Empirical Paper

Jakub Borowski, Krystian Jaworski*

The Russian invasion of Ukraine and the exchange rate of the Polish zloty: A fallacy of monetary autonomy?

https://doi.org/10.2478/ijme-2023-0026
Received: July 6, 2023; accepted: December 6, 2023

Abstract: We use the Twitter application programming interface to construct a novel indicator capturing the varying perceptions of geopolitical risk related to the war in Ukraine. We show that the Twitter variable is a statistically significant determinant of the EUR/PLN exchange rate following the invasion. We estimate that the war in Ukraine was responsible for an increase in the EUR/PLN exchange rate of about 5.0% in the first 2 weeks following its breakout and that the weakening of PLN contributed to an increase of headline inflation in Poland by about 0.33 percentage points. Our findings suggest that monetary policy autonomy can be substantially constrained due to conflicts in nearby countries. Therefore, they provide an argument for Poland in seeking Eurozone membership as a way to contain the impact of geopolitical factors on exchange rate volatility, which is likely to remain at play in the longer run.

Keywords: conflict, currency volatility, geopolitical risk, regional spillovers, the Russia–Ukraine war
JEL Classification: F31, F51, G15

1 Introduction

Russia's invasion of Ukraine in February 2022 has led to a rapid increase in geopolitical risk. The war between Russia and Ukraine has also raised concerns regarding the economic and security-related ramifications of this conflict for neighboring countries. These concerns are particularly lively in Poland, whose land borders with countries involved in the conflict (Belarus, Russia, and Ukraine), is long (1,155 km), and constitutes a large share of Poland's total land border (38%). These worries have occurred despite low exposure to external negative demand shock due to limited trade and capital linkages between Poland and the aforementioned states, as well as the more than two-decade long membership of Poland in the North Atlantic Treaty Organization (NATO). The uncertainty regarding the possible consequences of the war is reflected in the violent rise of costs of hedging against the risk of Poland's default on US dollar-denominated government debt, i.e., an increase in credit default swaps (CDS, see Figure 1).

Another vivid consequence of the outbreak of the war is the significant depreciation of the Polish zloty. The slide of currency in the aftermath of the Russian invasion was inconsistent with the tightening of monetary policy that had been conducted since October 2021, as a response to the buildup of significant inflationary pressure. Following the last prewar meeting of Poland's Monetary Policy Council in February 2022, the statement "zloty appreciation would be consistent with the direction of monetary policy conducted

***Corresponding author: Krystian Jaworski,** Collegium of World Economy, SGH Warsaw School of Economics, Warsaw, Poland. E-mail: kjawor@sgh.waw.pl
Jakub Borowski, Collegium of World Economy, SGH Warsaw School of Economics, Warsaw, Poland.

Open Access. © 2024 Borowski and Jaworski, published by Sciendo.
This work is licensed under the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 License.

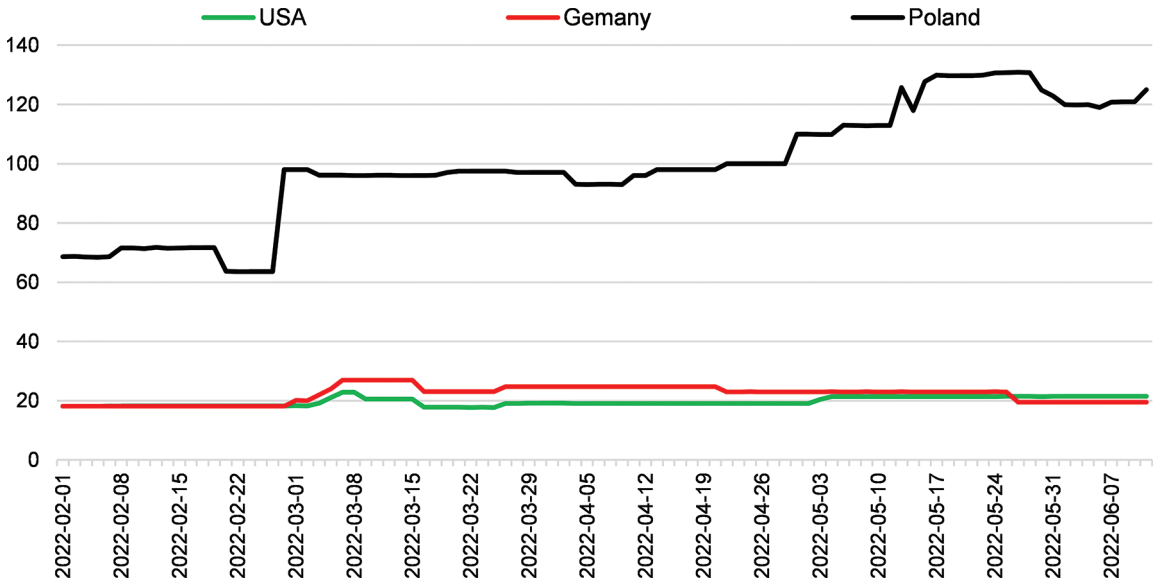


Figure 1. Credit default swaps for US dollar-denominated 10-year government bonds.
Source: Refinitiv.

by the NBP [National Bank of Poland]" was a part of the postmeeting press release. A rapid fall of the Polish currency triggered by the outbreak of the war provided an even stronger underpinning for this statement.

The sizable depreciation of the Polish zloty caused by Russia's invasion of Ukraine suggests that even within the framework of a floating exchange rate regime, monetary policy autonomy can be substantially constrained due to conflicts in nearby countries. In other words, repeated geopolitical jitters can generate large shocks to the currencies of countries whose geographical location makes them particularly susceptible to such shocks. This conclusion is consistent with the Mundell II framework. It postulates that in a world with free capital flows, the floating exchange rate does not always act as a stabilizing force and becomes a source of asymmetric shocks [Mundell, 1973; De Grauwe, 2006], and there is ample empirical evidence pointing to disconnection between the exchange rates and their fundamental values [De Grauwe and Grimaldi, 2006]. In small open economies with floating exchange rates, these shocks increase output and inflation volatility and render the central bank's task to maintain price stability much more difficult. Morvillier [2020] shows that higher currency undervaluations magnify the negative impact of inflation on growth, as an undervalued currency implies additional cost-push inflation. Addressing such exchange rate shocks with interest rate increases may prove to be ineffective and even counterproductive, as large and short-lived swings in interest rates may add to increased market volatility, thus magnifying exchange rate gyrations. Therefore, elevated exchange rate volatility induced by a protracted war or recurring military conflicts in neighboring countries may reduce the benefits of autonomous monetary policy as a tool of mitigating demand shocks and delivering price stability. This, in turn, would suggest that the costs of monetary integration arising from giving up the domestic interest rate policy may be lower for countries bordering with an area laden with long-term military tensions.

