Implication of Carry Trade on Monetary Policy during the Financial Crisis[1]

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Abstract
Investment strategies based on so called carry trade strategy have been widely used in international financial markets, especially on the forex market. The failure of the theory of uncovered interest rate parity has enabled investors to speculate on expected appreciation of low interest rate currency, although the theory predicts exactly the opposite. Despite of currency interventions from side of central banks, unwinding of carry trade brought with itself strong turmoil to the financial markets.
From this reason, the goal of this paper is to provide empirical evidence of the presence of carry trade strategy during the latest financial crisis. In the second part of this paper we will mainly focus on describing the strategies of various central banks aimed at preventing the impacts of depreciation or appreciation caused by carry trade trading. Finally, we will assess possibility of central banks to fight against higher exchange rate volatility as a result of carry trading

Keywords: carry trade, monetary policy, forward premium puzzle, financial crisis
JEL codes: G120, G130, G140

1. Introduction

Carry trade is a well documented investment strategy widely used among investors that is based on a so called "forward premium puzzle". This notion refers to a well-known finding that forward exchange rate is a biased predictor of future spot rate. While the economic theory predicts that currencies with higher interest rate should depreciate in future because of the no arbitrage opportunity condition, in reality most of the currencies that account for higher interest rate differentials experience a significant appreciation over time. Apparently, by existence of possibility to earn excess yield from carry trade investment strategy assumptions of the risk-neutral efficient-market hypothesis are violated[2].

Violation of the uncovered interest rate parity in financial markets has been tested over last three decades. Is has been generally believed that increasing efficiency of financial markets driven by mainly technological development should lead to elimination of arbitrage opportunities; hence, carry trade strategy should not bring excessive returns in long-term perspective.

However, economic reality proved otherwise. As illustrated in various documentation prepared by the Bank for International Settlement (BIS, 2010; Kohler, 2010; BIS, 2009) positive relationship between 6-month average interest rate differential and change in exchange rate has been becoming more apparent toward the end of period in 2008 and not to the beginning of the sample in 1997.

Although the evidence in favor of carry trade strategy seems to be striking decisive one possible explanation for such a „misbehavior" of the exchange rates may explain excessive carry trade

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[2] The RNEMH states that today's prices are best predictor of future prices as they incorporate all current and historically available information. Risk neutrality implies that forward exchange rate is equal the market expectations of future spot rate (Meredith and Ma, 2002).

return as a premium paid for excessive risk. Gyntelberg and Remolona (2007) shows that 1% excess return on high interest rate currency is related to 2.6% loss on the same currency due to its depreciation in case of massive closing of investment positions by other carry traders (so called "unwinding of carry trade").

Investment decisions based on carry trade strategy belongs to the area of game theory probably even more than other investment strategies. Some authors point out on this self-reinforcing arbitrage feature of carry trade (Brière and Drut, 2009) where a profitable strategy characterized as going long in a high interest rate currency and short on low interest rate currency may be bring excessive return only in a case where other investors behave in the same way. Cumulative power of investors may impose pressure on a high interest rate currency and subsequently lead to its appreciation.

1.1 Theoretical framework of the relationship between carry trade and monetary policy

In the theoretical literature most of the studies focus on the relationship between interest rate set up in the presence of inflation targeting and its implication for carry trade activity.

There are two types of models that try to incorporate relationship between central bank as an agent setting the interest rate and carry trade investors.

First type of the models strongly relies on a game theoretical approach, as for example paper by Wanaguru (2011). By interaction between two types of players, carry traders and liquidity providers in the presence of central bank setting the main interest rate they try to incorporate link between those players and model possible impact of change in policy coefficients on the behavior of exchange rate.

Second type of models refers to a general equilibrium model and tries to incorporate monetary policy rule into the basic Lucas equation of UIP conditions. An example of such a model is presented in Backus (2010) that tries to incorporate various forms of Taylor monetary rule and solve for equilibrium. He shows that there exists set of policy rules which, by specific assumptions, are consistent with the carry trade evidence. According to his words there is possible intriguing connection between monetary policy, interest rates and exchange rates (Backus, 2010).

Possible impact of setting the overnight rate by central bank was partly investigated in Hattor and Shin (2007). Their findings suggests that that the overnight rate set by central banks may play an important role in influencing the scale of the carry trade, but more broadly in determining balance sheet size in the financial sector as a whole.

In general, the effect of monetary policy on exchange rate behavior is questionable. Study conducted by Faust and Rogers (1999) using 7-variable and 14-variables VAR model for explaining fluctuations in exchange rate provided the evidence that does not clearly support this view. Finally, the results suggest that monetary policy shocks may explain less exchange rate variance than previously believed.

