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UNCOVERED INTEREST PARITY IN CENTRAL AND EASTERN EUROPE COUNTRIES

Master´s Thesis

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Tallinn 2015

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ABSTRACT

The present master´s thesis is dedicated to the problem of uncovered interest parity (UIP) in Central and Eastern Europe (CEE) countries.

The hypothesis of UIP is much researched and highly debated topic in macroeconomic literature. A plenty of studies were conducted for developed countries and most of them failed to give evidence in favor of the UIP hypothesis. As there were not so many researches carried out exactly for the Central and Eastern Europe countries, the purpose of this research work is to ascertain, whether UIP holds for these countries, and if not, which factors can influence the failure of the UIP condition.

In order to achieve the goal there was an econometric analysis performed by the author of the present research work. The analysis is based on the testing of three CEE countries, which are Poland, Hungary and Czech Republic. UIP is tested for abovementioned countries 3 months interest rate and exchange rate data between 1999 and 2014.

In order to test the validity of the UIP condition for the abovementioned countries the following methods were used by the author of the present master´s thesis:

- Linear regression analysis
- Factor analysis

As a result of the regression analysis performed UIP is rejected for the 3-month horizon in all sample countries. During the further analysis it was revealed that the main reasons for that are frequent structural breaks and risk aversion of investors. In addition, as the coefficient β stayed negative, carry trade can also play a role.

Moreover, during the factor analysis performed for the same data it was discovered that besides all above described factors, there are also commonalities between different countries' interest rates differentials and exchange rates changes, which are not captured by the UIP theory.

Keywords: uncovered interest parity, Central and Eastern Europe, interest rate, floating exchange rate, arbitrage, carry trade, free capital mobility, rational expectation and risk neutrality

INTRODUCTION

The hypothesis of uncovered interest parity rests on the arbitrage assumption and generally means that no excess return can be gained from the investing in foreign currency, as the nominal interest rate differential between two countries are equal to expected change in the exchange rate. Thus, the validity of the UIP condition indicates that capital markets are efficient.

The actuality of the present master´s thesis is based on the fact, that however UIP hypothesis is widely discussed and much tested topic in macroeconomic world, there is lack of research of UIP for the CEE countries.

The fact, that the CEE countries experienced significant economic transformation over the past two decades, makes the topic even more attractive for the research.

Firstly, the breakdown of socialism in the former Soviet Union and its satellite states, led to a complete new economic structure in the CEE countries, namely there was a transition from centrally planned economies to the market oriented economy.

Secondly, joining the European Union as soon as possible, which was a strategic goal for all CEE countries, accelerated the liberalization of their capital markets and contributed to the removal of remaining exchange rate restrictions and minimisation of investment risks. All of this led to the substantial capital inflows to these countries, which played a key role in rapid economic growth of the CEE countries. (Глинкина, Куликова, 2013,8)

And finally, clash with global financial crisis in 2008, which had stronger negative impact on Central and Eastern Europe comparing to the other regions and caused significant decrease in capital inflows to the CEE countries during 2008-2009. After the recovery of the world economy in 2010 the economic growth in the CEE countries has resumed, but recovery index in this region was the weakest all over the world. Thus it is

fair to say, that the CEE economies are not still fully recovered from abovementioned economic downturn.

Thus, all above discussed caused significant changes in capital flows to the CEE countries during their transformation period, which may affect the relationship between exchange rates and interest rates in the CEE countries (Filipozzi, Staehr, 2011)

Moreover foreign currency borrowing increased significantly during the run-up to euro adoption in the CEE countries (Rosenberg, Tirpak 2008, 3). This means that investors expected borrowing in a foreign currency to be cheaper than borrowing in domestic currency. Thus, validity of the UIP hypothesis in the CEE countries during that period may be under the question.

The present master´s thesis focuses on the hypothesis of uncovered interest parity in Central and Eastern Europe countries.

The purpose of this paper is to determine, whether UIP holds for the CEE countries and which are potential factors that may affect the rejection of the UIP hypothesis for the CEE.

In order to achieve the goal the following tasks were formulated by the author of the present master´s thesis:

- examine the theory of UIP;
- explore empirical researches performed by other authors;
- test the UIP for the CEE countries by using econometric models based on monthly interest rate and exchange rate data between 1999 and 2014;
- investigate, which factors influence UIP in the CEE countries.

The author sets up a hypothesis that UIP does not hold for the CEE countries, mainly because there was abrupt change in capital flows to the CEE countries during the testing period.

The present master´s thesis is divided into five sections. The first part deals with the theory of uncovered interest parity and is mostly dedicated to the exploration of previously done research works. First of all, author examines the concept of interest rate parity and its two forms – covered and uncovered interest parity. Then author focuses more on the UIP condition, observes main assumptions, which are necessary for UIP to hold and main reasons, why there can present deviations from the UIP condition. Author gives a brief

overview of the UIP tests performed for developed and emerging economies and introduces a concept of carry trade, which is directly related to the UIP condition.

The second section of the present master´s thesis focuses exactly on the CEE countries and examines the most important changes in the economic situation of these countries, which took place during the testing period.

The third section contains empirical part of the work. In this section author gives an overview of the dataset, the main characteristics for the sample of three CEE countries (Czech Republic, Hungary and Poland) and a short description of methodology used for the testing. Then author presents the preliminary results of regression analysis performed and conclusions regarding the validity of the UIP hypothesis.

The next section examines which are the possible explanations for the low explanatory power of the UIP estimations in the CEE countries. As a hypothesis author puts forward that frequent structural breaks and inconstant risk premium may be the possible reasons explaining the deviations from the UIP condition.

And the last section of the present master´s thesis examines the UIP condition through the factor analysis, which is not quite common approach for the testing of UIP and was not used in previously done research works.

1. THE THEORY OF UNCOVERED INTEREST PARITY

„The theory of interest parity received prominence from expositions by Keynes, whose attention had been captured by the rapid expansion of organized trading in forward exchange following World War I. Although an understanding of the forward exchange market must have developed within various banking circles during the second half of the nineteenth century, apart from an isolated exposition by a German economist, Walther Lotz (1889), the nineteenth-century literature on foreign exchange theory apparently dealt only with spot exchange rates. Forward exchange trading gave rise to the notion of covered interest parity (CIP), which related the differential between domestic and foreign interest rates to the percentage difference between forward and spot exchange rates. Since it was clear that forward rates also reflected perceptions about future spot rates, it was a short step to the assumption of uncovered interest parity (UIP), which builds on the theory of CIP by essentially postulating that market forces drive the forward exchange rate into equality with the expected future spot exchange rate.“ (Isard 2006, 3)

The first section of present master´s thesis addresses to the concept of uncovered interest parity. Firstly, author gives an understanding of interest parity condition in general and afterwards focuses in more detail exactly on the uncovered interest parity hypothesis. In this section author observes main assumptions, which are necessary for UIP to hold and possible explanations for the UIP failure. Author gives a brief overview of the UIP tests performed for developed and emerging economies and introduces a concept of carry trade, which is directly related to the UIP condition. Present sections of the master´s thesis is dedicated mostly on the observation of different researches carried out by other authors for different countries and different periods of time.

1.1. The concept of interest rate parity

Interest rate parity is an important component of the macroeconomic analysis and one of the basic models used in international finance. The validation of interest parity has essential implications for international corporate finance decisions and for international investments. (Horobet etc 2009, 21-22)

There are two forms of interest rate parity developed: covered interest parity (CIP) and uncovered interest parity (UIP), also known as International Fisher effect. Both forms of interest parity provide simple relationships between interest rates, and foreign exchange market prices, as spot or forward exchange rates. (Ibid.)

According to the concept of interest rate parity, the difference between the market interest rates in any two countries is about the same as the difference in percent terms in the exchange rates of their respective currencies. Therefore no arbitrage opportunity in the mutual trading of their currencies can exist if interest parity holds.

As per Chinn and Menzie (2007) the easiest way to understand the condition of interest rate parity is consider how a typical investor can save in different locations. Supposing that the home currency is USD, and the foreign currency is EUR and assuming that there is a forward market exists, the investor can either save at home, receiving interest rate i, or converting by the exchange rate S, receiving interest rate i^* abroad, and then converting back to home currency by the forward rate F obtaining at time t for a trade at time $t+1$.

If the gross return from $(1+i)$ greater than $(1+i_t^*)\frac{F_{t,t+1}}{S_t}$, the investors will obviously prefer to invest their capital in the home country. Otherwise they will place their capital abroad.

According to the arbitrage assumption both returns should be equalised, as there is no risk exists in nominal terms. Thus, below is presented condition for covered interest parity:

$$\frac{(i-i^*)}{(1+i_t^*)} = \frac{F_{t,t+1}-S_t}{S_t} \quad (1)$$

CIP condition reflects the fact that investors are „covered“ against currency risk by using forward contracts.

Uncovered interest parity departs from CIP by not covering the exchange rate exposure of a cross-border investment with a forward currency contract. Thus, there is a risk for the investor that future spot exchange rates may differ from expectations. (Mansori 2003, 5)

$$\frac{(i-i^*)}{(1+i_t{}^*)} = \frac{S^e{}_{t,t+1}-S_t}{S_t} \quad (2)$$

Above is presented equation (2) for uncovered interest parity, where variable $S^e{}_{t,t+1}$ denotes the expectation in period *t* for the exchange rate in period $t+1$.

1.2. Uncovered interest parity

The UIP theory asserts forward market efficiency. It states that a country's currency is expected to depreciate against a foreign currency when its interest rate is higher than the foreign country's interest rate due to international capital arbitrage. (Ray 2012, 236)

Thus, the nominal interest rate differential between two countries must be equal to expected change in the exchange rate.

According to Ray (2012, 236) „uncovered interest parity is a typical subject of international finance, a critical building block of most theoretical models, and a miserable empirical failure". It is truly so, because a vast number of empirical tests were done in order to confirm UIP hypothesis and most of them gave unfavorable results. However, UIP predicts that countries with high interest rates should have depreciating currencies, in most cases such currencies tend to appreciate. This phenomenon is known as Forward Premium Puzzle.

In addition to the existence of arbitrage, there are three implicit assumptions done when testing UIP. These are free capital mobility, rational (unbiased) expectation and risk neutrality. The failure of these assumptions may contribute to the failure of UIP test.

1.2.1. Uncovered interest parity assumptions

The Basic assumption underlying UIP is the efficient market hypothesis. According to this hypothesis price should fully reflect all available information, which According to this hypothesis price should fully reflect all available information, which means no profitable opportunities for the investors. Thus, if the assumption of market efficiency does not fail, exchange rates should quickly adjust to any new information, which should immediately be reflected in the exchange rate (Ray 2012, 236).

In addition, it can be considered as a joint hypothesis that investors have rational expectations and that they are risk neutral (Ibid.).

The theory of rational expectations was first proposed by John F. Muth of Indiana University in the early 1960s. He used the term to describe the many economic situations in which the outcome depends partly on what people expect to happen. (Sargent 2008)

In case of UIP the theory of rational expectations assumes that market participants make investment decisions based on their expectations of future forward exchange rate. The rational expectations assumption can be defined as:

$$S_{t+1} = S^{e}_{t,t+1} + \xi_{t,t+1} \tag{3}$$

where $\xi_{t,t+1}$ is the white noise error term that is, by definition, uncorrelated with all information known at time *t* including the interest rate differential and the spot exchange rate. The rational expectations theory states that future realizations of S_{t+1} will be equal to the value expected at time t plus a white-noise error term $\xi_{t,t+1}$. (Bui 2010, 4)

The risk neutrality assumption implies that investors are indifferent to interest rates in two countries and care only about expected returns, while risk-averse investors ask premia for taking additional risks. The existence of these additional premia can be justified by incomplete institutional reforms, weaker macroeconomic fundamentals, more volatile economic conditions and shallow financial markets, which are typical characteristics of developing economies (Alper, Ardic and Fendoglu 2007, 18).

As it was already mentioned, tests of the UIP condition involves a joint hypothesis. Thus, besides rational expectations and risk neutrality there are also other assumptions imposed for the UIP condition. These assumptions can be stated as follows: transaction

costs are negligible, underlying assets are identical in terms of liquidity, maturity and default risks, and there are deep financial markets and perfect capital mobility existed (Ibid.)

Thus, the rejection of the UIP condition indicates one or more of these assumptions fail, which, in turn, indicates that capital markets are not efficient and there is a possibility of arbitrage opportunity.

1.3. Uncovered interest parity affecting factors

Traditionally, departures from the UIP condition are attributed to non-rationality of market expectations and/or risk aversion of agents that demand a premium for taking additional risk. Essentially, these two are tested jointly and a rejection of the UIP condition implies that rational expectations and/or risk neutrality assumptions do not hold. (Alper, Ardic and Fendoglu 2007, 4)

In addition to aforementioned reasons, there are also other factors, which contribute to the unfavorable empirical evidence for the UIP condition. These are, first of all, the existence of additional premium for default risk, intensive policy actions of central bank and relatively frequent structural breaks, which are mostly characteristics of developing economies.

Many papers dedicated to the investigation of UIP in emerging economies indicated that default risk provides valuable information about the behavior of domestic interest rates. While UIP assumes that agents have rational expectations and are risk neutral, the rejection of the UIP condition indicates one or more assumptions fail. If the assumption of rational expectations is retained, then the failure of UIP is obviously attributable to the failure of risk neutrality assumption. Thus, if investors are risk averse, it is possible to consider the existence of a premium due to exchange rate risk, which contributes to the deviations from the UIP condition. In the emerging economies default risk premium arises mostly due to the volatile economic condition, incomplete institutional reforms and weaker macroeconomic fundamentals. Thus, it is quite expected that developing market assets offer an additional premium to investors for default risk beside exchange rate risk, which leads to the deviations from the UIP condition much more compared to developed countries. (Karahan, Colac 2012, 387)

Another distinctive feature of developing economies is policy actions of central bank. So over-react tendency of central bank towards exchange rate movements has significant implications for deviations from the UIP condition. As per McCallum (1994) monetary authorities tend to use interest rate as a policy tool in order to resist rapid changes in exchange rates, which could be one more reason for UIP to fail. Chinn and Meredith (1994) documented that deviations from the UIP condition are primarily due to monetary policy reactions to temporary disturbances in the exchange rate (Alper, Ardic and Fendoglu 2007, 6). Moreover Cavoli and Rajan (2006) conducted the research over dynamic links between monetary sterilization of capital inflows and uncovered interest rate differentials in the five south Asian economies (Indonesia, Korea, Malaysia, the Philippines and Thailand) and found that deviations from the UIP condition may be a result of complete monetary sterilization towards capital inflows (Karahan, Colac 2012, 388).

One more important feature within the context of testing for the UIP condition is the existence of relatively frequent structural breaks. Generally, financial liberalization process is characterised by incomplete institutional reforms, relatively volatile economic conditions, weaker macroeconomic fundamentals and shallow financial markets (Alper, Ardic and Fendoglu 2007, 10). All abovementioned characteristics of structural transition may cause the failure of assumptions, under which UIP holds and consequently the failure of the UIP condition.

In addition, there can be also another reasons, why UIP does not hold (Filipozzi, Staehr, 2011, 5):

- Financial markets may not be fully integrated because of regulation, institutional barriers or undeveloped trading possibilities. In this case, the trades needed to arbitrage different expected returns may not be available.
- Illiquidity, which leads to market inefficiency as prices may not reflect available information. Thus, it creates more risks and makes arbitrage trades more complicated.
- Transaction cost can make trades unprofitable, which may also exploit small deviations from UIP.
- Information costs which are needed for making expectations about exchange rate movements may be high.

- The asymmetric tax treatment of interest returns and returns from capital gains may mean that the strict UIP hypothesis which does not take account of taxation would not hold.

