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## Covered Interest Parity and the Global Financial Crisis in Four Central and Eastern European Countries

*ABSTRACT: This paper examines the empirical validity of the covered interest parity (CIP) hypothesis in the Czech Republic, Hungary, Poland, and Romania. Before the global financial crisis, CIP was mostly satisfied for the first three countries but not for Romania. During and after the crisis, deviations from CIP have been substantial in all cases but with large differences across the countries. Estimations tie the observed pattern to developments in both global and country-specific risks. In the case of the Czech Republic, increased global risks led to a lower risk premium, indicating that Czech assets functioned as a “safe haven.” In Hungary and Poland, increased global risks led to higher risk premiums, suggesting a flight to quality out of Hungarian and Polish assets. Finally, for Romania the deviations from CIP were unrelated to developments in global or local financial risks, reflecting a repressed financial system.*

Financial markets have developed rapidly in Central and Eastern Europe (CEE) since the countries adopted market-based economic systems in the early 1990s. This development has taken place amid growing international trade, more cross-border investment, and foreign banks penetrating the CEE markets. This financial deepening has also led to substantial volumes of forward exchange transactions, often in the form of foreign exchange swaps in which spot and forward exchange transactions are executed simultaneously. Forward purchase or the sale of foreign

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exchange locks in future exchange rates and thereby helps market participants manage exchange rate risks.

The access to forward exchange implies that investors can invest in domestically denominated assets as well as in foreign-denominated assets and, through forward exchange contracts, hedge or cover all their exchange rate exposure. Market efficiency would entail that the price formation of forward exchange lead to the same return on the two investment possibilities. Covered interest parity (CIP) theory posits that the return on investment in assets denominated in domestic currency must equal the return on investment in assets denominated in foreign currency, given that all currency exposure is hedged through a forward or swap contract. The argument is that otherwise there would be a possibility of riskless arbitrage profits, as the exchange rate exposure is covered.

This paper examines the extent to which the price formation of forward exchange in four major CEE economies, the Czech Republic, Hungary, Poland, and Romania, lend support to the CIP condition during the period 2004–11. All the countries had floating exchange rates during the sample period and saw increasing integration into European economic and financial structures. The main point of investigation is the extent to which the price formation changed in connection with the global financial crisis and whether the empirical relation between the variables of CIP changed. The analysis provides information on the efficiency of financial markets in CEE countries, which is important for the ability of agents to use financial instruments to carry out risk management and intertemporal reallocation. The analysis also sheds light on the effects of the global financial crisis on financial pricing far from the epicenter of the crisis and, hence, provides information on possible contagion effects.

The theory underlying covered interest parity is based on the assumption that arbitrage equalizes the returns on investing in domestic and foreign assets (actually, domestically and foreign-denominated assets) (e.g., Levi 2005: ch. 7). At time  $t$ , an investor seeks to invest one domestic currency unit for a holding period of  $h$  years,  $h > 0$ , and considers whether to invest in a domestic or in a foreign asset. Investment in the domestic asset earns the annual interest rate  $i_{t,h}$ . Investment in the foreign asset at the interest rate  $i_{t,h}^*$  entails buying foreign currency at the spot exchange rate  $S_t$  and hedging the exposure by selling forward the foreign gross return at the forward exchange rate  $F_{t,h}$ . The covered foreign exchange position implies that both alternatives, in theory, are riskless, and arbitrage therefore entails that the gross returns from the domestically and foreign-denominated assets must be identical.

$$(1 + i_{t,h})^h = (1 + i_{t,h}^*)^h \frac{F_{t,h}}{S_t}. \quad (1)$$

This is the covered interest parity condition. If the interest rates are relatively small, the CIP condition can be expressed as the following approximation:

$$\frac{F_{t,h} - S_t}{hS_t} = i_{t,h} - i_{t,h}^* \quad (2)$$

The left-hand side of Equation (2) is the annualized forward premium or capital gain, which the investor attains if the forward rate differs from the spot rate. The right-hand side is the spread between the domestic and foreign interest rates. A positive forward premium entails a positive capital gain for an investor who buys a foreign denominated asset; this is only compatible with CIP if the domestic interest rate is higher than the foreign one.