Second branch of economic literature relevant for our topic of study focuses on an effectiveness of intervention of central banks on a foreign market. Also here the final conclusion has not been reached yet. Good up-to-date evidence in this field of research is provided in Adler and Tovar (2011). As authors point out:

"In general, however, the literature has failed to reach a conclusion about the effects of sterilized interventions on exchange rates, frequently suggesting the absence of any relationship."

Throughout this text we will assume that interventions that took place during our selected period took a form of sterilized intervention. This is a plausible assumption as our sample consists of countries that operate in inflation targeting environment which enables us to do so as the central bank need to keep an eye on a inflationary pressures in the economy. As we will see further the conclusion regarding the effectiveness of monetary intervention is questionable which is in line with Adler and Tovar (2011).

2. Empirical analysis

In our paper we will proceed in two steps. Firstly, we will evaluate currencies and time period since the beginning of 2007 that exhibit signs of carry trade presence. In this step we will follow procedure as described in Meredith and Chin (1998). As the procedure in that paper applies for panel data while we are about to use time series data for single countries we will estimate the following regression by OLS procedure.

The simple econometric model is therefore described as following:

$$\ln(S_{t+3} / S_t) = \beta_0 + \beta_1 \ln(R_{t,ON} / R^*_{t,ON}) + \ln(VIX_t) + \xi_t \quad (1)$$

where S_{t+k} represents spot exchange rate in time t+k in direct quotation with US dollar as a base currency (e.g. how many units of domestic/quote currency for one unit of US dollar), $R_{t,ON}$ represents interbank interest rate for deposits in foreign currencies from perspective of domestic currency, VIX is volatility index representing risk toward the future as perceived by financial market participants and ζ_t is residual that is assumed to be following white noise process with normal distribution of zero mean and constant variance.

In standard model of testing for presence of carry trade there is no volatility index used as a measurement of market volatility. In this standard model beta zero is expected to be zero and beta one unity in order UIP to holds. Other combination of numbers for coefficients beta zero and beta unity are considered as an evidence for failure of the UIP if statistically significant. Important for our future analysis will be results that accounts for coefficients beta unity lower than zero as they will indicate a situation where higher interest rate spread over deposits in US dollar accounts for appreciation of spot rate in time t+3.

As an extension of the standard model our model incorporates measurement of volatility in financial markets the VIX index and will capture presence of expectations towards future regarding uncertainty and risk. This feature allows us to test for any relationship between market volatility and real change in exchange rates.

Second difference to the standard model lies in the interest rate maturity used for a testing of (1). In general, for a k-period change in spot exchange rate a k-period interest rate is used. In our model we decided to use over-night offered interbank interest rate as we believe that this interest rate is able to accounts for a smaller volatility changes as the interest rate of 3 months maturity [1]; secondly, during the time of distress in financial markets short-term period interest rates are of an important indicator for changes in financial markets [2], thirdly as pointed out by Hattor and Shin overnight interest rate might carry data regarding the scale of carry trade and impact on balance sheet of the banks [3].

Data are quoted on daily basis and drawn from various sources: inter-bank interest rates are mainly taken from British Bank Association database (LIBOR interest rate on deposits in 10 main currencies) or from central banks databases; exchange rates quotations are drawn from OANDA corporation database; VIX data are publicly available from Chicago Boards Option Exchange database.

Full period of 04/01/2007 to 29/07/2011 is divided into ten sub-periods for which the OLS estimation is run and results are collected. This step enables us to collect ten different measures of beta one coefficients that will differ over time. Thanks to this we will be able to evaluate carry trade evidence throughout the whole period in detailed way not as a one compact estimator as generally used in testing the UIP failure. Moreover, we will collect data for every single currency pair which will allow us to specify which currencies where used as a funding and which as an investment currencies during the full period and how their status has changes, if eventually.

We eliminated zero observations from data set and resulted in 1107 observations available in the full sample. For division into ten sub-periods a simple algorithm was used based on rolling algorithm procedure:

- for first 200 observations create a first sub-set thus interval has following description $[n_{low,1,1}; n_{high,\ 1,200}]$, for t=1:200,
- the interval for observations included in the second subset is $[n_{low,\ 2,200\text{-}100}; n_{2,200+100}]$, for t=100:300,
- continue in similar fashion further.

Variable $n_{low,i,t,}$ represent lower bound of an interval for interval i, where i=1,2,…,10 and t is a ordering place starting from 1 (first observation in the total sample) and finishing at T=1107. Similar for $n_{high,i,t,}$

This procedure tracks back to Meredith and Ma (2002) as they use rolling UIP regression for full period of observations. For our purposes we have compacted rolling regression into ten sub-sets.

