Optimal Carry Trade Strategy Based on Currencies of Energy and Developed Economies

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Abstract: Optimal investment strategy depends on the loan in currencies of developed economies (EUR, JPY) and lending in currency of energy economies (RUB, BRL). Since 2014, there has been a shift to euro funding as the currency of financing for carry trade against the backdrop of the European Central Bank (ECB) not changing the volume of incentives to accelerate economic growth. There is some evidence to support the use of euro as a funding currency for carry trade, such as the irrational behavior of the currency during the Greek shock in the middle of 2015. Thus, the impact of yen-based trading strategies on the Japanese stock market is unconventional. It also became evident that the relationship between the dynamics of US dollar and S&P 500 index is extremely uncertain. When risk appetite waned due to the high volatility, the money was back. The ECB's zero-rate monetary policy has some impact on the global stock market.

Keywords: Carry trade, Uncovered interest parity, CRB industrial return, Monetary policy, Optimal parametric portfolio.

1. INTRODUCTION

The stock market is closely linked to the currencies of developed countries, while energy prices are more important for developing countries than the stock market factor. Many researchers (Baz at al., 2001; Beckmann and Czudaj, 2013; Bhar and Hammoudeh, 2011) propose papers about the impact oil prices on carry trade efficiency. The carry trade strategy is an investment strategy that involves borrowing in low interest rate currencies and investing in high interest rate currencies. The papers of Fama (1984); Fama and French (1993) tell about relations between different markets.

The risk factors for the currencies of developed countries differ from those of developing countries. Cash injections into hedge funds are associated with the profitability of the carry trade strategy in developed countries.

Risks in the stock and commodity markets can be segmented. Agricultural commodity prices are closely linked to the stock markets of developing countries, and metal prices are largely influenced by advanced economies. This heterogeneity is due to the greater liquidity of the currencies of developed countries, which are regarded as investment asset classes. Prices for exports and imports of goods are related to interest rates developed country. Moreover, the commodity exporters are few developing countries with a high interest rate.

2. LITERATURE REVIEW

Brunnermeier, Nagel and Pedersen (2009) show that the decline in the stock market may bring a better price yield than the formation of a portfolio based on the traditional capital asset pricing model (CAPM). Commodity prices, however, were a source of financial information that could be useful. Currencies of commodity-producing countries, such as Australia and Canada, are correlated with commodity prices. Barroso and Santa Clara (2014). proposed construction of currency portfolios based on the forecasted yield in commodity prices. The risk of the stock market is not related to emerging currency portfolios.

There is a risk of the carry trade strategy, trade, which is associated with commodity prices. This price risk in commodity markets is linked to the currencies of developing countries.

Our empirical results are confirmed by the Menkhoff at al. (2012), which demonstrates that the reversal of the direction of the strategy of carry trade during the financial crisis has a clear pattern only for the currencies of developed countries.

Thus, commodity prices can affect the profitability of currency trading. We find that commodity prices are

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JEL: G11, G15, F31.

important risk factors for the profitability of currency transactions. Chen and Rogoff (2003) link the commodity price index to future currency returns, but we focus on the relationship between excess currency returns and commodity risk factors.

This result is supported by the conclusion of Hattori and Song (2009), which explains the strong decline in carry trade transactions during the financial crisis in developed markets.

3. METHODS

We use power utility as the objective function:

$$U(r_p) = \frac{(1+r_p)^{1-\gamma}}{1-\gamma} \quad (1)$$

where γ is the coefficient of relative risk aversion (CRRA). The main advantage of this utility function is that it shows process and asymmetry, as opposed to the average deviation utility, which focuses only on the first two moments of the distribution of returns. The investor does not like the critical risks and values that help to reduce it even if they do not add to the Sharpe ratio.

The main limitation imposed on the investor's problem is that θ is maintained constant over time. This significantly reduces the chances of retraining, since only the vector of characteristics k × 1 is evaluated.

The assumption that it does not change allows it to be evaluated using samples:

$$\hat{\theta} = \arg_\theta \max \frac{1}{T}\sum_{t=0}^{T-1} U\left(RF_y^{US} + \sum_{i=1}^{N_t}\left(\frac{\theta^T x_{i,t}}{N_t}\right) r_{t+1}^i - \sum_{i=1}^{N_t}\left|\frac{\theta^T x_{i,t}}{N_t}\right| c_{i,t}\right), \quad (2)$$

where Ci, t is the transactional value of currency i at time t, which we calculate as:

$$c_{i,t} = \frac{F_{i,t,t+1}^{ask} - F_{i,t,t+1}^{bid}}{F_{i,t,t+1}^{ask} + F_{i,t,t+1}^{bid}}. \quad (3)$$

Most studies in recent foreign-exchange-rate-of-return literature use larger samples of countries, including many emerging economies (e.g., Burnside (2012), Burnside *et al*. (2011), Lustig and Verdelhan (2007), Lustig *et al*. (2011), (2014)). However, this raises possible problems of shifting choices. It may also be difficult to specify the exact time at which a developing country's currency first became a suitable investment asset. The exchange rate is taken from the Datastream. These include spot exchange rates at a monthly frequency from 2008 to 2018 and a 1-month exchange rate.