1.4. Uncovered interest parity and developed economies

As it was previously mentioned, there are lot of researches carried out in order to test the UIP and most of them have failed to find evidence for the validity of the UIP hypothesis. Furthermore, against to the UIP condition, the majority of the papers found an inverse relation between the spot exchange rate movement and interest rate differential, which are called „forward premium bias" (Karahan, Colac 2012, 387). Basically, it means that positive interest differentials are associated with appreciating currencies, rather than depreciating currencies as UIP predicts. However, some works suggest that the forward premium bias or forward puzzle diminished in the mid to late 1990s. Choudry (1999) found no forward puzzle in at least some cases and Bansal and Dahlquist found that the forward puzzle disappears for many emerging economies. (Mansoni 2003, 5)

Most of the researches have tested the UIP condition based on countries specificities. There is an a lot of papers dedicated to the analysis of a certain differentiation of the UIP according to the peculiarities of the macroeconomic environment, especially in the light of the differentiation between emerging and developed countries. (Triandafil, Richter 2012, 4)

Comparing results of research works performed for developed and emerging economies the UIP theorem is much more often confirmed at the level of developed countries. The reason for that is the absence of a potential lack of risk premiums as a result of more stabilized macroeconomic environment in developed countries. (Ibid.)

At the same time the UIP condition at the level of developed countries is much more supported for the long horizon and much less for the short horizon. Generally short horizon considered to be 12 months or less.

According to the results of research performed for G7 countries by M. Chinn and G. Meredith in 1998 UIP is rejected for the short run and much more supported for the long horizon. These authors have found that as the time period increases, the rejection of

the UIP hypothesis becomes less decisive. They interpret this as meaning that any risk premium is relatively stable over very long horizons. (Chaboud, Wright 2003, 351) In the short run, the failure of UIP results from the interaction of stochastic exchange market shocks with endogenous monetary policy reactions (Chinn, Menzie 2007, 409).

1.5. Uncovered interest parity in developing countries

Earlier literature on the UIP condition mostly focuses on developed economies because of data availability. However, increased degree of financial liberalization in emerging markets over the last 15 years enabled many researchers to analyze foreign exchange market efficiency in these economies as well (Alper, Ardic and Fendoglu 2007, 3).

As many developing countries have completed liberalizing their financial markets in the late 1980s, they became a good candidate of fieldwork for a new area of research concerning with testing UIP. (Karahan, Colac 2012, 386-387)

On the one side, many emerging countries are characterised by the high trend inflation, which facilitates the forecasting of exchange rate developments and thus makes the UIP condition more likely to hold (Filipozzi, Staehr, 2011, 7). As an example, Bansal and Dahlquist (2000) performed UIP analysis for 28 developed and emerging countries using monthly data for the period 1976-1998 and found that the UIP condition is more likely to hold for countries with lower per capita GNP, lower credit ratings, higher average inflation and higher inflation volatility.

On the other side, besides inflation there are also another features typical for emerging countries like weaker macroeconomic fundamentals, more volatile economic conditions, shallower financial markets and incomplete institutional reforms. As there is quite high probability of default risk arising from the abovementioned characteristics, it is plausible that developing market assets offer an additional premiums to investors for default risk beside exchange rate risk, which trigger the rejection of the UIP theory (Karahan, Colac 2012, 387).

In addition, emerging markets are much more exposed to peso problem compared to developed economies. Peso problem occurs „when a market expects a discrete change in the exchange rate which is not materialized at that extent for a prolonged period. In this

case deviations from UIP may be caused by the following mechanism: when market expectations about the future value of the exchange rate are not fulfilled for a prolonged period, the realized value of the exchange rates deviates from the expected change rate systematically. Since market expectations are reflected in the forward premium, this persistent deviation causes forward premium to be a biased predictor of the future exchange rate.“ (Alper, Ardic and Fendoglu 2007, 14)

Some other researches performed for the emerging economies unveiled that UIP may vary from country to country. For example, Filipozzi and Staehr (2011) analyzed the UIP condition in the CEE countries and found that UIP gains more support in the Czech Republic and Hungary, which are most open and integrated in the European economy countries and least in the Poland, which is the country with the more closed economy.

1.6. Carry trade – a bet against the UIP condition

Another issue which is directly related to the UIP condition and has recently received much attention is carry trade activity.

A currency carry trade is usually defined as a leveraged cross-currency position designed to take advantage of interest rate differentials and low volatility. The strategy involves borrowing funds at a low interest rate in one currency (the funding currency) and buying a higher-yielding asset in another (the target currency). (Galati, Heath and McGuire, 28)

The uncovered interest parity condition states that the interest rate differential between riskless assets denominated in foreign and domestic currency is equal to the rate at which the foreign currency is expected to depreciate against the domestic currency. As long as UIP holds, the profit of carry trade strategy is zero on average, since the interest rate premium is perfectly offset by the exchange rate depreciation (Felcser, Vonnak 2013, 6). One motivation for investors to engage in the carry trade is, however, that UIP does not appear to hold and high interest rate currencies are more likely to appreciate than depreciate against low interest rate currencies, as it was mentioned in previous subsections. Consequently, in historical data, carry trades have earned positive average returns in excess of the interest differentials between the relevant currencies. (Burnside 2011,1).

Supposing that the home currency is USD denoted by risk-free rate i_t, the interest rate on risk-free foreign denominated securities is i_t^* and no transaction costs exist, the payoff to borrowing one USD in order to lend the foreign currency will be (Burnside, Eichenbaum, Rebelo 2011, 3):

$$(1 + i_t^*)\frac{S_{t+1}}{S_t} - (1 + i_t) \tag{4}$$

where *St* denotes the spot exchange rate expressed as USD per foreign currency unit. The payoff to the carry trade strategy is, therefore (Ibid.):

$$z_{t+1} = (i_t^* - i_t)[(1 + i_t^*)\frac{S_{t+1}}{S_t} - (1 + i_t)] \tag{5}$$

A second way to implement the carry trade is to exploit the forward premium, which is the difference between the forward exchange rate and the spot exchange rate of two currencies. If a currency is assumed to depreciate against another currency because the forward rate is higher than the spot rate, it has a forward premium and is likely to be sold or becoming the funding currency. Contrary, if a currency is assumed to appreciate having a forward exchange rate that is below the spot exchange rate, it has a forward discount and may become the target of investors. This is then an investment currency. (Hoffman 2012, 1480)

The payoff to this strategy can be written as follows (Burnside, Eichenbaum, Rebelo 2011, 3):

$$z^F{}_{t+1} = (F_t - S_t)\,(F_t - S_{t+1}) \tag{6}$$

Following Brunnermeier et al. (2009) carry trade is influenced by the liquidity conditions. If the liquidity conditions are favorable, carry trade is lucrative. At the same time carry trade returns are strongly related to the exchange rate volatility. Thus, higher market volatility is associated with carry trade losses (Clarida, Davis and Pedersen 2009, 4).

The volume of carry trade increased substantially in emerging markets prior to the 2007-2008 financial crisis. Especially Central and Eastern Europe attracted a surge of un-hedged cross-border investment and lending. The reasons for that may be different. Firstly, the CEE economies were expected to catch-up to the EU during that period, which typically goes along with a productivity-driven appreciation of their currencies. Secondly, many CEE countries intervene in the foreign exchange market to stabilize exchange rates against the euro. (Hoffman 2012, 1479, 1483)

2. ECONOMIC TRANSITION IN THE CEE COUNTRIES – CZECH REPUBLIC, HUNGARY AND POLAND EXPERIENCE

The present master´s thesis is dedicated to the analysing of the UIP condition in the Central and Eastern Europe countries. Three countries were chosen for the analysis: Czech Republic, Hungary and Poland.

In the second part of the paper author focuses exactly on the three abovementioned CEE countries and describes the major changes these countries had to face during their transformation period. Thus, it becomes more clear why it is especially interesting to analyse the UIP condition in these countries.

2.1. Economic transformation of Central and Eastern Europe

In late 1989 the economic and political systems of Central and Eastern Europe, including Czech Republic, Hungary and Poland, faces major changes as they shifted from administrative and command economies to market economies (Orescovic 2012, 1). The common goal for these countries has been to gain membership to the European Union (EU).

Joining the European Union accelerated the liberalization of Central and Eastern Europe capital markets, which led to the substantial capital inflows to these countries.

However, at a moment where the economic environment used to look bright Central and Eastern Europe was hit by the global financial crisis 2008 and most transition countries experienced a dramatic decline of capital inflows and even reversals of former investments (Hölscher 2009, 10).

2.1.1. Hungary

When Hungary started her economic transformation in 1990, the country experienced a critical financial situation coupled with the disintegration of former trade links with Comecon countries, a galloping inflation and high unemployment rate. As Hungary foreign debt was around 21.2 billion USD, the government decided to sell state properties instead of distributing it to the population for free. (Orescovic 2012, 16).

In order to achieve the macro-economic stabilization and start with trade liberalization there was adopted a step-by-step approach by the Hungarian Government. They tried to limit the hardship of the transition while cutting back some social welfare expenditures and reducing the state deficit. (Ibid., 17)

Moreover, at the beginning of her transformation process Hungary faced a severe exchange liquidity crisis. The Forint was devaluated, taxes were increased and a tight monetary policy was put in place.

The main problem for Hungary was the fact that there was no single strategy and the government always tried to postpone painful economic decisions. All in all, it led to the drop of GDP by more than 20% and industrial production by more than 30%. At the same time inflation rose over 28% (Table 1).

Table 1. Change in Consumer prices (%) in Hungary

Year	1990	1995	2000	2005	2010	2012
Change in Consumer prices (%)	28.37	18.87	9.08	4.03	3.92	1.71

Source: Eurostat

Regarding foreign direct investments, Hungary attracted a total of 39 billion US dollars for the first ten years of the transition. Initially Hungary was viewed as an attractive place for foreign investment because of its legal system and educated population. However, continued transformation of Czech Republic and its favorable geographical location at the crossroad of a Germany and growing Poland offered better business opportunities for investors compared to Hungary, the changing politics, new reforms and economic slowdown of which created more uncertainty for investors. (Orescovic 2012,

19). Thus, after joining the European Union in 2004 Czech Republic and Poland started to attract more and more capital inflows, while investment in Hungary turned to be less attractive and after 2006 there was almost no growth in foreign direct investments in Hungary. Changes in foreign direct investments in the three abovementioned countries are shown on the Figure 1 below.

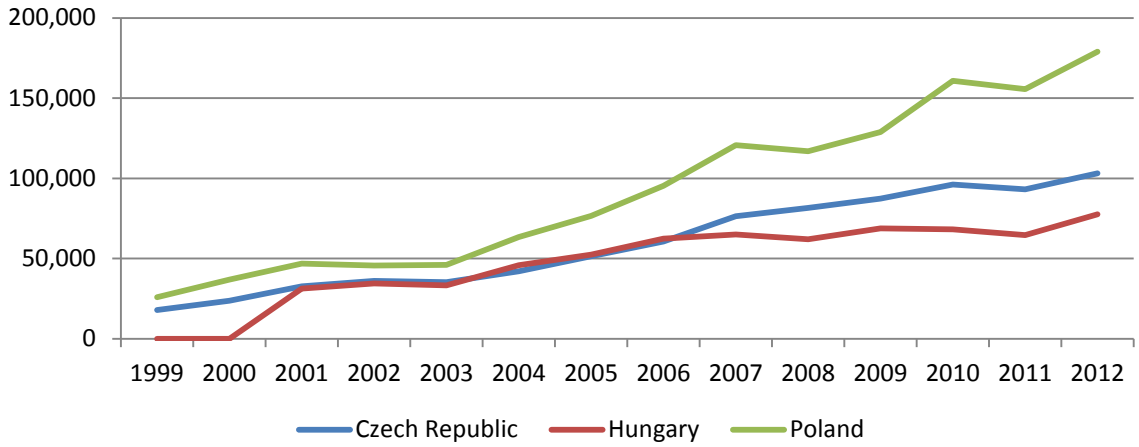

Figure 1. Foreign direct investment to Hungary, Czech Republic and Poland during 1997-2012

Source: Eurostat

Financial Fall of 2008 affected Hungarian exports and the country current account gap rose to 4.9% of GDP.

As Hungary´s major banks were owned by global banks, they issued in the mid 2000 mortgages in Euros and Swiss Francs in order to meet the demand for new private housing. European wide recession, which was caused by the global financial crisis 2008-2009 and later the 2010-2011 European fiscal crisis, significantly damaged Hungary terms of trade. As a result, the Forint fell drastically. Many of the mortgage holders faced with exorbitant foreign currency payments. Thus, in order to improve the situation, the prime minister of Hungary, Victor Orban imposed an artificially low exchange rate to the Forint against the Swiss Franc and Euro. (Orescovic 2012, 20)

The decline of GDP in 2009 was minus 12.9%. After 2009 there was an increase in GDP of Hungary, but European fiscal crisis again led to the drop of GDP by 1.65% in 2012 (Table 2).

Table 2. Hungarian GDP at market prices (EUR) during 2008-2012

GEO/TIME	2008	2009	2010	2011	2012
Hungary	107 150.1	93 371.7	97 814.8	100 350.9	98 699.4
Change	*5.84%*	*-12.86%*	*4.76%*	*2.59%*	*-1.65%*

Source: Eurostat

2.1.2. Czech Republic

The initial phase of the economic transition was marked for Czech Republic as well as for Hungary by initial price shocks, high inflation and a quasi output collapse (Orescovic 2012, 15).

Differently from Hungary Czech Republic decided on a privatization strategy, which however first proved to be a rapid and efficient way in creating small and medium size enterprises, finally resulted in delaying economic changes (Ibid., 17).

For the first ten years of the transition Czech Republic attracted 28 billion US dollars of foreign direct investments, but after 1999 the trend was reversed and the next significant increase in capital inflows to Czech Republic took place after joining the European Union in 2004 (Figure 1).

Financial crisis 2008 hit Czech Republic as well as another Central Europe countries, but comparing to Hungary experience Czech Republic suffered from this downturn less. Firstly, Czech banking sector was mostly free of bad assets which had been earlier transferred to the Czech Consolidation Agency. Secondly, Czech Republic had a relatively small mortgage market and Czech banks were not part of global financial groups (Orescovic 2012, 20).

Table 3. GDP at market prices (EUR) in Czech Republic during 2009-2012

GEO/TIME	2009	2010	2011	2012
Czech Republic	148 357.4	156 369.7	163 579.1	160 947.8
Change	*-7.83%*	*5.40%*	*4.61%*	*-1.61%*

Source: Eurostat

The decline of GDP in 2009 was minus 7.83%, which is less than in Hungary. As well as in Hungary after 2009 there was an increase in GDP of Czech Republic, but European fiscal crisis again led to the drop of GDP by 1.61% in 2012 (Table 3).

2.1.3. Poland

The economic transition of Poland began in 1989 from the realization of the so-called „Balcerowicz's Plan". Balcerowicz was the Minister of Finance this time. The new plan was able to improve the Polish economy considerably and resulted in liberalization of the domestic prices, considerable growth of the domestic import, sharpening the pay control and a new financial policy towards the existing companies.

Another important task was to introduce interest rates higher than the inflation, as well as to apply the convertibility of the dollar and the stability of the dollar exchange rate (Crombrugghe, Lipton 1994, 114).

All abovementioned changes made the Polish economy stabilize. As a result the borders of the country opened to the global market, which in turn contributed to the large inflows of foreign direct investment (FDI) to the country. In 1998 Poland attracted 40% of all FDI flows to the Central and Eastern Europe and the Baltic States (Lenain 2000). Increase in foreign direct investment is illustrated in the Figure 2 below.

