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THE PROFITABILITY OF JAPANESE YEN CARRY TRADES

ZYSKOWNOŚĆ STRATEGII *CARRY TRADE* OPARTYCH NA JENIE JAPOŃSKIM

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Summary: The aim of the paper is to examine the profitability of Japanese yen carry trade strategies. It has been shown that for the sample of 11 years, annualized excess return of carry trade strategies are positive. Estimated average excess returns, Sharpe ratio and Calmar ratio turn out to reach the levels similar to those reported by other researchers. Moreover, the paper reports that estimated excess returns and Sharpe, Calmar ratios are high and positive during the period from 01.2006 to 07.2007 and negative during the time of high financial turbulence. Additionally, during the time of turbulence in financial markets, when carry trade performs poorly, low-yielding currencies tends to appreciate against high-yielding currencies. It implies that Japanese yen, as an example of the most popular funding currency, may provide a hedge during unstable times of high price volatility in financial market.

Keywords: foreign exchange market, carry trade, Japanese yen, Sharpe ratio, Calmar ratio.

Streszczenie: Celem artykułu jest ocena zyskowności wybranych strategii *carry trade* opartych na walucie japońskiej. Wykazano, że w okresie 01.2006–12.2016 średnie roczne stopy zwrotu z inwestycji w strategie *carry trade* były dodatnie. Uzyskane wartości mierników, takich jak wskaźniki Skarpe'a i Calmara, są zbliżone do tych uzyskanych przez innych badaczy. Dodatkowo pokazano, że w okresie 01.2006–07.2007 strategie te generowały znacznie wyższe stopy zwrotu od tych uzyskanych w czasie kryzysu i niepokoju na rynkach finansowych. Warto podkreślić, że w czasie, kiedy strategie *carry trade* generowały niższe, często ujemne stopy zwrotu, waluty krajów o niskich stopach procentowych miały tendencję do aprecjacji względem walut krajów o wysokich stopach procentowych. To sugeruje, że japoński jen, jako jedna z najbardziej popularnych walut finansujących w strategiach *carry trade*, może służyć jako inwestycja zabezpieczająca w czasie kryzysu i dużej zmienności cen na rynku finansowym.

Słowa kluczowe: rynek walutowy, *carry trade*, jen japoński, wskaźnik Sharpe'a, wskaźnik Calmara.

Learn how to see. Realize that
everything connects to everything else

Leonardo da Vinci

1. Introduction

The carry trade is one of the oldest and most popular currency speculative strategies. The motivation behind the strategy is to exploit profit by applying the combination of low cost of funds in one market and high returns in another. A currency carry trade comprises borrowing money in a low-yielding currency and investing those funds in high-yielding currencies [Fong 2010]. In the simplest form of carry trade the investors convert the borrowed funds in the spot market and then invest money in securities denominated in high-yielding currencies. After a holding period the borrowed amount is converted to low-yielding currency in order to repay the loan.

Market evidence suggests that carry trades are the most widely used currency speculative strategy [Galati, Melvin 2004]. Profitability of carry trade is highly affected by the exchange rates' and interest rates' volatility. It has been shown by many researchers that these speculative strategies may generate high returns with Sharpe ratios at least as high as those on the equity market [Egbers, Swinkels 2015].

The paper is focused on the carry trade in Japanese yen. The prolonged low-interest-rate policy of the Bank of Japan has made that currency one of the most often employed funding currencies in carry trades. The Japanese yen carry trade is popular not only among institutional but also among retail currency traders [Liu et al. 2012]. Huge number of participants who are actively involved in yen carry trade strategy trigger enormous changes in both the volume and price in the Japanese yen foreign exchange market. Therefore, in terms of Japanese economy, the analysis of Japanese yen carry trade seems to be crucial.

