes. The latest data from the Bank for International Settlements (2013) show that in 2007 the overall daily turnover of foreign exchange products (spot contracts and currency derivatives both traded over the counter and in exchanges)

* Corresponding author.
E-mail addresses: natalja.lace@rtu.lv (N. Lace), irena.macerinskiene@mruni.eu (I. Mačerinskienė), abalci@mruni.eu (A. Balčiūnas).

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was $3.456 tn., in 2010 it increased by 19.33 per cent up to $4.124 tn., and in 2013 it was $5.505 tn., which shows an increase of 33.49 per cent. The increase of currency trading volumes is usually explained by an increase in international trade. Levels of foreign direct investments and portfolio investments are also increasing, with fund managers having greater exposure to financial market instruments overseas, and therefore a greater demand for foreign currencies. Moreover, developments of information technologies also add to increasing currency trading volumes—now it is easier to access the market especially for the retail participants. King and Rime (2010) argue that the part of the retail traders in 2013 composed approximately 8–10% of the overall daily turnover in the market, which is already more than the size of international trade, which, according to Lyons and Moore (2009), is 6%. Therefore the structure of market participants is changing.

Since the collapse of the Bretton Woods system there were many attempts to determine the exchange rates. Based on the market analysis types, two main groups of foreign exchange forecasting models can be distinguished. Fundamental models, which can be also called macro-economic models, state that the fluctuations of exchange rates depend on macro-economic determinants, like inflation, or consumer price index, monetary base, gross domestic product, interest rates, international trade, etc. Some examples of the models are the purchasing power parity model, the interest rate parity model, the monetary model, the Dornbusch sticky price model, etc. (for further discussion on fundamental exchange rate forecasting models see Macerinskiene & Balciunas, 2013). On the other hand, there are many discussions whether these models can forecast the exchange rates in the short term and it has been agreed that in the short run the exchange rate disconnect puzzle (Bachetta & van Wincoop, 2006; Evans & Lyons, 2002; Sarno & Taylor, 2002) exists, because many researches show that the fundamental models fail to determine the short term exchange rates better than a random walk. Technical analysis models are based on the assumption that the price of an asset depends on its price in the past. There is a wide discussion on the technical analysis use for analysing securities' prices since it eliminates the assumption that the markets are efficient (for further discussion see Kirkpatrick and Dahlquist (2013), for the survey of the results of the trading strategies based on technical analysis models see Schulmeister (2008) and de Zwart et al. (2009)). Another one – the microstructure approach - can be used to determine the exchange rates in the short run. In the microstructure approach models it is stated that the exchange rates are determined by market participants' positioning or order flow. On the other hand, Chinn and Moore (2011); Jalil and Feridun (2010); Rime et al. (2007); Sager and Taylor (2008); Vitale (2007) discuss that application of the microstructure approach model faces many challenges. Since the foreign exchange market is the over-the-counter market by its nature, it is complicated to collect order flow information from its participants. Therefore there is no common model, which could show the best results in determining the short term exchange rate.

Boschen and Smith (2012) find that the uncovered interest rate parity model, which states that the exchange rates fluctuate based on the interest rates of the two economies, shows that the interest rates can determine the exchange rate better than they did in the past because of the increasing size of the market and increasing heterogeneity of the market participants. Therefore it is reasonable to provide additional research on how the exchange rates can be determined by the interest rates in the short run, by using 2-year and 10-year government bond yields. The **problem** of the research: how do government yields determine the exchange rate in the short run? The **objective**: to distinguish and evaluate the possibilities for determining the exchange rates with government bond yields. The **tasks** of the research: to provide the discussion on exchange rate forecasting with uncovered interest rate parity; to provide a model for determining the exchange rates with government bond yields. Methods used in the research: analysis and synthesis of scientific literature, linear regression, analysis of statistical data.

2. Literature review

The uncovered interest rate parity states that there are no excess profits available from investing into the same risk assets in different countries when the exchange rate fluctuations are taken into account, as it is stated in Fig. 1.