Oil price can influence on the carry trade efficiency, the oil price growth to increase carry trade efficiency (Figure **1**).

We calculate the real exchange rates of each currency against us dollar using spot exchange rates.

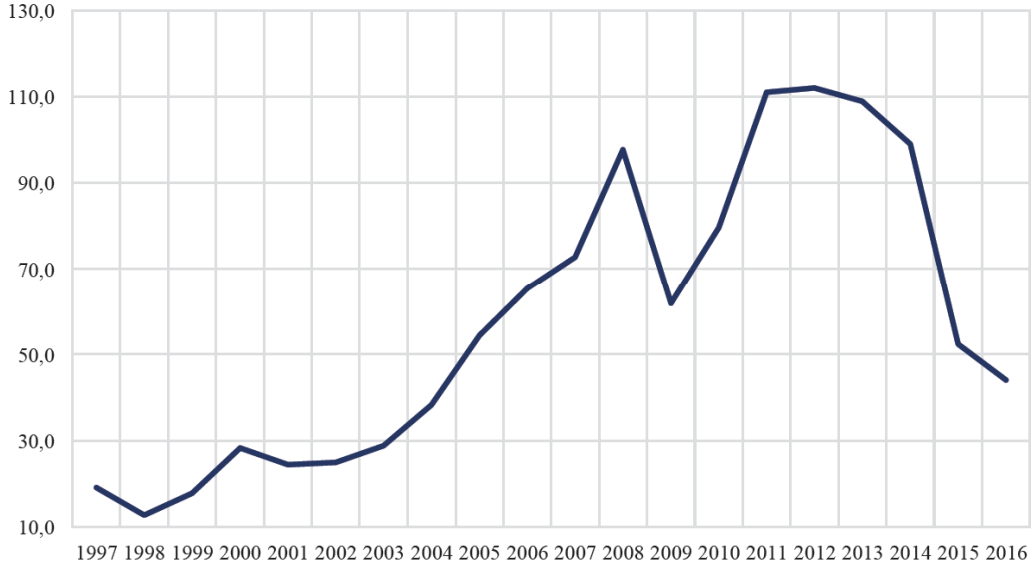

Figure 1: Brent crude oil price (1997-2017).

Source: compiled according to the World Bank.

Electronic resource http://www.worldbank.org/en/research/commodity-markets.

We test the economic significance of the transfer, momentum and value users, combined with the basic principles of the foreign exchange market investment strategy. The variables used in the optimization:

1. Forward discount. The value of the direct discount of the currency against the US Dollar. 1, if the currency is trading at a discount (Fi, t> Si, t) and -1, if it is trading at a premium. As indicated in the work of Sarno at al. (2012) we take it as a reference throughout the article.
2. Interest rate spread. This standard differentiation measures forward discount in standard deviations above or below the average for all countries. Key interest rates show here (Figures **2-12**).
3. Currency momentum. We use the cumulative appreciation of the currency over the last three months, standardized by section. This variable explores the short-term preservation of foreign exchange earnings.

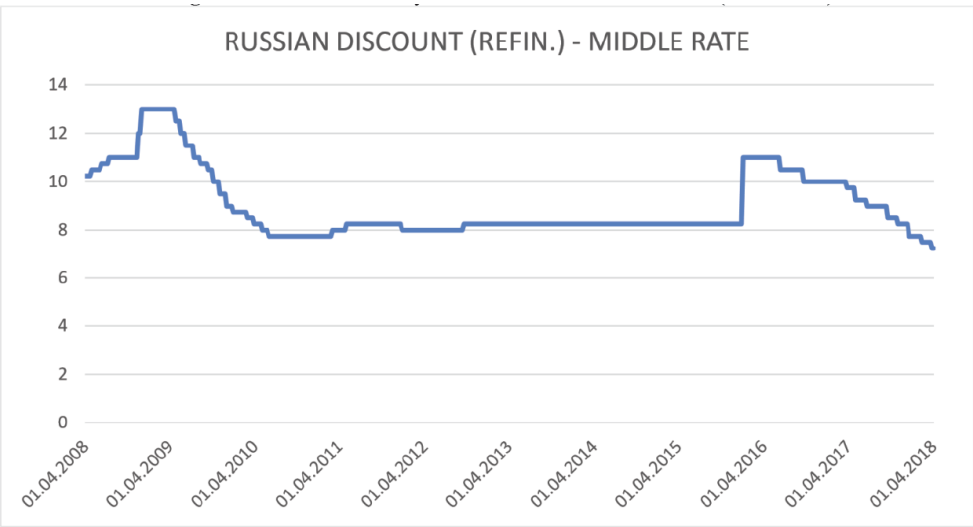

Figure 2: Central bank key rate in the Russian Federation (2008-2018).

Source: Thomson Reuters Datastream.