As soon as we have collected information about the sign and statistical significance of estimator beta one for 14 selected currencies for ten periods we will look for an evidence of central bank interventions that may have been triggered by carry trade activity. Finally, we will assess the procedure of central bank interventions and describe their impact on exchange rate behavior.

Data used in analysis were collected for following currencies: Pound sterling (GBP), South African rand (ZAR), Icelandic krona (INR), Czech krona (CZK), Turkish lira (TRY), Norwegian krona (NOK), Swedish krona (SEK), New Zealand dollar (NZD), Australian dollar (AUD), Canadian dollar (CAD), Swiss frank (CHF), Japanese yen (JPY), euro (EUR), US dollar (USD). Interest rates for selected currencies are quoted either by LIBOR quotes on selected currencies (EUR, USD, GBP, JPY, CHF, CAD, AUD, NZD, SEK) or by inter-bank ON interest rate published by national central banks (NIBOR, PRIBOR, SABOR, REIBOR, CBRT).

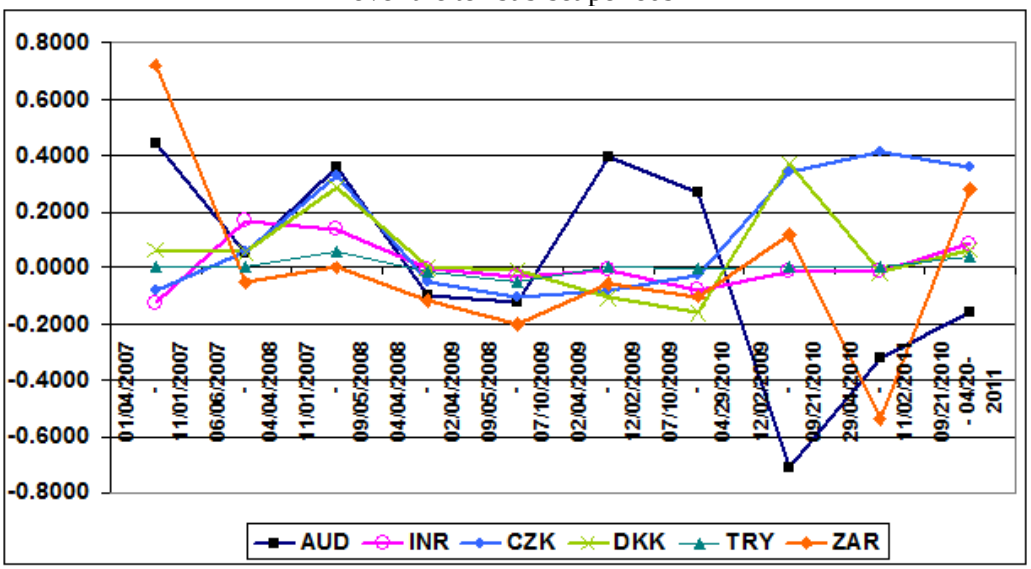
3. Explaining the results

In the following section we will discuss empirical results of our analysis based on two-step procedure as described in the previous section. Firstly, we will deal with the evidence of the presence of UIP failure in forex market.

Since 2007 toward the middle of 2008 most of the currencies accounted for positive values of coefficient beta one that indicate that throughout this period the UIP parity condition was mostly satisfied. Exceptional in this observation period were only CZK, AUD and CHF but only in the case of the first half of 2007.

Towards the end of 2008 the trend had reversed and most of the currencies accounted for a negative coefficient beta one that indicates violation of UIP condition. This empirical result should indicate that currencies with increasing interest rate differential toward US dollar should appreciate while currencies with decreasing interest rate. However, during this period majority of the currencies accounted for a strong depreciation toward US dollar. As pointed out in BIS Quarterly Review (BIS, 2010) the countries that accounts for higher interest rate differentials depreciated more and this relationship specific for crisis period grows over time in comparison to previous two crisis (1997 Asian crisis and 1998 Russian crisis).

Figure 1: Evolution of the coefficient beta one from equation (1) for selected currencies over the ten sub-set periods



Source: author's calculation

At the first look this may be viewed as a counter-intuitive. Yet, we need to take a look on the next sub-section results in order to get a better picture. From the empirical results we may indicate that the carry trade activity started ***after*** the unwinding of previous carry trade in the September and October of 2008, as the negative signs for subsequent periods 09/05/2008 - 07/10/2009 and 02/04/2009 - 12/02/2009 (INR, DKK, ZAR, CZK) prevails. Remember, for a period 09/05/2008 – 07/10/2009 the exchange rates assigned to are from 05/12/2008 – 10/10/2009 and their values already incorporate possible appreciation through carry trade activity.