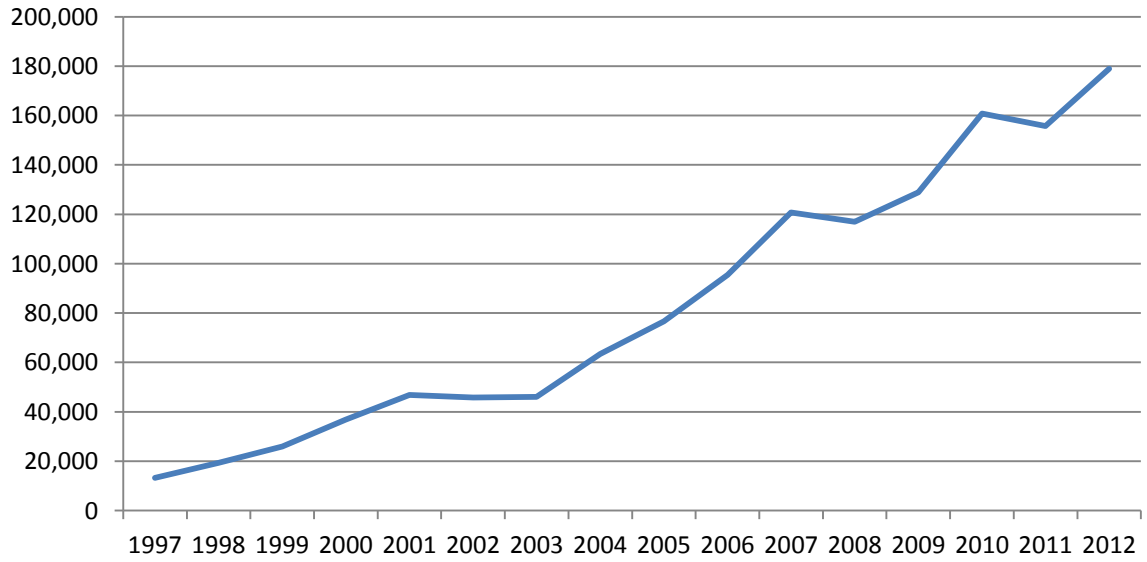

Figure 2. Foreign direct investment to Poland during 1997-2012

Source: Eurostat

As Figure 2 depicts there was a particularly noticeable increase in foreign investments to Poland after country joined the European Union in 2004 until the financial downturn in 2008. Financial crisis brought decline in FDI to Poland, but as Figure 2 shows, it was not very drastic and soon started to increase again

There were two main challenges for Poland during its transition period. The first one was keeping inflation under control, which was after the breakdown of Soviet Union extremely high in Poland.

The second challenge Poland faced was how to continue financing its large current account deficit. The deficit has widened prior to 2000 because of higher imports, a reflection of strong domestic demand. Exports have also been growing, but not fast enough to prevent the trade deficit from widening (Lenain 2000).

Poland was the only EU country, which was able to avoid a recession in 2008-2009, and despite the current turbulences in the Eurozone it is still expected to be among the fastest-growing EU members this year.

Although some other central and eastern European countries offer similar opportunities, Poland is still an attractive choice relative to its neighbors mostly because of its large domestic market. Whereas the Czech Republic and Hungary have richer and more open economies, Poland has much lower labor costs and has grown more rapidly.

3. EMPIRICAL ANALYSIS OF THE UNCOVERED INTEREST PARITY CONDITION

Over the past two decades the CEE countries experienced significant economic transformation from centrally planned economies to the market oriented economy. During their financial liberalization period prior to the integration in to the European Union all exchange rate restrictions were removed and the CEE region experienced substantial capital inflows, which significantly reduced following the global financial crisis. Thus, aforementioned circumstances obviously could influence the relationship between exchange rates and interest rates in the CEE countries and consequently lead to the deviations from the UIP conditions.

The second section of present master´s thesis is dedicated to the empirical analysis of the uncovered interest parity condition. In this section author gives an overview of the dataset, the main characteristics for the sample of three CEE countries (Czech Republic, Hungary and Poland), a short description of methodology used for the testing and the results of preliminary regression analysis. The main goal of this section is to determine, whether the UIP condition holds for the CEE countries or not.

3.1. Data and methodology

In order to obtain an empirical evidence for the failure of the UIP condition in Central and Eastern Europe three countries were chosen for the analysis - Czech Republic, Hungary and Poland. UIP is tested for abovementioned countries 3 months interest rate and exchange rate data between 1999 and 2014. All abovementioned countries had floating exchange rates during the observed period, although Poland formally used managed

devaluations until April 2000 and Hungary used different corridors until 2008 (Filipozzi, Staehr, 2011, 8).

As it was discussed in the first section the results of the analysis performed over the UIP condition may vary with the investment horizon. As it is known from the numerous researches UIP was rejected in all cases for the short run and in some cases it was confirmed for the longer horizons. As 3-month money market is one of the most liquid segments of the market, 3-month horizon was chosen for the analysis.

As all three countries experienced increased integration with the euro area during the sample period, the euro area is considered to be the reference area. Thus, the exchange rates are in units of local currency per euro and the interest rate spreads of the local interest rate are against the Euribor rate.

The main statistics of the series are presented below in the Table 4.

Table 4. Main time-series statistics of exchange rate returns and interest rate spreads for Czech Republic, Hungary and Poland

FX return:					
Country	Mean	Median	Min	Max	Std. Dev.
Czech Republic	-0.004	-0.006	-0.066	0.162	0.031
Hungary	0.004	0.004	-0.116	0.165	0.044
Poland	0.001	-0.008	-0.095	0.263	0.057
Interest spread:					
Country	Mean	Median	Min	Max	Std. Dev.
Czech Republic	0.001	0.001	-0.003	0.016	0.003
Hungary	0.015	0.014	0.005	0.033	0.006
Poland	0.012	0.008	0.001	0.036	0.010
Time period	31.12.1998-30.05.2014				
Source	Ecowin				

Source: Appendix 1

All numbers contained in the above presented Table 4 are in percent (%) terms and describe 3-month horizon (not annualized).

As it is seen from the Table 4 Czech Republic stands out from the rest of the countries. First of all, Czech Republic has negative FX return, which means that Czech Koruna (CZK) on average appreciated. Moreover, interest spread in Czech Republic is also much lover comparing to Hungary and Poland.

In order to test the UIP condition in the CEE countries author decided to prepare regression models for each single country and to analyse whether UIP holds in these countries and which factors it could be influenced by.

3.1.1. Data overview

While analysing exchange and interest rates in the three CEE countries some major differences can be noticed among them. Firstly, there is considerable differences in exchange rate dynamics exist across Poland, Czech Republic and Hungary. The fluctuations of the nominal exchange rate of local currency in the abovementioned countries against euro are shown in Figure 3. The nominal exchange rate is presented in local currency for one euro.

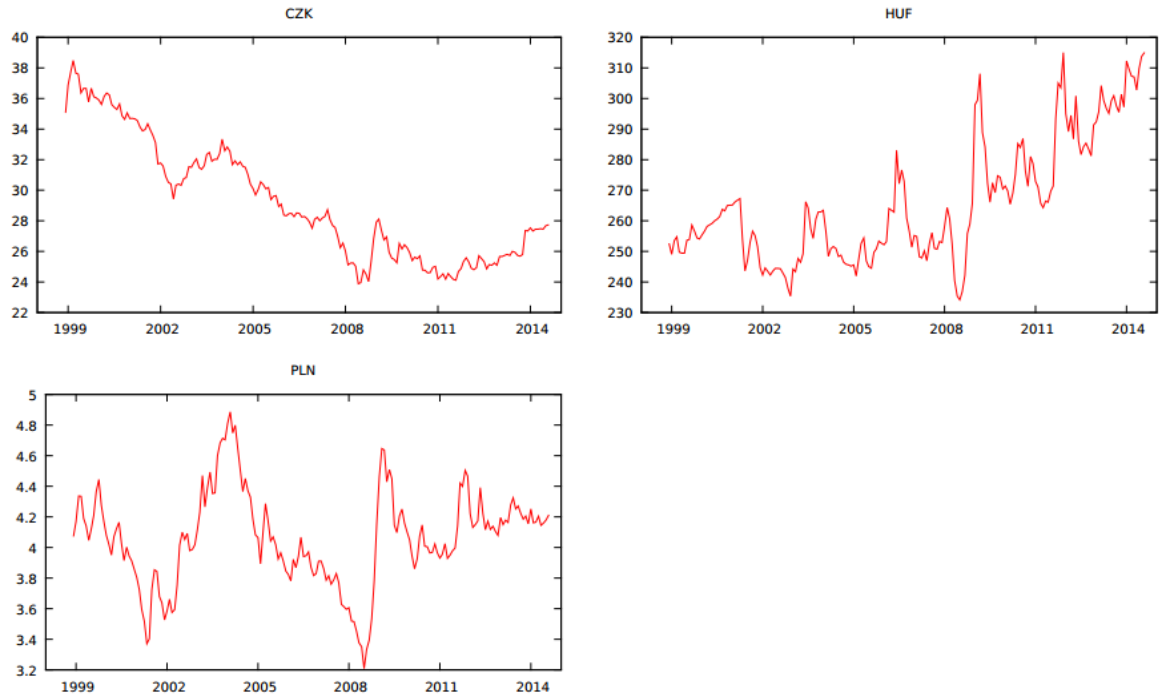

Figure 3. Nominal exchange rate of local currency against euro for the period 1999-2014
Source: Appendix 1, author´s calculations

Figure 3 shows that during 1999-2014 exchange rates in each country moved absolutely differently across the time. For example, Czech Republic had rather strengthening exchange rate over abovementioned period, when Hungary and Poland exchange rates were relatively stable. However, it is seen that after financial crisis 2008 Hungarian forint started to depreciate.

The main reason for this may be the fact that all these countries were going through the transition from the centrally planned economies to the market economy very differently. Thus, it is not possible to say that there is something common between nominal exchange rate development in the CEE countries. Thus, the UIP condition is not necessarily working the same way in all sample countries, but may vary from country to country.

In addition, while examining 3-month annualised exchange rate returns obtained from investing in the CEE countries as presented below on the Figure 4, it is possible to notice that all returns are very volatile and extremely low at the peak of the global financial crisis.

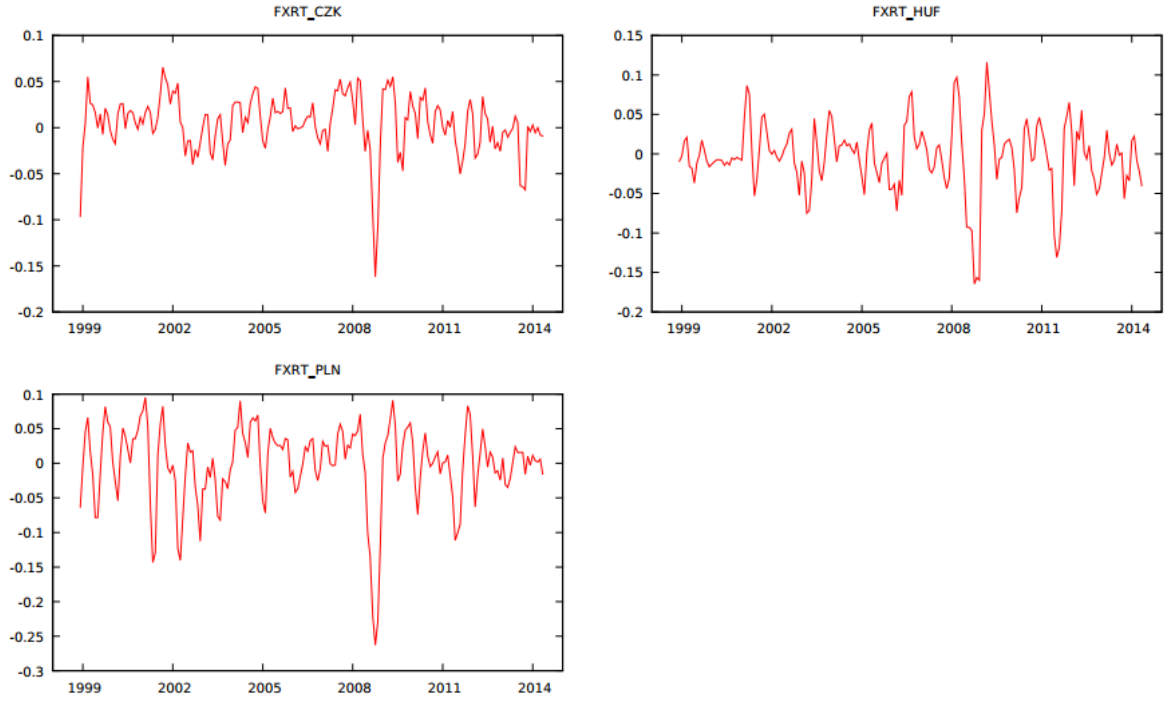

Figure 4. Annualised FX return of local currency versus euro over 3-month period

Source: Appendix 1, author´s calculations

As it was mentioned above FX returns on investment in the CEE countries were very volatile during 1999-2014. Thus, for the UIP condition to hold, the interest rate differentials between the countries and the euro area have to be similarly volatile. However, as Figure 5 depicts, the interest rate spreads are much less volatile compared to the FX returns on the same horizon.

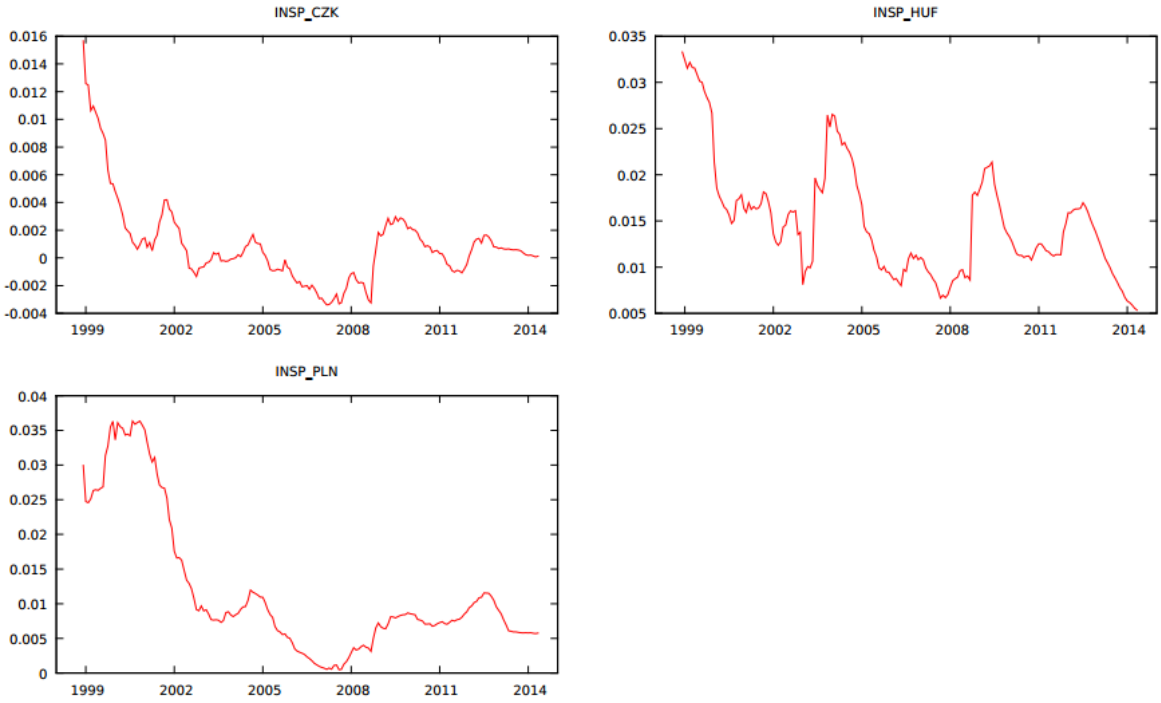

Figure 5. Annualised interest rate spreads on 3-month deposits

Source: Appendix 1, author´s calculations

3.2. Preliminary results of the regression analysis

In order to analyse whether the UIP condition holds for the CEE countries the following regression model was prepared by the author of the present master´s thesis:

$$FXRT = \alpha + \beta\_INSP + u\_i \tag{7}$$

where *FXRT* is FX return calculated as the annualised 3-month depreciation of the local currency against the euro (%) and *INSP* is annualised spread between 3-month interbank offered rate on local currency and 3-month Euribor rate (in %-points).

According to the theory UIP holds if $\alpha = 0, \beta = 1$ and the residuals do not exhibit serial correlation of the third or a higher order (Filipozzi, Staehr, 2011, 12).

As for the analysis is used monthly observations, but 3-month data, the overlapping data problem should be taken into consideration. The conventional estimation approach with overlapping data is to use the Newey-West estimation procedure. It is used by the most of the empirical articles that using overlapping data. (Harri, Brorsen 2009, 81)

The results of the Newey-West test are presented below in the Table 5.