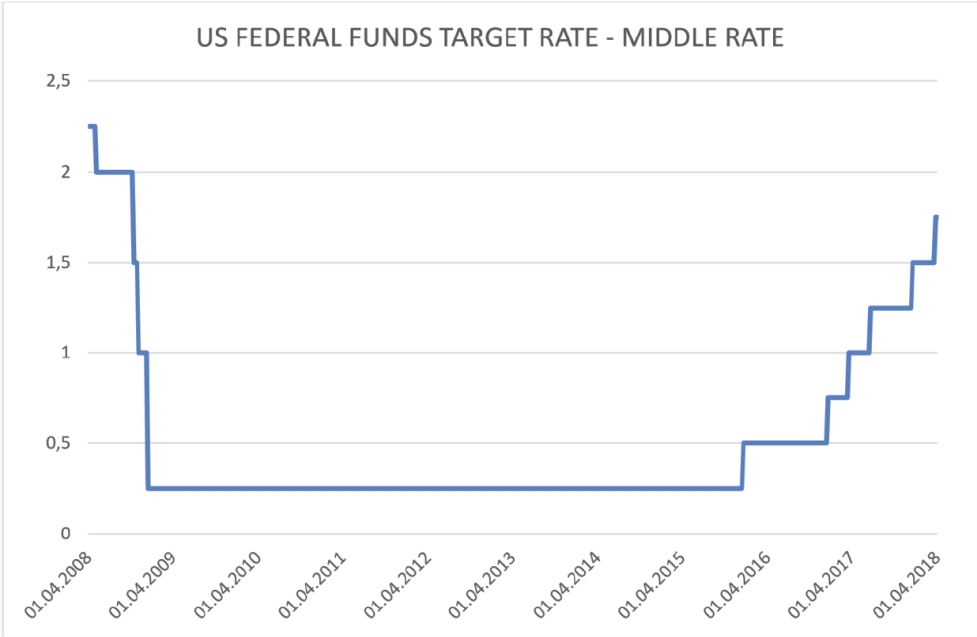

Figure 3: Central bank key rate in USA (2008-2018).

Source: Thomson Reuters Datastream.

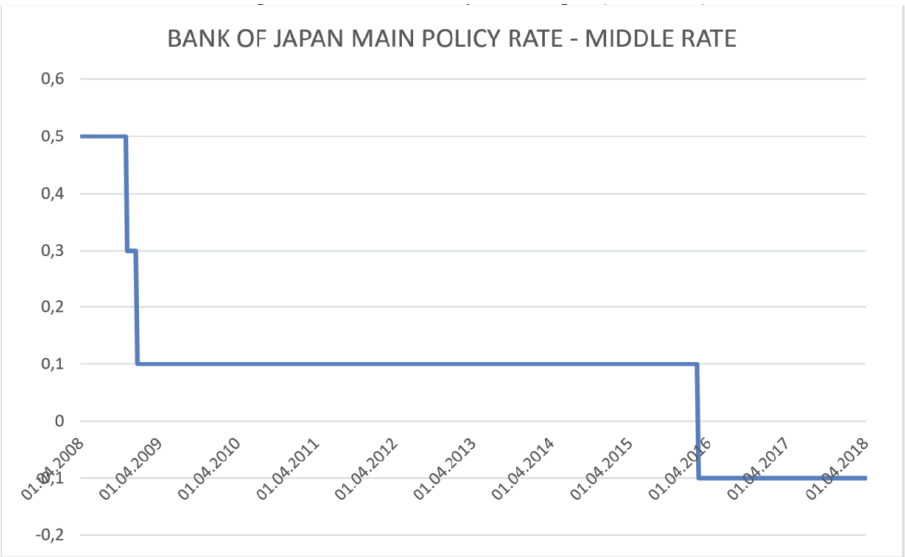

Figure 4: Central bank key rate in Japan (2008-2018).

Source: Thomson Reuters Datastream.

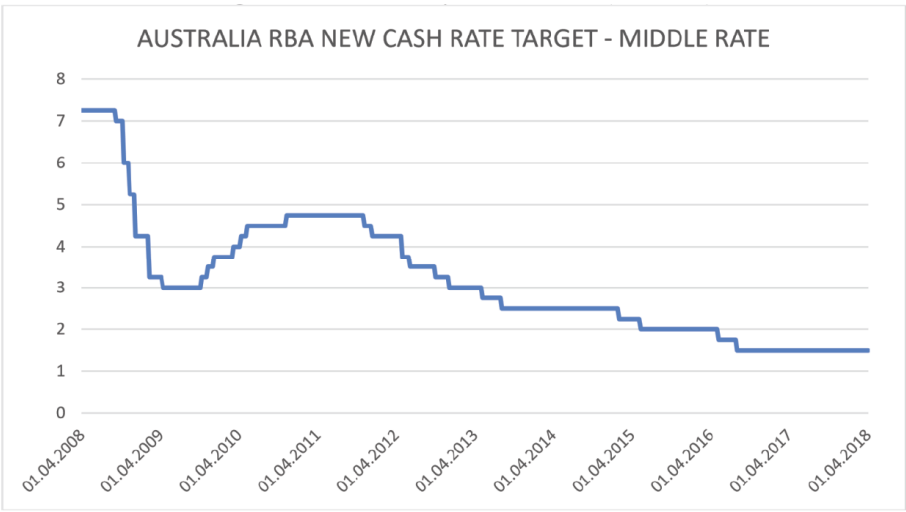

Figure 5: Central bank key rate in Australia (2008-2018).