The power of the arguments in favor of reduced monetary policy effectiveness in countries highly exposed to geopolitical risk requires empirical verification. To this end, in this study, we assess the influence of Russia's invasion of Ukraine on the weakening of the EUR/PLN exchange rate. To broaden the analysis of monetary policy-relevant implications of the increased geopolitical risk, we also examine the impact of the war-driven zloty depreciation on headline inflation in Poland. We use the Twitter application programming interface (API) to construct a novel indicator capturing the varying relevance of the war in Ukraine for the public in Poland and serving as a proxy for changes in geopolitical risk. We show that the war in Ukraine was responsible for a sizable increase in the EUR/PLN exchange rate in the first 2 weeks after the invasion, which contributed to a significant rise in headline inflation after the outbreak of the war. Our results show that monetary policy autonomy can be substantially limited due to protracted military conflicts in

neighboring countries, a finding that suggests that the potential long-term impact of geopolitical factors on the degree of freedom in monetary policy-making should be included in the calculus of costs of monetary integration.

The remainder of the paper is structured as follows: Section 2 provides a short review of related literature, Section 3 presents the data and preliminary analysis, and Section 4 shows the main empirical results. Finally, Section 5 contains some concluding comments and policy implications.

2 Literature review

Our study is related to two rising strands of research. Firstly, we contribute to the literature on the economic spillover effects of regional conflicts in neighboring countries. Ades and Chua [1997] show that regional instability in neighboring countries, proxied by the average number of revolutions and coups per year of all the countries in the defined region, disrupts trade flows. Murdoch and Sandler [2002] use a neoclassical growth model to empirically test the influence of a civil war on steady-state income per capita in neighboring countries. They conclude that the observed short-term negative growth effects of civil wars result from factors such as uncertainty and direct disruption of economic activity, and the countries most at risk are those with longer contiguous borders with nations in civil conflict. They extend this account by showing that the distance from the conflict is the most accurate measure of the diffusion of the negative economic effects of civil wars on other countries [Mardoch and Sandler, 2004]. They estimate that a nearby civil war reduces the per capita growth of the neighboring country by 30% and 24%, respectively, of the growth reduction in the country in civil war in the long and short run. De Groot [2010] revisits the analyses executed by Mardoch and Sandler [2004], concluding that directly contiguous countries suffer from the negative effects of proximate conflicts, but noncontiguous countries can benefit from the conflict, which is even more so for the countries that are closer to the conflict country. Dunne and Tian [2015] argue that studies that use only geographical distance measures may overestimate the impact of the conflicts on neighbor countries and show that negative spillover effects are smaller when bilateral trade intensities and political similarities between the countries in conflict and countries affected by the spillover effects are considered. Quershi [2013] examines the impact of internal and external armed conflicts in contiguous states on international trade and show a significant disruptive effect of both intrastate and international conflicts on the bilateral trade of neighboring countries, even if the country is not involved in any conflict itself. He shows that the decline in trade caused by an intrastate or international conflict in the neighborhood of two countries at war is about 3%–6%. He estimates that it takes bilateral trade about 5 years from the end of international conflict in neighboring states to recover. Aliu et al. [2022] analyze the impact of the Russian ruble depreciation against the euro on the exchange rates of the euro against the US dollar, Japanese yen, British pound, and Chinese yuan in the period from November 1, 2021 to May 1, 2022. They show that the depreciation of the ruble against the euro arising from the Russian invasion of Ukraine caused the weakening of the euro against the analyzed currencies, thus exposing the fragility of the European financial system to external shocks. Taken together, the results of these studies point to significant economic spillover effects of regional conflicts on the neighboring countries seen from the perspective of growth, trade, and exchange rate developments. Our work contributes to this line of research by highlighting the impact of the external conflict on inflation in neighboring states exerted via the exchange rate channel.

Our work also connects to the emerging strand of research on the impact of geopolitical risk on exchange rates. The geopolitical risk can be defined as "the threat, realisation, and escalation of adverse events associated with wars, terrorism, and any tensions among states and political actors that affect the peaceful course of international relations" [Caldara and Iacoviello, 2022]. Kisswani and Elian [2021] show that the global geopolitical risk index obtained from Caldara and Iacoviello [2018], based on the number of occurrences of words linked to geopolitical tensions that appeared in 11 of the foremost international newspapers from January 1985 to date, tends to have symmetric long-term effects on five US dollar-based exchange rates of Canada, China, Japan, Republic of Korea, and the UK (the same exchange rate response