In practice, CIP will typically not hold precisely because of transaction costs, different risks of domestic and foreign assets, and liquidity constraints. Deviations from CIP for the  $h$ -year holding period,  $D_{t,h}$ , can be computed as the annualized forward premium minus the interest rate spread:

$$D_{t,h} = \frac{F_{t,h} - S_t}{hS_t} - (i_{t,h} - i_{t,h}^*) \quad (3)$$

If  $D_{t,h}$  differs nonnegligibly from zero, CIP does not hold. Deviations can emerge because investors are unable or unwilling to exploit arbitrage opportunities. Capital controls, capital requirements, and other constraints on capital flows can make arbitrage trades unfeasible. Reductions in the absolute value of  $D_{t,h}$  can therefore be seen as a sign of increased international financial integration (Clinton 1988; Crowder 1995).

In spite of the exchange rate exposure being covered, investment in domestic and foreign assets may still entail differences in counterparty and transaction risks as well as liquidity exposure. A positive deviation,  $D_{t,h} > 0$ , implies that the return on investment in foreign assets exceeds the return on investment in domestic assets, which may occur if investors perceive that investment in foreign assets entails greater risks than investment in domestic assets and/or if foreign assets are seen as less liquid than domestic assets. A negative deviation,  $D_{t,h} < 0$ , could emerge in a situation where domestic assets are assessed to be more risky or less liquid than foreign assets.

It follows that changes in risks or liquidity conditions may affect the deviation from CIP. Market instability may lead to a “flight to quality” to markets seen as relatively safe and liquid (“safe havens”), which could increase the deviation in safe and liquid markets and lower it in risky and illiquid markets.

Numerous studies have examined the empirical validity of the CIP condition, typically by examining measures of deviation from CIP such as the one in Equation (3). The general conclusion is that the condition holds well as long as financial markets are deep and not affected by major turbulence or disruption. Clinton (1988) considers five major currencies against the U.S. dollar and finds that the deviation from CIP is typically within a range of  $\pm 0.06$  percentage points, and ascribes such level of deviation to transaction costs that render low-margin arbitrage trades unprofitable.

Dooley and Isard (1980) provide an early study of reasons for deviations from CIP in the DEM/USD market. They find that deviations can partly be explained by the introduction of capital controls or the expectation of such policy measures. Taylor (1989) documents that deviations from CIP in the GBP/USD market often occurred during market turbulence caused by events such as the devaluation of the GBP in 1967 and floating in 1972, but political events on both sides of the Atlantic have also played a role.

A number of studies have examined deviations from CIP in the period around the global financial crisis, which manifested itself in the bailout of Bear Stearns in March 2008 and the bankruptcy of Lehman Brothers in September 2008. Baba and Packer (2009) consider the dollar/euro market and find that very large deviations from CIP occurred already in the middle of 2007 and that the deviations became quite persistent from mid-2008. They link the deviations to different developments of counterparty risks in Europe and the United States. Intervention from the European Central Bank seems to have stabilized the markets, although deviations from CIP persisted throughout the sample period. Jones (2009) also concludes that increased riskiness of the U.S. banking and money markets was behind the emergence of deviations from CIP in mid-2007. Griffoli and Rinaldo (2010) provide a detailed study of deviations from CIP on the dollar/euro market. They find persistent deviations and conclude that arbitrage broke down because market participants had problems obtaining dollar funding.

Studies of the empirical validity of covered interest parity in countries from Central and Eastern Europe are relatively scarce and in all cases focus on the effects of economic or financial integration. Mansori (2003) argues that estimations of CIP for the Czech Republic, Hungary, and Poland show many similarities to estimations of CIP for Western European countries. Herrmann and Jochem (2007) find that the removal of capital controls in the period before 2002 reduced deviations from CIP for four CEE countries. Ferreira (2011) compares financial integration in Western European countries and the Czech Republic, Hungary, and Poland using, *inter alia*, tests of CIP. For the Czech Republic, the CIP condition cannot be rejected for holding periods of six and twelve months, while for Hungary and Poland the CIP condition is consistently rejected. The data sample ends in 2004, which may explain the finding of limited financial integration.

This paper is to our knowledge the first to analyze deviations from covered interest parity in CEE countries during the period surrounding the global financial crisis. The analysis progresses in two steps. First, the paper documents the size and timing of deviations from CIP in each of the four sample countries. Second, possible causes of CIP deviations are investigated in regression analyses in which proxies for global and local market risk are explanatory variables.

