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Effects of Uncertainty on Interest Rate Parity in Central and Eastern European Economies After the Global Financial Crisis*

Skutki niepewności dla parytetu stóp procentowych w gospodarkach Europy Środkowej i Wschodniej po globalnym kryzysie finansowym

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Abstract

This paper examines the role of uncertainty in explaining the Uncovered Interest Parity (UIP) puzzle in Central and Eastern European (CEE) economies from 2008 to 2022. We investigate the UIP puzzle in four CEE economies: the Czech Republic, Hungary, Poland, and Romania. First, using the baseline Fama regression, we check if the UIP condition is satisfied. In the second model, regressions associated with uncertainty variables, such as Economic Policy Uncertainty and the World Uncertainty Index, are performed. Finally, using local projections models, we check how the UIP premium reacts dynamically to uncertainty shocks. The first finding is that the UIP condition holds better for the US dollar as the reference currency and that the UIP puzzle is more pronounced in a longer time horizon. Second, during periods of heightened uncertainty, for USD-based regressions, investors demand higher excess returns. Third, the dynamic responses of the UIP premium to uncertainty shocks prove that, for USD-based models, excess returns tend to increase in the short run before exhibiting a reversal effect after 12 months. In contrast, in EUR-based models, the UIP premium remains stable at around zero. In general, the results suggest that uncertainty has a significant impact on the UIP puzzle in CEE economies when the US dollar is used as the reference currency.

Streszczenie

W artykule analizowana jest rola niepewności w wyjaśnianiu zagadki niezabezpieczonego parytetu stóp procentowych (UIP) w gospodarkach Europy Środkowej i Wschodniej (CEE) w latach 2008–2022. Zagadka została zbadana dla czterech gospodarek regionu CEE: Czech, Węgier, Polski i Rumunii. Po pierwsze, wykorzystując podstawową regresję Famy, sprawdzono, czy warunek UIP jest spełniony. W drugim modelu przeprowadzono regresje związane ze zmiennymi dotyczącymi niepewności ekonomicznej (takimi jak niepewność polityki gospodarczej i świa-

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towy indeks niepewności). Na koniec, korzystając z lokalnych modeli prognoz (*local projections*), sprawdzono, jak premia UIP reaguje dynamicznie na szok niepewności. Pierwszy wniosek brzmi: warunek UIP sprawdza się lepiej w przypadku dolara amerykańskiego jako waluty referencyjnej, a zagadka UIP jest bardziej widoczna w dłuższym horyzoncie czasowym. Po drugie, w okresach podwyższonej niepewności w przypadku regresji opartych na dolarze amerykańskim podmioty gospodarcze wymagają wyższych nadwyżkowych stóp zwrotu. Po trzecie, dynamiczne reakcje premii UIP na szok niepewności dowodzą, że w modelach opartych na dolarze amerykańskim zwroty nadwyżkowe mają tendencję do wzrostu w krótkim okresie i zaczynają spadać (*reversal effect*) po 12 miesiącach, podczas gdy w przypadku modeli opartych na euro premia UIP utrzymuje się na stabilnym poziomie wynoszącym około zera. Wyniki sugerują, że niepewność ma znaczący wpływ na zagadkę UIP w gospodarkach Europy Środkowo-Wschodniej przy dolarze amerykańskim jako walucie odniesienia.

Słowa kluczowe:
Europa Środkowo-Wschodnia, niepewność polityki gospodarczej, zagadka parytetu stóp procentowych, zagadka UIP, zwroty nadmiarowe

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Introduction

Interest rate parity is an important pillar in the study of international macroeconomics. The uncovered interest rate parity (UIP) theory states that, under conditions of full capital mobility, the average value of excess returns on investments in the international market is zero [**Engel, 2016**]. According to the theory, if the interest rate in one country is higher than the interest rate in another country, it is expected that the currency of the first country will depreciate relative to the currency of the second country [**Kalemli-Özcan, Varela, 2021**]. However, since **Fama** [**1984**], empirical analyses have shown that the UIP condition does not hold. The majority of research proves the existence of positive excess returns when investing in high interest rate currencies.

Risk and uncertainty play a key role in the study of the UIP puzzle. Although the two concepts may appear similar, they differ fundamentally. In a risky situation, such as investing in foreign currency, the probabilities of different outcomes (e.g., appreciation or depreciation) can be estimated. In contrast, uncertainty refers to situations in which outcomes are unknown and their probabilities cannot be calculated [**Knight, 1921**]. **Bekaert et al.** [**2021**] emphasise that uncertainty shocks are closely associated with market downturns and macroeconomic contractions. Concerns about policy uncertainty have become increasingly prominent in the aftermath of the Global Financial Crisis (GFC) [**Baker et al., 2016**]. In the last decade, several major global events have significantly affected uncertainty levels, including Brexit in 2016, US-China trade tensions, the COVID-19 pandemic, and Russia's invasion of Ukraine in 2022. More recently, tariff announcements by US President Donald Trump have led to greater uncertainty [**Gelfand, 2025**]. Furthermore, recent policy announcements by the White House have contributed to the depreciation of the US dollar, which may also affect the UIP puzzle [**Qian, 2025**]. Collectively, these events increase uncertainty, influence currency appreciation and depreciation dynamics, and consequently affect the UIP premium.

The aim of this paper is to investigate the impact of uncertainty on the UIP puzzle. Although advanced economies (AEs) have been widely studied in the literature, emerging market economies (EMEs) are often overlooked [**Engel, 2016**]. Moreover, it seems worthwhile to investigate economies with floating exchange rates, independent monetary policies, and free capital mobility (financial trilemma). To address this gap, this study focuses on the UIP puzzle in four emerging European economies: the Czech Republic, Hungary, Poland, and Romania. Although some research on the UIP puzzle for these economies already exists (see, e.g., **Jiang et al.** [**2013**], **Dąbrowski and Janus** [**2024**]), much remains to be explored in these markets, especially in comparison to the extensive studies conducted on AEs.