Source: Thomson Reuters Datastream.

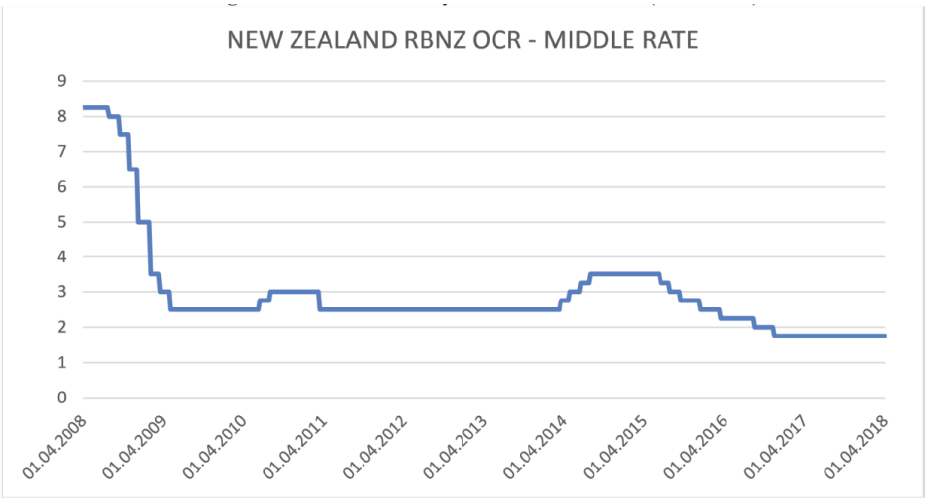

Figure 6: Central bank key rate in New Zealand (2008-2018).

Source: Thomson Reuters Datastream.

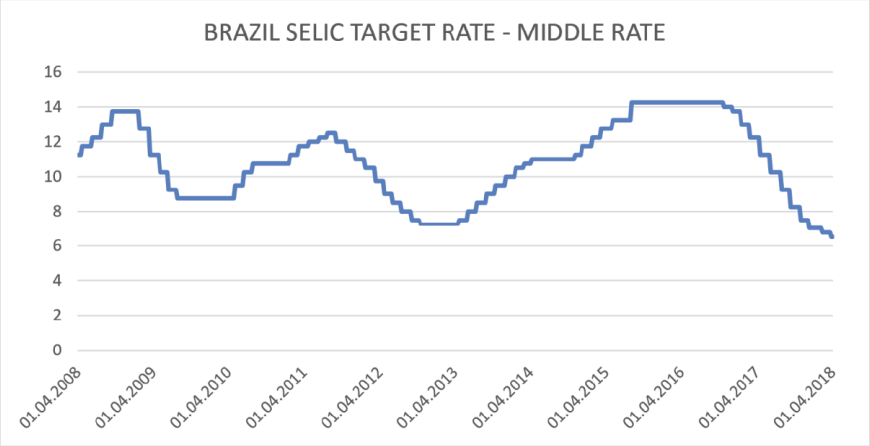

Figure 7: Central bank key rate in Brazil (2008-2018).

Source: Thomson Reuters Datastream.

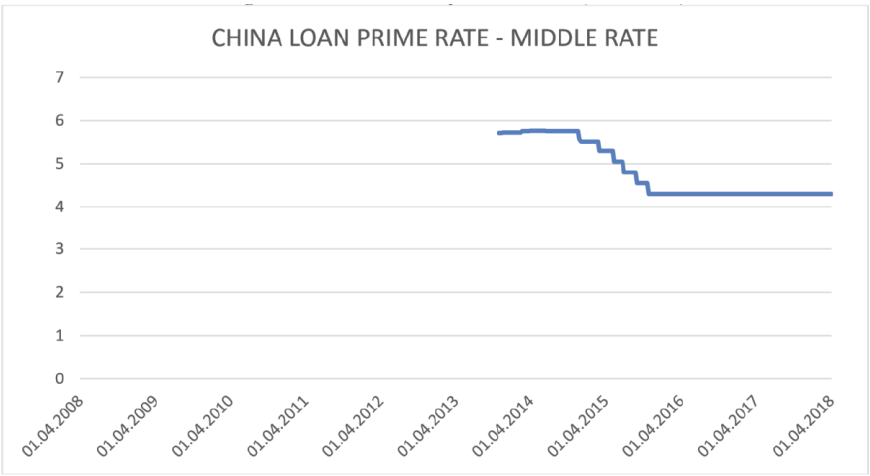

Figure 8: Central bank key rate in China (2008-2018).

Source: Thomson Reuters Datastream.