Table 5. UIP estimation results using Newey-West test

Country	Coefficient α	Coefficient β	F-stat	R-squared
Czech Republic	-0.004	-0.361	0.230	0.001
	(0.004)	(1.308)		
Hungary	0.019**	-1.037**	4.161	0.022
	(0.011)	(0.563)		
Poland	0.008	-0.541	1.731	0.009
	(0.011)	(0.571)		

Source: Appendix 1, author´s calculations

While analysing the results presented in the Table 5, attention should be paid on some important indicators. Firstly, there are extremely low R^2 of the regressions, what means that the interest rate spreads have very limited ability to explain the FX returns. The reason for that could be the fact that interest rate spreads in the CEE countries are not so much volatile as the exchange rate returns (Figures 4 and 5).

Secondly, according to the results of the preliminary regression analysis coefficient β is not statistically significant from 0 at the both 5% and 10% level of significance for Czech Republic and Poland, what means that it is not possible to establish any connections between exchange rate returns and 3-month interest rate spreads in these countries during 1999-2014. Thus, it is difficult to say something about the validity of UIP in these countries for the abovementioned period. At the same time in case of Hungary coefficient β is statistically significant at the both 5% and 10% level of significance, but it is strictly opposite to the UIP condition, because in case of depreciating currency interest rates should increase.

From the regression analysis performed for Hungary it was obtained that the coefficient β is statistically significantly different from 0, which indicates some relation between exchange rate return and interest rate spreads in this country for the period 1999-2014. However, it is not enough for stating that the UIP holds for the abovementioned period in Hungary. In order to analyze whether the UIP condition is really confirmed it is necessary to test if the coefficient β is also statistically significantly different from 1. For that purpose Wald test was chosen by the author of the present master´s thesis. The results of Wald test are presented below in the Table 6.

Table 6. Wald test results for Hungary

Test Statistic	Value	df	Probability
F-statistic	16.05385	(1, 184)	0.0001
Chi-square	16.05385	1	0.0001

Source: Appendix 1, author´s calculations

For the UIP to hold the probability of F-statistic and Chi-square of Wald test must be greater than 0.1. If the probability of both test statistics is 0, it is possible to say that coefficient β is certainly different from 1. If it is greater than 0.1, coefficient β is not different from 1 and consequently UIP can be confirmed.

According to the results of Wald test performed for Hungary the probability of both F-statistic and Chi-square is almost 0. Thus, coefficient β is statistically significantly different form 1, which means that there is no evidence for the validity of UIP hypothesis for Hungary as well.

Moreover, according to the results of regression analysis coefficient β is negative for Hungary, which means that in case of depreciation of forint interest rate spread is also decreasing against the Euribor. UIP assumes that on the contrary high interest rate currencies tend to depreciate. Thus, all above discussed could be an indication for a lucrative carry trade in Hungary.

The relation between exchange rate returns and interest rate spreads is quite well illustrated on the Figure 6 below. As Figure 6 depicts, the interest rate differential between local currency and euro is not offsetting by a depreciation of local currency.

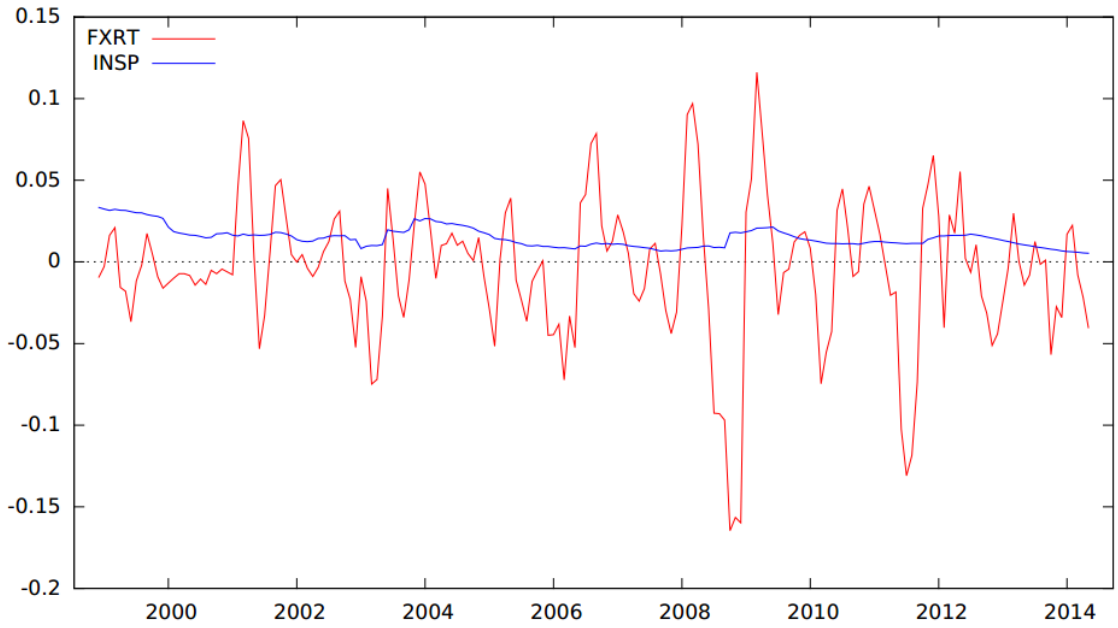

Figure 6. The relation between FX return and interest rate spread in Hungary during 1999-2014

Source: Appendix 1, author´s calculations

The estimated constants of the regression presented in the Table 5 are positive for Hungary and Poland and negative for Czech Republic, but statistically significantly different from 0 only for Hungary. Normally constants should indicate the presence of either a risk premium or barriers to entry (Filipozzi, Staehr, 2011, 13). As it was alredy previously mentioned the CEE countries experienced significant economic transformation during the sample period and seemed to be more risky from the investor´s point of view due to the volatile economic condition, incomplete institutional reforms and weaker macroeconomic fundamentals. That is why investors required additional premium for the risk. However, as numerous research works have shown, risk premium is generally not constant and varies across the time. Thus, it is quite complex to model risk premium as a constant.

As a conclusion of the first part of the analysis performed for the 3-month horizon the UIP condition is rejected for all sample countries. Moreover, there was identified the possibility of existence of lucrative carry trade in Hungary, as the relation between FX return and interest spreads are opposite to this described by UIP. As a result, capital markets in the 3 abovementioned CEE countries do not seem to be efficient for the sample

period and consequently there is opportunity to gain additional profit from the investing in these countries.

3.2.1. UIP test for the 12-month horizon

Previously UIP was tested for the 3-month horizon and no evidence for the validity of the UIP condition in the CEE countries was obtained. Most studies, however, suggest, that the UIP may hold better at longer investment horizons. In order to test, whether the same principle is applicable in case of the CEE countries, additional regression analysis was performed over 12 months interest rate and exchange rate data. The results of regression are presented in the Table 7 below. As in case of the 3-month horizon data Newey-West test was used in order to avoid the overlapping data problem.

Table 7. UIP estimation results for the 12-month horizon using Newey-West test

Country	Coefficient α	Coefficient β	F-stat	R-squared
Czech Republic	−0.016	−0.666	3.769	0.021
	(0.010)	(0.552)		
Hungary	0.009	0.194	2.891	0.016
	(0.010)	(0.185)		
Poland	−0.015	0.879**	14.979	0.079
	(0.016)	(0.280)		

Source: Appendix 2, author´s calculations

According to the results of the regression analysis performed for each sample country at 12-month horizon R^2 of the regressions is low as well as in case of 3-month horizon data, which still means that FX return cannot be fully explained by the interest rates. However, it should be stressed that in case of 12-month horizon data R^2 is pretty much higher for Czech Republic and Poland compared to 3-month horizon, which indicates the improvement of explanatory power of the interest rates for the longer periods.

Comparing to the results of the regression analysis performed for the 3-month horizon data some differences have been identified during the testing of the 12-month horizon data. Firstly, in case of 12-month horizon data coefficient estimates are not statistically significant at the both 5% and 10% level of significance for Czech Republic

and Hungary, what means that there is no relation between FX rates and interest rates during that period in these countries. At the same time, coefficient β is statistically significant at the both 5% and 10% level of significance for Poland.

As in case of the 3-month horizon data in order to control whether the UIP holds for the 12-month horizon in Poland, Wald test was used by the author of the present master´s thesis. The results of Wald test are presented below in the Table 8.

As per results of Wald test performed for the 12-month horizon data introduced below in the Table 8, both the probability of F-statistic and the probability of Chi-square are greater than 0.1 for Poland. This means that it is not possible to say that coefficient β is different from 1. Thus, according to the results of Wald test UIP is confirmed at the level of Poland for the 12-month horizon data.

Moreover the coefficient β is positive for Poland, which is in line with the UIP condition and describes that in case of high interest rates currency tends to depreciate.

Table 8. Wald test results for Poland at the 12-month horizon

Test Statistic	Value	df	Probability
F-statistic	0.186695	(1, 175)	0.6662
Chi-square	0.186695	1	0.6657

Source: Appendix 2, author´s calculations

As a result of analysis performed for the 12-month horizon UIP is rejected for Czech Republic and Hungary, but confirmed for Poland.

The one reason for that could be the fact that there were very high interest rate differentials in Poland during the testing period, especially prior to the convergence with the European Union. As it is known, there is no reason for doing arbitrage when the interest rate spreads are low because in this case transaction costs will be to high and no profit can be gained. When interest rate spreads are on the contrary high, there is an opportunity for the investors to get abnormal return. Thus, considering the fact that interest rate spreads were high in Poland, there was an opportunity for making arbitrage profit.

Another reason could be the fact that FX movements have always been less subject to carry trades and sudden outflows of capital (for global risk aversion), but more linked to economic, fundamental factors. For example, Poland attracted more FDI than other CEE countries because of lower labor costs.

4. EMPIRICAL EXPLANATION FOR THE FAILURE OF THE UIP CONDITION IN THE CEE COUNTRIES

During the regression analysis described in the previous section the validity of the UIP condition in the CEE countries was not confirmed for the 3-month horizon. As it was described in theoretical part of present master´s thesis different factors may influence the validity of the UIP condition. These factors are, for example, non-rationality of market expectations and risk aversion of agents, structural breaks and central bank policy.

The last section of present master´s thesis examines which are possible explanations for the low explanatory power of the UIP estimations in the CEE countries.

As Central and Eastern Europe went through the long and significant transformation period author puts forward the hypothesis that structural breaks and risk premium are the first and most important factors, which may impact the validity of the UIP condition in the CEE countries.

4.1. Structural breaks

As it was already previously mentioned Central and Eastern Europe experienced significant structural transformations over the past two decades, beginning with the collapse of Soviet Union and transition from centrally planned economies to the market oriented economy and ending with joining the European Union and clash with global financial crisis in 2008. Generally, financial liberalization process is characterised by incomplete institutional reforms, relatively volatile economic conditions, weaker macroeconomic fundamentals and shallow financial markets (Alper, Ardic and Fendoglu 2007, 10). All abovementioned characteristics of structural transition may cause the failure of assumptions, under which UIP holds and consequently the failure of the UIP condition.

Thus, one possible explanation for the failure of the UIP condition in the CEE countries can be existence of frequent structural breaks.

In order to test whether structural breaks impact the UIP condition in the CEE countries it was decided to introduce into the regression model dummy variables. Normally dummy variable is one that takes the value 0 or 1 to indicate the absence or presence of some categorical effect that may be expected to shift the outcome.

Obviously the most important events during the sample period in Czech Republic, Hungary and Poland were joining the European Union in 2004 and financial crisis 2008-2009. That is why author decided to introduce two different dummy variables. The first one higlights joining the EU by the three above discussed countries and the second one is financial downturn started in 2008.

In order to test whether two abovementioned events in the history of Czech Republic, Hungary and Poland can really impact the UIP condition in these countries, the following regression model was prepared by the author of the present master´s thesis:

$$FXRT = \alpha + \beta\_INSP + \gamma\_STBE + \delta\_STBC + u\_\text{i} \quad (8)$$

where *FXRT* is FX return calculated as the annualised 3-month depreciation of the local currency against the euro (%), *INSP* is annualised spread between 3-month interbank offered rate on local currency and 3-month Euribor rate (in %-points), *STBE* indicates joining the European Union by the sample countries and STBC indicates the clash with global financial crisis.

The results of regression are presented below in the Table 9.

Table 9. UIP estimation results, including structural breaks

Country	Coefficient α	Coefficient β	Coefficient γ	Coefficient δ	F-stat	R-squared
Czech Republic	−0.001	−1.229	−0.016**	0.0217***	0.003	0.074
	(0.005)	(0.861)	(0.007)	(0.006)		
Hungary	0.022*	−1.105*	−0.006	0.006	0.186	0.026
	(0.012)	(0.579)	(0.009)	(0.008)		
Poland	0.063***	−2.383***	−0.069***	0.032***	0.000	0.118
	(0.015)	(0.604)	(0.015)	(0.010)		

Source: Appendix 1, author´s calculations

Compared to the results of the preliminary regression analysis performed for the 3-months horizon R-squared of the estimations has improved, but still stays extremely low. According to that, it is fair to say that neither interest rate spreads nor structural breaks have the ability to explain FX returns in the sample countries. At the same time coefficient β, which indicates interest spreads, is even more negative compared to the results of preliminary regression. It confirms that the drivers of FX changes are not interest rate spreads. However, in contrast to the preliminary regression analysis most coefficients are statistically significantly different from 0, which indicates that there is relation between FX return and above described variables. The coefficients indicating joining the European Union and financial downturn are statistically significant for Czech Republic and Poland, but not statistically different from 0 for Hungary. At the same time coefficient γ describing the fact of joining the European Union in 2004 is negative for all sample countries, which means that this event affects FX return rather positively, as it contributed to the removal of remaining exchange rate restrictions and minimisation of investment risks, which in turn led to the substantial capital inflows to the CEE countries.

Coefficient δ is, on the contrary, positive. It means that FX return is negatively affected by the financial downturn 2008-2009, which is also quite logical, as financial crisis makes the investments to the particular country much more risky and capital inflows to this country decrease significantly, which lead to the depreciation of the local currency.

Thus, despite the fact that the influence of structural breaks is not confirmed for Hungary, the evidence for the impact of structural transformation on the UIP condition was found for Czech Republic and Poland.

In case of Hungary the reason why structural breaks are not statistically significant could be the fact that Hungary was always driven more by the local factors and less by the external factors.

4.2. Risk aversion

Another possible explanation for the failure of the UIP condition in the CEE countries can be the fact that the risk premium is not constant (Filipozzi, Staehr, 2011, 18).

As it was discussed in the previous chapter, Central and Eastern Europe went through the significant transformation period over the past two decades, and its countries

are characterised by volatile economic condition, incomplete institutional reforms and weaker macroeconomic fundamentals. All this factors generally lead to the appearance of default risk premium. Thus, it is quite expected that the CEE countries offer an additional premium to investors for default risk beside exchange rate risk, which leads to the deviations from the UIP condition.

In order to test whether the risk aversion of investors really influences the failure of the UIP condition in the CEE countries, VIX index is used as a proxy of the risk premium. VIX index is the Chicago Board Options Exchange Market Volatility Index which captures expectations for S&P 500 stock market volatility (Hoffman 2012, 1483). The index is considered one of the main indicators of risk aversion in global financial markets and thus seems to be appropriate for the CEE countries as well.

After adding VIX index as an additional explanatory factor the following expression was obtained:

$$FXRT = \alpha + \beta\_INSP + \gamma\_VIX + u\_i \tag{9}$$

where *FXRT* is FX return calculated as the annualised 3-month depreciation of the local currency against the euro (%), *INSP* is annualised spread between 3-month interbank offered rate on local currency and 3-month Euribor rate (in %-points) and VIX is volatility index (in %-points).

The results are reported below in the Table 10.