This paper makes several key contributions to the existing literature. First, we show that the choice of the time horizon plays a crucial role in the UIP puzzle. Specifically, we examine two baseline regressions with time horizons $t+1$ and $t+12$ and prove that the coefficients of the $t+12$ horizon (an approach adopted in studies such as **Engel** [**2016**], **Kalemli-Özcan and Varela** [**2021**]) are statistically more significant than those obtained from the regression of the time horizon $t+1$ (e.g., as used in **Dąbrowski and Janus** [**2024**]). This finding suggests that the UIP puzzle becomes more pronounced when analysed over a longer time horizon. Second, we demonstrate that the choice of the reference currency significantly influences the insights of the UIP test in CEE economies. Our findings align with the existing literature, which highlights that UIP deviations can vary depending on whether exchange rate dynamics are analysed against the USD or the EUR. For instance, **Dąbrowski and Janus** [**2024**] show that the UIP puzzle is stronger for the EUR as the reference currency, while the relationship between the interest rate differential and excess returns is weaker, when the USD is used in the regression. Our results contribute to this discussion by confirming that after the GFC the selection of the reference currency also plays a crucial role in shaping UIP test outcomes in emerging market economies. Third, uncertainty measurements (WUI and EPU indices) significantly enhance baseline testing regressions. Consistent with the findings of **Gole et al.** [**2024**] (WUI index employed) and **Kalemli-Özcan and Varela** [**2021**] (EPU index employed), our results show that these uncertainty indicators exhibit positive and statistically significant coefficients when the US dollar is used as the reference currency. Additionally, we employ both the WUI and EPU indices and extend the analysis by examining both the USD and the EUR as the reference currencies, which has not been previously explored in this context. We show that both uncertainty indices enhance baseline regression and decrease the standard errors. We demonstrate that they have a positive and statistically significant effect on the UIP premium only when the USD is used as the reference currency. Fourth, the dynamic reactions of the UIP on uncertainty shocks show that while for the USD as the reference currency, the UIP premium tends to increase in the short run and decrease after a period of 12 months (reversal effect), for the EUR as the reference currency, the UIP premium remains at a stable level around zero. In the existing literature, there are studies such as **Kalemli-Özcan and Varela** [**2021**] that demonstrate the dynamic reactions of excess returns to the interest rate differential or EPU shocks on the interest rate differential, and we contribute to the literature with the dynamic reactions of the UIP premium to uncertainty shocks.

The structure of the paper is as follows: Section *Related literature* provides a review of recent studies on the UIP puzzle. Section *Theoretical background* establishes the theoretical framework. Section *Data and models* describes the data used in the analysis and empirical models. Section *Results and analysis* presents the empirical results and discusses the main findings. Finally, Section *Conclusions* concludes the paper and suggests directions for future research in this area.

Related literature

The theoretical framework explaining the UIP puzzle attributes deviations from the UIP condition to several factors, including time-varying risk premia, deviations from rational expectations, and deviations from covered interest parity. With respect to time-varying risk premia, **Engel** [**2016**] argues that, due to exchange rate fluctuations, short-term deposits in countries with relatively high interest rates are perceived as riskier, whereas deposits denominated in investors' domestic currencies are considered risk-free. Consequently, excess returns are a reward for investors bearing exchange rate risk. The ex-ante risk premium must therefore vary over time and covariate with the interest rate differential. Deviations from rational expectations are explained, among other factors, by the so-called "peso problem." In the early 1970s, interest rates on Mexican peso deposits were higher than those on US dollar deposits, even though the exchange rate had remained fixed for more than a decade. Another explanation for deviations from rational expectations involves the role of behavioural expectations, which may influence the effectiveness of monetary and fiscal policy in an open economy and could therefore also impact the UIP puzzle [**Brzoza-Brzezina et al., 2025**].

In this paper, we focus on the key role that uncertainty plays in explaining UIP deviations. Uncertainty has an impact on three fields: it leads to reduced investment due to higher risk aversion; it affects exchange rate and excess returns volatility; and it causes market inefficiency [**Baker et al., 2016**]. The methodology of uncertainty measurements is often complicated. Because of the different types of uncertainty (global vs. domestic, macro vs. micro) there are different approaches used in the studies. Ahir et al. [2022] present three methods that are currently used to measure the level of uncertainty: (1) an approach based on the realised volatility of key economic and financial variables (e.g., volatility of exchange rates); (2) an approach based on text-searching newspaper archives – e.g., the Economic Policy Uncertainty (EPU) Index, the World Uncertainty Index (WUI); (3) an approach based on capturing the uncertainty that business executives have about the sales outlooks of their own firms. In this paper, the second approach is applied.

There are studies aiming to explain positive excess returns by global and local uncertainty indicators. Gole et al. [2024] show that during periods of uncertainty, the behaviour of excess returns diverges between EME and AE currencies. Uncertainty levels tend to be higher in developing countries, while advanced economies exhibit greater synchronisation due to their stronger trade and financial connections. Specifically, deviations from the UIP condition tend to widen for EMEs and narrow for AEs. This pattern is explained in the literature by the fact that EMEs are seen as *risky* countries (see e.g. Engel [2016], Dąbrowski and Janus [2024]). Itskhoki and Mukhin [2021] indicate that risk aversion influences changes in currency flows, capital flows and international investments. Therefore, changes in uncertainty affect the level of excess returns.