Secondly, sharp depreciation in interest rates of high yielding currencies lasted for short period after the period of distress **they quickly moved back to their pre-crisis levels**. This development would be reflected in negative sign of coefficient beta. Thirdly, as the Federal Reserve System of the USA sharply had been continuously decreasing official interest rates to unprecedented levels during this period this led to a widening of the gap between interest rates of high yielding currencies and US dollar.

Additionally, in some currencies we almost do not observe change in beta one coefficient during the whole period of 2007-2011. Those currencies are EUR, JPY and CHF with one exception – in the last observed sample of 09/21/2010 - 04/20-2011 JPY and CHF accounts for a strong evidence of negative beta one. Especially in the second case, this may indicate change of CHF from funding currency to investment currency. We will discuss this later on in this text.

In the periods following the peak of the crisis in 2008, some currencies have maintained the status of investment currency throughout the longer period, especially AUD and NZD (Graph 2), South African rand, Turkish lira and Czech koruna. These movements may be clearly attributed to the failure of UIP and thus existence of carry trade activity.

Generally, our results suggest that after a strong depreciation phase in the third quarter of 2008 many currencies with high interest rate differentials accounts for carry trade evidence. This result is in accordance with a recent study by Battini and Dowling (2011) that argue that exchange rate movements during crisis were characterized by both safe-haven effects and carry trade that resulted from interest rate differentials. According to their results, UIP decompositions in the initial depreciating phase and the subsequent appreciating phase by parametric estimation methodology of Nelson-Siegel concludes that In the majority of countries, the initial depreciating phase against the U.S. dollar cannot be explained in terms of changes in expected relative real interest rates. By contrast, the appreciating phase of some currencies (EUR, BRL, CLP, MXN) can be largely explained through changes in expected nominal rate differentials with the Fed Funds rate (Battini and Dowling, 2011).

3.1. Monetary policy and the evidence of carry trade

In this section we will firstly review the evidence of central bank interventions on foreign exchange market in order to be able to asses whether some of them were implication of carry trade activity on financial markets. Secondly, we will assess their effect on change of nominal exchange rate.

In the Table 1 is provided an overview of central bank or other institution interventions during the period analyzed. In the following text we will firstly evaluate the impact of central bank interventions on exchange rate behavior.

In case of Switzerland the major intervention period starts from the end of 2009 toward the middle of 2010. The Swiss National Bank directly intervention may be viewed as successful during this period, however after the intervention were over the exchange rate returned back to its pre-intervention level before and even break this point to account for new highs. Similar pattern is visible in the New Zealand dollar where central bank hugely intervened since the beginning of 2007 toward the middle of 2007. After the intervention in June of 2007 the currency depreciated for a small share but then reached its new high.

In case of Australian dollar, central bank intervention in August of 2007 again accounts for a similar patter as in the previous two examples. After short-time devaluation of strong Australian dollar, currency reached its new high consequently.

Table 1: Overview of foreign exchange intervention during the crisis in 2007-2011
(Indicative, not exhausted list)

Institution/Country	Period	Reason for intervention
Swiss National Bank	May 2010	direct intervention against strong franc
Swiss National Bank	April 2010	direct intervention against strong franc
Swiss National Bank	Dec 2009 – Mar 2010	direct intervention against strong franc
Swiss National Bank	March 12, 2009	direct intervention against strong franc
Swiss National Bank	Since May 2011	intervention against strong franc
Reserve Bank of New Zealand	June 2007	first direct intervention since of March 1985
Reserve Bank of New Zealand	June 2007	indirect intervention as a recommendation for FX market
Reserve Bank of New Zealand	January 2007	intervention against strong dollar
CB of Turkey	October 2010	new procedure for FX purchase, regular purchase of foreign currency
CB of Turkey	September 2010	increase of reserve requirement on deposits in foreign currency
Reserve Bank of Australia	October 2008	direct intervention due to lack of liquidity
Reserve Bank of Australia	August 2007	direct intervention
G7 countries	March 2011	first joint intervention since 2000 against strong yen
Bank of Japan	September 2010	first direct intervention in past six years
South African Reserve Bank	August 2010 – January 2011	continuing sterilized interventions against strong rand
Government of Iceland + Central bank	October 2008	restrictions on foreign exchange transactions
Government of Iceland + Central bank	October 2008	failed attempt to introduce currency peg as capital flight lead to high depreciacion

Source: author's compilation

Probably one of the famous currencies that were subject to foreign exchange intervention during the crisis since 2007 is Japanese yen. First wave of intervention from the Bank of Japan came in September of 2007 followed by joint intervention of G7 countries in March 2011. However, as seen in the Appendix I, those interventions resulted in a small peak in upper part (indicating depreciation) but were again followed by step back and continuing appreciation towards today.