in percentage terms to increase or decrease of the geopolitical risk index by 1%) and short-term asymmetric effect on the Republic of Korea's won and the UK's pound. Hui [2022] uses the same index for augmenting the theoretical exchange rate models and shows that geopolitical risk drives the US dollar-based exchange rates of the Malaysian ringgit, Indonesian rupiah, Thai baht, and Philippine peso in the long run, and higher geopolitical risk leads to depreciation of these currencies. Iyke et al. [2022] use country-specific geopolitical risk indices developed by Caldara and Iacoviello [2018] for 17 emerging market economies and show that geopolitical risk predicts 59% of exchange rate returns in in-sample tests, and 88% in out-of-sample tests. Salisu et al. [2022] analyze the predictability of global and country-specific geopolitical risk indices developed by Caldara and Iacoviello [2019] for exchange rate volatility of BRICS countries (Brazil, Russia, India, China, South Africa). They find that the BRICS exchange rates are more vulnerable to recent data than historical data. What is more, global geopolitical risk measures have a stronger effect on BRICS exchange rates than country-specific indices of geopolitical risk. Dodd et al. [2022] estimate the impact of the elevated geopolitical risk around Russia's invasion of Ukraine on the performance of exchange rates of the US dollar against 31 currencies classified by IMF as free-floating or floating. They capture the degree of geopolitical risk using measures of political exposure (past Eastern bloc membership, NATO membership, and being listed as one of Russia's "unfriendly" countries), geographic distance to the war (between Kyiv and the country's capital), and economic proximity to the war (intensity of bilateral trade with Russia). They show that the currencies of former Eastern bloc members are more sensitive to the elevated geopolitical risk related to the invasion, as they depreciate more from the outset of the war. They also find that before and during the war, the geographic distance is the only significant country-level determinant of currency returns. This result suggests that the term "proximity penalty," coined by Federle et al. [2022] to describe the importance of the distance to the Ukraine conflict for the stock markets' reaction, can be extended to the currency market. In sum, recent research reveals the rising relevance of the geopolitical risk for exchange rate volatility. We contribute to this literature by introducing a country-specific variable based on Twitter messages, which serves as a proxy for investors' perception of geopolitical risk in Poland before and after the outbreak of the war in Ukraine.

3 Material and methods

Our analysis focuses on the determinants of the Polish zloty vs. the euro exchange rate (EUR/PLN) during Russia's invasion of Ukraine in 2022. In April 2022, Russia withdrew its forces from around Kyiv. By June 2022, the military operations had concentrated in the east and south of Ukraine. The geographical shift of the military conflict significantly further away from the Polish–Ukrainian border contributed to weakening its impact on market sentiment and the EUR/PLN exchange rate (in line with the decreased "proximity penalty" mentioned in the literature review). Our dataset spans from February 23, 2022 (the day before the breakout of the war) up to June 10, 2022 (the latest data available at the time of writing). Despite the initial shortness of the time sample, by using data in daily frequency we have enough data points (78 daily observations) to ensure proper econometric modeling.

The array of potential explanatory variables is limited almost solely to financial market indicators (available daily) due to shortness of the aforementioned sample. Macroeconomic indicators are usually available monthly, which means that that there would only be four to five observations pertaining to the period of the war in Ukraine, effectively ruling out the use of econometric analysis. Also, the volatility of the EUR/PLN exchange rate in that period was significant. Therefore, by aggregating the daily observations into weekly or monthly intervals, we would lose important information about that variance.

We analyze the determinants of the EUR/PLN exchange rate from the perspective of different kinds of uncertainty. Our potential explanatory variables include measures of global risk aversion (VIX index, the so-called "fear index"), concerns about public finances and a possible default of the government (Credit Default Swaps on Polish government bonds issued in euros or US dollars) and the risk premium (spread between the yield on Polish and German 10-year government bonds). All the financial variables were obtained from the Refinitiv database.

To quantify the influence of the war in Ukraine on the EUR/PLN exchange rate, we constructed a novel indicator. Using the Twitter API, we are able to programmatically retrieve the numerical count of tweets (i.e., individual messages) for a given query. Our indicator comprises the daily number of individual tweets containing the phrase "war in Ukraine" in Polish (i.e., *"Wojna w Ukrainie"*). We only use the number of original messages, without retweets. This indicator captures the varying relevance of the war in Ukraine for the public in Poland, which consequently also influences investor sentiments. Therefore, we believe this indicator may also act as a proxy for capturing the varying investors' perception of geopolitical risk related to the war in Ukraine.

We have used Twitter, instead of other social media networks, as a source for calculating our sentiment variable for one important reason. Twitter offers full transparency – all messages (individual tweets) are public and visible to all users. On the other hand, other services (e.g., Facebook) limit the accessibility of the messages to selected groups of users, e.g., friends, making it impossible to collect such data for further analysis. Therefore, we believe that by using Twitter, we are able to capture the public sentiment more precisely than by utilizing other social networks.

Henceforth, we refer to this indicator as the "Twitter variable." Figure 2 shows the evolution of our novel variable over time. It can be seen that by mid-June, the aforementioned number of tweets declined to a level similar to those observed before the breakout of the war in Ukraine, pointing to the declining importance of the conflict for the public. Such findings support the range of our estimation sample ending in mid-June 2022.

On March 1, 2022, the National Bank of Poland (NBP) informed that "the depreciation of the Polish zloty, which has been observed in recent days, is not consistent with the fundamentals of the Polish economy and the direction of the monetary policy implemented by the NBP. The NBP has an adequate level of foreign exchange reserves and has at its disposal an appropriate set of instruments to counteract negative trends in the financial and currency markets. The NBP is ready at any time to respond to excessive exchange rate fluctuations of the Polish zloty that could disrupt the smooth functioning of the foreign exchange market or financial market, or negatively affect financial stability or the effectiveness of the NBP's monetary policy." [National Bank of Poland, 2022]. Following that announcement, the NBP issued three separate press releases (on 1, 2, and 4 March 2022) stating that on that day the central bank "sold a certain amount of foreign currency for the Polish zloty." Such interventions of the central bank on the foreign exchange market were aimed at strengthening the Polish currency. In the statement after the meeting of

