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Cash Supply Changes in Poland During COVID-19 and the War in Ukraine: Implications for a Cashless Society

Abstract

RESEARCH OBJECTIVE: This article investigates the impact of two major external shocks—the COVID-19 pandemic and the war in Ukraine—on the supply of cash (M0) in Poland. The study aims to assess how these crises have influenced the progress toward transitioning to a cashless society and their broader implications for monetary policy.

THE RESEARCH PROBLEM AND METHODS: The study utilises Interrupted Time Series (ITS) analysis to examine changes in the cash supply during and after these external shocks. This methodology enables a robust analysis of the immediate and long-term impacts of crises on cash supply, incorporating key economic variables such as inflation, interest rates, and exchange rates.

THE PROCESS OF ARGUMENTATION: This article contributes to the literature on monetary policy and financial stability by providing new insights into cash demand during external shocks. The use of ITS analysis offers a novel approach to understanding the dynamics of cash supply in crisis periods, particularly in the context of transitioning towards a cashless economy.

RESEARCH RESULTS: The results indicate a significant short-term increase in cash supply following both crises, driven by societal behavioural responses to economic uncertainty. Individuals opted for cash withdrawals, which were not returned to banks, suggesting cash's ongoing use for transactional purposes. In the long term, the study found no statistically significant changes in cash

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supply trends, indicating that the crises' effects were absorbed without altering the long-term trajectory.

CONCLUSIONS, INNOVATIONS, AND RECOMMENDATIONS:

These findings have important implications for the debate on the transition to a cashless society. While digital payments offer convenience, the study highlights the continued societal preference for cash as a security measure during crises. Policymakers should consider maintaining a balance between promoting cashless transactions and ensuring the availability of physical cash to support financial stability.

KEYWORDS:

cash supply, cashless society, monetary policy, financial stability, interrupted time series analysis

JEL Classification: E41, E42, E51, E52, E58

1. INTRODUCTION

The COVID-19 pandemic and the war in Ukraine have presented unprecedented challenges to global financial systems, including those in Central and Eastern Europe. As a key economy in this region, Poland also did not avoid the disruptions associated with those “black swans”. Understanding the dynamics of cash supply (M0) in response to these external shocks is crucial for policymakers and financial institutions aiming to maintain financial stability and navigate the transition towards a cashless society.

The transition to a cashless society has been a topic of considerable debate, with advocates highlighting digital transactions' efficiency, convenience, and security benefits. In the European Union, there is a concerted effort to limit cash transactions as part of broader regulatory measures aimed at combating money laundering (AML) and countering the financing of terrorism (CFT). Specifically, the EU has proposed a maximum limit of €10,000 for cash payments. This limit reduces the anonymity of large cash transactions, which are often exploited for illicit activities such as money laundering and terrorist financing. Member states can impose lower thresholds if they deem it necessary to enhance transparency and security in financial transactions (Ughade, 2024). These regulations also align with the EU's Know Your Customer (KYC) policies, which mandate financial

institutions to verify the identities of their clients, thus reducing the risk of fraud and illegal financial activities. The KYC protocols require thorough customer due diligence, including identifying and verifying the identity of the counterparty for transactions exceeding certain thresholds. Enhanced due diligence measures are especially critical in high-risk transactions and relationships, ensuring financial institutions maintain robust monitoring and reporting mechanisms. Also, some authors argue that the promotion and increased use of cashless payments are essential for broader community adoption, which can enhance economic growth and efficiency (Aminata & Sjarif, 2020).

However, there are also differing perspectives on this issue. For example, the National Bank of Poland (NBP) strongly advocates for the continued use of cash. The NBP emphasises the importance of physical money as a public good, ensuring accessibility and providing a reliable means of payment, especially for individuals who may not have access to digital payment methods. The NBP's stance highlights the need for a balanced approach that considers the advantages of cashless transactions while preserving the accessibility and security of cash payments (Cash Essentials). This divergence in policy perspectives underscores the complex dynamics of transitioning towards a cashless society. While the regulatory framework in the EU is increasingly geared towards limiting cash usage to enhance financial security and regulatory oversight, national entities like the NBP advocate for maintaining cash as a vital component of the financial system.