These findings align with the idea that, during uncertain times, global investors can adjust their risk preferences, shifting from high-risk currency investments in EMEs to safer options in AEs (a phenomenon known as *flight to safety)* [Janus, 2023]. This pattern has become more visible since the GFC. An essential aspect of the UIP study is its behaviour within the business cycle, which is related to the levels of uncertainty. The key finding in this case is that the UIP condition holds better during crises, when the volatility of interest rates and exchange rates is higher [Flood, Rose, 2002; Clarida et al., 2009]. Additionally, high interest rate currencies tend to depreciate, which is indicated by the UIP theory. During periods of high volatility, the currency with the lower interest rate tends to appreciate [Clarida et. al, 2009].

Uncertainty measured by the EPU index for EMEs is examined in a study presented by Kalemli-Özcan and Varela [2021]. It demonstrates that increasing the uncertainty of economic policy is associated with a higher UIP premium. The findings for CEE economies presented by Dąbrowski and Janus [2024] suggest that investors' risk aversion (measured by realised exchange rate volatility, VIX and EPU indices) is time-varying. The latest research presented by Janus [2025] shows that global risk-on/risk-off shocks generate positive but temporary impacts on excess returns in CEE countries.

In general, in the current literature, more emphasis is placed on the impact of risk on the level of the UIP premium than on the impact of uncertainty on the UIP premium. No research has been conducted on the impact of different measures of uncertainty (as distinct from risk) on CEE countries. To cover this gap, this article analyses the impact of uncertainty (measured by the WUI and EPU) on the UIP premium. Given the differences between the sources used to construct the WUI and EPU (with the WUI relying on country-specific reports emphasising economic and political developments, while the EPU is based on newspapers that also cover global news), a possible explanation for the differences in correlations is that the EPU index places greater weight on global events than the WUI, making it more global in nature [Ahir et al., 2022].

Theoretical background

Uncovered interest-rate parity (UIP) is one of the key theories adopted in analytical work in both international finance and international monetary economics [Lothian, Wu, 2003]. The UIP assumes free capital mobility and unrestricted access of households to international funds [Schmitt-Grohé et al., 2022]. If the exchange rate s_t is defined as units of domestic currency per foreign currency (e.g., EUR 1 = PLN 4.20), its increase will reflect a depreciation of the domestic currency. On this assumption, the UIP condition follows the below equation:

$$(i_t - i_t^*) - (s_{t+h}^e - s_t) = 0 \tag{1}$$

where $(i_t - i_t^*)$ is the interest rate difference between the interest rate in the home currency (i_t) at time t and the foreign currency (i_t^*) and $(s_{t+h}^e - s_t)$ is the expected exchange rate adjustment during the time horizon from t until $t+h$.

The UIP condition from Eq. (1) states, that under the assumption of free capital mobility, the domestic currency interest rate should be equal to the foreign currency interest rate adjusted by the expected depreciation of the domestic currency $(i_t = i_t^* + (s_{t+h}^e - s_t))$. However, empirical studies increasingly disprove the existence of UIP, even if the assumption of full capital mobility is met [**Hassan, Zhang, 2021**]. This means that the UIP condition does not hold and the difference between the interest rate differential and exchange rate adjustment is positive – a UIP premium (excess returns) exists. Such scenario is described in the literature as the *UIP puzzle*. **Bansal and Dahlquist** [**2000**] define the UIP puzzle as a situation in which the observed direction of exchange rate changes is opposite to the one suggested by the UIP theory. In the literature, one also encounters the terms *Fama puzzle*, associated with the influential work of **Fama** [**1984**], and *forward premium puzzle*, since, under certain assumptions, the UIP puzzle implies that the forward premium is connected to exchange rate appreciation – instead of depreciation, as in the UIP condition [**Kalemli-Özcan, Varela, 2021**]. Under the condition of rational expectations (when $s_{t+h} = s_{t+h}^e$) the UIP premium can be described as follows:

$$\rho_{t+h} = (i_t - i_t^*) - (s_{t+h} - s_t) \tag{2}$$

There are three key theoretical explanations for UIP deviations: (1) a time-varying risk premium, (2) deviations from rational expectations, and (3) deviations from covered interest rate parity (CIP). In this study, we employ the first approach. In the empirical analysis, [**Engel, 2016**] proves that countries with higher interest rates have higher returns on short-term securities (Engel points to a horizon of a week or a quarter). This means that short-term deposits in a high-interest-rate country are riskier – chiefly due to changes in exchange rates since deposit rates in investors' local currencies are considered risk-free. Therefore, the expected positive excess return from investing in a high-interest-rate currency is a risk premium – reward for taking on disaster risk. Especially in times of increased uncertainty, heightened risk can lead to greater risk aversion among investors, prompting them to delay investment decisions and/or demand higher excess returns as compensation for taking on currency risk [**Gole et al., 2024**].

Data and models

In this section, the data sources, key variables and econometric models used in the analysis are described.

Data description

We employ daily interest rate and exchange rate data from the Refinitiv Eikon database (previously Reuters). For all currencies, interbank interest rates on 1-month and 1-year deposits are taken. Following [**Engel, 2016**] equation, the interest rate per month is constructed for regressions with the $t+1$ time horizon.

$$i_{mon} = \left(\left(1 + \frac{i_{year}}{100}\right)^{\frac{1}{12}}\right) - 1 \tag{3}$$