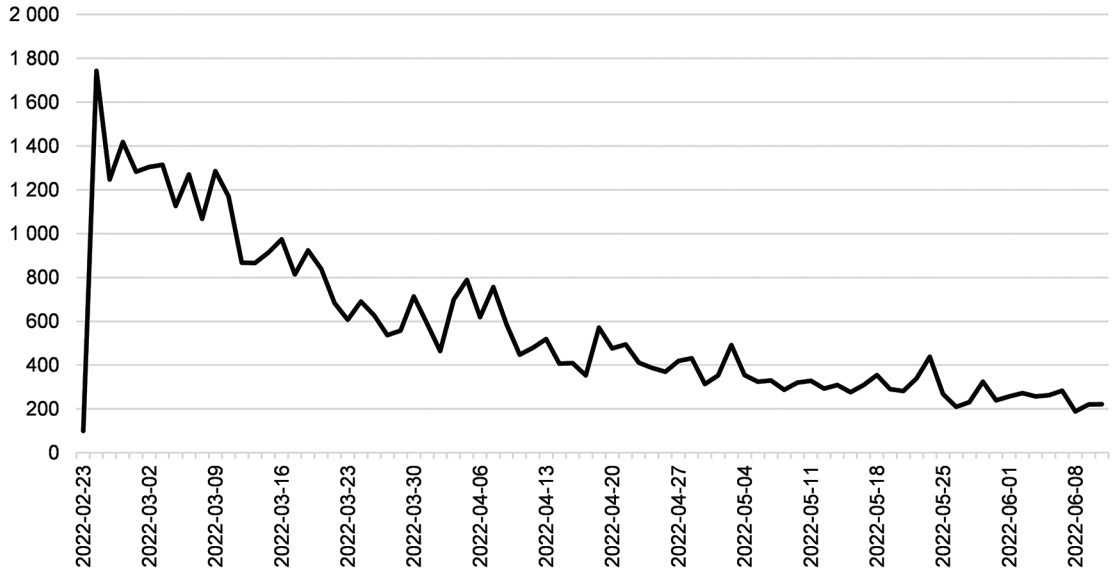


Figure 2. Daily number of individual tweets containing the phrase "Wojna w Ukrainie."

Source: Own calculations using the Twitter API.

API, application programming interface.

Monetary Policy Council, the governor of NBP pointed that the depreciation of the zloty was inconsistent with economic fundamentals and the interventions were necessary to address this misalignment.[1] In order to capture the influence of these interventions on the EUR/PLN exchange rate, we have constructed a binary variable ("NBP interventions") that is equal to one on the aforementioned three days and equal to zero throughout the rest of the sample.

4 Results

4.1 Results of econometric modeling

We regressed the level of the EUR/PLN exchange rate on the level of the VIX index, our "Twitter variable" (daily number of tweets containing the phrase "war in Ukraine"), the weekly change of Credit Default Swaps for Polish 10-year government bonds issued in US dollars (lagged by 1 day), and the weekly change of the spread between the yields on Polish and German 10-year government bonds. These four main explanatory variables in our model represent different kinds of risk or uncertainty, which in theory are negative for the value of the Polish currency. Therefore, all the coefficients are positive – intensification of a given risk (represented by a higher value of explanatory variables) leads to a higher EUR/PLN exchange rate (meaning weakening of the PLN). Each of the aforementioned variables in our model is statistically significant at p = 0.01. Our model also captures the impact of NBP interventions on the foreign exchange market via the binary variable "NBP interventions." The coefficient for this covariate is negative and indicates that each of the 3 interventions by the NBP contributed to a decline of the EUR/PLN exchange rate by 0.087 (i.e. by about 2%). This variable is statistically significant at p = 0.1. During the initial estimation, we encountered issues with autocorrelation and heteroscedasticity of the error term in the estimated model. To cope with it, we utilized heteroskedasticity- and autocorrelation-consistent (HAC) estimators of the variance–covariance matrix [Newey and West, 1987] ensuring correct properties of our model. For detailed results of the regression, see Table 1.

Considering that the majority of our explanatory variables concern the situation in the financial markets at a time of a significant shock, one could be worried about their co-movement due to elevated risk aversion and consequent issues of multicollinearity in our regression. However, such concern is unsubstantiated. We have calculated the Pearson correlation coefficients between all explanatory variables (see Table 2). It turns out that the correlation between covariates in our sample is rather weak and does not exceed 0.40. Similar conclusions can be drawn from the analysis of the variance inflation factor (VIF). In the case of all explanatory variables, VIF stands between 1 and 2, indicating negligible risk of multicollinearity issues in our model (see Table 3).

According to the results of the augmented Dickey–Fuller (ADF) test (see Table 4), we were unable to reject the null hypothesis that a unit root is present in the sample for the level of the EUR/PLN exchange rate, VIX index, and our Twitter variable. Such results suggest that these three variables are integrated of the order 1. For the remaining two explanatory variables (weekly changes of credit default swaps and government bond yield spreads), we rejected the null hypothesis of ADF test at p = 0.01, which suggests that they are stationary. Using a model to explain an integrated variable with a mixture of integrated and stationary covariates is not uncommon, as long as cointegration occurs [Dong and Linton, 2018; Hannadige et al., 2023; Peng and Dong, 2022].

We performed the ARDL bounds test with the approach of Pesaran et al. [2001] to check whether the endogenous variable and two aforementioned integrated explanatory variables are cointegrated.

1 NBP interventions did not – in a sustainable manner – prevent the zloty from weakening and NBP governor considered them as unsuccessful: "*These interventions worked, they didn't work much. They didn't work enough for us to conduct them on a larger scale. We were aware that we were leaning against the wind. The wind resulting from the war, from global jitters, is very strong and it is extremely difficult to oppose this wind. Nevertheless, it was necessary to show that we are on the market, that we are ready to intervene and we are still ready to intervene*" [Glapinski, 2022].

Table 1. Model explaining fluctuations of the EUR/PLN exchange rate

Variable	Coefficient	HAC *t*-statistic
Constant	4.5082	(126.81)***
VIX	0.0034	(2.99)***
Twitter variable	0.0001	(3.57)***
Credit default swaps (weekly change, lagged by 1 day)	0.0032	(4.1)***
Government bond yield spread (weekly change)	0.0706	(4.28)***
NBP interventions	−0.0873	(−1.72)**
Observations	78	
R^2	0.690	
Adjusted R^2	0.669	
F-statistic	32.12***	

***$p < 0.01$, **$p < 0.1$.

Source: Own calculations.

HAC, heteroskedasticity- and autocorrelation-consistent; NBP, National Bank of Poland.

Table 2. Correlation coefficients between explanatory variables

Explanatory variables	VIX	Twitter variable	Credit default swaps	Government bond yield spread
VIX	1.000	0.177	0.383	0.255
Twitter variable	0.177	1.000	0.246	0.365
Credit default swaps	0.383	0.246	1.000	0.205
Government bond yield spread	0.255	0.365	0.205	1.000

Source: Own calculations.