The aim of the paper is to examine the profitability of chosen Japanese yen carry trade strategies. The paper is organised as follows. Section 2 contains literature review concerning currency carry trades. The forward premium anomaly phenomenon and its relationship with carry trade activity is described. Moreover, carry trades profits and their impact on forward premium puzzle are discussed. Section 3 is focused on Japanese yen carry trade profitability. The chosen measures of carry trade returns, like Sharpe and Calmar ratios, are calculated and presented. The author of the paper studies three different carry trade strategies where Japanese yen is a funding currency and a few chosen emerging currencies are marked to be target high-yielding currencies. Section 4 contains conclusions.

2. Carry trade excess returns and uncovered rate parity theory

According to Uncovered Interest Parity (UIP) theory a high-yielding currencies have a tendency to depreciate and low-yielding currencies to appreciate. However, many researchers have usually rejected the theory and claimed that there is usually positive

relationship between country's interest rate and the value of its currency. This puzzling feature of foreign exchange market is one of the robust anomaly in financial economy and it is generally known as forward premium puzzle [Fama 1984]. There appears to be overwhelming empirical evidence against uncovered interest parity theory. Fama [1984], Froot and Frankel [1989], McCallum [1994], among others, observe UIP deviations in relation between two countries interest rates differential and their exchange rates.

Flood and Rose [2002], and Clarida et al. [2009] claim that uncovered interest rate parity assumptions are generally fulfilled during the time of crisis. On the other hand, forward premium is usually observed during stable time period. They associate this phenomenon with financial market prices' volatility. It is assumed that for high-volatility periods UIP holds and for low-volatility and stable time problem of forward premium anomaly arises. Moreover, it is believed that there are regimes in which UIP holds and regimes in which forward premium anomaly is identified. Ichiue and Koyama [2011], and Czech [2017] applied Markov-switching regression in the analysis of forward premium puzzle phenomenon. They have shown that exchange rates returns are strongly influenced by regime switches in relationship between countries' interest rate differential and change in their exchange rates. In addition, they have claimed that low-yielding currencies appreciates less often than depreciates, but once it occurs, their appreciation is bigger and faster than depreciation.

According to Baillie and Chang [2011] uncovered interest parity deviations may be explained by the existence of carry trade speculative strategies. They assume that forward premium anomaly may result from the growth in carry trade activity. Higher demand for high-yielding currencies and higher supply for low-yielding currencies lead to an appreciation of high-yielding currency against low-yielding one. It needs to be emphasized that depreciation of low interest-yielding currencies is favourable to the carry trade speculators. Furthermore, higher investors' involvement in carry trade leads to higher returns from the strategy because the simultaneous bets depreciates low-yielding currency stronger and stronger. Severe depreciation of low interest rate currency, in turn, contributes to further deviations from uncovered interest rate parity hypothesis. However, in the time of crisis, the direction in the exchange rate market is opposite. Carry trade unwinding leads to the appreciation of low interest-yielding currencies and depreciation of high interest-yielding currencies. This movement is consistent with uncovered interest rate parity. It implies that carry trade activity may explain, at least to some extent, the UIP puzzle. When speculators' involvement in carry trade is high, then the UIP is violated. Carry trades have gained considerable attention by both academics and practitioners. These strategies have turned out to be highly profitable and attractive for investors in international financial market.

It needs to be emphasized that when foreign exchange market is effective and that uncovered interest rate parity holds, the carry trade strategy should on average yield zero return. Thus, high excess returns of carry trade violates the UIP condition.

Researchers struggle to explain carry trade profitability. Darvas [2009] finds that carry trade strategy is profitable. He examines the carry trade returns for all possible pairs of eleven currencies. Darvas shows that unleveraged carry trade positions yield significantly positive excess returns. Gyntelberg and Remonola [2007] also study carry trade profitability. They examine data from January 2001 to September 2007. They find that yen carry trades generated higher risk-adjusted returns than global share market. Fong [2010] shows that yen carry trades were highly profitable during the period before crisis (January 2001 to June 2007). Moreover, he reports that even during financial crisis the mean return from the strategy was higher relative to stock market. Lu and Jacobsen [2016] have shown, however, that during the time of drops in equity market, profits from shorting low-yielding currencies tend to decrease as well. Moreover, they have found that responses in carry trade profits to shock in both commodity and share markets are delayed and short-lived rather than persistent, which may result from market inefficiency.