Fig. 1 shows an example of a deposit placed in a bank on the 1st of January for one year, the interest rate for deposits in domestic currency is r. At the end of the period, on the 31st of December, the investment will be worth *1000 EUR X (1+r)*. The investor also has a possibility to exchange the currency on the 1st of January at the exchange rate s and to receive the interest rate for deposits in foreign currency $r*$. At the end of the period the investor will have received the foreign interest rate for the foreign currency deposit, and he/she will have to

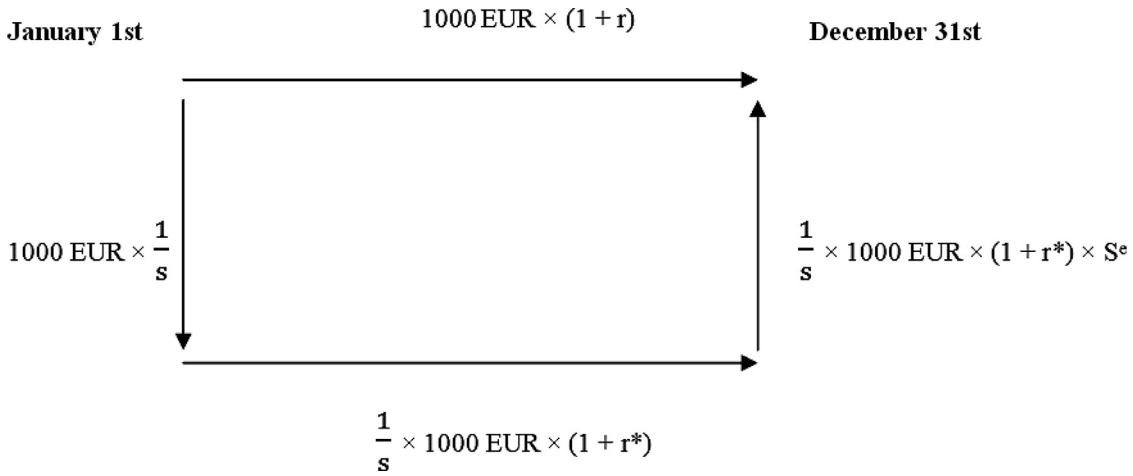

Fig. 1. Exchange rate determination with the help of the uncovered interest rate parity model.

exchange the currency (and the yields) back to the domestic currency at the expected exchange rate S^e. Also it is important to notice that on the 1st of January the investor does not know what the S^e is going to be at the end of the period. The uncovered interest rate parity states that the change in the exchange rate by the end of the period will offset the difference between the domestic and foreign interest rates and no excess profits will be made.

It is widely discussed whether the uncovered interest rate parity holds in reality. Sarno (2005) states that the covered interest rate parity, where the expected exchange rate is hedged with a future or forward contract, holds most of the time, although the same author discusses that the uncovered interest rate parity rarely holds, therefore an interest rate parity puzzle, or anomaly, exists. Hacque (2010) made a research on the covered interest rate parity and found out that the covered interest rate parity held, because the forward exchange rate was equal to the spot exchange rate adjusted by the interest rate. Kohler (2008) argues that investors are irrational, what leads to the formation of bubbles, that is, a greater deviation from the equilibrium exchange rate determined by the interest rate parity. On the other hand, Chen and Tsang (2013) argue that the yield curve factors can explain the excess currency returns one month to two years ahead. Boschen and Smith (2012) state that nowadays the uncovered interest rate parity tends to hold more often because of the increasing trading turnover in the foreign exchange market and the increasing level of heterogeneity of market participants, Hacque (2010) emphasizes the lack of empirical tests in covered and uncovered interest rate parity research. Alexius and Sellin (2012) state that there are more researches on exchange rates and long term interest rates should be done.

3. Methodology and data sample

The design of the study is aimed to determine how well the yields of government bonds can determine the exchange rate. For the research the mostly traded EUR/USD currency pair was chosen. In 2013 the turnover of the currency pair composed more than 24% of the overall turnover in the foreign exchange market. Since the selected currency pair is EUR/USD, the yields of United States Treasury issued bonds and German bonds (the largest economy in the euro zone) were chosen.

In other researches various interest rates were used. Hacque (2010) applied bank deposit rates, Srikanth and Kishor (2012) used 3-month Libor and Mibor, Hacker et al. (2012) used 3-month treasury bills, while Suthar (2008) applied long term (10-year) and short term (90 days) government bond interest rates. Alexius and Sellin (2012) argue that there is a lack of research in the long term interest rates and that it would be reasonable to use long term bond yields for forecasting short term fluctuations in exchange rates. Therefore 2- and 10-year U.S. and German bond yields will be applied in this research.

A model of linear regression will be composed for evaluating how well the interest rates can determine the exchange rate. Linear regression models were used by Evans & Lyons, 2002; Rime et al., 2007 to determine whether the exchange rate can be forecasted by using order flow data and interest rates. The ordinary least

Table 1
Results of the regression model.