Table 3. VIF

Variable	VIF
VIX	1.222
Twitter variable	1.282
Credit default swaps	1.805
Government bond yield spread	1.215
NBP interventions	1.784

Source: Own calculations.

NBP, National Bank of Poland; VIF, variance inflation factor.

With a test statistic of 5.69, larger than the upper critical value of 4.015, the test suggested rejecting the null hypothesis of no cointegration. As a double check, we also performed the Engle–Granger test. It turns out that the residuals from our baseline model are stationary according to the ADF test, pointing to cointegration. Finally, the Johansen test was performed. With a test statistic of 38.03, larger than the critical value of 34.92, the Johansen test suggested rejecting the null hypothesis that the number of cointegration vectors for the three aforementioned variables is zero. Therefore, all three tests mentioned above suggest that the EUR/PLN exchange rate, VIX index, and our Twitter variable are cointegrated.

Table 4. Results of the ADF test

Variable	Statistic
EUR/PLN	−3.613
VIX	−2.121
Twitter variable	−2.127
Credit default swaps	−4.99***
Government bond yield spread	−5.138***
Residuals	−4.598***

***$p < 0.01$.

Source: Own calculations.

ADF, Augmented Dickey–Fuller.

Presence of cointegration means that nonstationarity in our data does not pose a risk for our estimation results. Furthermore, this means that by using our model, we estimated the long-term relationship between the EUR/PLN exchange rate, the level of global risk aversion (captured by the VIX index), and the relevance of the war in Ukraine (reflected by our Twitter variance). The exchange rate may temporarily diverge from this cointegrating relationship in the short term due to changes in market concerns about the government default and fluctuations of risk premium (captured by the CDS and yield spreads, respectively) or other factors (e.g., interventions of the central bank). Moreover, the existence of cointegration also means that the ordinary-least-squares estimator of the coefficients in our model is superconsistent.

4.2 The influence of the war in Ukraine on the EUR/PLN exchange rate

The most illustrative way to pinpoint the importance of various factors influencing the EUR/PLN exchange rate after the breakout of the war in Ukraine is to compare the fitted value of the endogenous variable over time with its initial value just before the start of the war (February 23, 2022). By multiplying the coefficients obtained with our model (see Table 1) and the changing values of the explanatory variables over time, we can explain which factors (and to what extent) drive the fluctuations of the EUR/PLN exchange rate during the war in Ukraine.

However, we need to highlight that our model does not perfectly explain the variance of the EUR/PLN exchange rate during the time period in question, as the R^2 amounts to 0.69. It means that around 31% of the fluctuations in the EUR/PLN exchange rate are driven by some other factors that are unaccounted for or could even be unobservable.

Figure 3 shows the results of our calculations. We can see that just after the breakout of the war in Ukraine, we observed a significant increase of the EUR/PLN exchange rate (by almost 9%), indicating a substantial weakening of the Polish currency against the euro. It was driven mainly by the growing relevance of the war for the public (captured by the marked increase of the number of tweets mentioning the phrase "war in Ukraine," orange bars) and intensification of market concerns about the default of the Polish government (reflected by the increase of CDS quotations, black bars). The other factors captured by our model played a minor role in the weakening of the Polish currency. The interventions of the NBP on the foreign exchange market limited the scale of the PLN's depreciation at the beginning of March 2022. Three weeks after the breakout of the war, the decreasing global risk aversion (reflected in the decrease of VIX index) was conducive to a limited appreciation of the Polish currency, which signals that the war in Ukraine was not an important global issue for investors, but it was treated as an idiosyncratic problem of the Central and Eastern European region. Over time, the number of tweets mentioning "war in Ukraine" declined, indicating the falling relevance of the war for the public and for the markets, leading to appreciation of the Polish currency.

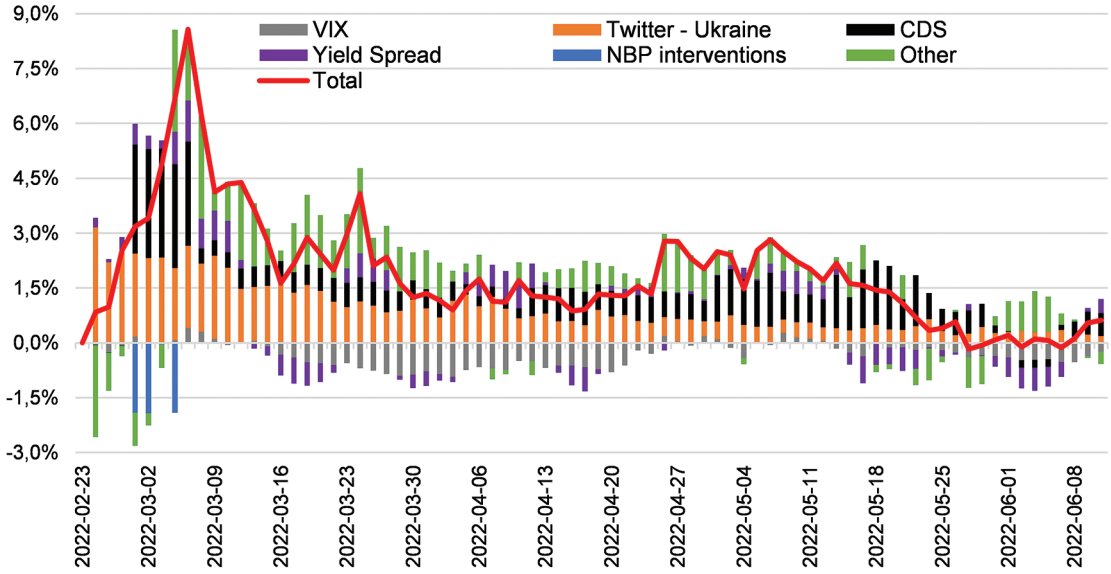


Figure 3. Breakdown of EUR/PLN exchange rate fluctuations into underlying factors.
Source: Own calculations.
NBP, National Bank of Poland.