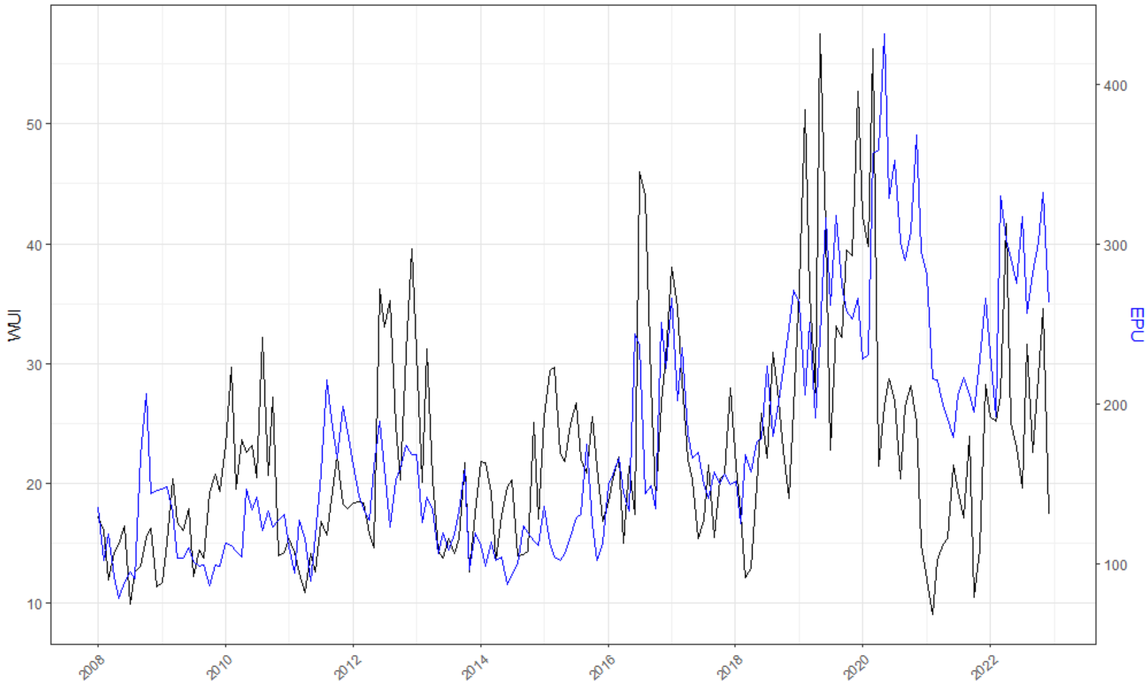
To construct exchange rate differentials, we calculate the difference of the logarithms of daily exchange rates. Then we take the last observations for each month for both interest rates and exchange rates.

In this article, two uncertainty indices are employed: WUI and EPU. WUI was constructed by **Ahir et al.** [**2022**] for 143 individual countries. The index measures how often the term *uncertainty* (including its variations) appears in EIU country reports. To ensure comparability across countries, the raw counts are scaled by the total word count in each report, expressed as the number of times the word "uncertainty" appears per thousand words. For the analysis in this paper, the global index was also expressed per thousand words. The EPU

Index developed by Baker et al. [2016] quantifies economic uncertainty by tracking the frequency of 10 leading US newspaper articles containing a predefined set of keywords related to the economy, policy, and uncertainty. The differences in the sources of both WUI (country-specific reports) and EPU (US articles covering also major global events) suggest that the EPU index is inherently more global in nature compared to the WUI.

Figure (1) compares two uncertainty indices: WUI and EPU. The correlation between these indicators is 0.46. Both increased following the Global Financial Crisis (GFC). However, EPU surged more significantly in 2009, while the WUI saw a notable rise in 2010. Both indicators peaked after the Brexit referendum in 2016 and the US elections. Further increases for WUI occurred in 2019 due to US-China trade tensions and ongoing Brexit developments. At that time, EPU remained at a lower level. During the COVID-19 pandemic, both indices indicated high levels of uncertainty. However, WUI dropped rapidly in 2021, whereas EPU remained elevated. Similarly, during the Russia-Ukraine conflict, EPU stayed at a high level, while the WUI declined.

Figure 1. World Uncertainty Index and Economic Policy Uncertainty Index after Global Financial Crisis



Source: Author's own elaboration.

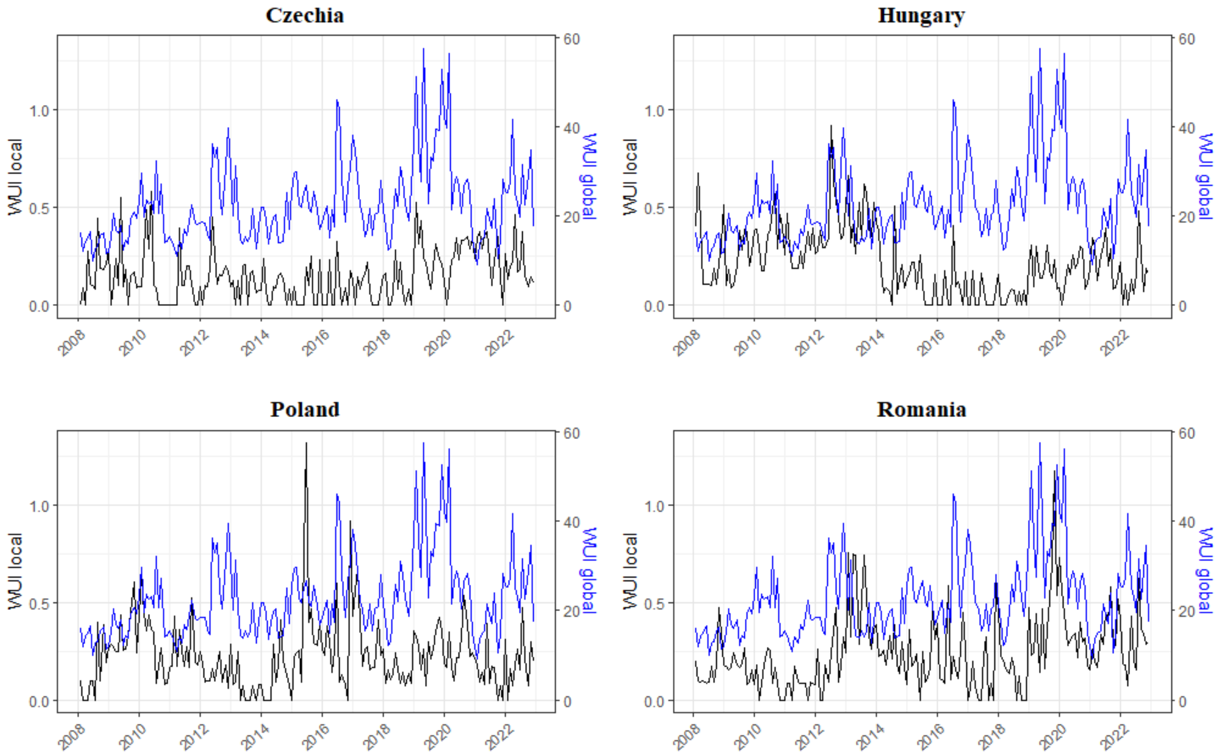
To highlight the differences between the local and global uncertainty indices and between the economies analysed, a comparison of local and global peaks in four analysed CEEs is presented in Figure (2).[1] This chart reveals several key findings. First, both local and global WUI are characterised by high volatility over time, with periodic spikes indicating episodes of heightened uncertainty. Second, the global WUI (blue line) tends to have sharper spikes, particularly around global crises, whereas the local WUI (black line) remains more stable but follows a similar trajectory. Third, major peaks are observed around 2009–2010 (GFC), 2016 (Brexit and geopolitical tensions), 2020 (COVID-19 pandemic), and 2022 (Russia-Ukraine war). Fourth, country-specific observations show that the local WUI of the Czech Republic and Hungary are in harmony with the global WUI, indicating that these economies are sensitive to global events, while Poland is not synchronised with the global indicator. Romania's local WUI is smoother and aligns with global peaks during major crises.