It needs to be stressed that most of the literature about both uncovered interest rate theory and carry trades analyses the currency market after the collapse of the Bretton Woods system in 1973. There are, however, several papers that investigate carry trade profits going back further in history. Lothian and Wu [2011] studied UIP by constructing ultra-long time series that covers two centuries. They say that there are prolonged periods when forward premium anomaly exists and carry trade generates high excess returns. Nevertheless, over the long period, uncovered interest parity holds. Accominotti and Chambers [2016] apply a sample that covers two periods. The first one is from 1920 to 1927 and the second one is from 1932 to 1939. The result of their research implies that carry trade generated high excess returns also in these periods. Moreover, in their opinion, carry trades performed similarly or better than British stock and bond market over these periods.

The majority of published research findings provide evidence that carry trade usually generate high excess returns. Moreover, many researchers pointed out that this currency speculative strategy may be more profitable than investment in share market. It makes these strategies very popular and well-reputed among financial market's participants.

3. Carry trades in Japanese yen

The excess return of basic carry trade strategy is computed as a difference between interest rates plus the currency return on the foreign exchange position. Carry trade returns arise from interest rate differentials and from exchange rates movements. Profit of the basic form of yen carry trade (P_t) may be defined as a difference between interest earned in foreign currency (i_t^F) and interest paid in Japanese yen (i_t^J) plus the appreciation of foreign currency in terms of yen ($s_{t+k} - s_t$).

$$P_t = i_t^F - i_t^J + s_{t+k} - s_t.$$

Carry trade often generates high and positive excess returns, but they entail considerable risk as well. One of the most popular measure of risk-adjusted return is the Sharpe ratio [Sharpe 1994]. The measure takes into account both differential returns (carry trade returns minus risk-free rate of return) and variability of that return (standard deviation of return). Another measure of risk-adjusted return is the Calmar ratio, that determines returns in relation to downside risk [Young 1991]. It is calculated by dividing the annualized return by maximum downside (the largest difference between a high and a low of a series during a time period).

The empirical analysis of yen carry trade profitability is carried out based on daily data of exchange rates and 3-month Libor interest rates. Data covers the period from January 2006 till December 2016. The study is made for three different periods. The first period (I) involves data of the whole analysed period (01.2006–12.2006). Subsample II covers a period before financial crisis of 21st century, when investors' risk aversion was low and carry trade strategies generated high profits (01.2006–07.2007). Subsample III embraces the time of crisis, when carry trades might have generated negative excess returns (08.2007–01.2010). The study embraces 14 currencies. The Japanese yen (JPY) is assumed to be funding currency, in which investors borrow money. South African rand (ZAR), Brazil real (BRL), Mexican peso (MXN), Hungarian forint (HUF), Indian rupee (INR), Indonesian rupiah (IDR), Turkish lira (TRY), Polish zloty (PLN), Icelandic krona (ISK), Russian ruble (RUB), Argentine Peso (ARS), Thai baht (THB), Philippine peso (PHP) are the chosen target currencies in which carry traders invest their money. The sample of 14 currencies is split into 3 portfolios. The first one (strategy A) includes eight emerging currencies (target currencies). This is one of the most popular carry trade basket of emerging currencies. Bloomberg developed its own index known as "Cumulative FX Carry Trade Index for 8 Emerging Market Currencies". Their target currencies are the same like in analysed strategy A, what justifies the choice of target currencies. Moreover, it is assumed that investment is in 3-month money-market securities and each of the eight currencies assigned an equal weight in the target currencies basket. However, unlike strategy A, Bloomberg index assumes that long position in eight emerging currencies is fully funded by short position in US dollar. In the paper only Japanese yen is treated as a funding currency.