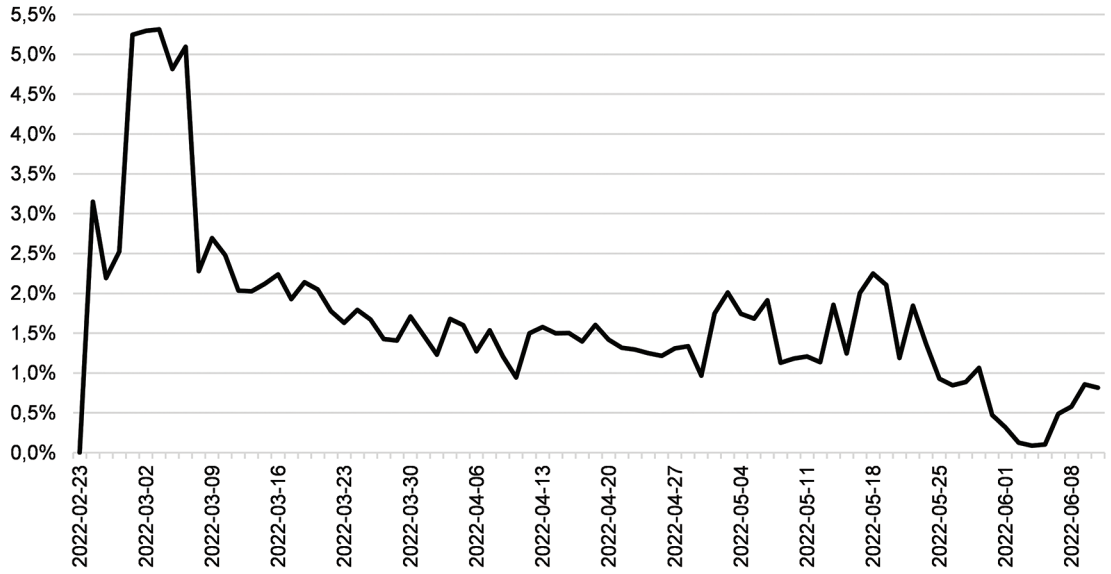


Figure 4. Estimated impact of the war in Ukraine on the EUR/PLN exchange rate.
Source: Own calculations.

The aim of this paper is to estimate the impact of the war in Ukraine on the EUR/PLN exchange rate. We believe that two explanatory variables in our model capture this influence. The first one is the Twitter variable – constructed in such a way as to reflect the varying relevance of the war in Ukraine for the public in Poland. The second variable capturing the impact of the war in Ukraine on the EUR/PLN exchange rate are the credit default swaps. After the breakout of the war, we observed an increase of CDS in various economies located geographically close to Ukraine (including Poland), which reflected heightened investor worries about the default of the Polish government. The cumulative impact of the two aforementioned factors (i.e., the orange and black bars from Figure 3 together) is depicted in Figure 4.

The remaining explanatory variables in our model were largely independent from the war in Ukraine. The VIX index is a measure of global risk aversion and did not materially react to a localized military conflict.

The spread between the yield on Polish and German government bonds in 2022 was driven not only by a higher risk premium, but also by the divergence in the monetary policy of the NBP and the European Central Bank (ECB). In the first half of 2022 (i.e., the time sample we are analyzing), the EBC maintained stable interest rates, whereas the NBP tightened the monetary policy by 75 bp per month on average. Therefore, we cannot precisely isolate the impact of the war in Ukraine on the EUR/PLN exchange rate reflected in this variable.

According to our model, the war in Ukraine was responsible for an increase of the EUR/PLN exchange rate by about 5.0% in the first 2 weeks after the breakout. After that, the estimated negative impact of the war in Ukraine on the Polish currency gradually declined. Finally, starting from the last week of May 2022, the war in Ukraine contributed to an increase of the EUR/PLN exchange rate by less than 1% compared to its level just before the start of the war (i.e. February 23, 2022).

4.3 Weakening of the PLN and inflation in Poland during the war in Ukraine

The war in Ukraine has influenced the inflation in Poland via many channels, including, but not limited to, increasing prices of many commodities, especially fuel and energy prices, causing supply constraints, and increasing uncertainty. Last but not least, the weakening of the PLN induced by the Russian aggression was also conducive to higher prices. A precise estimation of the overall inflationary effects of the war in Ukraine is an ambitious endeavor and it is not the aim of this paper. However, to get a fuller picture of how a war-related increase in geopolitical risk may affect the conduct of monetary policy, we calculate the effect of the war-driven weakening of the Polish zloty on Poland's inflation. Considering that the basic statutory objective of NBP is to maintain price stability, the CPI inflation (including its fluctuations due to shocks) is the most monetary policy-relevant variable. The response of inflation to the war-driven weakening of the Polish zloty is calculated using estimates of the monetary policy transmission mechanism prepared by the NBP [Chmielewski et al., 2020]. Using a small structural model of monetary policy, the authors provide an estimated response of selected macroeconomic variables to the nominal effective exchange rate (NEER of PLN) impulse. Figure 5 presents the response of core inflation and CPI inflation (in percentage points) to the appreciation of the NEER by 1% for 1 quarter. It can be seen that a 1% appreciation of PLN leads to a drop in total CPI inflation by 0.17 percentage points and core inflation by 0.15 percentage points after about 4 quarters. After that, the response of the inflation gradually subsides.