## **Data**

The sample comprises four major CEE economies, namely the Czech Republic, Hungary, Poland, and Romania. All data are monthly (end-of-the-month value).

The endpoint of the sample at the end of 2011 is common to all series, but the starting date differs across the countries, depending on data availability. The differences do not affect the comparisons of results between countries, since all estimations cover the relatively stable years before the global financial crisis as well as the period after the crisis. The four countries all had floating exchange rates during this period, although Hungary used different corridors for its exchange rate until 2008.

Based on Bloomberg data, the forward premium and the interest rate spread is calculated for each of the four countries. The reference area is taken to be the eurozone; the exchange rates are in units of local currency per euro, and the interest rate spreads of the local interbank offered interest rate are against the Euribor rate. The analyses are undertaken for investment horizons of three months, implying that the returns on the currency exposure and the interest rate differential are both calculated for a three-month holding period. This horizon has been chosen because the three-month money market is one of the most liquid segments of the market.

Deviations from CIP are explained by two variables capturing the riskiness of investment in different markets. The first variable is the VIX index, the volatility of U.S. equities calculated from options on the S&P500 index over the next month. The variable is a measure of the market pricing of expected stock market volatility and is often taken as a proxy for short-term risks in global financial markets. A higher value indicates increased perceived risks.

The other variable is the credit default swap (CDS) spread of five-year government bonds for each of the four countries. A CDS allows an investor to hedge against the risk of default on a specific asset. The spread or fee paid is a measure of the market pricing of the default risk; an increase in the spread implies a higher perceived riskiness of the reference asset. We take the CDS spread as a proxy for local or country-specific financial market risk. A high CDS spread signals a high risk of government default, which will lead to turbulence in domestic financial markets; financial market turbulence typically also affects CDS spreads as the government's financial outlook deteriorates. The VIX index and the CDS spread are also used in the studies by Griffole and Rinaldo (2010) and Skinner and Mason (2011) to explain deviations from CIP.

The problem with using VIX as a proxy for global risks and CDS as a proxy for local risks is that the two variables are highly correlated, having a correlation coefficient around 0.7 for each of the four sample countries. The high degree of correlation reflects that financial risks covary across countries as global risks spill over to local or country-specific markets. The correlation of the two measures of pricing of risks makes it difficult to identify the separate effects of global and local risks. Given the size and global impact of the countries in the sample, global risks are likely to have affected local risks, while causality in the other direction is unlikely.

Following this reasoning we seek to remove the global component, VIX, from the measure of local risks, CDS. The variable VIX is regressed on the variable

CDS for each of the four countries separately and for the corresponding sample period. The residual is labeled CDSU, as in Equation (4). The constant and the slope coefficient  $b$  are estimated using ordinary least squares (OLS):

$$\text{CDS} = \text{Constant} + b \cdot \text{VIX} + \text{CDSU}. \quad (4)$$

The coefficient of determination is around 0.6–0.7, and the estimated slope coefficients are positive for all four countries and statistically significant for three of them, but not for Hungary. The residual CDSU contains the orthogonal component, that is, the variation in CDS that cannot be explained by global developments. The variable CDSU is thus a measure of idiosyncratic risks, that is, the risks that stem from the individual country.

The development of the CDSU variables is generally intuitive. Before the global financial crisis, the volatility of the residuals was fairly low in all four countries. After the Lehman Brothers default, differences across the countries emerged. In the Czech Republic, the volatility of CDSU was still low, while it increased in the other countries, in particular in Hungary and Romania. In other words, the differences between the countries became more pronounced after the outbreak of the crisis.

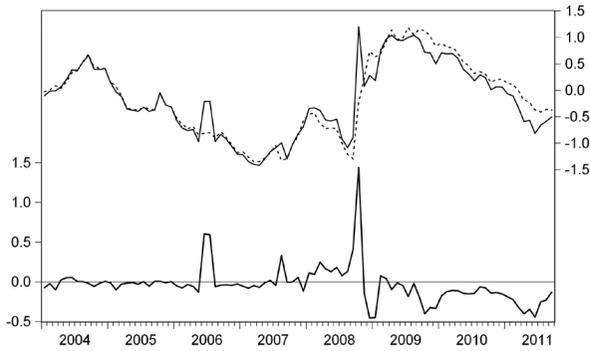
Tests of the time-series properties of the data series are not reported to save space; the tests are available from the corresponding author upon request. In general the forward premium and the interest rate spreads are stationary variables, although the results vary somewhat depending on the time sample. For Poland, the hypothesis of a unit root in the deviation from CIP is rejected only at the margin. Unsurprisingly, the time-series properties of the two risk variables, VIX and CDSU, also depend on the specific sample used for the test.