Table 10. UIP estimation results, including VIX

Country	Coefficient α	Coefficient β	Coefficient γ	F-stat	R-squared
Czech Republic	−0.019***	−0.846	0.001***	0.021	0.041
	(0.006)	(0.757)	(0.000)		
Hungary	0.006	−1.291**	0.001**	0.015	0.045
	(0.010)	(0.518)	(0.000)		
Poland	−0.024**	−0.807**	0.002***	0.003	0.063
	(0.012)	(0.409)	(0.001)		

Source: Appendix 1, author´s calculations

R-squared of the estimations continues to stay low, however it has increased compared to the results of the preliminary regression analysis performed for the 3-month horizon. Thus, as in case of structural breaks, VIX index has low ability to explain FX returns as well. At the same time the coefficient of VIX is positive and statistically significant for all sample countries. According to these results risk aversion reflected in the VIX index has real influence on the UIP failure in the CEE countries. When the level of risk aversion is high, the FX return is negatively affected.

4.3. The importance of interest rates

One more criteria, which could impact the UIP validity is how high are the interest rates. Normally UIP assumes that high interest rates should have depreciating currencies. As per Lothian and Wu (2011) uncovered interest rate parity should hold better during periods of large interest rate differentials.

In order to test the importance of interest rates, as well as in case of the testing of structural breaks, dummy variables were used. High interest rates got value 1 and low interest rates – 0. In order to drive the line between high and low interest rates author decided to take the average for the period 1999-2014. All interest rates that are above the average are considered to be high and on the contrary all interest rates below the average are classified as low interest rates.

For the analysis of the importance of interest rates the following regression model was prepared by the author of the present master´s thesis:

$$FXRT = \alpha + \beta\_INSP + \gamma\_INIP + u\_\text{i} \quad (10)$$

where *FXRT* is FX return calculated as the annualised 3-month depreciation of the local currency against the euro (%), *INSP* is annualised spread between 3-month interbank offered rate on local currency and 3-month Euribor rate (in %-points) and *INIP* indicates whether it is a high or low interest rates.

The results of regression are presented below in the Table 11.

Table 11. UIP estimation results, including coefficient of the interest rates importance

Country	Coefficient α	Coefficient β	Coefficient γ	F-stat	R-squared
Czech Republic	−0.002	−0.107	−0.005	0.509	0.007
	(0.003)	(0.799)	(0.005)		
Hungary	0.022**	−1.368**	0.006	0.099	0.025
	(0.009)	(0.690)	(0.009)		
Poland	0.015**	−1.915**	0.036*	0.097	0.025
	(0.008)	(0.897)	(0.021)		

Source: Appendix 1, author´s calculations

R-squared of the estimations remains low, but higher compared to the preliminary regression, which refers to the low explanatory power of the coefficient γ, which indicates the importance of interest rates.

Coefficient γ is statistically significantly different from 0 only for one country, which is Poland. Coefficient γ is positive for Poland, what means that high interest rates lead to the depreciation of currency, as UIP assumes. However, as the influence of the value of interest rates was not confirmed for the other sample countries, it is not possible to say that it may really influence the validity of the UIP hypothesis in the CEE countries. Although, it can be applicable for Poland. The reason for that could be the fact that there were very high interest rate differentials in Poland during the testing period, especially prior to the convergence with the European Union.

5. TESTING THE UIP BY USING FACTOR ANALYSIS

While previous section of present master´s thesis analyses UIP affecting factors by using simple linear regression models, in current section author uses another approach for testing, which factors are important for the failure of the UIP condition in the CEE countries. This approach is known as Factor Analysis.

In this section author shortly introduces the main goal and most important features of Factor Analysis, describes the results obtained from this analysis for the UIP condition in Czech Republic, Hungary and Poland and compares them to the results obtained from linear regression models described in the 4th section of the present master´s thesis.

5.1. Introduction to the concept of Factor Analysis

Factor analysis is a collection of methods for explaining the correlations among variables in terms of more fundamental entities called factors (Cudeck 2000, 265).

The main goal of factor analysis is to reduce "the dimensionality of the original space and to give an interpretation to the new space, spanned by a reduced number of new dimensions which are supposed to underline the old ones" (Rietveld, Van Hout 1993, 254). Otherwise factor analysis helps to explain the variance in the observed variables in terms of underlying latent factors.

Thus, the main advantages of factor analysis are, firstly, the opportunity to obtain a clear view of the data, and secondly, the possibility of using the output in subsequent analyses (Ibid.).

The basis for factor analysis is a correlation matrix, which represents the intercorrelations between the observable variables. Highly correlated variables normally measure one underlying variable – factor. Thus, the scores of original variables are projected on the factor, which lead to the two results: factor scores and factor loadings, where the first

ones are the scores of a subject on a factor, while the second ones are the correlation of the original variable with a factor (Rietveld, Van Hout 1993, 292). Usually the factor scores are used as a new scores in multiple regression analysis and the factor loadings help to determine the substantive importance of a particular variable to a factor by squaring this factor loading (Field 2000, 425).

Factor analysis can give multiple solutions depending on the method and the estimates of communality.

The next section of the present master´s thesis describes testing of the UIP in the CEE countries using maximum likelihood method and principal factors method.

5.2. Implementation of Factor Analysis for testing of the UIP in the CEE countries

Factor analysis for UIP condition in Czech Republic, Hungary and Poland was carried out in EViews statistical package. The same data as for the linear regression analysis described in section 3 and 4 was used for the factor analysis: 3 months interest rate spreads and exchange rate returns between 1999 and 2014.

5.2.1. Maximum likelihood method

As a first step there was computed a Correlation matrix using maximum likelihood method. The number of factors was selected using Velicer´s minimum average partial (MAP) method. According to Zwick and Velicer (1986) it is considered to be more accurate than more commonly used Kaiser-Guttman method. Starting values for the communalities were taken from the squared multiple correlations (SMCs). The results of the estimated model are performed below in the Table 12.

Table 12. FX return and interest rate spread correlation matrix using Maximum Likelihood method

	Unrotated Loadings			
	F1	F2	Communality	Uniqueness
FXRT_CZK	-0.110248	0.684532	0.480739	0.519261
FXRT_HUF	-0.165885	0.732802	0.564517	0.435483
FXRT_PLN	-0.161018	0.838950	0.729765	0.270235
INSP_CZK	0.927278	0.107743	0.871452	0.128548
INSP_HUF	0.830293	0.043469	0.691277	0.308723
INSP_PLN	0.694056	0.022570	0.482223	0.517777

Factor	Variance	Cumulative	Difference	Proportion	Cumulative
F1	2.096544	2.096544	0.373115	0.548837	0.548837
F2	1.723429	3.819973	---	0.451163	1.000000
Total	3.819973	5.916517		1.000000	

	Model	Independence	Saturated
Discrepancy	0.032096	2.546830	0.000000
Chi-square statistic	5.937689	471.1636	---
Chi-square prob.	0.2039	0.0000	---
Bartlett chi-square	5.803957	463.9475	---
Bartlett probability	0.2143	0.0000	---
Parameters	17	6	21
Degrees-of-freedom	4	15	---

Source: Appendix 1, author´s calculations

While analysing the results of the correlation matrix performed in the Table 12, as a first thing it is possible to see that Velicer´s MAP method has retained two factors „F1" and „F2". A brief examination of the unrotated loadings indicates that interest rate spreads load on the first factor, while exchange rate returns load on the second factor. Thus, it is fair to say that the first factor is an indicator of commonality between interest rates spread changes, while the second factor indicates the changes in exchange rate returns.

According to these results quite interesting relations were revealed, which was not possible to see during the linear regression analysis. Namely, during the whole testing of the UIP condition it was supposed that there is a relation between interest rate spreads and exchange rate returns in the CEE countries, as the UIP theory assumes. Above described factor analysis shows that there is actually quite strong relation between exchange rate returns themselves. This means that exchange rates in Czech Republic, Hungary and Poland depend not only on some other factors, but actually there is a another „unknown" factor which impacts the three FX rates in the same way. Thus, it is possible to say that exchange rate in Czech Republic is influenced by the exchange rate in Hungary and Poland

and changes in the exchange rate of one country will probably reflect in the exchange rate of another country.

In addition, from the second section of the Table 12 it is noted that the variance accounted for by the two factors is 3.82, which is close to 64% (3.82/6) of the total variance. Furthermore, it is seen that the first factor F1 accounts for 55% (2.1/3.82) of the common variance and the second factor F2 accounts for the remaining 45% (1.72/3.82).

The last important thing, which has to be pointed out, is Chi-square and Barlett probabilities. In present case they both are around 0.21, which is much below 0.75. This indicates that two factors explain only some part of the variation in the data, but their explanatory power is quite low. At the same time, despite the fact that the total covariance explained is low, the main results stay: there is a common factor driving FX in different countries and interest rates spreads in different countries. There is no factor linking interest rates spreads and FX changes in each country.

5.2.2. Principal factors method

In order to ensure in correctness of the results obtained during the analysis described previously there was computed another correlation matrix. As estimation method author used principal factors method. Principal factors method based on the idea that the common factors should explain the common portion of the variance.

The number of factors was selected using Kaiser-Guttman method. Kaiser-Guttman rule is the most commonly used method, which is commonly termed „eigenvalues greater than 1“. In this approach, there are computed the eigenvalues of the unreduced dispersion matrix and in the end retained only these factors that exceed the average. For a correlation matrix the average eigenvalue is 1. However, this criterion has been sharply criticized, it remains popular.

Below is presented eigenvalues of the matrices in graphical form. All factors that are below 1 have no explanatory power. Thus, as the Figure 7 depicts, only 2 factors can really explain the variety of matrices.

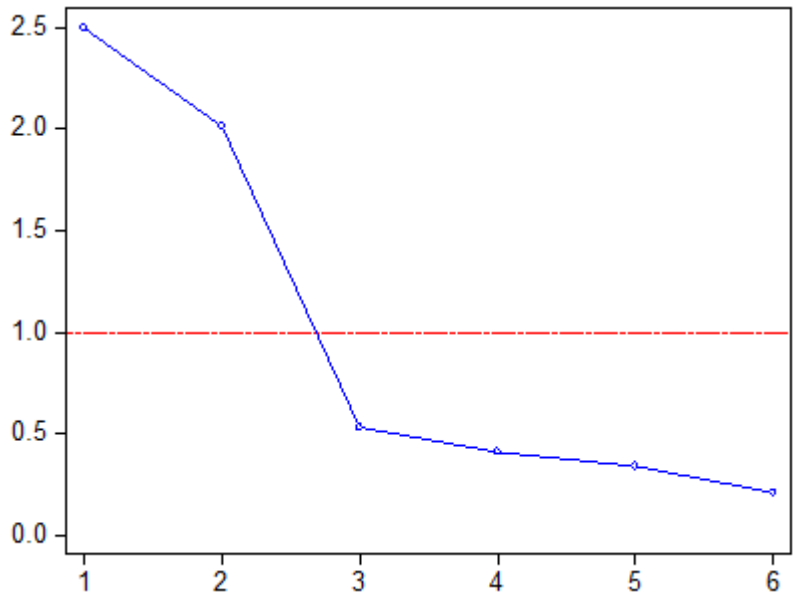

Figure 7. Eigenvalues for a variety of matrices in graphical form

Source: Appendix 1, author´s calculations

The results of the estimated model are performed below in the Table 13.

Table 13. FX return and interest rate spread correlation matrix using Principal Factors method

	Unrotated Loadings			
	F1	F2	Communality	Uniqueness
FXRT_CZK	-0.240577	0.484171	0.292299	0.707701
FXRT_HUF	-0.287603	0.496773	0.329499	0.670501
FXRT_PLN	-0.292534	0.540371	0.377577	0.622423
INSP_CZK	0.539649	0.322041	0.394931	0.605069
INSP_HUF	0.528950	0.272966	0.354298	0.645702
INSP_PLN	0.450358	0.220395	0.251396	0.748604

Factor	Variance	Cumulative	Difference	Proportion	Cumulative
F1	1.000000	1.000000	1.11E-16	0.500000	0.500000
F2	1.000000	2.000000	---	0.500000	1.000000
Total	2.000000	3.000000		1.000000	

	Model	Independence	Saturated
Discrepancy	0.600790	2.443625	0.000000
Parameters	17	6	21
Degrees-of-freedom	4	15	---

Source: Appendix 1, author´s calculations

The results described in the Table 13 are not much different form the results obtained during the analysis using maximum likelihood method.

As in case of previous testing two factors „F1“ and „F2“ are retained by the principal factors method, where interest rate spreads load on the first factor, while exchange rate returns load on the second factor. Thus, the first factor indicates changes in interest rates, while the second factor is an indicator of the changes in exchange rates.

Thereby, principal factors method gave the same results as minimum likelihood method and the same conclusion can be made - besides another factors there is a common factor driving FX in different countries. The same can be said about interest rates.

5.2.3. The interpretation of the retained factors

During the above described analysis using both maximum likelihood and principal factors methods only two factors, which can really explain the variety of matrices, were retained. The main problem is that these factors do not have any economic significance, as they are not identified.

Thus, the next step of the analysis is identification of these factors.

Below presented Figure 8 shows the correlation between the two factors F1 and F2. As it is seen from the graph there is no correlation between the two above described factors. On the contrary, both factors are moving in the opposite directions. For example, while F2 significantly increased after 2008, F1 in turn started to drop. Thus, it is fair to assume that there is different economic reasons behind these two factors. Therefore, UIP does not hold, as both interest rates, which load on the first factor, and exchange rates loading on the second factor are driven by different economic reasons.

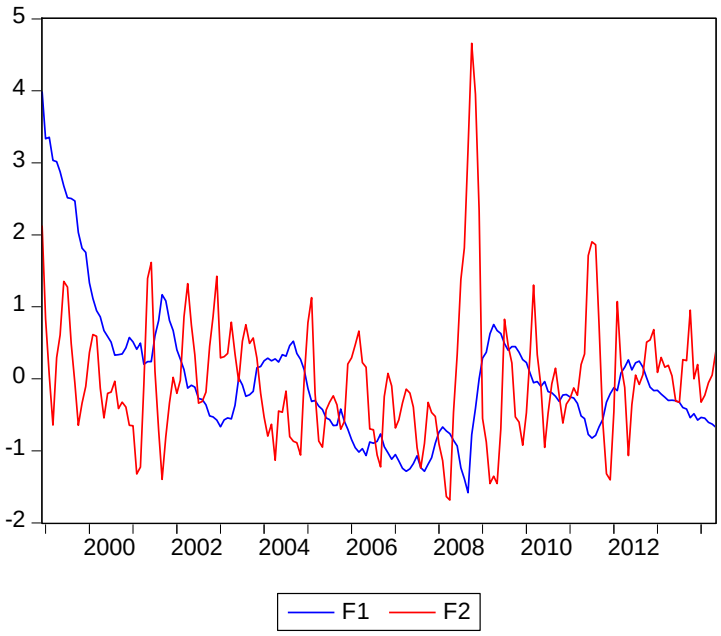

Figure 8. Correlation between F1 and F2 during 1999-2014
Source: Appendix 1, author´s calculations

In order to find out what economic reasons could drive F1 and F2 and consequently what could be interest rates as well as exchange rates influenced by, there was added VIX index, which is used as indicator of risk aversion in global financial markets, to the correlation matrix.

Table 14. Correlation matrix including F1, F2 and VIX

	F1	F2	VIX
F1	1.000	0.029	0.131
F2	0.029	1.000	0.311
VIX	0.131	0.311	1.000

Source: Appendix 1, author´s calculations

As it is seen from the above presented matrix, there is no correlation between F1 and F2, but VIX is correlated with both factors, whereas there is stronger correlation between VIX and the second factor F2, which, as it was previously discovered, drives the exchange rates.

Development of the both factors F1 and F2 as well as VIX over the time is presented on the Figure 9 below.