Extreme situation from interventions point of view represent behavior of the Icelandic krona. Due to major capital outflows from the Iceland during the second half of 2008 monetary authorities together with Icelandic government tried, unsuccessfully, to establish a currency peg. Moreover, they were forced to impose capital movement restriction to stop strong depreciation of Icelandic currency. As visible in the Appendix I, first signs of continuous appreciation came to effect at the end of the first quarter of 2009. Appreciation was followed by decreasing of interbank interest rate which is in line with UIP prediction.

However, the situation in case of Turkey is slightly different. After the appreciation of Turkish lira at the beginning of the 2009 the Turkish currency accounted for only minor change in ER during the year 2009 and 2010. The major appreciation came to the end of 2010 and was followed by intervention by Central bank of Turkey that, different as in previous cases, led to stable depreciation toward the end of period analyzed in 2011.

The major question that is in core of this paper is whether the central bank interventions can be partly assigned to the carry trade operations in the financial markets during the financial crisis and after its peak in 2008.

In order to be able to answer this question, even partially, we will look at the evidence of carry trading activity measured by OLS and compare it to the timing of central bank interventions. In the Table 2 the estimated results from coefficient beta one are presented for countries that are subject to further analysis of central bank interventions.

Table 2: Overview of the beta one coefficient values during the period analyzed for selected currencies (**indicates significant value at the 5% level)

	01/04/2007 - 11/01/2007	**06/06/2007 - 04/04/2008**	**11/01/2007 - 09/05/2008**	**04/04/2008 - 02/04/2009**	**09/05/2008 - 07/10/2009**
AUD	0.4390**	0.0500**	0.3590**	-0.0970**	-0.1230**
INR	-0.1270**	0.1680**	0.1360**	***-0.0030***	-0.0320**
TRY	***-0.0010***	***0.0050***	0.0560**	***-0.0190***	-0.0490**
CHF	-0.1140**	0.1010**	0.2740**	0.0280**	0.0770**
NZD	0.4490**	0.1890**	0.3780**	-0.1000**	***0.0150***
JPY	***0.0370***	0.1390**	0.0900**	***0.0174***	0.1630**
	02/04/2009 - 12/02/2009	**07/10/2009 - 04/29/2010**	**12/02/2009 - 09/21/2010**	**29/04/2010 - 11/02/2011**	**09/21/2010 - 04/20-2011**
AUD	0.3930**	0.2650**	-0.7080**	-0.3210**	-0.1640**
INR	***-0.0090***	-0.0820**	***-0.0140***	***-0.0120***	0.0850**
TRY	***-0.0020***	***-0.0060***	***0.0030***	***0.0030***	0.0410**
CHF	***0.1830***	1.1260**	0.8950**	0.5330**	-0.7940**
NZD	0.1430**	0.3170**	-0.2510**	-0.1960**	0.7450**
JPY	0.1360**	0.0630**	0.1680**	0.2180**	-0.1940**

Source: author's calculation

Firstly we will look at the situation of the Swiss central bank. Throughout the period there was no evidence for UIP failure on the CHF except of the last period from the last quarter of 2010. The coefficient for beta one indicates that there is an evidence for UIP failure, thus carry trade activity. We may see from the Table 2 that while the previous interventions in 2010 were not backed by the evidence on UIP situation in the 2011 is different. Clearly, CHF exhibits signs of investment currency with appreciating while increasing the interest rate differential. However, the success of this strategy questionable as the previous experiences from foreign exchange interventions suggests possible failure of this policy in the future.

For New Zealand the foreign exchange interventions are mainly distributed at the beginning of the 2007. From the Table 2 we may derive that there was no clear evidence in favor or direct interventions due to carry trade activity. While in the case of the year 2010 there is evidence in favor of carry trade activity due to failure of UIP the central bank decided not to intervene.

In Turkey there was an evidence in favor of carry trade activity throughout the 2009 (significant) and 2010 (not significant) we can not decide whether the intervention motives behind were supported by the existence of UIP failure or not. More likely explanation is that central bank may impose intervention due to other factors that have caused appreciation of the TRY (especially due to "currency wars" among other emerging countries that lead to synchronized behavior).

Behavior of the Australian central bank again does not contain signs of imposing exchange rate intervention mainly due to carry trade. Although the main evidence for carry trade is visible for years 2009 and 2010 there was no explicit intervention during this period. However, in the second half of 2010 central bank often warn from possible intervention that could be come in effect in the future as a result of strong AUD.

The case of Iceland is complicated as they faced bankruptcy that had a strong effect on all economic indicators. As visible from the Table 2 the evidence for carry trade activity is mixed throughout the entire period. Moreover the central bank interventions in the second half of 2008 were more likely due to general distress on financial markets than due to carry trade activity itself.

Japanese case reflects in many cases the situation of Switzerland. From the evidence of carry trade point of view Japanese yen is not perceived as an investment currency but a funding currency. In the case of central bank interventions throughout the late 2010 and 2011 they are likely to be caused by other factors than interest rate differential.