### Deviations from Covered Interest Parity

This section presents empirical evidence on the fulfillment of the covered interest parity condition for the four sample countries, the Czech Republic, Hungary, Poland, and Romania. Figure 1 shows the annualized three-month forward premium and the corresponding three-month interest rate spread (upper part), as well as the deviation from CIP (lower part).<sup>1</sup> The scale differs across the four plots.

Before the outbreak of the global financial crisis, the Czech Republic, Hungary, and Poland had deviations from CIP that were small and fluctuated around zero. This reflects relatively deep financial markets that were integrated into Western European markets (Zoli 2007). In the case of Romania, the pricing of forward exchange was essentially disconnected from the interest rate spread; the deviations from CIP were very large, highly variable, and almost consistently below zero. The latter result suggests that investors attached a substantial risk and liquidity premium to assets denominated in the Romanian currency (RON). Romania joined the European Union only in 2007, and financial indicators generally show

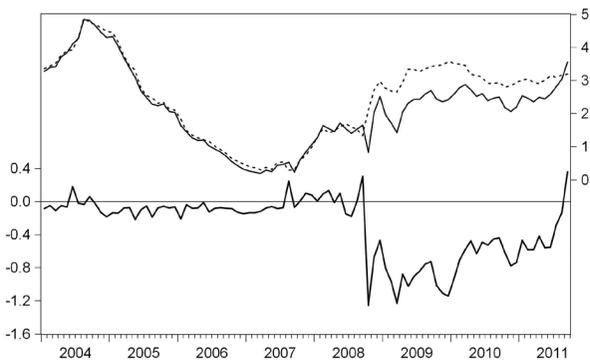
**Figure 1. Annualized Three-Month Forward Premium and Interest Rate Spread, Percent, Deviation from CIP, Percentage Points, Monthly Data, 2004:1–2011:12**



(a) Czech Republic



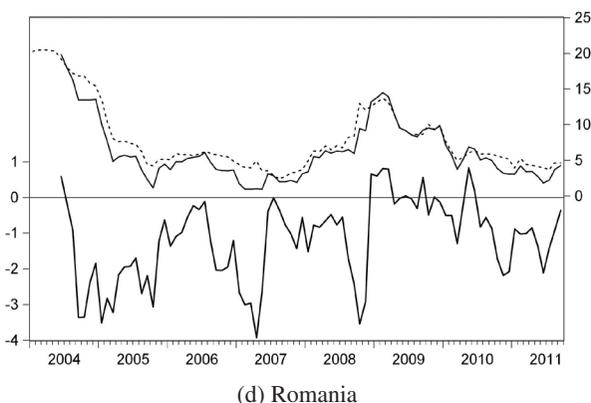
(b) Hungary



(c) Poland

*(continues)*

Figure 1 (Continued)



*Note:* The forward premium (solid line) and the interest rate spread (dashed line) are shown in the upper part of each plot, the deviation from CIP in the lower part.

modest financial depth due to macroeconomic instability and governance and regulatory issues (Zoli 2007).

Turning to the period around the outbreak of the global financial crisis, the four countries exhibit very diverging developments. In the Czech Republic, deviation from CIP had a modest positive tendency as early as mid-2007, when financial markets in the United States and Europe came under increasing strain. Investors saw investment in the Czech currency (CZK) as entailing little risk; this currency was arguably a “safe haven” currency. The immediate effect of the crisis was an upward spike in the deviation from CIP in the Czech Republic, confirming the role of the koruna as the currency of choice during uncertain times. In the following period the deviations were small, although larger than before the global financial crisis and with a negative tendency in 2011.<sup>2</sup>

In Hungary the outbreak of the global financial crisis led to large, negative deviations from CIP as investors fled exposure to the Hungarian currency (HUF). The negative deviation was relatively short lived, mainly thanks to the intervention by the Hungarian central bank in the forward exchange swap market (Mak and Pales 2009). Between September 2008 and February 2009 the central bank introduced five different instruments to ensure liquidity in the swap market. With these measures, the Hungarian central bank became the counterparty of foreign exchange swaps with local banks, which could not find other counterparties willing to take on HUF exposure. The swap transactions entailed different pairs of currencies (HUF/EUR, HUF/CHF) and different maturities (from overnight to six months). It is noteworthy that the deviation from CIP increased in 2010–11, possibly due to increased risks stemming from persistent fiscal problems in Hungary.