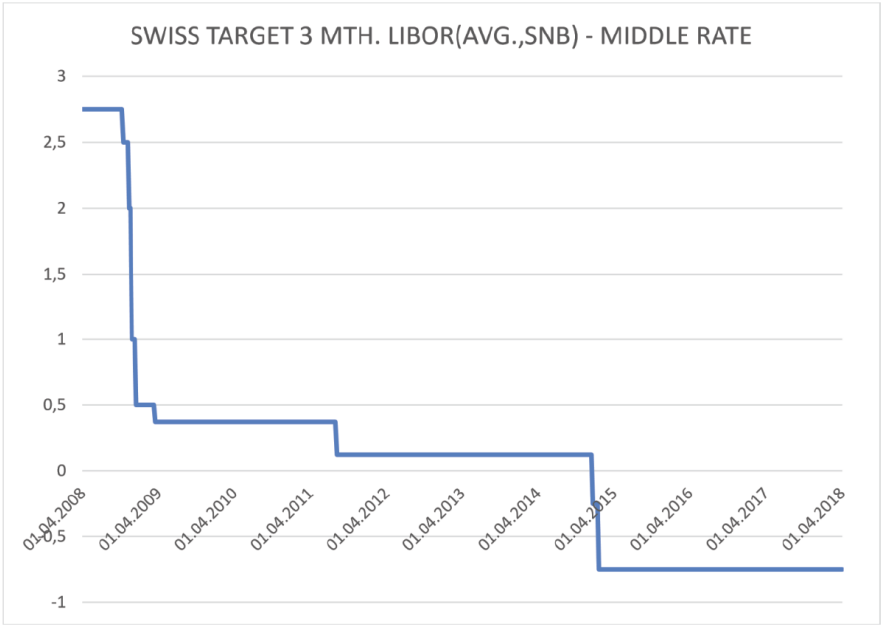

Figure 9: Central bank key rate in Switzerland (2008-2018).

Source: Thomson Reuters Datastream.

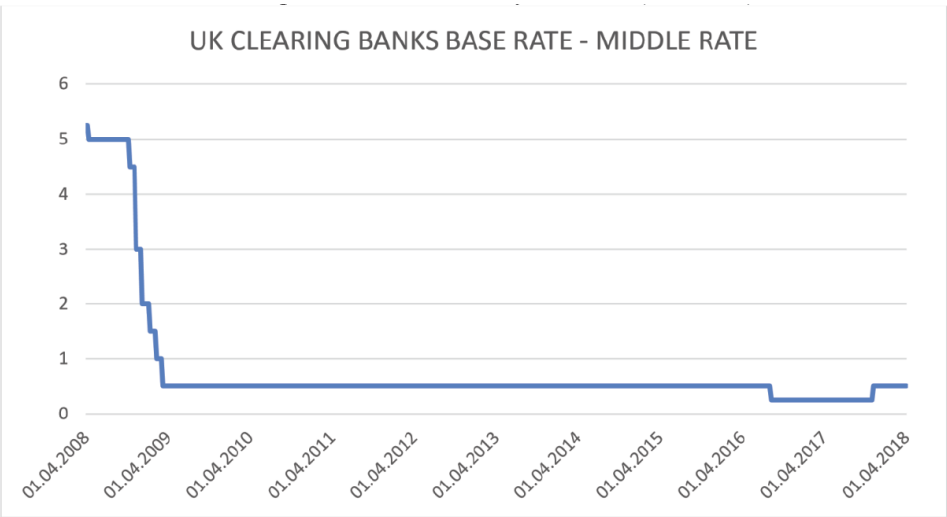

Figure 10: Central bank key rate in UK (2008-2018).

Source: Thomson Reuters Datastream.

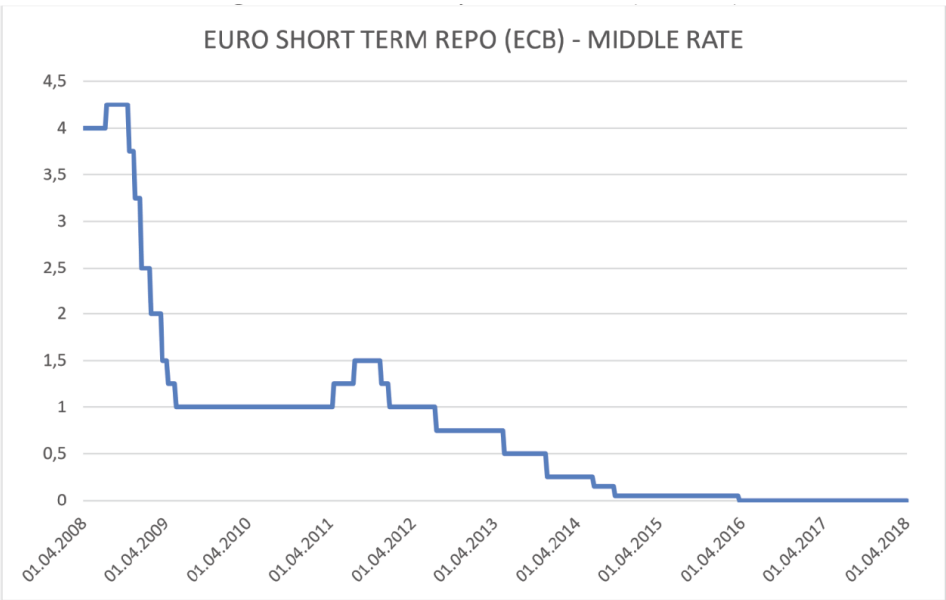

Figure 11: Central bank key rate in Eurozone (2008-2018).

Source: Thomson Reuters Datastream.