Regardless of the assessment of the cashless society concept, a significant step in moving individual communities closer towards in a cashless society is contactless payments (Loh et al., 2022). Although, as Taskinsoy (2020) demonstrates, contactless payments and the ability to avoid cash payments may have helped mitigate the spread of the coronavirus during the global pandemic, the COVID-19 pandemic itself triggered a sudden increase in the public's demand for physical cash, increasing the monetary base (M0). Similarly, geopolitical conflicts have exposed vulnerabilities in financial systems, emphasising the enduring importance of cash. These events have triggered households to increasingly turn to cash as a safe haven during periods of uncertainty. Considering that, this study aims to assess the impact of two major external shocks—the COVID-19 pandemic and the war

in Ukraine—on the supply of cash in Poland. To achieve the study's objectives, the following research questions were posed: How did the COVID-19 pandemic and the war in Ukraine affect the supply of cash (M0) in Poland? And in particular:

- Was the M0 money supply increase observed due to the COVID-19 pandemic and the war in Ukraine in the short term?
- Did COVID-19 and the war in Ukraine change society's behaviour and increase the M0 money supply in the long term?

We believe that getting an answer to this question can contribute to the discussion on the legitimacy of the transit towards a cashless society. The findings will provide valuable insights into how external shocks influence cash supply and societal behaviours, which is essential for shaping adaptive monetary policies. Understanding these dynamics is important not only for immediate crisis management but also for ensuring the long-term stability and resilience of financial systems. In examining the Polish context, this research highlights the dual role of cash in the context of precautionary and transactional motives for holding cash and the smooth intermingling of these motives during external economic shocks. The insights gained from this study will inform policymakers about the critical role of cash during crises and guide the development of resilient financial systems that accommodate both digital and physical forms of currency. Ultimately, this research advocates for a nuanced understanding of cash's role in contemporary economies, especially in light of the challenges posed by global crises, including the geopolitical instability that has recently intensified.

2. LITERATURE REVIEW

2.1. Theory of motives for holding cash

Already in the first half of the 20th century, Keynes (1936, Chapter 15) detailed three primary motives for holding cash. The first is the transaction motive, understood as the need to hold money for everyday payments and routine economic activity. In modern economies this demand is increasingly influenced not only by income and expenditure timing but also by the availability of electronic

payment instruments and the accessibility of payment infrastructure (Dos Santos & Harvold Kvangraven, 2017). Moreover, companies' motives for holding cash may differ between developed and developing countries (Akhtar, 2023).

The second motive for holding cash is the precautionary motive, understood as having a certain reserve of available cash in case an unexpected expense has to be made or an unforeseen purchase opportunity arises. As Keynes (1936, Chapter 15) believes, the strength of the impact of this motive will depend on the certainty of the possibility of obtaining the cash needed in the event of such an emergency. After all, there is no point in holding idle cash if you can quickly obtain it when needed. The key question addressed in this article in relation to the precautionary motive is whether, in emergencies such as COVID-19 or war in a neighbouring country, cash can in fact be obtained whenever it is needed. Huynh et al. (2014) proved that the risk of lack of card acceptance is an essential reason for precautionary cash balances. Considering this, the fear of unavailability of funds triggered by a massive run on the bank will also be a critical determinant of this motive to hold cash (Dijk, 2017)

The final motive detailed by Keynes is the speculative motive. This motive, which is related to expectations about interest rates and asset prices, plays a limited role in the case of narrow money aggregates such as M0. For this reason, the precautionary motive is typically considered more relevant in the context of cash demand during periods of uncertainty. Furthermore, Cunha and Pollet's (2020) findings show that companies significantly increase cash levels in response to an exogenous increase in investment opportunities. In contrast, we assume that the speculative motive is not crucial regarding a potential increase in the monetary base (M0) in Poland in the context of external shocks, as funds held for potential speculation are usually not held in physical form but in bank deposits or brokerage accounts.