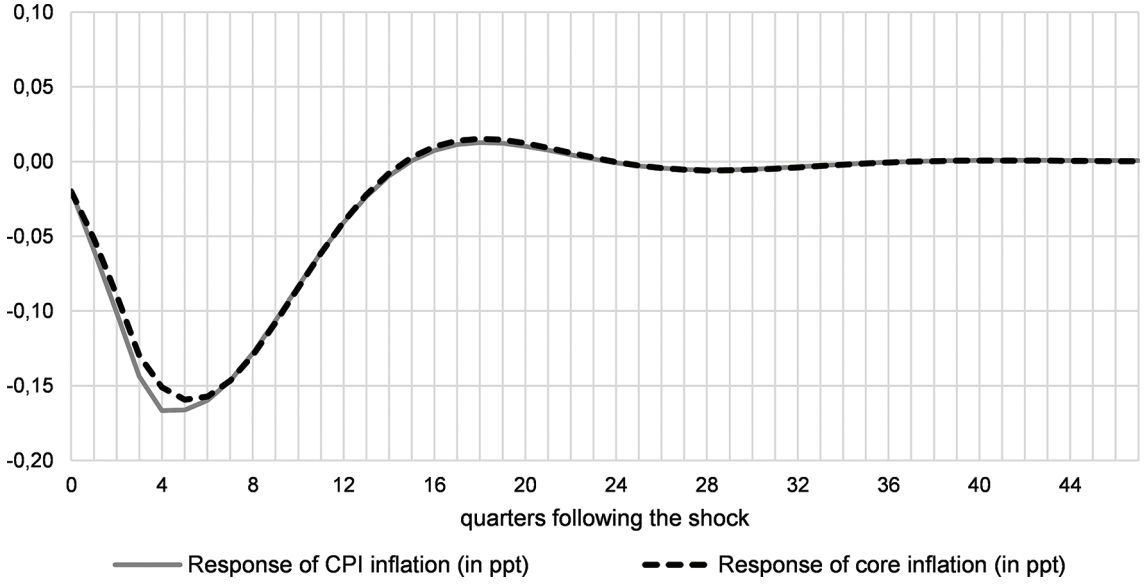


Figure 5. Response of inflation to the NEER impulse.

Source: NBP Working Paper No. 329 (2020) – Annexes.

NBP, National Bank of Poland; NEER, nominal effective exchange rate.

In the case of the war in Ukraine, the response of inflation will be reversed (weakening PLN leads to an increase in inflation) but be similar on a relative scale. Considering that the Eurozone is responsible for a dominant portion of Poland's international trade (i.e., the euro has the largest weight among all currencies in the PLN effective exchange rate), we assume that the reaction of inflation to the change in the EUR/PLN exchange rate is similar to the response in the case of the NEER impulse. We estimate that the war in Ukraine contributed to an increase in the EUR/PLN exchange rate by about 2.0% on average in the first quarter after it started. Using estimates of the NBP, we can calculate that the weakening of PLN due to the war in Ukraine contributed to an increase in headline inflation by about 0.33 percentage points.

5 Conclusions

The Russian invasion of Ukraine has caused an increase in geopolitical risk and concomitant significant depreciation of the Polish zloty. We use a variable based on the count of Twitter messages to proxy the changes of investors' perception of geopolitical risk to measure the impact of the invasion on the EUR/PLN exchange rate. We estimate that the war in Ukraine was responsible for an increase in the EUR/PLN exchange rate by around 5.0% in the first 2 weeks following its breakout. We also show that the impact of foreign exchange interventions conducted by the NBP in March 2022, aimed at containing the scale of the zloty's depreciation, was significant, but interventions did not prevent the Polish zloty from falling markedly. We corroborate the results of the emerging literature pointing to the significant impact of geopolitical risk on currency pricing. We believe that Twitter-based proxies for changes in geopolitical risk can supplement other measures of that risk, such as those based on the number of news articles discussing adverse geopolitical events and related threats proposed by Caldara and Iacoviello [2022]. We view this as a promising area for future research.

Research on the negative economic spillovers of regional conflicts in neighboring countries has been focused on their effects on real economy indicators such as GDP growth and international trade. We extended this research by turning the spotlight to inflation, and estimate that the war-driven depreciation of the zloty caused an increase of headline inflation by about 0.33 percentage points within a year after the outbreak of the war. Our findings suggest that in countries with a floating exchange rate regime, the effectiveness of autonomous monetary policy can be substantially subdued due to ongoing nearby conflicts and the related increase in exchange rate volatility. Central banks are unlikely to address this exchange rate instability, as it usually requires a large and short-lived interest rate adjustment that could increase exchange rate volatility even further and undermine central bank credibility. The case of Poland, where war-related depreciation of the currency was inconsistent with the monetary tightening cycle, is highly illustrative in this respect.

Our results should be juxtaposed with the recent research focused on monetary policy independence in the Central and Eastern European countries operating floating exchange rate regimes. It is suggested that the central bank in Poland would be able to retain relative monetary policy independence when the ECB enters the tightening cycle in its monetary policy [Dabrowski et al., 2019]. Our findings suggest that this independence may be substantially reduced due to geopolitical factors.

Our findings are in line with the Mundell II framework, which emphasizes that the floating exchange rate does not always work as a shock absorber and it may be a source of asymmetric shocks leading to higher output and inflation volatility. Our results, consistently with previous studies, point to regional conflicts and related increase in geopolitical risk that could generate such asymmetric shocks. Assuming that Russia's invasion of Ukraine marks the beginning of a long-term geopolitical shift, Poland, due to its geographical location (the aforementioned "proximity penalty"), will be more exposed to such asymmetric shocks than most of the non-Eurozone EU member states. This would mean that the long-term cost of losing monetary policy autonomy arising from adopting the euro in Poland would decrease.

We see our results as an argument for Poland to seek Eurozone membership as a way to contain the impact of geopolitical factors on exchange rate volatility, which is likely to remain at play in the longer run. It should be noted that the nexus between geopolitical risk and the pace of monetary integration in Europe

has already been observed in the context of the Baltic states' accession to the Eurozone. One of the drivers of the euro adoption in these countries was the intensity of geopolitical threats due to Russia's foreign policy. This argument was reflected in the public statements made by their policy makers [Vilpišauskas, 2014; Markevičiūtė and Kuokštis, 2016; Feldmann and Kuokštis, 2021] and reinforced by Russia's actions in Ukraine in 2014. As noted by Feldmann and Kuokštis [2021], in the Baltic states, the euro was seen as a mean to reduce the Russian threat by promoting deep integration with Western Europe, even though belonging to the common currency area was not associated with any explicit security guarantees such as those provided by NATO membership. Therefore, our results corroborate the conclusions from the previous studies pointing to the euro adoption as a tool for limiting the impact of geopolitical risk on the economies of the former Eastern Bloc countries.

Declaration of interest

None.

Data availability statement

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

References

Ades, A., Chua, H.B. (1997), Thy neighbor's curse: regional instability and economic growth, Journal of Economic Growth, Vol. 2, No. 3, pp. 279–304.