Table 1 presents average annualized excess returns, standard deviation, Sharpe ratio, maximum downside (drawdown) and Calmar ratio for the strategy A in three periods of time. All calculations are based on Bloomberg software.

For the entire sample of 11 years, annualized excess return of carry trade A strategy is 2.8% and generates Sharpe ratio of 0.18 and Calmar ratio 0.07. Doskov and Swinkels [2015] studied 19 currency spot rates during the period from January 1900 to December 2012. They showed that, for the entire sample of 112 years, carry trading average rate of return is 2.4% per year for a Sharpe ratio of 0.26. Menkhoff et al. [2012] examined 48 currency pairs over the period December 1983 to August 2009. They report that an average annualized carry trade return is 2.0% with Sharpe

Table 1. The profitability of Japanese yen carry trade strategy A during the period from January 2006 till December 2016

Profitability measures	I	II	III
Average Excess Return (%)	2.77	19.26	–3.26
Standard Deviation (%)	15.54	9.53	22.92
Sharpe Ratio	0.18	2.02	–0.14
Maximum Drawdown (%)	38.63	8.04	38.63
Calmar Ratio	0.07	2.39	–0.08

I – 01.2006–12.2016, II – 01.2006–07.2007, III – 08.2007–01.2010; funding currency: Japanese yen (JPY); target currencies: South African rand (ZAR), Brazil real (BRL), Mexican peso (MXN), Hungarian forint (HUF), Indian rupee (INR), Indonesian rupiah (IDR), Turkish lira (TRY), Polish zloty (PLN).

Source: own calculations based on Bloomberg Software.

ratio 0.27. In spite of the fact, that analysed sample covers the period of only 11 years, the results obtained in the paper are similar to those reported by Doskov and Swinkels [2015], and Menkhoff et al. [2012].

It needs to be emphasized, however, that returns from carry trade portfolio, like from any other investment portfolio, may differ substantially over the analysed period of time. Table 1 presents average annualized excess returns, Sharpe ratio and Calmar ratio for two subperiods. Period II embraces data that covers the period from January 2006 till July 2007, which is generally reported as good period for carry traders. Table 2 shows that, during period II, carry trade annualized average excess return is as high as 10.2% with Sharpe ratio 2.44 and Calmar ratio 2.51. Moreover, annualized volatility of returns over the period 01.2006–07.2007 seems to be small, in comparison to period I. Standard deviation and maximum drawdown are 8.27% and 8.05%, respectively. The carry trade strategy A, however, generates negative annualized excess return over the period August 2007 to January 2010. This was bad period for carry trades with average losses over 3% and negative Sharpe and Calmar ratios. Additionally, during the third analysed period, the volatility of carry trade returns are significantly higher than in the second period.

Tables 2 and 3 present the average annualized excess returns, standard deviation, Sharpe ratio, maximum downside (drawdown) and Calmar ratio for two different carry trade strategies in three periods of time. The choice of target currencies results from the analysis of historical carry trade returns for each emerging currency separately. The combination of the most profitable currencies is taken into account. Strategy B comprises four target currencies, that is Indian rupee (INR), Indonesian rupiah (IDR), Thai baht (THB), Philippine peso (PHP). Portfolio C embraces following currencies: Icelandic krona (ISK), Russian ruble (RUB), Argentine Peso (ARS), and Indonesian rupiah (IDR).

Table 2. The profitability of Japanese yen carry trade strategy B during the period from January 2006 till December 2016

Item	I	II	III
Average Excess Return (%)	3.99	20.18	–5.56
Standard Deviation (%)	12.02	8.27	15.82
Sharpe Ratio	0.33	2.44	–0.35
Maximum Drawdown (%)	29.45	8.05	28.12
Calmar Ratio	0.14	2.51	–0.20

I – 01.2006–12.2016, II – 01.2006–07.2007, III – 08.2007–01.2010; funding currency: Japanese yen (JPY); target currencies: Indian rupee (INR), Indonesian rupiah (IDR), Thai baht (THB), Philippine peso (PHP).