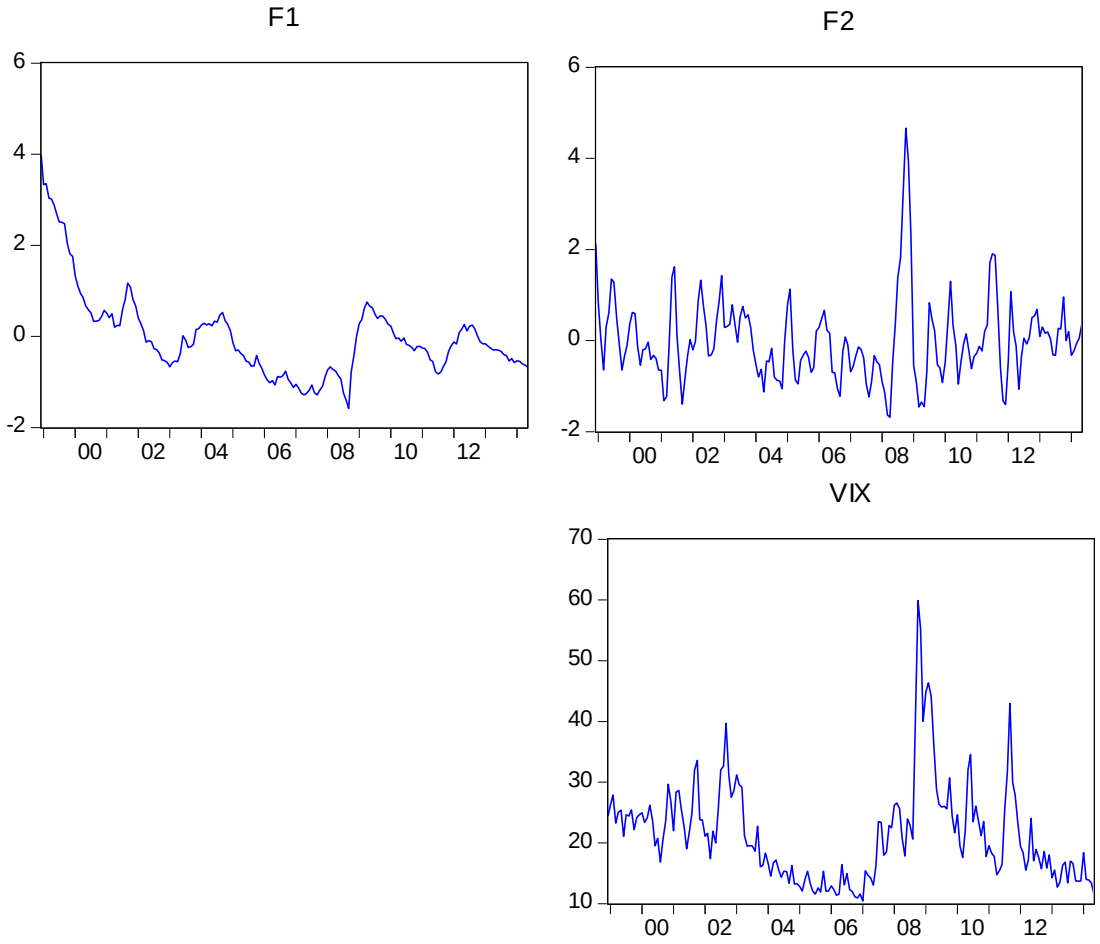

Figure 9. F1, F2 and VIX development during 1999-2014

Source: Appendix 1, author´s calculations

As the Figure 9 depicts, there is quite strong correlation between VIX and both factors (F1 and F2). For example, prior to 2004, when Czech Republic, Hungary and Poland joined the European Union, both F1 and VIX decreased. As F1 is the one which drives the interest rates and after 2004 became more stable, it is possible to assume that the convergence with the European Union can be an important driver behind this factor.

At the same time all 3 above described variables moved up after 2008, when Europe faced the global financial crisis.

Thus, it is fair to say that VIX impacts both F1 and F2, whereas F2, which drives the exchange rates, is impacted more than F1 (Table 14).

As a result of factor analysis performed, several important conclusions were reached by the author of present master´s thesis. Firstly, according to the UIP theory there is a relation between FX returns and interest rate spreads: when the last ones are high, currencies should depreciate. During the factor analysis it was revealed that actually FX returns in the three abovementioned countries are strongly correlated with each other as well as interest rate spreads are correlated with each other. Thus, FX return in each country is not impacted by interest rates differentials in the specific country, but rather by an „unknown“ factor, which does not depend on local interest rates and which is common with the other exchange rates changes in the region.

Another important breakthrough of the present paper is the fact that risk aversion of investors impacts FX return as well as interest rate spreads, whereas FX returns are impacted by VIX more than interest rates. Thus, one more reason for violation from the UIP condition can be the fact that the exchange rates are affected by the risk more than interest rates.

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CONCLUSION

The purpose of present master´s thesis was to determine, whether uncovered interest parity holds for the CEE countries and which are potential factors that may affect the rejection of the UIP hypothesis for the CEE.

The first section of present paper focused on the theory of uncovered interest parity and is mostly dedicated to the exploration of previously done research works. The hypothesis of uncovered interest parity rests on the arbitrage assumption and generally means that no excess return can be gained from the investing in foreign currency, as the nominal interest rate differential between two countries are equal to expected change in the exchange rate. Thus, the validity of the UIP condition indicates that capital markets are efficient. In addition to the existence of arbitrage, there are three implicit assumptions done when testing UIP, which are free capital mobility, rational (unbiased) expectation and risk neutrality. The failure of these assumptions may contribute to the failure of UIP test. In addition to aforementioned reasons, there are also other factors, which contribute to the unfavorable empirical evidence for the UIP condition. These are, first of all, the existence of additional premium for default risk, intensive policy actions of central bank and relatively frequent structural breaks, which are mostly characteristics of developing economies. Comparing results of research works performed for developed and emerging economies the UIP theorem is much more often confirmed at the level of developed countries and for the long horizon and much less for the short horizon.

In the second section author gave an overview of the sample countries, which were Czech Republic, Hungary and Poland. All of them were going through the economic transformation differently, but compared to Czech Republic and Poland Hungary´s financial sector has been weaker and it was more impacted by the financial crisis started in 2008 than other abovementioned countries. At the same time, Poland has much lower labor

costs and has grown more rapidly attracting significant part of all FDI inflows to the Central and Eastern Europe.

The third section contained empirical part of the work. UIP was tested for Czech Republic, Hungary and Poland. 3-month interest rate and exchange rate data between 1999 and 2014 was used for the analysis. As a method for the testing of the validity of the UIP condition in these countries linear regression analysis was used. As a result of the analysis performed UIP was rejected for the 3-month horizon in all cases. Moreover, it was revealed that there was a possibility for the lucrative carry trade in Hungary during the testing period.

As many research works state that the UIP may hold better at longer investment horizons, it was decided to control, whether the UIP holds in the CEE for the 12-month horizon. During the analysis performed for the 12-month horizon data it was revealed that as in case of 3-month horizon UIP was rejected for Czech Republic and Hungary, but it was confirmed for Poland. One possible explanation for that could be the fact that there were very high interest rate differentials in Poland during the testing period, especially prior to the convergence with the European Union.

The fourth section of the present master´s thesis examined, which are the possible explanations for the low explanatory power of the UIP estimations in the CEE countries for the 3-month horizon. As Central and Eastern Europe went through the long and significant transformation period author put forward the hypothesis that structural breaks and risk premium could be the most important factors, which may affect the validity of the UIP condition in the CEE countries.

In order to test whether the structural breaks impact the UIP in the sample countries author decided to introduce two different dummy variables. The first one highlighted joining the EU and the second one clash with the financial crisis started in 2008. As a result, the influence of structural breaks was confirmed for Czech Republic and Poland, but rejected for Hungary, as Hungary was always driven more by the local factors and less by the external factors.

In order to test whether the risk aversion of investors really influences the failure of the UIP condition in the CEE countries, VIX index was used as a proxy of the risk premium. According to the results of analysis performed risk aversion reflected in the VIX

index has real influence on the UIP failure in the CEE countries. When the level of risk aversion is high, the FX return is negatively affected.

One more criteria, which could affect the UIP validity is how high are the interest rates. For the testing of the importance of interest rates, as well as in case of the testing of structural breaks, dummy variables were used. High interest rates got value 1 and low interest rates – 0. As a result, the influence of the value of interest rates was confirmed only for Poland, as there were very high interest rate differentials during the testing period.

And the last section of the present master´s thesis examined the UIP through the factor analysis, which was not previously used for the testing of the UIP condition. During the factor analysis it was revealed that actually FX returns in the three sample countries are strongly correlated with each other as well as interest rate spreads are correlated with each other. Thus, FX return in each country is not impacted by interest rates differentials in the specific country, but rather by an „unknown" factor, which does not depend on local interest rates, but which is common with the other exchange rates changes in the region. One more important finding of the factor analysis was the fact that risk aversion of investors impacts FX return as well as interest rate spreads, whereas FX returns are impacted by VIX more than interest rates. Thus, one more reason for violation from the UIP condition can be the fact that the exchange rates are affected by the risk more than interest rates.

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SUMMARY

UNCOVERED INTEREST PARITY IN CENTRAL AND EASTERN EUROPE COUNTRIES

Tatjana Starkova

The presented research work is dedicated to a theme of uncovered interest parity in Central and Eastern Europe countries. The problem of this research work is actual, as UIP is one of three key international financial relations that are used repeatedly in macroeconomic analysis and international finance. And, however, support for UIP has been growing, it has been conclusively rejected at the empirical level (Olmo, Pilbeam 2009, 370). In addition, the actuality of the present master´s thesis is based on the fact, that, however, UIP hypothesis is widely discussed and much tested topic in macroeconomic world, there is lack of research of UIP for the CEE countries. The fact, that the CEE countries experienced significant economic tarnsformation over the past two decades, makes the topic even more attractive for the research.

The purpose of this paper is consisted in determining, whether UIP holds for the CEE countries and which are potential factors that may affect the rejection of the UIP hypothesis for the CEE. To achieve the goal author was posed some problems:

- To examine the theory of UIP
- To explore empirical researches performed by other authors
- To test the UIP for the CEE countries by using econometric models based on monthly interest rate and exchange rate data between 1999 and 2014
- To investigate, which factors influence UIP in the CEE countries

- To apply a new approach for the testing of the UIP condition by using factor analysis

As a hypothesis author puts forward that UIP does not hold for the CEE countries mainly due to the inconstant risk premium and frequent structural breaks. As a result, the hypothesis was accepted, but in addition, there were another interesting relations revealed during the factor analysis.

Author has discovered that UIP was rejected for the 3-month horizon in all cases. Moreover, it was revealed that there was a possibility for the lucrative carry trade in Hungary during the testing period. At the same time UIP was confirmed for the 12-month horizon in Poland.

During the regression analysis, the influence of structural breaks was confirmed for Czech Republic and Poland, but rejected for Hungary, as Hungary was always driven more by the local factors and less by the external factors.

In order to test whether the risk aversion of investors influences the failure of the UIP condition in the CEE countries, VIX index was used as a proxy of the risk premium. According to the results of analysis performed risk aversion reflected in the VIX index has real influence on the UIP failure in the CEE countries. When the level of risk aversion is high, the FX return is negatively affected.

In addition to the results of the regression analysis there were some interesting relations discovered during the factor analysis. Firstly, it was revealed that actually FX returns in the three sample countries are strongly correlated with each other as well as interest rate spreads are correlated with each other. Thus, FX return in each country is not impacted by interest rates differentials in the specific country, but rather by an „unknown“ factor, which does not depend on local interest rates, but which is common with the other exchange rates changes in the region. One more important finding of the factor analysis was the fact that risk aversion of investors impacts FX return as well as interest rate spreads, whereas FX returns are impacted by VIX more than interest rates. Thus, one more reason for violation from the UIP condition can be the fact that the exchange rates are affected by the risk more than interest rates.

APPENDICES

Appendix 1. 3-month interest rate spreads and exchange rate returns between 1999 and 2014 for Czech Republic, Hungary and Poland

Date	Czech Republic		Hungary		Poland		VIX
	FX return	Interest spread	FX return	Interest spread	FX return	Interest spread	
12/31/1998	9.63%	1.57%	0.93%	3.33%	6.35%	3.00%	24.42
1/29/1999	2.13%	1.26%	0.29%	3.24%	0.48%	2.48%	26.25
2/26/1999	-0.42%	1.25%	-1.63%	3.15%	-4.49%	2.46%	27.88
3/31/1999	-5.52%	1.06%	-2.10%	3.22%	-6.63%	2.51%	23.26
4/30/1999	-2.65%	1.10%	1.56%	3.16%	-1.65%	2.63%	25.07
5/31/1999	-2.46%	1.05%	1.80%	3.16%	1.63%	2.65%	25.39
6/30/1999	-1.64%	1.01%	3.67%	3.08%	7.84%	2.64%	21.09
7/30/1999	0.04%	0.94%	1.17%	3.01%	7.86%	2.67%	24.64
8/31/1999	-1.49%	0.90%	0.19%	3.00%	1.56%	2.69%	24.45
9/30/1999	0.74%	0.85%	-1.74%	2.90%	-4.43%	3.14%	25.41
10/29/1999	-2.09%	0.63%	-0.49%	2.84%	-8.20%	3.27%	22.20
11/30/1999	-1.41%	0.54%	0.91%	2.78%	-5.96%	3.55%	24.18
12/31/1999	0.30%	0.54%	1.61%	2.67%	-5.30%	3.63%	24.64
1/31/2000	1.25%	0.48%	1.30%	2.13%	-0.25%	3.36%	24.95
2/29/2000	1.76%	0.43%	0.99%	1.85%	2.59%	3.61%	23.37
3/31/2000	-1.52%	0.37%	0.72%	1.77%	5.42%	3.55%	24.11
4/28/2000	-2.58%	0.31%	0.72%	1.71%	-1.13%	3.53%	26.20
5/31/2000	-2.61%	0.22%	0.83%	1.65%	-5.09%	3.43%	23.65
6/30/2000	0.13%	0.20%	1.42%	1.63%	-3.88%	3.45%	19.54
7/31/2000	-1.55%	0.18%	1.05%	1.56%	-1.99%	3.42%	20.74
8/31/2000	-1.86%	0.11%	1.38%	1.47%	-0.03%	3.63%	16.84
9/29/2000	-1.62%	0.09%	0.51%	1.51%	-3.54%	3.59%	20.57
10/31/2000	-0.52%	0.06%	0.72%	1.72%	-3.55%	3.61%	23.63
11/30/2000	0.19%	0.09%	0.44%	1.74%	-4.78%	3.63%	29.65
12/29/2000	-1.11%	0.14%	0.61%	1.78%	-6.86%	3.57%	26.85
1/31/2001	-0.38%	0.14%	0.79%	1.64%	-7.57%	3.51%	22.02