We use momentum over the previous 3 months because there is sufficient evidence of persistence in earnings for portfolios with this shaping period, and there are no significant gains (in fact, the momentum effect is often smaller) when considering longer shaping periods (Menkhoff *et al*., 2012; Mikhaylov, 2014; Mikhaylov, 2018a). The three-month momentum was also used in Plantin and Shin paper (2011). Cross-sectional standardization means that the pulse measures relative performance. Even if all currencies are related to the US Dollar, those that fell less would have a positive impact (Mikhaylov, 2018b).

4. RESULTS

The rate of USDJPY has an impact on the profitability of the stock market. In addition, there are additional effects:

1. Positive interactions between carry trade returns and the stock market performance of countries that match the target investment currencies (Australia, new Zealand and China);

2. There is a negative correlation between the exchange rate of the US Dollar and the dynamics of US stock market, while the

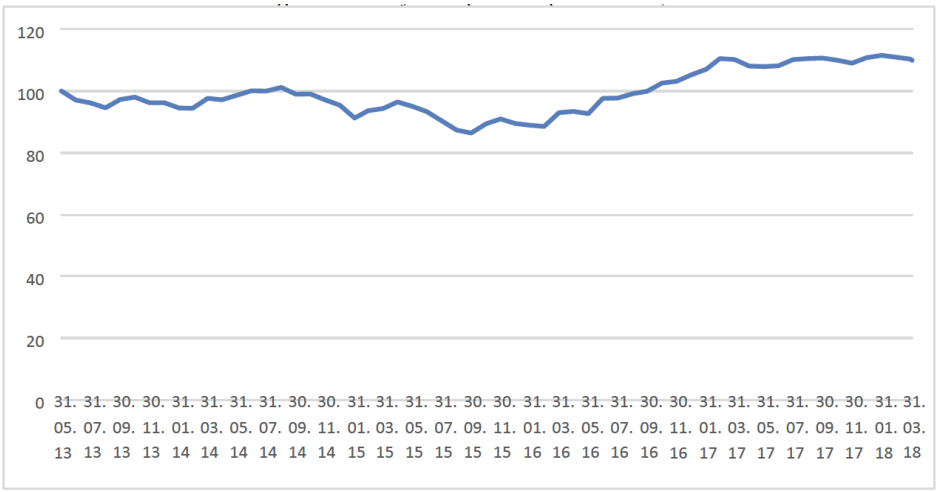

Figure 12: Carry trade portfolio performance, %.

Source: Thomson Reuters Datastream, author calculation.

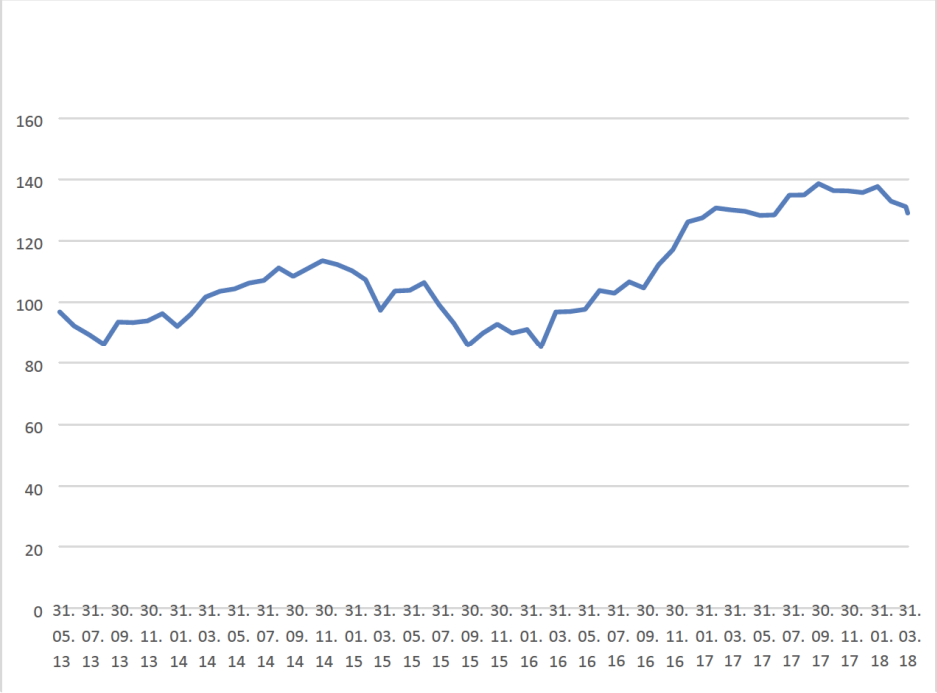

Figure 13: JPYBRL carry trade strategy performance, %.

Source: Thomson Reuters Datastream, author calculation.

relationship between the yen and Japanese stock prices is positive.

3. The performance of carry trade portfolio at the period of 2013-2018 is 10% (Figure **12**).

4. The best performers of carry trade strategies at the period of 2013-2018 are JPYBRL, EURBRL, EURRUB (Figures **13-15**).