4. Conclusion

Carry trade activity on the financial markets have been widely discussed on the international financial markets because of its possible impact on exchange rate development. In economic theory there are two possible ways of interaction between monetary policy and carry trade activity.

First direction goes from setting the interest rate by central bank that is observed by market player that base their possible carry trade strategy on the interest rate differential. Their actions consequently affect exchange rate behavior, e.g. appreciation in case of higher interest rate differential and depreciation otherwise. Second direction goes from carry trade activity and its implication for exchange rate behavior and goes back to central bank side who may eventually decide to intervene in case of strong pressure on exchange rate due to carry traders' activity. In this paper we decide to investigate the second process.

Firstly, in order to be able to specify periods from 2007 until today where the carry trade activity was present we tested standard UIP condition by OLS estimation. The test was conducted by using interbank interest rates instead of official interest rates of the central banks as they are likely to capture more of the real condition in credit/deposit relationship among the market participants. The standard equation was enhanced by index of volatility VIX that may capture effect of market condition expectations on exchange rate behavior. Our results suggest that in case of the biggest peak of the crisis 2008 the carry trade activity in most currencies was present ***after*** the peak and in many cases ***was persistent*** throughout the entire period. Secondly, some selected currencies mostly funding currencies with lower interest rates such as EUR, JPY or CHF do not report failure of the UIP.

First step of our analysis has enabled us to proceed to evaluation of central bank interventions during the period of 2007 up to today. In general we may conclude, that majority of the official interventions trigger only small change in exchange rate that is not persistent over time. The exchange rate comes back to its pre-intervention level. On exception from this pattern goes to Turkey where in intervention in late of 2010 was associated with decrease of interest rate and increase in reserve ratio on foreign deposits held by domestic banks. This may indicate that exchange rate intervention without change in interest rate may be effective only in short-time period. However, even in such a case the implication on change in interest rate may not even have a significant impact on exchange rate behavior. On top that, change in interest rate may burst carry trade activity and the central bank finds itself in a vicious circle.

Based on the overview of central bank interventions during the period of 2007 until 2011 and the results of OLS analysis of UIP failure we tried to indicate whether the incentive behind the central bank interventions was partly due to carry trade activity. Our empirical results suggest that majority of central bank interventions during this period is not backed by the evidence of the failure of UIP. Even thought there might be some periods where the presence of carry trade was statistically significant (Australian dollar in 2009 and 2010 or New Zealand in 2010) the central banks decided not to intervene. This may indicate that the reasons behind the central bank interventions in foreign markets are in general other than carry trade activity as the central banks tries to fulfill their obligation to let currency freely flow.

Second reason behind their decision might be connected to their inflation targeting strategy. In environment of the inflationary pressures the change in interest rates (decrease of interest rate that would cause depreciation of the currency or vice versa) will have undesirable effect on inflation which will contradict their main goal of inflation targeting.