In Poland the global financial crisis brought about large, negative deviations from CIP. After the default of Lehman Brothers, the Polish central bank launched a “confidence pact” designed to guarantee the local banking sector liquidity in both the Polish currency (PLN) and in foreign currencies (Narodowy Bank Polski 2010, 2011). The latter was achieved through foreign exchange swaps against USD, EUR, and CHF with weekly and monthly maturity. The demand for swap transactions with the Polish central bank decreased substantially in the last quarter of 2009 and the transactions ceased in the spring of 2010.<sup>3</sup> In contrast to developments in Hungary, the deviation from CIP fell from 2009 to 2011, signaling a gradual return to normality.

In Romania, the outbreak of the global financial crisis led to a very large negative deviation from CIP that lasted half a year. The approach of the central bank of Romania was different from the one applied by the central banks of Hungary and Poland; no explicit foreign exchange swap instrument was set up, probably because the main risk identified was the solvency of the local banks. The Vienna Initiative meant, however, that the nine biggest foreign banks committed themselves to maintain their exposure to Romania and strengthen the capitalization of their affiliates (Banca Nationala a Romaniei 2009, 2010).<sup>4</sup>

The conclusion from Figure 1 and the discussion above is that developments in the relationship between the forward premium and the interest rate spread differed substantially across the four countries. In the relatively calm years before the global financial crisis, CIP held relatively well in the three most advanced countries, which is a finding in line with earlier results in Ferreira (2011), Herrmann and Jochem (2007), and Mansori (2003). CIP did not hold for Romania, due to the more gradual economic and financial integration process in this country.

When the crisis hit, the CIP condition generally ceased to hold while the differentiation across the countries became more pronounced. The Czech Republic exhibited features resembling a safe haven at least during the early stages of the crisis. Hungary and Poland exhibited developments more characteristic of emerging market economies as the deviation from CIP increased markedly and systematically, even after intervention by the central banks. Finally, Romania is a particular case, as empirical evidence does not support CIP either before or after the outbreak of the global financial crisis.

### **Explaining Deviations from Covered Interest Parity**

The analysis in the previous section shows a clear change in the deviations from CIP in at least three of the four sample countries around the outbreak of the global financial crisis. In this section we assess the extent to which the deviations from CIP can be tied to measures of risks. The global financial crisis affected risks in financial markets across the world, and it may thus be a source of contagion to forward exchange markets in the CEE countries. Skinner and Mason (2011) find that measures of risk generally have substantial explanatory power with respect

to deviations from CIP in a number of emerging market economies outside CEE. We examine the respective importance of global risks and idiosyncratic, country-specific or local risks.

The estimations are undertaken separately for each country. The estimation sample period is January 2004 to September 2011 except for the Czech Republic and Romania, for which the sample period starts later due to data unavailability. The dependent variable is DEV, which is the deviation from CIP computed in Equation (3) and shown in Figure 1. (Indices for time and holding period are suppressed.) In addition to the variables for global and country-specific risks, the interest rate spread is included as a control variable in case interest rate differentials do not feed into the forward premium on a one-to-one basis.<sup>5</sup>

The three explanatory variables are demeaned (their mean is used within the estimation samples for the individual countries). This allows us to interpret the estimated constant as the average risk premium not captured by the three explanatory variables. The demeaned interest rate spread is labeled SPREAD', the demeaned global risk variable is labeled VIX', and the demeaned idiosyncratic risk variable (found in Equation (4)) is CDSU'. To facilitate the discussion of the economic significance of the estimation results, Table 1 shows the standard deviations of the three explanatory variables for each country.

The cross-country differences in the standard deviation of the global risk variable VIX' stem from the different sample periods. The CDSU' variable reflects country-specific risks and the standard deviation is highest for Hungary and Romania, reflecting a more unstable environment in these two countries. The variance of the spread variable SPREAD' also differs across the countries; Hungary and Romania show the greatest variation.