While Keynesian motives remain a useful analytical framework, contemporary research emphasises that cash-holding behaviour is also shaped by technological and institutional developments in payment systems. The spread of digital payments, card acceptance networks, ATM availability, and the overall level of financial digitalisation significantly influence how households and firms manage liquidity (Bagnall et al., 2014). In addition, recent crises have highlighted the

resilience function of cash. In periods of systemic uncertainty, disruptions to electronic payment systems, or declining trust in digital infrastructure, economic agents may temporarily increase their preference for physical liquidity. Therefore, modern analyses of cash demand combine classical monetary theory with insights from the literature on payment innovation, financial resilience, and behavioural responses to economic shocks (Skibińska-Fabrowska, 2023).

2.2. Determinants of money supply—a review of research findings

There is no doubt that the key driver of supply (including money supply) is demand. Numerous studies confirm the importance of The precautionary motive in the context of the emerging demand for money during the crisis (Shirai & Sugandi, 2019). Those authors show that the effects of crisis episodes are not uniform across countries. In their study, crisis-related dummy variables were not statistically significant for the United States, the euro area, and Japan, suggesting that the transmission of external shocks to cash demand may depend on institutional conditions, payment habits, and the broader macroeconomic environment. Reimers, Schneider and Seitz (2020) note that during crises such as the financial crises of 2008/2009 and 2011/2012, there was a significant increase in cash demand. According to these authors, the key question in this context is whether these are short-term effects or a change in societal behaviour that makes the increase in cash demand persist in the long term. The same authors found a significant and positive correlation among households' cash holdings, transaction volumes, and the size of the shadow economy, consistent across all euro area countries regardless of their size. Moreover, as Sisak (2011) shows, the increase in non-transactional cash demand may be caused by illegal economic activities. Furthermore, there is an inverse relationship between the accessibility and availability of cashless payment methods and the demand for cash. Additionally, a reduction in the number of ATMs is associated with decreased cash holdings (Reimers et al., 2020). Other authors' results provide evidence that differences in incentives (e.g. the relative cost of cards compared with cash) and differences in ATM withdrawal

costs are key factors explaining the demand for cash across many developed economies (Arango-Arango et al., 2018).

Huang et al. (2021) study confirms that in times of uncertainty, companies reduce their allocation of funds to financial assets other than currency. Moreover, during periods of recession, maintaining cash reserves can be an effective strategy to weather the downturn without seeking additional financing (Iuliana Oana & Riana Iren, 2018). It is also often mentioned that the reasons private companies hold cash—primarily driven by a precautionary motive—are very similar to those of households (Potì et al., 2020).

In an attempt to capture the importance of the precautionary motive in empirical studies using regression models, researchers often include a dummy variable representing the timing of the crisis (Shirai & Sugandi, 2019). Unfortunately, this approach did not capture the long-term impact of the external shock on cash holdings. Moreover, researchers have often included other control variables in the model to isolate the impact of external shocks that amplify the precautionary effect of holding cash. Alvarez and Lippi (2009), studying the motives for holding cash, consider such variables as interest rates and inflation rate, with clear indications that interest rates have a negative effect on non-transactional cash demand (Sisak, 2011). Other authors emphasised that exchange rate dynamics can affect the monetary base by influencing the cost of importing and exporting goods, thereby affecting the balance of trade and the flow of money into the economy (Frömmel et al., 2011).

A literature review allowed us to identify those studies that sought to capture the impact of COVID-19 and the war on the money supply. As Caddy et al. (2020) show, prior to the COVID-19 pandemic, the use of cash for daily payments had been steadily decreasing globally. However, this does not mean that the supply of cash has decreased. As Tobin (1958) indicated, if actors take cash from the bank at the onset of an external shock, it is most likely driven by a precautionary motive. Crises are often associated with uncertainty and unpredictability, prompting people to hedge for sudden, unforeseen financial needs. Also, the economists at the Bank of Australia noticed that since the COVID-19 pandemic began, the value of banknotes in circulation has increased significantly, even though people use cash less for daily transactions. The rise in cash demand is because people want

to keep it as a safety measure or for saving purposes. This trend is typical during times of economic uncertainty and stress, and similar patterns were seen in many other countries (Guttmann et al., 2021).

Nevertheless, Wolff (1981) highlights differences in the importance of individual motives depending on the wealth of individual households. Moreover, Hou and Liu's (2020) research shows that non-residents tend to hold more cash, often with different motives than residents. This heterogeneity makes it more difficult to quantify the impact of individual variables (including external shocks) on the money supply, especially using panel studies. Taking this into account, in our study, we decided to focus on the impact of external shocks on the M0 money supply in a single country, which will increase the chances of isolating the impact of these shocks from the impact of the other control variables.