In accordance with modern methods of trading in the financial markets, traders sell forward currency contracts with a premium and buy forward currency contracts with a discount to make a profit. Investors profit not only from interest rate differentials, but also from appreciation of the national currency during the investment horizon. For example, during the period from 2003 to 2007, when the currency markets were relatively stable, there were high volumes of carry trade for the Australian and New Zealand dollars against the Japanese yen, which further increased the income of the strategy carry trade.

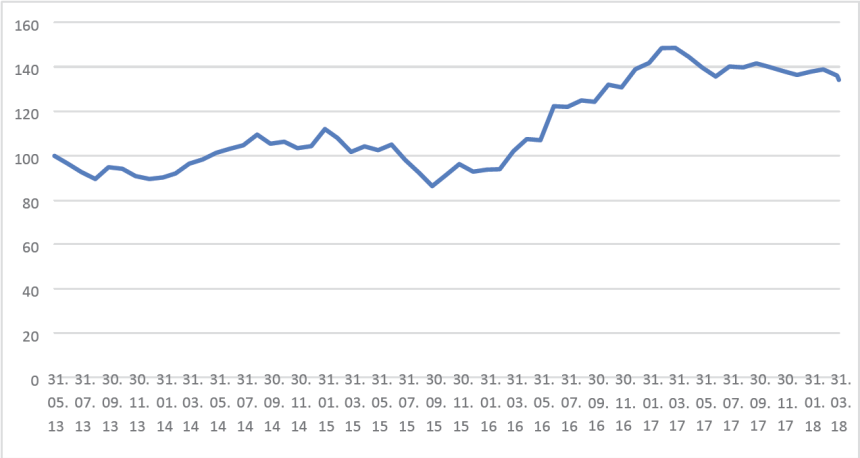

Figure 14: EURBRL carry trade strategy performance, %

Source: Thomson Reuters Data stream, author calculation.

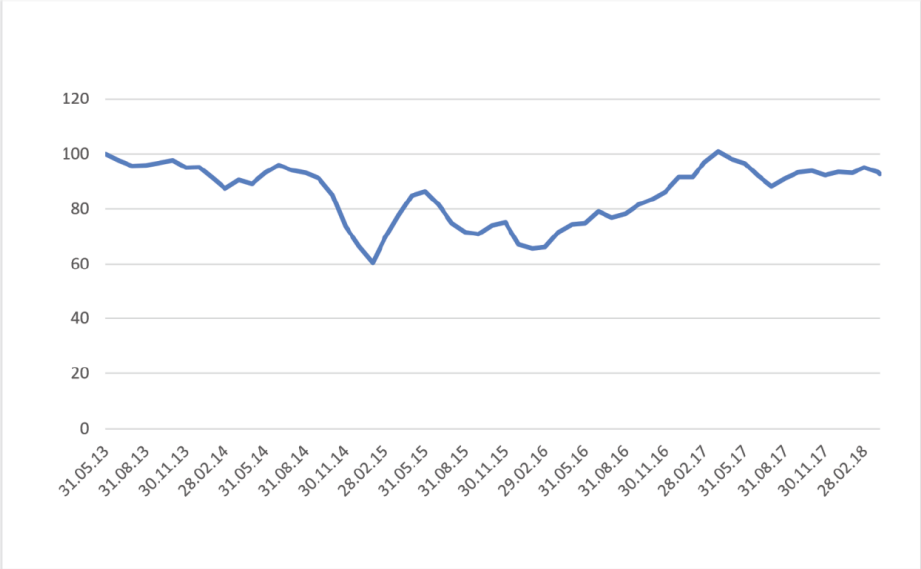

Figure 15: EURRUB carry trade strategy performance, %

Source: Thomson Reuters Datastream, author calculation.

In times of financial turmoil, such as the global crisis of 2008, huge losses have been incurred, as a result of unfavorable exchange rate fluctuations and the reduction of interest-rate differentials. Thus, the effectiveness of trade largely depends on the volatility of financial markets and investors ' risk sentiment.

In addition, investment currencies are at risk of devaluation, which significantly devalues their exchange rate during periods of instability.

Table **1** shows the performance indicators of investment strategies for the period 2013-2018.

Max., Min. are the maximum and minimum 1-month income expressed in percentage points. Mean. - the average annual return as a percentage. The standard deviation (St. Dev.) and the Sharpe ratio (SR) is also accounted for on an annualized basis, as is the case with Kurt. And Skew. The certainty equivalent (CE) is expressed in annual percentage points. This is a steady income, which will provide the same utility as a number of revenues of this strategy.

Meese and Rogoff (1983) concluded that the profitability of carry trade was not related to standard risk factors. As mentioned earlier, the popular funding currency, the yen, experienced strong volatility surges as a result of the 2008-2009 crisis. A possible explanation for this reversal is investors' appetite for risk. The investment currency is estimated vaguely in

Table 1: Strategy Performance

Strategy	Max.	Min.	Mean	St.Dev.	Kurt.	Skew	SR	CE
FD	15.91	−25.39	19.23	19.47	4.48	−1.23	0.99	18.97
MOM	17.31	−11.60	8.01	14.23	1.80	0.21	0.56	11.61
REV	8.38	−11.31	3.09	8.72	2.24	−0.26	0.36	8.95
SIGN	21.29	−30.11	17.96	18.74	7.35	−0.90	0.96	18.29
CA	2.79	−3.47	0.61	3.86	1.24	−0.44	0.16	7.59
q	2.02	−2.32	0.12	1.79	4.44	−0.74	0.07	7.34
FD,MOM,REV,SIGN	56.83	−32.78	44.30	32.89	5.54	0.66	1.35	34.72

relation to its financing currency due to the imbalance between supply and demand. Typically, investors who borrow money at a low interest rate will invest in high-yield assets, such as other currencies or stock markets.