The equation to be estimated is shown in Equation (5), where  $\varepsilon$  is an error term. The constant and the three slope coefficients,  $\beta$ ,  $\gamma$ , and  $\delta$ , are estimated using OLS.

$$\text{DEV} = \text{Constant} + \beta \cdot \text{SPREAD}' + \gamma \cdot \text{VIX}' + \delta \cdot \text{CDSU}' + \varepsilon. \quad (5)$$

The results are reported in Table 2. The results are first discussed for the four sample countries separately and then compared across the countries.

In the Czech Republic, global risks, as captured by the VIX' variable, have a positive impact on the deviation from CIP, implying a lower risk premium when local risks increase. The estimated coefficient is, however, relatively small and only marginally significant. Local risks, as captured by the CDSU' variable, have a negative impact on the deviation from CIP, suggesting a higher risk premium when local risks increase: an increase in CDSU' by one standard deviation leads to a reduction in DEV of 0.1 percentage point. The coefficient of the interest rate spread is negative and statistically different from zero, which is in contrast to the prediction of the covered interest parity condition. As a robustness check, we restricted the coefficient of the spread variable to be zero as theory predicts, but in qualitative terms, the other estimated coefficients remain unchanged (not

Table 1. **Standard Deviation of Explanatory Variables**

	VIX'	CDSU'	SPREAD'	Sample
Czech Republic	10.57	0.38	0.83	2006:5–2011:9
Hungary	10.06	0.98	2.03	2004:1–2011:9
Poland	10.06	0.49	1.26	2004:1–2011:9
Romania	10.28	0.87	3.91	2004:6–2011:9

shown). Finally, the constant is very small and statistically insignificant, that is, there is no autonomous time-invariant risk premium.

For Hungary, the estimated coefficients of both the global and the local risk variables are negative and statistically significant. The quantitative importance of the two effects is relatively similar: an increase of one standard deviation in VIX' reduces DEV by 0.3 percentage points, while a similar increase in CDSU' reduces DEV by 0.2 percentage points. The constant term is statistically significant and negative, suggesting a country-specific risk premium.

For Poland, the estimation results resemble those for Hungary. Both global and local risks have a negative effect on the deviation from CIP. An increase of one standard deviation in VIX' diminishes DEV by 0.2 percentage points, while an increase of one standard deviation in CDSU' diminishes DEV by around 0.3 percentage points. The constant is negative and of the same magnitude as in the case of Hungary.

For Romania, the main result is that none of the coefficients of the risk proxies attain statistical significance. This is related to the extreme volatility of DEV. Experiments in which the sample was shortened to start in 2008 or later resulted in estimated coefficients that are very unstable and generally not statistically significant. The estimated constant is negative and around  $-1.2$ , which suggests a much higher time-invariant risk premium than for Hungary and Poland.

Overall, the results show striking differences across the countries. The Czech Republic stands out as a country for which global risks are of little importance (or even associated with a lower risk premium), local risks seem to increase the risk premium, and the constant risk component is negligible. Hungary and Poland share many characteristics, as the deviation from CIP increases both when global and country-specific risks increase. The first result suggests that the countries are susceptible to flight to quality as risks in global markets increase. There are also small constant risk premiums in both cases. Romania stands out, as deviations from CIP are extremely large and apparently unrelated to either global or local risk factors. Furthermore, there is a large constant risk premium.

The robustness of the results has been checked in a number of ways. First, Equation (5) has been estimated for all the countries using the common sample 2006:5–2011:9. Poland is the only country for which the estimation results

Table 2. Results of OLS Estimations of Deviation from CIP

	Constant	VIX'	CDSU'	SPREAD'	R <sup>2</sup>	Sample
Czech Republic	-0.042 (0.031)	0.009* (0.005)	-0.255** (0.118)	-0.107** (0.048)	0.360	2006:5–2011:9
Hungary	-0.257*** (0.056)	-0.027*** (0.009)	-0.184*** (0.066)	0.008 (0.028)	0.427	2004:1–2011:9
Poland	-0.292*** (0.042)	-0.018*** (0.005)	-0.327*** (0.094)	-0.038 (0.027)	0.499	2004:1–2011:9
Romania	-1.188*** (0.172)	0.037 (0.024)	0.372 (0.225)	-0.024 (0.052)	0.178	2004:6–2011:9