Variable	Coefficient	P-level
Change in yield of German 10-year government bond	0.027	0.000
Change in yield of German 2-year government bond	0.000	0.157
Change in yield of U.S. 10-year government bond	–0.017	0.000
Change in yield of U.S. 2-year government bond	0.029	0.002

Source: composed by the authors with SPSS 20.

squares method was used by Suthar (2008) for evaluating how well the exchange rate can be forecasted by short term interest rates.

The model for the study is composed in Formula 1:

$$chEURUSD = ch2G + ch10G + ch2US + ch10US, \tag{1}$$

Where:

chEURUSD is the change in EUR/USD exchange rate.
ch2G is the change in German 2-year government debt yield.
ch10G is the change in German 10-year government debt yield
ch2US is the change in U.S. 2-year government debt yield
ch10US is the change in U.S. 10-year government debt yield

Formula 1 shows that the change in the exchange rate is determined by the change in the 2-year U.S., 2-year German, and 10-year U.S. and 10-year German bond yields. The daily data is collected from the U.S. Treasury department and data source investing.com, SPSS 20 is used for the calculations.

Since most of the previous researches were carried out for the pre-crisis or crisis periods (Hacque, 2010;Hsing, 2015; Lim & Ogaki, 2013), for this study the period after the end of the great recession was chosen. Based on the business cycles data from the National Bureau of Economic Research the latest crisis ended in June of 2009 (NBER, 2015), the last day of the period is the 27th of November 2015.

4. Findings of the study

After conducting the research it was found that the model can determine 5.3% of the exchange rate fluctuations. Similar results were found by Evans and Lyons (2002) where the authors showed that interest rate variable can determine 10 per cent of the exchange rate variations, while the interest rate variable was not significant. The results are presented in Table 1.

As it can be seen from Table 1, only one variable is not statistically significant—that is the change in the German 2-year government bond yield. The best determinant is the change in the U.S. 2-year government bond yield, while the change in the 10-year U.S. government bond yield affects the change in the currency pair the least.

Moreover, it is worth to notice that the change in the 10-year U.S. government yield affects the increase of the U.S. dollar, that is, the decrease of the EUR/USD exchange rate, while the change in the 2-year U.S. government debt yield affects the increase in the exchange rate (euro appreciation, USD depreciation). An increase in the 10-year German government bond yield leads to an appreciation of the exchange rate.

Therefore, a conclusion can be made that both the increase in the long term (10-year) government bond yields positively affect the price of the currency in which they are denominated, while the increase in the shorter term (2-year) U.S. government bond yield affects the price of the currency conversely. This supports the conclusion made by Hacker et al. (2012) that, as stated in the sticky-price models, an increase in the short term interest rates leads to a depreciation of the currency, and in the long term, as in the flexible-price monetary models, an increase in the long term interest rates leads to an appreciation of the currency, in which the interest yielding instruments are denominated.

A conclusion for further discussion on the application of interest rates for determining the exchange rates can also be done. Since the model can determine only 5.3% of the fluctuations in the EUR/USD exchange rate, a

further study is encouraged. Similarly as in other researches (like Benrud, 2008; Chen & Tsang, 2013) not pure government bond yields, but the yield curve and the difference between the two country government bond yields could be applied for the calculations.

5. Conclusions

There are many models, which can be used for determining the exchange rate—they can be classified as fundamental, technical and microstructure approach models. Various researches have shown that from fundamental models the uncovered interest rate parity should provide the best results by stating that the exchange rates can be determined by the interest rates. It is thought that order flow data from the microstructure approach could determine the exchange rates as well. Moreover, it is argued that the uncovered interest rate parity should hold better in recent periods, since the turnovers and the heterogeneity of currency market participants are increasing, which lead to better information efficiency in the foreign exchange market.

In the research government bond yields were chosen as determinants of the exchange rate. Shorter term 2-year, yields of German and U.S. debt securities were used with long term (10-year) yields to determine the mostly traded EUR/USD exchange rate. The research was done for the post-crisis period. It is shown that the model can determine 5.3% of the exchange rate fluctuations by the change in the 2-year U.S. government debt instrument being the best determinant. Other findings support the sticky and flexible price monetary models for exchange rate determination. The increase in the shorter term bond yield leads to a depreciation of the currency in which the fixed income security is denominated, while the increase in the yield of long term (10–year) securities lead to an appreciation of the currency in which they are denominated.

Since the model can determine 5.3% of the exchange rate fluctuations, further research for a better model is encouraged. Instead of pure government bond yields a yield curve for exchange rate determination could be used, moreover, a difference between government bond yields of two countries could be applied in the model.

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