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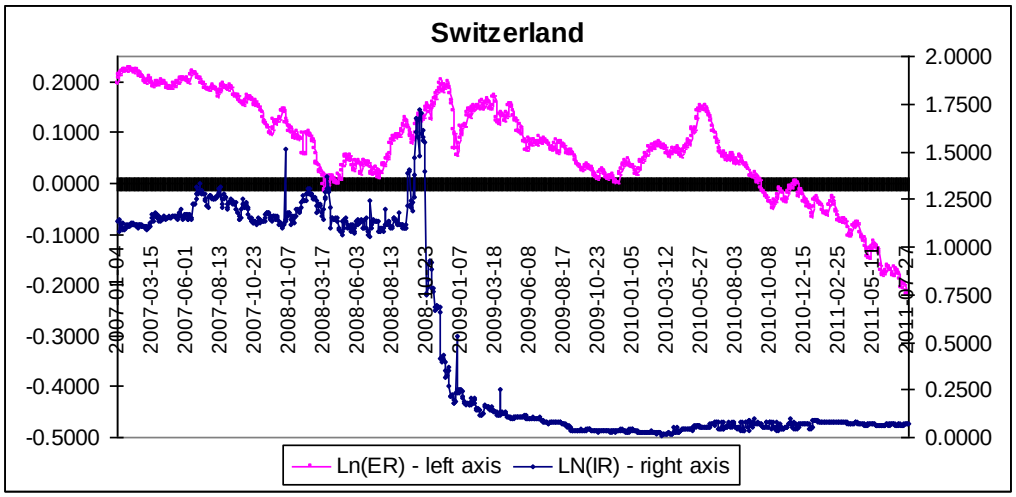
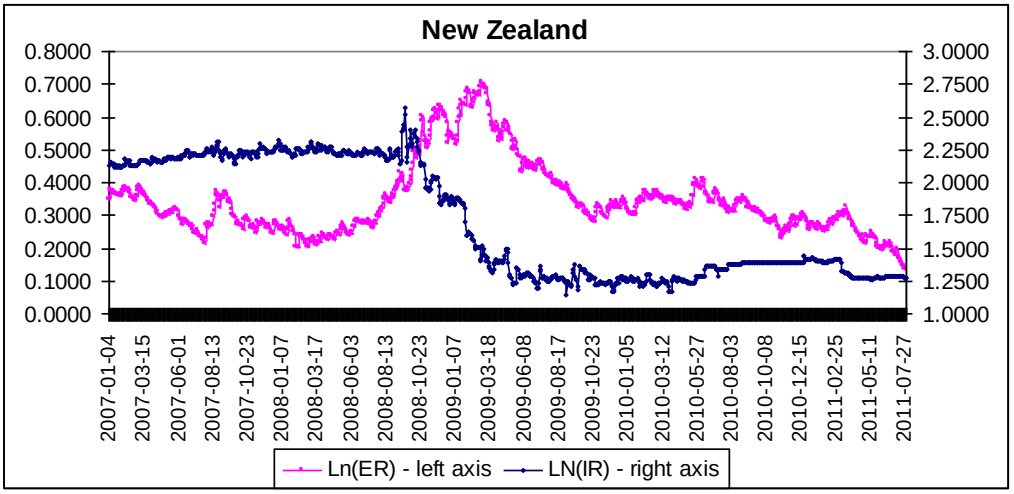
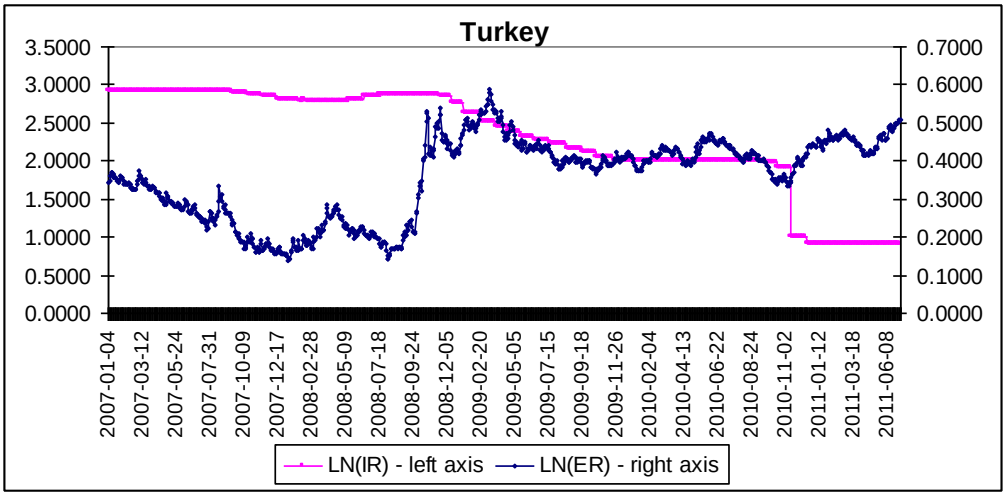
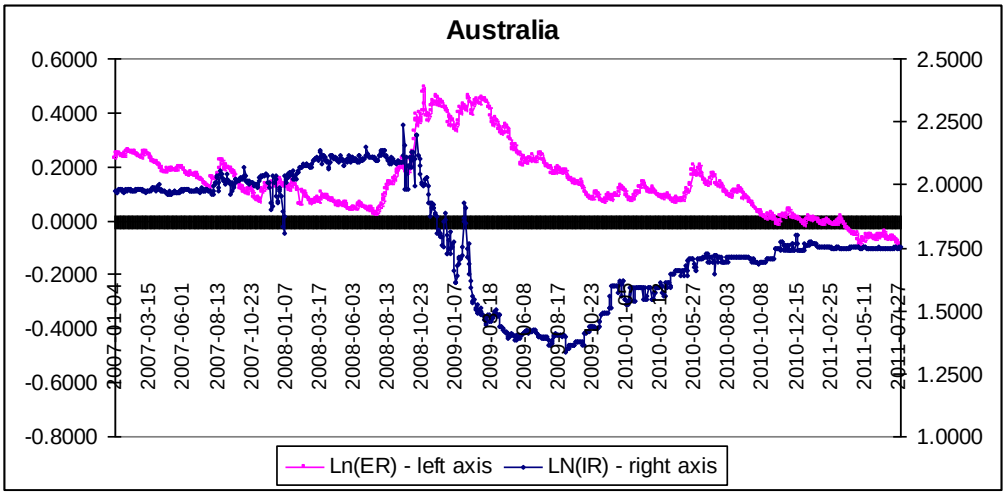
Appendix I