Notes: Newey–West standard errors are shown in parentheses. \*\*\*, \*\*, and \* coefficient estimate is statistically different from 0 at the 1 percent, 5 percent, and 10 percent levels of significance, respectively.

change for the shorter sample; although the coefficients of  $VIX'$  and  $CDSU'$  are not statistically significant anymore, the signs and approximate size are retained. Second, we included the lagged dependent variable in the estimations. The lagged dependent variable is statistically insignificant in the case of the Czech Republic, while it is significant and with a positive sign in the three other cases. While many coefficients lose their statistical significance with the inclusion of the lagged dependent variable, their signs generally remain the same. Finally, we removed some outliers, in particular around the outbreak of the global financial crisis. As would be expected, the removal of observations with high leverage affects the statistical significance and sometimes also the size of the estimated coefficients, but the qualitative results remain largely unchanged.

## Conclusions

This paper analyzes the empirical validity of the covered interest rate condition in four major CEE countries with floating exchange systems. The main focus is on the impact of the global financial crisis and the possible causal links between the crisis and deviations from CIP.

In the period before the global financial crisis, the CIP condition is largely satisfied for the three more advanced countries in the sample but not for Romania, which has seen relatively sluggish financial development. After the outbreak of the crisis, CIP does not hold for any of the four sample countries, but there are substantial differences across the countries. In the Czech Republic the deviation from CIP is generally small and even negative at times. In Hungary and Poland the deviation from CIP is larger, but while it gradually decreased in 2009–11 in Poland, it increased in Hungary. Finally, in Romania the deviation from CIP is very large, thus being in line with the period before the crisis.

Interestingly, the deviations from CIP closely correspond to the interventions in foreign exchange markets undertaken by the central banks after the global financial crisis. The Czech central bank did not deem it necessary to intervene, as market-based arbitrage continued to function reasonably well. The Hungarian and Polish central banks both entered the foreign exchange swap markets to counteract the effects of limited private liquidity. The Romanian central bank did not undertake any direct measures, as forward exchange markets never played a major role, which is also reflected in the large deviations from CIP before the crisis.

Econometric analysis lends further support to the conclusions above. The deviations from CIP can be linked to both global and idiosyncratic, local risks, but the pattern differs across the countries. For the Czech Republic, global risks that do not spread to the local risk measure appear to reduce the risk premium; for Hungary and Poland both global and idiosyncratic, local risks lead to higher risk premiums; and in Romania, deviations from CIP do not depend on the risk factors in the model.

In the precrisis period, there were clear differences between the three economically more advanced countries in the sample—Czech Republic, Hungary, and Poland—and the least developed country, Romania. The econometric analysis suggests that the differences are partly due to the low degree of financial integration and the perceived riskiness of investment in Romania. With the outbreak of the global financial crisis, the covered interest parity condition generally ceases to hold, but at the same time differentiation across the three more advanced countries increases. The Czech Republic exhibits features of an advanced economy or even a safe haven, while Hungary and Poland are more characteristic of emerging market economies, where increased riskiness and reduced liquidity make investors flee the country. Finally, Romania appears to have been little affected by the increased risks during the crisis because of the limited development and integration of its financial markets.

## Notes

1. The deviation from CIP, shown in the lower part of each plot, corresponds to  $D_{i,h}$  in Equation (3), with  $h = 1/4$ .

2. The relatively stable developments in the Czech Republic after the global financial crisis are also confirmed by the fact that the Czech central bank did not intervene in foreign exchange markets. The only measure taken was a liquidity-providing repo (with government bonds as collateral), which had the objective of supporting the government bond market (Ceska Narodni Banka 2009).

3. The range of maturities covered by instruments issued by the Polish central bank never involved swaps above one-month maturity, unlike the Hungarian central bank's instruments, which had a maximum maturity of six months.

4. The Vienna initiative, created in 2009 with the European Bank for Reconstruction and Development in the leading role, brought together public authorities and EU-based cross-border banking groups operating in emerging Europe. The aim was to provide a coordination framework to deal with problems arising from the crisis and to agree on measures to limit deleveraging in emerging Europe.

5. We also experimented with the exchange market pressure (EMP) index from Filipozzi and Harkmann (2010) as a proxy for exchange rate risks, but the EMP index generally has little explanatory power (estimation results not shown).

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