Aliu, F., Hašková, S., Bajra, U.Q. (2022), Consequences of Russian invasion on Ukraine: evidence from foreign exchange rates, The Journal of Risk Finance, Vol. 24, No. 1, pp. 40–58.

Caldara, D., Iacoviello, M. (2018), Measuring Geopolitical Risk, International Finance Discussion Papers 1222, Board of Governors of the Federal Reserve System.

Caldara, D., Iacoviello, M. (2019), Measuring Geopolitical Risk, Working Paper, Board of Governors of the Federal Reserve Board.

Caldara, D., Iacoviello, M. (2022), Measuring geopolitical risk, American Economic Review, Vol. 112, No. 4, pp. 1194–1225.

Chmielewski, T., Kocięcki, A., Łyziak, T., Przystupa, J., Stanisławska, E., Walerych, M., Wróbel, E. (2020), Monetary policy transmission mechanism in Poland. What do we know in 2019?, NBP Working Paper, no. 329, Narodowy Bank Polski, Economic Research Department.

Dabrowski, M.A., Papież, M., Śmiech, S. (2019), Monetary independence of Central and Eastern European economies with flexible exchange rate regimes, Eastern European Economics, Vol. 57, No. 4, pp. 295–316.

De Grauwe, P. (2006), What have we learnt about monetary integration since the Maastricht Treaty?, Journal of Common Market Studies, Vol. 44, No. 4, pp. 711–730.

De Grauwe, P., Grimaldi, M. (2006), The exchange rate in a behavioral finance framework, Princeton University Press, Princeton.

De Groot, O.J. (2010), The spillover effects of conflict on economic growth in neighboring countries in Africa, Defence and Peace Economics, Vol. 21, No. 2, pp. 149–164.

Dodd, O., Fernandez-Perez, A., Sosvilla-Rivero, S. (2022), Currency and commodity return relationship under extreme geopolitical risks: Evidence from the invasion of Ukraine, Working Paper 2022/04, Research Institute of Applied Economics, University of Barcelona.

Dong, C., Linton, O. (2018), Additive nonparametric models with time variable and both stationary and nonstationary regressors, Journal of Econometrics, Vol. 207, No. 1, pp. 212–236.

Dunne, J.P., Tian, N. (2015), Conflict, economic growth and spillover effects in Africa, ERSA Working Paper 561, Economic Research Southern Africa.

Federle, J., Meier, A., Müller, G. Sehn, V. (2022), Proximity to war: The stock market response to the Russian invasion of Ukraine, Discussion Paper 17185, London: Centre for Economic Policy Research.

Feldmann, M., Kuokštis, V. (2021), The Baltic states and the Eurozone, in: K. Arató, B. Koller, A. Pelle, (Eds), The political economy of the Eurozone in Central and Eastern Europe, Routledge, London and New York, pp. 238–254.

Glapinski, A. (2022), Ocena bieżącej sytuacji ekonomicznej – marzec 2022, retrieved from https://www.youtube.com/live/bB3jT4zitnY?feature=share [16th June 2022].

Hannadige, S., Gao, J., Silvapulle, M.J., Silvapulle, P. (2023), Forecasting a nonstationary time series with a mixture of stationary and nonstationary factors as predictors, Journal of Business & Economic Statistics, pp. 1–13.

Hui, H.C. (2022), The long-run effects of geopolitical risk on foreign exchange markets: evidence from some ASEAN countries, International Journal of Emerging Markets, Vol. 17, No. 6, pp. 1543–1564.

Iyke, B.N., Phan, D.H.B., Narayan, P.K. (2022), Exchange rate return predictability in times of geopolitical risk, International Review of Financial Analysis, Vol. 81, pp. 102099.

Kisswani, K.M., Elian, M.I. (2021), Analyzing the (a) symmetric impacts of oil price, economic policy uncertainty, and global geopolitical risk on exchange rate, The Journal of Economic Asymmetries, Vol. 24, pp. e00204.

Markevičiūtė, A., Kuokštis, V. (2016), Race to the Eurozone: why Latvia joined before Lithuania, Baltic Journal of Political Science, No. 5, pp. 5–20.

Morvillier, F. (2020), Do currency undervaluations affect the impact of inflation on growth?, Economic Modelling, Vol. 84, pp. 275–292.

Mundell, R. (1973), Uncommon arguments for common currencies, in: H. Johnson, A. Swoboda, (Eds.), The economics of common currencies, Allen & Unwin, London, pp. 114–132.

Murdoch, J.C., Sandler, T. (2002), Economic growth, civil wars, and spatial spillovers, Journal of Conflict Resolution, Vol. 46, No. 1, pp. 91–110.

Murdoch, J.C., Sandler, T. (2004), Civil wars and economic growth: spatial dispersion, American Journal of Political Science, Vol. 48, No. 1, pp. 138–151.

National Bank of Poland. (2022), NBP Announcements, retrieved from https://www.nbp.pl/homen.aspx?f=/en/aktualnosci/info.htm [16th June 2022].

Newey, W.K., West K.D. (1987), A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix, Econometrica, Vol. 55, No. 3, pp. 703–708.

Peng, Z., Dong, C. (2022), Augmented cointegrating linear models with possibly strongly correlated stationary and nonstationary regressors, Finance Research Letters, Vol. 47.

Pesaran, M.H., Yongcheol, S., Smith, R.J. (2001), Bounds testing approaches to the analysis of level relationships, Journal of Applied Econometrics, Vol. 16, No. 3, pp. 289–326.

Qureshi, M.S. (2013), Trade and thy neighbor's war, Journal of Development Economics, Vol. 105, pp. 178–195.

Salisu, A.A., Cunado, J., Gupta, R. (2022), Geopolitical risks and historical exchange rate volatility of the BRICS, International Review of Economics & Finance, Vol. 77, pp. 179–190.

Vilpišauskas, R. (2014), Lietuvos narystė euro zonoje – pokyčių Lietuvos politikoje ir stojimo laiko pasirinkimo analizė [Lithuania's accession into the euro zone – analysis of institutional and political changes in Lithuania and the choice of the timing], Politologija, Vol. 76, No. 4, pp. 200–245.