Local WUI indices differ across economies. Country-specific uncertainty peaks are driven not only by global events but also by domestic economic and political uncertainty. Uncertainty levels in the Czech

[1] There is no data available for the local EPU indices for the analysed economies.

Republic remain consistently lower than in the other three economies throughout the period, with peak values not exceeding 0.6 points. The first significant increase in local uncertainty in Hungary is associated with the results of the Fidesz referendum, while most subsequent peaks correspond to periods of economic uncertainty between 2009–2014 and 2019–2022. In Poland, the highest peak occurred in 2015 and was driven by political uncertainty surrounding referendums proposed by then-President Bronisław Komorowski, followed by uncertainty related to the transition of power to the Law and Justice party. The most pronounced spike in Romania is observed during the COVID-19 pandemic, with uncertainty levels two to three times those in the other CEE economies.

Figure 2. World Uncertainty Index – global and local measurements over time



Source: Author's own elaboration.

Models specifications

Based on the interest rate parity condition described in Section Theoretical background we construct the baseline forward premium regression model:

$$\rho_{t+h} = \mu + \beta(i_t - i_t^*) + \varepsilon_{t+h} \tag{4}$$

where ε_{t+h} *is i.i.d*$N(0, \sigma^2)$. If $\beta = 0$, it means that interest rate parity holds. $\beta > 0$ indicates positive excess returns, meaning the existence of the UIP puzzle.

In the next step, the baseline forward premium regression is augmented with the uncertainty measurements (WUI and EPU indices). The inclusion of these variables in the regression is rooted in theoretical explanations for the failure of UIP. Uncertainty levels are likely to vary along with financial and business cycles in the global economy due to shared drivers of volatility. Accordingly, eq. (5) extends the baseline Fama regression as follows:

$$\rho_{t+h} = \mu + \beta(i_t - i_t^*) + UNC_t + \varepsilon_{t+h} \tag{5}$$

where UNC_t is given by the WUI or EPU index.

In the next model, we employ the *Local Projections* (LP) approach introduced by **Jorda [2005]** to analyse the dynamic effects of uncertainty shocks on excess returns. Unlike vector autoregressions (VAR), LPs offer greater flexibility by estimating impulse response functions (IRFs) directly at each forecast horizon, reducing the risk of misspecification. The model is estimated using Ordinary Least Squares (OLS) with heteroskedasticity and autocorrelation consistent (HAC) standard errors [**Newey, West, 1987**] to ensure robust inference. The IRFs are obtained by plotting β across different horizons.

The baseline LP equation is the following:

$$\rho_{t+h} = \alpha + \beta_h X_t + \varepsilon_{t+h} \tag{6}$$

where: β_h means the impulse response at the h horizon and X_t is the shock variable (normalised residuals from AR(3) process for WUI and normalised residuals from AR(4) process for EPU variables) at the time t[2]. The normalised residuals were tested and found to exhibit no autocorrelation. They were also tested for stationarity, which allowed for the application of the Granger causality test. The correlation analysis and Granger causality tests indicate that the residuals are exogenous to ρ_{t+h}, implying that excess returns cannot be predicted using these shocks. Furthermore, the realised volatility of exchange rates and the VIX index are also exogenous to the "shock" variable for all pairs at p-value = 0.05, indicating that the shocks cannot be predicted by either exchange rate fluctuations or the VIX index.

Results and analysis

In this section, the model results are presented, and the relationship between the empirical findings and the theoretical framework is analysed. The first part of the section presents the empirical results of the baseline Fama regressions for CEE countries, distinguishing between two time horizons: $t+1$ and $t+12$, and two reference currencies: the EUR and the USD. In total, 16 regression models are analysed. The second part presents models augmented with uncertainty factors, namely the WUI and EPU indices. From this point onward, models are performed based on the chosen time horizon for the more statistically significant β. In the third subsection, dynamic reactions of UIP to uncertainty shocks are analysed.