2/28/2001	-1.64%	0.08%	-4.64%	1.59%	-9.53%	3.33%	28.35
3/30/2001	-2.29%	0.11%	-8.65%	1.70%	-5.37%	3.16%	28.64
4/30/2001	-1.66%	0.05%	-7.57%	1.62%	5.92%	3.04%	25.48
5/31/2001	0.64%	0.13%	-0.32%	1.65%	14.33%	3.11%	22.64
6/29/2001	0.20%	0.16%	5.33%	1.63%	12.93%	2.87%	19.06
7/31/2001	-1.12%	0.26%	3.28%	1.64%	-1.21%	2.71%	21.62
8/31/2001	-3.58%	0.31%	-0.58%	1.69%	-5.59%	2.68%	24.92
9/28/2001	-6.56%	0.42%	-4.68%	1.81%	-8.24%	2.67%	31.93
10/31/2001	-5.43%	0.42%	-5.04%	1.79%	-2.56%	2.52%	33.56
11/30/2001	-4.61%	0.35%	-2.75%	1.71%	0.65%	2.21%	23.84
12/31/2001	-2.55%	0.33%	-0.45%	1.59%	1.37%	2.09%	23.80
1/31/2002	-3.97%	0.26%	0.01%	1.36%	0.25%	1.76%	21.09
2/28/2002	-3.73%	0.23%	-0.45%	1.27%	2.50%	1.66%	21.59
3/29/2002	-4.82%	0.21%	0.39%	1.24%	12.30%	1.67%	17.40
4/30/2002	-0.61%	0.11%	0.89%	1.27%	14.05%	1.63%	21.91
5/31/2002	-0.01%	0.08%	0.33%	1.43%	7.95%	1.48%	19.98
6/28/2002	3.08%	0.05%	-0.62%	1.45%	1.93%	1.34%	25.40
7/31/2002	1.44%	-0.07%	-1.24%	1.57%	-2.93%	1.29%	32.03
8/30/2002	1.39%	-0.08%	-2.62%	1.61%	-1.60%	1.22%	32.64
9/30/2002	4.02%	-0.10%	-3.11%	1.60%	-1.81%	1.08%	39.69
10/31/2002	2.38%	-0.13%	1.16%	1.61%	3.38%	0.92%	31.14
11/29/2002	3.22%	-0.07%	2.30%	1.35%	6.11%	0.90%	27.50
12/31/2002	1.62%	-0.07%	5.24%	1.38%	11.26%	0.97%	28.62
1/31/2003	-0.03%	-0.06%	0.90%	0.81%	3.69%	0.90%	31.17
2/28/2003	-1.42%	-0.04%	2.41%	0.95%	3.75%	0.91%	29.63
3/31/2003	-1.38%	-0.03%	7.48%	1.01%	0.52%	0.85%	29.15
4/30/2003	2.72%	-0.01%	7.20%	0.99%	2.06%	0.77%	21.21
5/30/2003	3.50%	0.04%	3.32%	1.06%	-0.75%	0.76%	19.47
6/30/2003	0.91%	0.03%	-4.51%	1.97%	2.38%	0.77%	19.52
7/31/2003	-0.97%	0.03%	-1.39%	1.88%	7.63%	0.76%	19.49
8/29/2003	-1.39%	-0.02%	2.09%	1.84%	8.20%	0.73%	18.63
9/30/2003	1.55%	-0.02%	3.40%	1.81%	2.26%	0.76%	22.72
10/31/2003	4.10%	-0.03%	1.11%	1.96%	2.67%	0.87%	16.10
11/28/2003	1.75%	-0.02%	-2.40%	2.65%	3.66%	0.88%	16.32
12/31/2003	1.35%	-0.01%	-5.52%	2.52%	0.95%	0.84%	18.31
1/30/2004	-2.38%	-0.01%	-4.76%	2.65%	-0.22%	0.82%	16.63
2/27/2004	-2.77%	0.00%	-1.96%	2.63%	-4.79%	0.84%	14.55
3/31/2004	-2.77%	0.02%	1.01%	2.47%	-5.18%	0.86%	16.74
4/30/2004	-2.70%	0.01%	-1.00%	2.44%	-9.04%	0.92%	17.19
5/31/2004	0.55%	0.04%	-1.12%	2.32%	-4.33%	0.95%	15.50
6/30/2004	-1.13%	0.08%	-1.76%	2.35%	-2.96%	0.96%	14.34
7/30/2004	-0.53%	0.09%	-1.03%	2.29%	-0.83%	1.05%	15.32
8/31/2004	-2.64%	0.13%	-1.27%	2.24%	-5.97%	1.20%	15.29
9/30/2004	-3.68%	0.17%	-0.52%	2.17%	-6.55%	1.17%	13.34

10/29/2004	-4.43%	0.11%	-0.09%	2.07%	-6.14%	1.15%	16.27
11/30/2004	-4.25%	0.10%	-1.49%	1.88%	-6.98%	1.12%	13.24
12/31/2004	-1.15%	0.10%	0.88%	1.79%	0.36%	1.10%	13.29
1/31/2005	1.46%	0.04%	2.86%	1.67%	5.48%	1.09%	12.82
2/28/2005	2.25%	0.02%	5.16%	1.44%	7.18%	1.02%	12.08
3/31/2005	0.16%	-0.02%	-0.19%	1.38%	-1.35%	0.92%	14.02
4/29/2005	-1.20%	-0.08%	-3.00%	1.36%	-5.05%	0.84%	15.31
5/31/2005	-3.20%	-0.09%	-3.91%	1.29%	-3.71%	0.80%	13.29
6/30/2005	-1.62%	-0.09%	1.12%	1.18%	-2.91%	0.67%	12.04
7/29/2005	-1.76%	-0.08%	2.36%	1.11%	-2.56%	0.61%	11.57
8/31/2005	-1.53%	-0.09%	3.64%	0.99%	-2.57%	0.59%	12.6
9/30/2005	-1.75%	-0.09%	1.19%	0.97%	-2.01%	0.56%	11.92
10/31/2005	-4.31%	-0.01%	0.54%	1.01%	-3.58%	0.57%	15.32
11/30/2005	-2.09%	-0.07%	-0.07%	0.95%	-3.39%	0.52%	12.06
12/30/2005	-2.14%	-0.08%	4.49%	0.95%	1.98%	0.50%	12.07
1/31/2006	0.42%	-0.13%	4.46%	0.90%	1.17%	0.44%	12.95
2/28/2006	-0.19%	-0.16%	3.82%	0.86%	4.23%	0.35%	12.34
3/31/2006	0.14%	-0.18%	7.23%	0.88%	3.70%	0.32%	11.39
4/28/2006	0.02%	-0.17%	3.32%	0.83%	1.86%	0.30%	11.59
5/31/2006	-0.12%	-0.21%	5.25%	0.80%	0.11%	0.29%	16.44
6/30/2006	-0.79%	-0.20%	-3.62%	0.98%	-2.36%	0.27%	13.08
7/31/2006	-1.24%	-0.20%	-4.12%	0.95%	-1.74%	0.23%	14.95
8/31/2006	-1.14%	-0.23%	-7.25%	1.09%	-3.28%	0.21%	12.31
9/29/2006	-2.70%	-0.20%	-7.86%	1.15%	-3.56%	0.18%	11.98
10/31/2006	-0.12%	-0.22%	-2.20%	1.09%	1.00%	0.14%	11.10
11/30/2006	1.11%	-0.25%	-0.66%	1.13%	2.49%	0.12%	10.91
12/29/2006	1.77%	-0.29%	-1.26%	1.08%	0.80%	0.10%	11.56
1/31/2007	0.31%	-0.29%	-2.88%	1.10%	-3.18%	0.08%	10.42
2/28/2007	0.19%	-0.32%	-1.86%	1.08%	-2.45%	0.07%	15.42
3/30/2007	2.58%	-0.34%	-0.52%	0.99%	-2.60%	0.05%	14.64
4/30/2007	-0.42%	-0.34%	1.95%	0.95%	0.07%	0.07%	14.22
5/31/2007	-2.08%	-0.32%	2.40%	0.92%	0.35%	0.06%	13.05
6/29/2007	-4.09%	-0.29%	1.64%	0.87%	0.25%	0.11%	16.23
7/31/2007	-3.99%	-0.26%	-0.79%	0.83%	-4.25%	0.12%	23.52
8/31/2007	-5.26%	-0.33%	-1.13%	0.75%	-5.65%	0.05%	23.38
9/28/2007	-3.67%	-0.32%	0.75%	0.66%	-4.61%	0.05%	18.00
10/31/2007	-3.45%	-0.26%	2.97%	0.70%	-0.59%	0.13%	18.53
11/30/2007	-4.30%	-0.22%	4.39%	0.67%	-2.60%	0.16%	22.87
12/31/2007	-4.93%	-0.14%	3.08%	0.70%	-2.21%	0.22%	22.50
1/31/2008	-2.99%	-0.11%	-2.24%	0.78%	-4.23%	0.29%	26.20
2/29/2008	-0.31%	-0.11%	-9.02%	0.85%	-4.00%	0.36%	26.54
3/31/2008	-5.36%	-0.16%	-9.69%	0.88%	-4.69%	0.33%	25.61
4/30/2008	-5.09%	-0.18%	-7.21%	0.89%	-7.08%	0.35%	20.79
5/30/2008	-0.95%	-0.18%	-1.53%	0.96%	-1.34%	0.38%	17.83

6/30/2008	2.58%	-0.18%	2.88%	0.97%	1.35%	0.40%	23.95
7/31/2008	0.29%	-0.25%	9.27%	0.89%	10.12%	0.37%	22.94
8/29/2008	2.32%	-0.30%	9.30%	0.90%	13.44%	0.36%	20.65
9/30/2008	9.59%	-0.32%	9.69%	0.86%	22.17%	0.31%	39.39
10/31/2008	16.19%	-0.06%	16.46%	1.78%	26.30%	0.50%	59.89
11/28/2008	10.80%	0.06%	15.65%	1.81%	22.90%	0.65%	55.28
12/31/2008	1.90%	0.18%	15.99%	1.78%	11.75%	0.72%	40.00
1/30/2009	-4.19%	0.16%	-3.05%	1.85%	-0.75%	0.67%	44.84
2/27/2009	-4.13%	0.17%	-5.08%	1.92%	-2.95%	0.65%	46.35
3/31/2009	-5.15%	0.23%	11.61%	2.07%	-4.05%	0.64%	44.14
4/30/2009	-4.46%	0.29%	-7.89%	2.08%	-6.42%	0.71%	36.50
5/29/2009	-5.51%	0.24%	-4.12%	2.10%	-9.12%	0.81%	28.92
6/30/2009	-2.68%	0.25%	-1.14%	2.14%	-5.44%	0.81%	26.35
7/31/2009	3.78%	0.30%	3.24%	1.90%	2.55%	0.79%	25.92
8/31/2009	2.67%	0.26%	0.66%	1.78%	1.54%	0.81%	26.01
9/30/2009	4.69%	0.29%	0.44%	1.67%	-2.52%	0.83%	25.61
10/30/2009	-1.07%	0.28%	-1.22%	1.54%	-4.75%	0.84%	30.69
11/30/2009	-0.85%	0.26%	-1.63%	1.43%	-5.24%	0.84%	24.51
12/31/2009	-3.92%	0.21%	-1.85%	1.37%	-5.85%	0.87%	21.68
1/29/2010	-2.34%	0.22%	-0.83%	1.33%	-3.02%	0.86%	24.62
2/26/2010	-1.57%	0.20%	1.99%	1.28%	3.38%	0.85%	19.50
3/31/2010	1.19%	0.20%	7.46%	1.21%	7.42%	0.84%	17.59
4/30/2010	-3.28%	0.18%	5.53%	1.14%	2.09%	0.77%	22.05
5/31/2010	-2.97%	0.13%	4.27%	1.13%	-1.75%	0.76%	32.07
6/30/2010	-4.30%	0.12%	-3.16%	1.13%	-4.41%	0.75%	34.54
7/30/2010	-0.65%	0.08%	-4.47%	1.11%	-1.03%	0.71%	23.50
8/31/2010	0.76%	0.09%	-2.05%	1.12%	0.47%	0.71%	26.05
9/30/2010	1.70%	0.08%	0.89%	1.12%	0.00%	0.71%	23.70
10/29/2010	-1.75%	0.04%	0.60%	1.08%	-0.92%	0.68%	21.20
11/30/2010	-2.39%	0.05%	-3.54%	1.14%	-1.66%	0.69%	23.54
12/31/2010	-1.93%	0.05%	-4.64%	1.21%	1.53%	0.71%	17.75
1/31/2011	-0.04%	0.03%	-3.16%	1.25%	-0.06%	0.73%	19.53
2/28/2011	0.82%	0.03%	-1.70%	1.25%	-0.18%	0.74%	18.35
3/31/2011	-0.76%	0.00%	0.14%	1.22%	-1.18%	0.71%	17.74
4/29/2011	-0.02%	-0.05%	2.04%	1.18%	1.72%	0.70%	14.75
5/31/2011	-1.76%	-0.06%	1.84%	1.17%	4.82%	0.73%	15.45
6/30/2011	1.38%	-0.09%	10.25%	1.14%	11.15%	0.76%	16.52
7/29/2011	2.92%	-0.10%	13.10%	1.12%	10.07%	0.75%	25.25
8/31/2011	5.04%	-0.09%	11.85%	1.14%	8.81%	0.77%	31.62
9/30/2011	3.65%	-0.09%	7.37%	1.14%	1.03%	0.78%	42.96
10/31/2011	1.78%	-0.11%	-3.27%	1.13%	-4.07%	0.80%	29.96
11/30/2011	-1.75%	-0.08%	-4.72%	1.38%	-8.29%	0.85%	27.80
12/30/2011	-3.06%	-0.05%	-6.52%	1.47%	-7.10%	0.88%	23.4
1/31/2012	-1.54%	0.01%	-2.82%	1.59%	-1.10%	0.94%	19.44

2/29/2012	3.31%	0.06%	4.03%	1.59%	6.31%	0.97%	18.43
3/30/2012	2.91%	0.12%	-2.88%	1.62%	1.77%	1.02%	15.50
4/30/2012	1.58%	0.14%	-1.76%	1.63%	-1.39%	1.04%	17.15
5/31/2012	-3.37%	0.14%	-5.53%	1.63%	-4.98%	1.09%	24.06
6/29/2012	-1.52%	0.11%	-0.22%	1.64%	-2.48%	1.09%	17.08
7/31/2012	-0.94%	0.16%	0.64%	1.70%	0.55%	1.16%	18.93
8/31/2012	1.59%	0.17%	-1.05%	1.66%	-1.63%	1.15%	17.47
9/28/2012	-0.15%	0.15%	2.10%	1.60%	-0.93%	1.15%	15.73
10/31/2012	2.32%	0.12%	3.14%	1.52%	1.39%	1.11%	18.60
11/30/2012	1.63%	0.08%	5.11%	1.45%	1.10%	1.05%	15.87
12/31/2012	2.56%	0.08%	4.41%	1.39%	2.44%	0.96%	18.02
1/31/2013	0.51%	0.07%	2.39%	1.32%	-0.78%	0.90%	14.28
2/28/2013	0.25%	0.07%	0.39%	1.25%	3.09%	0.86%	15.51
3/29/2013	1.04%	0.06%	-2.99%	1.17%	3.49%	0.77%	12.70
4/30/2013	0.52%	0.06%	-0.04%	1.10%	2.13%	0.69%	13.52
5/31/2013	0.07%	0.07%	1.42%	1.05%	-0.14%	0.61%	16.30
6/28/2013	-1.23%	0.06%	0.80%	1.00%	-2.37%	0.60%	16.86
7/31/2013	-0.55%	0.06%	-1.25%	0.93%	-1.57%	0.59%	13.45
8/30/2013	6.30%	0.06%	0.15%	0.88%	-1.56%	0.59%	17.01
9/30/2013	6.43%	0.06%	-0.11%	0.83%	-1.60%	0.59%	16.60
10/31/2013	6.75%	0.05%	5.68%	0.78%	1.60%	0.58%	13.75
11/29/2013	-0.15%	0.04%	2.74%	0.74%	-1.04%	0.58%	13.70
12/31/2013	0.41%	0.02%	3.41%	0.68%	0.27%	0.58%	13.72
1/31/2014	-0.28%	0.02%	-1.69%	0.63%	-1.13%	0.58%	18.41
2/28/2014	0.57%	0.02%	-2.23%	0.62%	-0.39%	0.58%	14.00
3/31/2014	0.00%	0.01%	0.80%	0.59%	-0.17%	0.57%	13.88
4/30/2014	0.79%	0.01%	2.18%	0.56%	-0.60%	0.57%	13.41
5/30/2014	0.90%	0.01%	4.02%	0.53%	1.56%	0.58%	11.40

Source: Ecowin, author´s calculations

Appendix 2. 12-month interest rate spreads and exchange rate returns between 1999 and 2014 for Czech Republic, Hungary and Poland