Source: own calculations based on Bloomberg Software.

Table 3. The profitability of Japanese yen carry trade strategy C during the period from January 2006 till December 2016

Item	I	II	III
Average Excess Return (%)	5.72	16.41	–6.02
Standard Deviation (%)	12.95	8.09	17.56
Sharpe Ratio	0.44	2.03	–0.34
Maximum Drawdown (%)	35.18	6.58	33.94
Calmar Ratio	0.17	2.49	–0.18

I – 01.2006–12.2016, II – 01.2006–07.2007, III – 08.2007–01.2010; funding currency: Japanese yen (JPY); target currencies: Icelandic krona (ISK), Russian ruble (RUB), Argentine Peso (ARS), Indonesian rupiah (IDR).

Source: own calculations based on Bloomberg Software.

The results presented in Tables 2 and 3 differs slightly from the results obtained in Table 1. For the entire sample of 11 years, strategy C turns out to be the most profitable with the average rate of return 5.7% per year, and Sharpe and Calmar ratio 0.44 and 0.17, respectively. However, taking into account the best period of time for carry trade (period II), strategy B comes out to generate the highest carry trade excess returns with annualized excess return over 20% and Sharpe and Calmar ratio about 2.5. As far as the volatility is concerned, with regard to strategy B and C, period II is marked with considerably lower volatility of carry trade returns.

It suggests that times of high volatility are times when carry trades perform poorly. These results are generally in line with those reported by Menkhoff et al. [2012]. They have shown that average excess carry trades returns increase monotonically when moving from high to the low volatility periods. Moreover, it implies that, over low volatility periods (e.g. period II), carry trade may generate high excess returns and lead high-yielding currencies to perform better than low-yielding currencies. However, during high volatility period (e.g. period III), low-

yielding currencies tend to appreciate against high-yielding. Menkhoff et al. [2012] claim that low interest rate currencies (e.g. Japanese yen) provide a hedge during times of high financial turbulence.

4. Conclusions

Carry trades are the currency speculative strategies derived from the forward premium anomaly phenomenon. Forward premium puzzle is closely related to the failure of uncovered interest rate parity and states that high-yielding currencies tends to appreciate rather than depreciate. If uncovered interest rate parity holds, then the average carry trades' returns should be zero. However, there is a broad literature demonstrating that carry trades generate statistically positive excess returns and high Sharpe ratio. Many researchers stress the fact that, very often, carry trade turns out to be more profitable than investment in equity market.

The paper empirically examines the Japanese yen carry trade profitability. The prolonged low-interest-rate policy of the Bank of Japan has made that currency one of the most often employed funding currencies in carry trades. The choice of target currencies has been driven by the obtained results from the analysis of historical carry trade returns for each emerging currency separately. 14 emerging currencies were pinched on carry trade portfolios. It has been shown that for the entire sample of 11 years, annualized excess return of chosen carry trade strategies are positive. Estimated measures of excess returns and Sharpe and Calmar ratios turn out to reach the levels similar to those reported by other researchers. It has been shown that, for all considered strategies, estimated excess returns and Sharpe, Calmar ratios are high and positive during the period from January 2006 to July 2007 and negative during the time of high financial turbulence (period III). Moreover, annualized volatility of returns over the period 01.2006–07.2007 seems to be small, in comparison to periods I and III. It suggests that times of high volatility are times when carry trades perform poorly. However, during low volatility period, carry trades generate attractive excess returns.

On the other hand, during the time of turbulence in global financial markets, when carry trade generates losses, low-yielding currencies (funding currencies) perform generally better than high-yielding currencies. It implies that Japanese yen, as an example of the most popular funding currency, may provide a hedge during unstable times of high price volatility in financial market and high global risk aversion.

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