Fama regressions

The baseline Fama regressions are analysed for four CEEs with the EUR and USD as reference currencies. The literature identifies two main approaches in terms of the time horizon adopted to perform such regressions (1) $t+1$ and (2) $t+12$. In this study, both approaches are examined, and the specification with the more statistically significant coefficients is selected for the remaining models.

The main finding, based on the results presented in Table (1), is that the UIP condition does not hold, indicating the existence of the UIP puzzle. This observation means that an increase in the interest rate differential between domestic and foreign interest rates leads to an appreciation of the domestic currency rather than a depreciation as suggested by the UIP condition. Furthermore, the coefficients of the model with time horizon $t+12$ are more statistically significant than those estimated for the $t+1$ time horizon. Only two currency pairs, USDCZK and USDPLN, are not statistically significant for the $t+12$ horizon, while only one pair, EURCZK, is statistically significant for the $t+1$ horizon. These results show that excess returns adjust more strongly to interest rate differentials over longer horizons. The UIP puzzle is stronger for the $t+12$ horizon and therefore requires further explanation. For this reason, the $t+12$ horizon is used in the remaining models to explain the UIP puzzle. Another important observation is that the EUR-based regressions exhibit more statistically significant coefficients than those with the USD as the reference currency. The USD-based regressions generally show weaker effects compared to the EUR-based regressions, with some coefficients

[2] The lag order was chosen based on the lag precision function.

being statistically insignificant or even negative (though only for the $t+1$ horizon). Among the regressions estimated using the $t+12$ horizon, the strongest effect of the interest rate differential on excess returns is found for the EURPLN pair ($\beta = 2.93$), while the weakest effect is observed for the USDRON pair ($\beta = 0.67$).

Table 1. Fama regressions for CEE with time horizons t + 1 and t + 12

	ρ_{t+1}		ρ_{t+12}	
	Constant	IR	Constant	IR
EURCZK	0.0001 (0.0015)	**1.4942**** (0.6733)	−0.0047 (0.0110)	**1.7210***** (0.4062)
EURHUF	−0.0032 (0.0022)	1.3221 (0.8356)	−0.0450*** (0.0139)	**1.5260***** (0.2692)
EURPLN	−0.0020 (0.0029)	1.2625 (1.2218)	−0.0634** (0.0322)	**2.9297***** (0.9836)
EURRON	0.0001 (0.0028)	0.4795 (1.1176)	−0.0124* (0.0075)	**0.8530***** (0.2622)
USDCZK	−0.0005 (0.0026)	−0.6569 (2.2862)	−0.0159 (0.0179)	0.5782 (1.4063)
USDHUF	−0.0051* (0.0029)	1.4555 (1.2654)	−0.0535** (0.0235)	**1.2057**** (0.5353)
USDPLN	0.0001 (0.0036)	−1.0033 (2.3008)	−0.0244 (0.0178)	0.2529 (1.0769)
USDRON	−0.0016 (0.0032)	0.4086 (1.3356)	−0.0269 (0.0182)	**0.6713*** (0.3834)

Notes: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

Source: Author's own elaboration.

Regressions augmented with uncertainty indices

Due to the fact that excess returns are not solely driven by interest rate differentials and the key role that uncertainty plays in the UIP puzzle, in the next model, the baseline Fama regression is extended to include the uncertainty variables. The exchange rate movements and UIP premium could be influenced by economic uncertainty, policy uncertainty, and market sentiment. Uncertainty measurements, such as the WUI and EPU indicators, would help capture these effects and improve the explanatory power of the model helping to explain deviations from UIP.

The analysis of regressions augmented with uncertainty measurements (Table 2) yields several observations. The most important finding is that higher uncertainty leads to a larger UIP premium, This result is in line with the risk-based theory proposed by [Engel, 2016], according to which elevated uncertainty results in greater risk aversion and raises investors' expectations of higher excess returns as compensation for bearing currency risk. Another significant observation concerns the choice of reference currency. The coefficients estimated for both WUI and EPU are statistically significant only in the USD-based regressions. This means that these uncertainty measures do not significantly affect excess returns in regressions using the euro as the reference currency. Finally, augmenting the regressions with uncertainty variables improves the results by reducing the standard errors of the interest rate differential.

Table 2. Regressions augmented with uncertainty indices

	Model I			Model II		
	Constant	IR	WUI_global	Constant	IR	EPU
EURCZK	0.0024 (0.0163)	**1.7668***** (0.4010)	−0.0003 (0.0007)	−0.0165 (0.0215)	**1.4586***** (0.5421)	0.0001 (0.0001)
EURHUF	**−0.0590**** (0.0274)	**1.5574***** (0.2563)	0.0006 (0.0009)	**−0.0609**** (0.0253)	**1.5334***** (0.2405)	0.0001 (0.0001)

cont. Table 2

	Model I			Model II		
	Constant	IR	WUI_global	Constant	IR	EPU
EURPLN	−0.0699 (0.0480)	**2.8409*****(0.8442)	0.0004 (0.0011)	**−0.0884*** (0.0485)	**2.8582***** (0.8912)	0.0002 (0.0001)
EURRON	**−0.0318*** (0.0163)	**0.9198***** (0.2763)	0.0008 (0.0007)	−0.0223 (0.0161)	**0.8915***** (0.2554)	0.0001 (0.0001)
USDCZK	**−0.1116***** (0.0362)	1.0052 (1.2589)	**0.0042***** (0.0014)	**−0.1156***** (0.0419)	0.1991 (1.3058)	**0.0006***** (0.0002)
USDHUF	**−0.1823***** (0.0462)	**1.6736***** (0.4368)	**0.0052***** (0.0016)	**−0.1601***** (0.0444)	**1.5209***** (0.4457)	**0.0006***** (0.0002)
USDPLN	**−0.1470***** (0.0418)	1.1381 (0.9118)	**0.0048***** (0.0016)	**−0.1546***** (0.0443)	1.4718 (1.0036)	**0.0006***** (0.0002)
USDRON	**−0.1566***** (0.0392)	**1.1805**** (0.4853)	**0.0050***** (0.0013)	**−0.1250***** (0.0420)	**1.0866**** (0.4378)	**0.0005***** (0.0002)

Notes: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Source: Author's own elaboration.