During and after the “lost decade” in Japan, the country's financial markets were supported by massive quantitative and qualitative easing, which created an uninteresting environment for domestic investment and facilitated external operations. Similarly, the global financial crisis of 2007-2008 also forced the US to soften interest rates in order to stimulate growth and restore the economy.

When the Federal Reserve System (FRS) lowered interest rates to zero in 2008, the us dollar was seen as the best option for borrowing, especially in the post-crisis period. On the other hand, the Australian and new Zealand markets were characterized by high interest rates, with yields on 10-year government bonds around 7% before the crisis. For each currency pair or trading strategy, there are two corresponding equity markets that have been used as dependent variables in regression equations.

As an indicator of market volatility, the VIX index is an important factor that affects profitability. Jurek (2014), Jurek and Xu (2013) explained two sources in detail. First, the profit of the strategy is proportional to the differential of interest rates between the currencies of financing and investments, if the exchange rate between the two currencies does not move.

Second, the exchange rate varies according to the movement of the exchange rate, that is, the appreciation of the investment currency against the financing currency.

If the opposite happens, losses due to exchange rate fluctuations usually offset the entire income from the difference in interest rates, resulting in a negative profit for the trading strategy. Moreover, the profitability of trade curry declined significantly during the crisis, as shown in the work of Chen and Rogoff (2003) and Cooper and Priestly (2009).

After a period of testing the validity of the interest rate parity hypothesis, the focus of research shifted to explaining profitability by looking for deviations.

5. CONCLUSION

One of the consequences of the introduction of the zero rate and aggressive weakening of monetary policy in Japan was the transformation of the Japanese yen (JPY) in the international funding currency. Higher profits from carry trade have increased the efficiency of stock markets, owing to capital flows from the financing currency to the financial markets of the country of investment. The volatility flow was investigated using GARCH models. The flow of investments from stocks to currency is observed during the financial crisis, the reverse movement is observed in the post-crisis period.

From January 1994 to March 2017, higher volatility rates were found in bullish markets than in bearish markets. This conclusion is consistent with the study Brandt (1999), Brandt at al. (2009) when the market is bullish; investors are more willing to invest in risky assets.

The positive impact of trade on the stock markets of the country of investment is consistent, according to Christiansen at al. (2010). Higher profits from carry trade have led to a significant improvement in profitability in the Australian stock market. Thus, it can be stated that there is a significant positive relationship between the profitability of the carry trade strategy and the profitability of shares in the target countries.

As demand for the investment currency increases, the value of the shares increases as the value of the

shares depends on the future expected cash flows of the company denominated in the relevant currency (Farhi at al., 2013).

The most common strategies of carry trade in the period from 2009 to 2014 are formed on the basis of two financing currencies (Japanese yen and US dollar) and three investment currencies (Australian dollar, new Zealand dollar and Chinese yuan.) After 2014, US dollar ceases to be the funding currency, giving way to euro.

Such a mechanism facilitates the withdrawal of capital from a low-income environment to a high-income environment, which effectively increases the liquidity of the stock market of the country of destination and leads to inflation.

There is a negative relationship between the volume of transactions on the strategy of carry trade and the profitability of the shares of the country of financing. There is also a significant relationship between the profitability of the carry trade strategy and the profitability of US stock market (Jensen at al., 1996; Jordá and Taylor, 2012).

In order to overcome the negative impact caused by the financial crisis of 2008, the U.S. Federal reserve adopted an aggressive monetary policy and lowered its key interest rate to zero.

This study found that there is a positive significant relationship between the dynamics of the yen and the performance of the Japanese stock market. It is contrary to traditional theory, which expects a negative relationship between the two markets due to capital outflows that occurred in Japan.

Thus, the impact of yen-based trading strategies on the Japanese stock market is unconventional. It also became evident that the relationship between the dynamics of US dollar and S&P 500 index is extremely uncertain.

Since 2014, there has been a shift to Euro as the currency of financing for carry trade against the backdrop of the European Central Bank (ECB) not changing the volume of incentives to accelerate economic growth.

There is some evidence to support the use of the Euro as a funding currency for carry trade, such as the irrational behavior of the currency during the Greek shock in mid-2015. When the Greek news was good, the risk appetite increased and encouraged investors to borrow euros to Finance operations abroad. However, when risk appetite waned due to the high volatility, the money was back, helping the growth of the Euro. The ECB's aggressive monetary policy has had some impact on the global stock market.

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Received on 29-05-2018 Accepted on 04-10-2018 Published on 12-11-2018

DOI: https://doi.org/10.6000/1929-7092.2018.07.54