Figure 3: Comparison of the evolution of exchange rate and interest rate of selected countries over the period of 2007 – 2011 (in logarithm)





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1.5000
1.2500
1.0000
2007-01-04
2007-03-15
2007-06-01
2007-08-13
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2008-03-17
2008-06-03
2008-08-13
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2009-10-23
2010-03-11
2010-05-27
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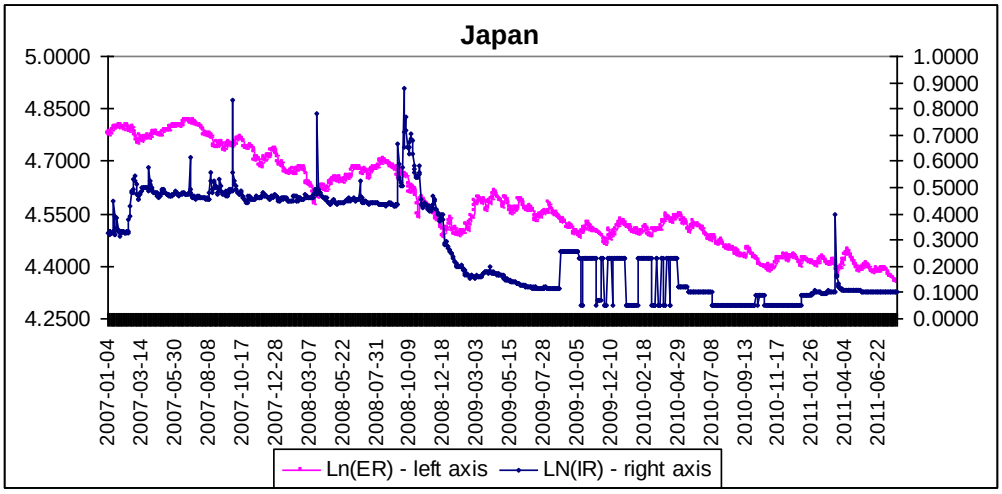
Ln(ER) - left axis
LN(IR) - right axis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4.4000
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1.0000
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0.5000
0.4000
0.3000
0.2000
0.1000
0.0000
2007-01-04
2007-03-14
2007-05-30
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2007-10-17
2007-12-28
2008-03-07
2008-05-22
2008-07-31
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2009-03-03
2009-05-15
2009-07-28
2009-10-05
2009-12-10
2010-02-18
2010-04-29
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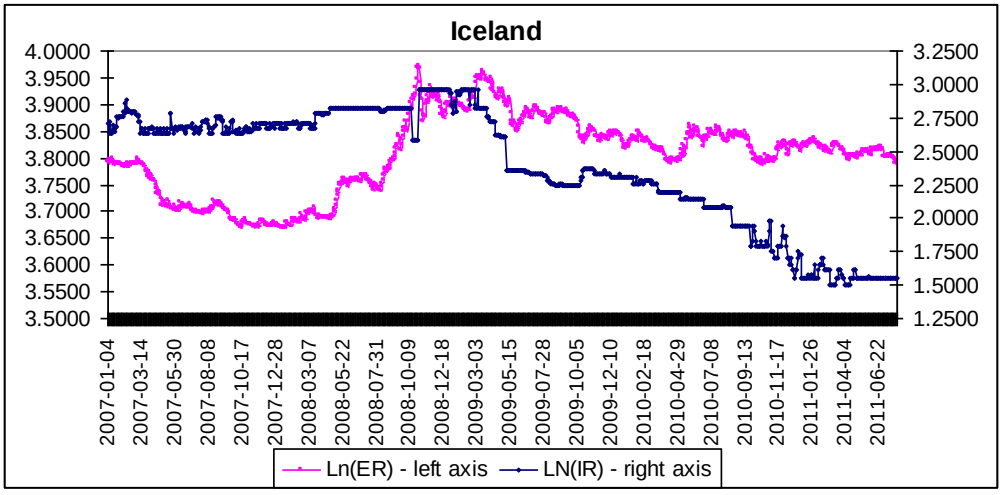
2010-11-17
2011-01-26
2011-04-04
2011-06-22
Ln(ER) - left axis
LN(IR) - right axis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3.2500
3.0000
2.7500
2.5000
2.2500
2.0000
1.7500
1.5000
1.2500
2007-01-04
2007-03-14
2007-05-30
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2009-12-10
2010-02-18
2010-04-29
2010-07-08
2010-09-13
2010-11-17
2011-01-26
2011-04-04
2011-06-22
Ln(ER) - left axis
LN(IR) - right axis