The regressions with uncertainty indices shown in Table (2) primarily consider global uncertainty measures. To check how excess returns react to local uncertainty, in the next step, we analyse the results presented in Table (3). The key observation is that, for most currency pairs, the local WUI variable is not statistically significant. A positive and statistically significant effect of local WUI on the UIP premium is observed only for the EURRON, USDPLN and USDRON pairs. In contrast, a statistically significant negative coefficient for local WUI is found for EURHUF. Although one might expect local uncertainty to exert a stronger influence on excess returns, the general conclusion is that local uncertainty does not have a substantial impact on the UIP premium. Due to its limited explanatory power, this variable is excluded from the subsequent models.

Table 3. Regressions augmented with WUI_local measurements

	Constant	IR	WUI_local
EURCZK	−0.0084 (0.0108)	**1.6393***** (0.3763)	0.0330 (0.0391)
EURHUF	**−0.0329***** (0.0115)	**1.6838***** (0.2056)	**−0.0771***** (0.0246)
EURPLN	**−0.0773**** (0.0350)	**2.9163***** (0.7148)	0.0679 (0.0531)
EURRON	**−0.0211***** (0.0069)	**0.8853***** (0.3122)	**0.0338*** (0.0196)
USDCZK	−0.0316 (0.0236)	0.4337 (1.4880)	0.1158 (0.0818)
USDHUF	−0.0412 (0.0259)	**1.3938**** (0.5476)	−0.0724 (0.0656)
USDPLN	**−0.0702**** (0.0283)	0.5179 (1.0810)	**0.1918**** (0.0899)
USDRON	**−0.0513*** (0.0265)	**0.7874*** (0.4223)	**0.0910*** (0.0502)

Notes: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

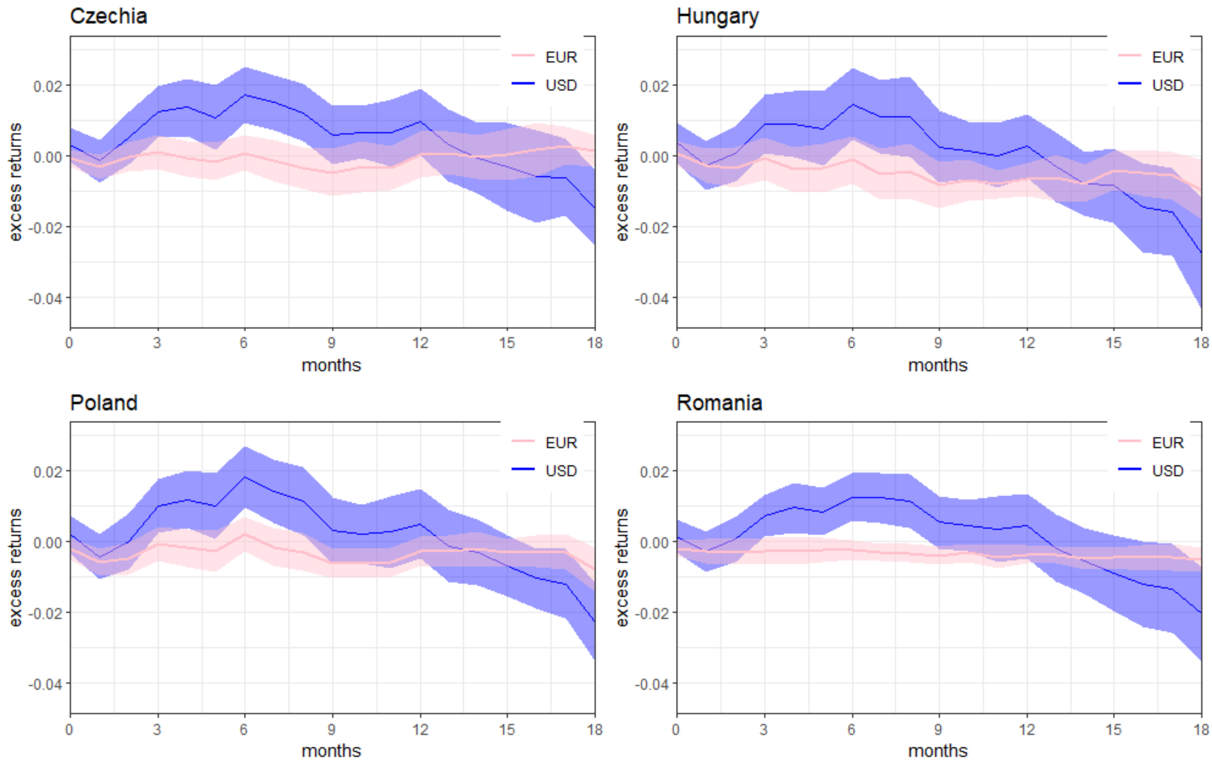
Source: Author's own elaboration.

Local projections

To capture the dynamic responses of the UIP premium to shocks in global uncertainty, measured as normalised residuals from the AR (3) process for the global WUI and AR (4) process for the EPU variables, Figures (3) and (4) present Impulse Response Functions (IRFs) estimated using local projections (LP) models. The IRFs illustrate how the UIP premium changes over an 18-month horizon following an uncertainty shock.