Date	Czech Republic		Hungary		Poland	
	FX return	Interest spread	FX return	Interest spread	FX return	Interest spread
12/31/1998	2.65%	5.72%	0.65%	-3.21%	2.34%	-3.21%
1/29/1999	-2.62%	5.09%	2.53%	-2.98%	-2.15%	-2.98%
2/26/1999	-5.67%	5.11%	1.24%	-3.07%	-7.30%	-3.07%
3/31/1999	-6.10%	4.17%	1.33%	-2.97%	-8.87%	-2.97%
4/30/1999	-3.46%	4.19%	3.57%	-2.68%	-2.86%	-2.68%
5/31/1999	-3.60%	4.43%	3.94%	-2.69%	-0.43%	-2.69%
6/30/1999	-2.12%	4.05%	4.25%	-2.94%	2.89%	-2.94%
7/30/1999	-3.39%	3.54%	2.71%	-3.13%	-2.34%	-3.13%
8/31/1999	-3.74%	3.27%	2.96%	-3.28%	-7.01%	-3.28%
9/30/1999	-0.37%	3.40%	1.99%	-3.35%	-8.29%	-3.35%
10/29/1999	-4.92%	2.44%	2.60%	-3.75%	11.26%	-3.75%
11/30/1999	-4.10%	2.09%	4.18%	-3.79%	-8.47%	-3.79%
12/31/1999	-2.71%	1.87%	4.33%	-3.88%	-7.43%	-3.88%
1/31/2000	-3.39%	1.94%	3.85%	-4.07%	-6.76%	-4.07%
2/29/2000	-2.54%	1.66%	3.69%	-4.16%	-7.31%	-4.16%
3/31/2000	-4.08%	1.29%	3.30%	-4.30%	-8.96%	-4.30%
4/28/2000	-4.95%	0.94%	3.32%	-4.57%	13.61%	-4.57%
5/31/2000	-5.80%	0.58%	-2.09%	-4.99%	18.26%	-4.99%
6/30/2000	-4.83%	0.73%	-6.31%	-5.04%	18.28%	-5.04%
7/31/2000	-4.05%	0.55%	-5.19%	-5.18%	-7.46%	-5.18%
8/31/2000	-2.67%	0.40%	-3.21%	-5.31%	-1.54%	-5.31%
9/29/2000	-4.76%	0.55%	-2.70%	-5.20%	-3.99%	-5.20%
10/31/2000	-3.63%	0.51%	-3.09%	-5.29%	-6.72%	-5.29%
11/30/2000	-4.38%	0.87%	-5.08%	-5.09%	-7.02%	-5.09%
12/29/2000	-9.54%	1.10%	-7.73%	-4.75%	-8.67%	-4.75%
1/31/2001	-8.39%	0.88%	-8.63%	-4.53%	-5.76%	13.03%
2/28/2001	-8.96%	0.60%	-8.10%	-4.54%	-1.72%	12.68%
3/30/2001	10.85%	0.64%	-8.70%	-4.32%	-0.59%	12.02%
4/30/2001	11.69%	0.32%	-9.34%	-4.69%	2.22%	11.30%
5/31/2001	10.90%	0.66%	-4.06%	-4.43%	11.35%	11.40%
6/29/2001	13.16%	1.06%	0.34%	-4.32%	17.97%	10.98%
7/31/2001	10.75%	1.66%	-1.04%	-4.23%	10.07%	10.59%
8/31/2001	11.47%	1.85%	-3.43%	-3.98%	5.14%	10.25%
9/28/2001	10.66%	1.93%	-5.33%	-3.50%	6.48%	9.86%
10/31/2001	-8.44%	1.91%	-5.37%	-3.20%	8.15%	8.73%
11/30/2001	-6.90%	1.51%	-5.42%	-3.22%	9.58%	7.69%
12/31/2001	-0.55%	1.14%	-3.77%	-3.34%	13.93%	7.02%

1/31/2002	-0.87%	0.83%	0.81%	-3.62%	14.74%	5.98%
2/28/2002	0.75%	0.77%	-0.50%	-3.61%	15.53%	6.00%
3/29/2002	3.71%	0.63%	1.73%	-3.95%	25.05%	5.82%
4/30/2002	3.19%	0.29%	1.71%	-3.76%	18.68%	5.80%
5/31/2002	3.16%	0.09%	2.35%	5.47%	16.94%	5.26%
6/28/2002	7.46%	-0.11%	8.92%	5.72%	11.93%	4.60%
7/31/2002	6.64%	-0.29%	8.07%	6.21%	6.19%	4.60%
8/30/2002	6.78%	-0.32%	5.40%	6.49%	7.51%	4.41%
9/30/2002	5.19%	-0.32%	4.66%	6.63%	12.42%	4.07%
10/31/2002	4.11%	-0.43%	7.90%	6.63%	17.74%	3.38%
11/29/2002	3.85%	-0.29%	10.50%	4.60%	18.22%	3.11%
12/31/2002	2.70%	-0.20%	11.69%	4.83%	17.08%	3.31%
1/31/2003	5.86%	-0.06%	7.84%	3.95%	16.93%	3.31%
2/28/2003	2.37%	-0.05%	5.43%	3.88%	15.49%	3.35%
3/31/2003	2.43%	0.00%	0.28%	4.15%	6.22%	3.19%
4/30/2003	3.37%	0.06%	1.80%	3.98%	12.52%	2.86%
5/30/2003	0.96%	0.24%	0.93%	4.10%	5.99%	2.73%
6/30/2003	0.98%	0.16%	-5.76%	6.90%	0.20%	2.88%
7/31/2003	-2.09%	0.15%	-5.99%	6.82%	0.29%	2.82%
8/29/2003	-1.91%	-0.19%	-3.40%	6.62%	2.17%	2.58%
9/30/2003	-1.07%	0.01%	-3.05%	6.43%	-5.02%	2.93%
10/31/2003	-1.65%	-0.19%	-5.64%	7.29%	-7.59%	3.45%
11/28/2003	-3.15%	-0.22%	-6.58%	9.52%	11.22%	3.64%
12/31/2003	-6.16%	0.03%	-6.72%	8.62%	13.20%	3.34%
1/30/2004	-9.71%	0.05%	-6.76%	9.85%	15.52%	3.36%
2/27/2004	-8.86%	0.24%	-5.71%	10.32%	20.34%	3.67%
3/31/2004	-8.48%	0.28%	-0.41%	8.60%	13.71%	3.80%
4/30/2004	-6.16%	0.20%	0.70%	8.50%	10.69%	4.20%
5/31/2004	-4.16%	0.33%	1.14%	8.41%	10.32%	4.43%
6/30/2004	-5.71%	0.59%	-1.59%	8.84%	10.22%	4.39%
7/30/2004	-4.71%	0.57%	-1.34%	8.37%	-6.78%	4.78%
8/31/2004	-7.74%	0.79%	-1.72%	8.47%	-9.74%	5.13%
9/30/2004	-6.18%	0.85%	1.29%	8.19%	10.18%	4.68%
10/29/2004	-5.89%	0.62%	2.04%	7.67%	-8.40%	4.65%
11/30/2004	-6.69%	0.59%	3.16%	6.84%	-6.47%	4.51%
12/31/2004	-4.29%	0.45%	3.03%	6.40%	-5.81%	4.08%
1/31/2005	-5.77%	0.08%	2.68%	6.16%	-5.91%	4.12%
2/28/2005	-4.58%	-0.15%	4.65%	5.14%	-2.85%	3.43%
3/31/2005	-5.26%	-0.27%	6.72%	5.02%	-4.30%	3.12%
4/29/2005	-6.73%	-0.37%	4.27%	5.34%	-9.75%	3.11%
5/31/2005	-6.86%	-0.49%	3.31%	5.18%	-5.52%	3.03%
6/30/2005	-5.28%	-0.34%	14.65%	4.61%	0.61%	2.42%
7/29/2005	-5.58%	-0.28%	11.07%	4.20%	-3.18%	2.26%
8/31/2005	-3.90%	-0.36%	13.16%	3.70%	-1.78%	2.24%

9/30/2005	-4.49%	-0.36%	9.28%	3.82%	1.18%	1.94%
10/31/2005	-5.07%	0.00%	4.03%	3.97%	-2.37%	2.01%
11/30/2005	-3.51%	-0.22%	1.27%	3.77%	-2.49%	1.93%
12/30/2005	-5.41%	-0.31%	-0.50%	3.84%	-0.42%	1.66%
1/31/2006	-0.92%	-0.68%	1.20%	3.55%	2.28%	1.37%
2/28/2006	-0.35%	-0.82%	0.67%	3.42%	3.44%	1.02%
3/31/2006	-1.62%	-0.82%	-5.97%	3.66%	-1.57%	0.85%
4/28/2006	-1.03%	-0.79%	-5.91%	3.36%	-2.12%	0.79%
5/31/2006	0.02%	-0.94%	-4.83%	3.22%	-3.20%	0.87%
6/30/2006	0.78%	-0.77%	12.77%	4.56%	-7.54%	1.10%
7/31/2006	-1.47%	-0.72%	-7.15%	4.11%	-3.84%	0.90%
8/31/2006	-1.93%	-0.92%	-7.41%	4.62%	-2.97%	0.88%
9/29/2006	-2.57%	-0.59%	-8.01%	4.78%	-5.07%	0.92%
10/31/2006	-4.22%	-0.74%	-3.92%	4.52%	-6.30%	0.65%
11/30/2006	-6.02%	-0.88%	-1.30%	4.25%	-5.34%	0.57%
12/29/2006	-3.54%	-1.22%	0.58%	3.97%	-6.11%	0.38%
1/31/2007	-7.41%	-1.17%	1.16%	4.19%	-7.78%	0.24%
2/28/2007	11.05%	-1.25%	3.72%	4.22%	10.04%	0.41%
3/30/2007	-9.89%	-1.32%	5.00%	3.52%	-8.92%	0.36%
4/30/2007	10.46%	-1.26%	1.82%	3.20%	-8.78%	0.36%
5/31/2007	11.49%	-1.23%	-3.85%	3.02%	11.47%	0.27%
6/29/2007	16.86%	-1.01%	-4.68%	2.71%	10.88%	0.52%
7/31/2007	14.66%	-0.81%	-7.33%	2.71%	15.30%	0.63%
8/31/2007	10.47%	-0.98%	-7.54%	2.75%	12.97%	0.59%
9/28/2007	11.09%	-0.90%	-3.52%	2.49%	-9.90%	0.62%
10/31/2007	10.86%	-0.76%	2.06%	2.57%	-2.59%	0.87%
11/30/2007	-3.30%	-0.59%	2.22%	2.75%	4.64%	1.24%
12/31/2007	1.15%	-0.52%	5.05%	2.74%	15.39%	1.35%
1/31/2008	7.28%	-0.23%	15.43%	3.18%	23.76%	1.59%
2/29/2008	11.96%	-0.23%	13.24%	3.83%	32.04%	1.89%
3/31/2008	8.42%	-0.40%	18.20%	4.29%	31.87%	1.78%
4/30/2008	5.96%	-0.69%	14.47%	4.04%	28.26%	1.59%
5/30/2008	7.67%	-0.81%	18.14%	3.89%	33.49%	1.50%
6/30/2008	8.65%	-0.93%	15.69%	3.83%	32.77%	1.42%
7/31/2008	6.67%	-1.33%	13.64%	3.31%	29.17%	1.34%
8/29/2008	2.71%	-1.49%	15.04%	3.35%	22.97%	1.22%
9/30/2008	3.08%	-1.49%	11.17%	3.29%	23.87%	1.10%
10/31/2008	10.38%	-0.23%	7.36%	6.99%	20.30%	1.95%
11/28/2008	3.07%	0.38%	5.94%	7.23%	10.06%	2.61%
12/31/2008	-1.53%	0.88%	1.80%	6.77%	-1.17%	2.83%
1/30/2009	-6.02%	0.68%	-8.94%	7.02%	-9.27%	2.57%
2/27/2009	-7.77%	0.79%	-9.89%	7.48%	15.15%	2.44%
3/31/2009	-7.16%	1.01%	13.85%	8.28%	16.74%	2.40%
4/30/2009	-4.21%	1.10%	-6.85%	8.08%	11.35%	2.78%

5/29/2009	-5.31%	0.99%	-3.17%	8.10%	-9.61%	3.30%
6/30/2009	-0.95%	1.08%	4.74%	8.18%	-6.79%	3.22%
7/31/2009	-3.02%	1.21%	6.72%	7.01%	-3.29%	3.08%
8/31/2009	-2.76%	1.12%	5.30%	6.44%	-2.27%	3.09%
9/30/2009	-2.59%	1.20%	2.60%	5.97%	-5.77%	3.15%
10/30/2009	-7.16%	1.12%	-1.25%	5.40%	-6.67%	3.14%
11/30/2009	-4.57%	1.07%	2.47%	4.94%	-3.30%	3.15%
12/31/2009	-5.38%	0.88%	3.06%	4.78%	-3.33%	3.18%
1/29/2010	-7.79%	0.85%	0.57%	4.64%	-2.91%	3.18%
2/26/2010	-6.06%	0.77%	0.48%	4.53%	0.35%	3.14%
3/31/2010	-3.41%	0.73%	0.13%	4.19%	4.25%	3.10%
4/30/2010	-5.62%	0.67%	-1.79%	3.90%	0.06%	2.92%
5/31/2010	-3.78%	0.52%	-3.15%	3.92%	-3.11%	2.89%
6/30/2010	-5.28%	0.45%	-6.70%	4.05%	-4.09%	2.84%
7/30/2010	-2.45%	0.35%	-5.04%	4.05%	-0.31%	2.71%
8/31/2010	-2.58%	0.36%	-5.41%	4.15%	3.37%	2.73%
9/30/2010	0.34%	0.36%	6.22%	4.17%	11.51%	2.73%
10/29/2010	1.05%	0.25%	12.43%	4.06%	10.87%	2.62%
11/30/2010	1.55%	0.26%	8.01%	4.33%	11.95%	2.67%
12/31/2010	2.27%	0.29%	13.04%	4.60%	12.67%	2.76%
1/31/2011	4.68%	0.15%	8.10%	4.55%	7.35%	2.76%
2/28/2011	2.22%	0.04%	6.68%	4.41%	4.40%	2.67%
3/31/2011	1.09%	-0.16%	10.81%	4.14%	3.09%	2.47%
4/29/2011	3.11%	-0.29%	8.49%	4.03%	6.22%	2.43%
5/31/2011	4.74%	-0.31%	12.90%	4.01%	11.20%	2.52%
6/30/2011	4.83%	-0.39%	7.47%	3.99%	6.17%	2.59%
7/29/2011	4.77%	-0.42%	4.44%	3.96%	2.98%	2.57%
8/31/2011	3.02%	-0.36%	4.72%	4.05%	0.80%	2.69%
9/30/2011	1.82%	-0.35%	-2.73%	4.10%	-6.85%	2.70%
10/31/2011	0.84%	-0.40%	-7.06%	4.15%	-5.93%	2.72%
11/30/2011	-0.36%	-0.34%	-7.35%	5.46%	-8.87%	2.84%
12/30/2011	-1.91%	-0.22%	-7.51%	5.66%	-8.67%	2.95%
1/31/2012	1.38%	-0.01%	-0.90%	6.21%	-0.58%	3.15%
2/29/2012	3.06%	0.16%	2.21%	6.21%	0.46%	3.27%
3/30/2012	3.77%	0.35%	3.31%	6.24%	0.71%	3.44%
4/30/2012	3.49%	0.47%	4.41%	6.25%	-0.25%	3.57%
5/31/2012	0.02%	0.53%	-1.36%	6.27%	-2.59%	3.81%
6/29/2012	1.89%	0.40%	3.19%	6.20%	2.42%	3.84%
7/31/2012	2.41%	0.57%	6.24%	6.39%	3.31%	4.10%
8/31/2012	3.58%	0.58%	5.89%	6.29%	2.38%	4.12%
9/28/2012	2.20%	0.56%	4.25%	6.14%	2.54%	4.17%
10/31/2012	2.81%	0.43%	4.24%	5.70%	1.13%	4.00%
11/30/2012	8.39%	0.31%	7.18%	5.44%	2.45%	3.77%
12/31/2012	8.93%	0.33%	2.00%	5.18%	1.84%	3.34%

1/31/2013	7.25%	0.22%	6.81%	4.73%	1.34%	3.09%
2/28/2013	6.49%	0.25%	4.76%	4.44%	0.28%	2.94%
3/29/2013	6.65%	0.21%	1.02%	4.14%	-0.31%	2.74%
4/30/2013	6.40%	0.25%	2.56%	3.88%	0.98%	2.41%
5/31/2013	6.83%	0.28%	2.02%	3.69%	-3.11%	2.07%
6/28/2013	5.55%	0.22%	4.96%	3.56%	-3.84%	2.08%
7/31/2013	6.70%	0.21%	4.83%	3.31%	-1.72%	2.10%
8/30/2013	7.71%	0.20%	4.64%	3.16%	-1.46%	2.13%

Source: Ecowin, author´s calculations