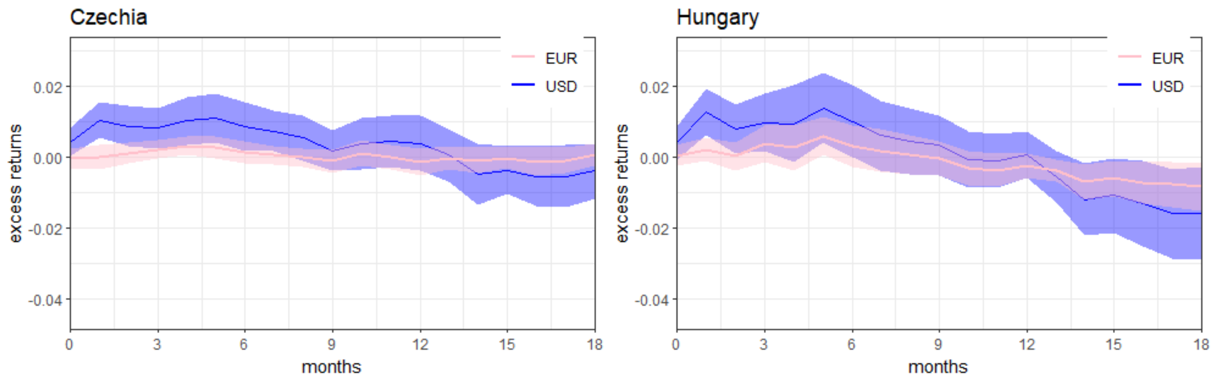
For both indices, when the US dollar serves as the reference currency (blue line), the UIP premium tends to increase in the short run (up to six months) and decline thereafter. This pattern indicates positive excess returns in the short term and a potential reversal effect after 12 months. By contrast, when the euro is used as the reference currency (pink line), the UIP premium remains stable across all currencies, exhibiting only minor fluctuations. The relationship between global uncertainty shocks and the UIP premium is stable, suggesting that excess returns are less affected by uncertainty shocks with the euro as the reference currency. The USD-UIP premium reacts more strongly to uncertainty shocks, implying that local assets are riskier in times of global uncertainty when the investors' currency is the US dollar. The reactions of the UIP premium to shocks measured by the two indices are broadly similar.

Figure 3. Response of the UIP premium to uncertainty (WUI) shocks

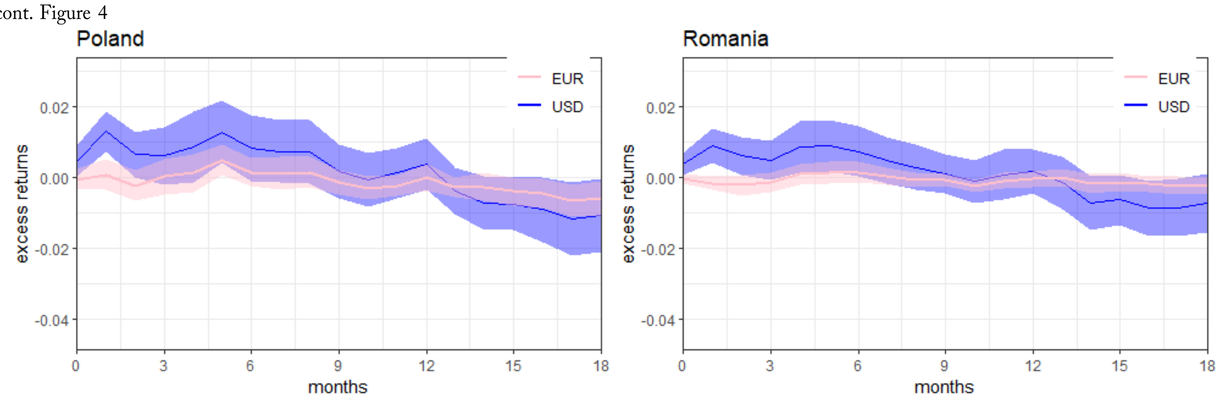


Source: Author's own elaboration.

Figure 4. Response of the UIP premium to uncertainty (EPU) shocks



cont. Figure 4



Source: Author's own elaboration.

Conclusions

This article highlights the role of uncertainty in explaining the UIP puzzle in CEE economies after the Global Financial Crisis. First, we confirm that the choice of a 12-month horizon significantly impacts the estimated coefficients in UIP regressions, indicating that the UIP puzzle becomes more pronounced over longer periods. Consequently, the analysis focuses on the 12-month specification. Furthermore, we demonstrate that the choice of reference currency influences the outcomes of UIP tests, with USD-based regressions showing a weaker effect of the interest rate differential on the UIP premium.

Additionally, incorporating uncertainty measures such as the World Uncertainty Index (WUI) and the Economic Policy Uncertainty Index (EPU) enhances the baseline regressions by reducing the standard errors for the interest rate differential, thereby strengthening coefficient significance and improving the explanatory power of the models. Similar to previous findings, we observe that uncertainty variables have a positive and statistically significant effect, particularly when the US dollar serves as the reference currency, indicating that investors demand higher excess returns during periods of heightened uncertainty.

The application of the local projections approach ensures better understanding of the dynamic responses of the UIP premium to uncertainty shocks. The results indicate that, in USD-based regressions, the UIP premium increases during the first six months following a shock and subsequently declines, leading to a reversal effect after 12 months. In contrast, when the euro serves as the reference currency, the UIP premium remains stable throughout the entire time horizon.

Overall, our results suggest that uncertainty has a significant impact on the UIP puzzle in CEE economies for the US dollar as the reference currency. The findings are also strongly influenced by the selected time horizon. Future research could further investigate the role of financial market integration in shaping UIP deviations in emerging European markets, as well as the impact of behavioural expectations on the UIP puzzle.

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