Evidence from Central and Eastern Europe (CEE) also suggests that crisis episodes may generate a temporary strengthening of cash demand, although the scale and persistence of this effect differ across countries. In Slovakia, the outbreak of the COVID-19 pandemic triggered a short-lived surge in euro cash issuance, particularly in high denominations (Národná banka Slovenska, 2020). In Hungary, the pandemic also affected payment habits and the balance between electronic and cash payments (Deák et al., 2020). More broadly, ECB survey evidence for central, eastern and south-eastern European countries indicates that the demand for cash during the pandemic remained linked to uncertainty, trust and household-level crisis responses (European Central Bank, 2021). These findings support the view that the role of cash in crisis conditions should be interpreted not only in macroeconomic terms, but also through institutional and behavioural differences across countries, which emphasises the heterogeneity between states.

3. METHODOLOGY

Based on our literature review, we included variables representing inflation, interest rates, and exchange rates. Furthermore, we assumed that unemployment or average wages could also determine the aggregate cash supply at the national level. To avoid the possible impact of the financial crisis on the estimation of the model parameters, we

conducted the study monthly from the beginning of 2012 to March 2024. All the variables we used are listed in Table 1.

Table 1. Data details

Variable	Description	Source
<i>M0</i>	Monetary base, i.e. cash in circulation.	National Bank of Poland
<i>CPI</i>	Consumer Price Index (CPI) measures the weighted average changes (percentage year-on-year growth) in the prices of consumer goods and services purchased by households in the economy.	Central Statistical Office in Poland
<i>WIBOR3M</i>	Interest rate benchmark, in the most commonly used tenor for banks' loans in Poland (3 months)	GPW Benchmark
<i>UNEM</i>	Unemployment rate [%] is the number of unemployed as a percentage of the labour force.	Central Statistical Office in Poland
<i>Salary</i>	Average monthly gross wages and salaries in the business sector (in PLN)	Central Statistical Office in Poland
<i>USD/PLN</i>	Exchange rate of the US Dollar to the Polish Zloty.	National Bank of Poland
<i>EUR/PLN</i>	Exchange rate of the Euro to the Polish Zloty.	National Bank of Poland
<i>COVID</i>	A dummy variable with a value of 1 at the start of the COVID-19 global pandemic period (March-April 2020). In other periods, the variable's value was 0.	–
<i>WAR</i>	Dummy variable with a value of 1 in the period after the start of the armed invasion of Ukraine by the Russian Federation (February-March 2022). In other cases, the variable was equal to 0.	–
<i>COVID_time</i>	The interaction term between COVID-19 and time captures the change in trend due to the pandemic until the quarantine is removed in Poland (March 2022).	–
<i>WAR_time</i>	An interaction term between the war and time, capturing the change in trend due to the war until March 2024.	–

Source: own elaboration.

After identifying the variables, we assessed their stationarity using the Augmented Dickey-Fuller (ADF) test. The results confirmed that most variables were non-stationary, necessitating differencing. Subsequently, we evaluated the variables' multicollinearity to confirm the appropriateness of including all control variables in the study.

In guiding our choice of research method, we considered the weaknesses pointed out by other researchers regarding the difficulty of

capturing the long-term impact of external shocks on money supply in traditional regression models. Taking this into account, we decided to use Interrupted Time Series Analysis (ITS), which is sometimes treated as a quasi-experimental method (Behzadifar et al., 2022). With ITS, it is possible to understand the effects of implementing a policy or intervention on a topic by comparing before and after, which can lead to a better understanding of policy or external events (Komen et al., 2017).

This time series technique allows for assessing the longitudinal effects of specific interventions. This type of regression analysis allows us to assess the impact of an intervention on a specific variable, whether the impact was immediate or occurred over time and whether factors other than the intervention can explain the change. It requires data measured on a continuous scale at regular, evenly spaced intervals. In this method, interpretation of the charts is crucial. If the graph of the dependent variable shows a sudden change of direction precisely at the point of intervention, the probability that the intervention has caused an impact on the dependent variable is high (Mpofu, 2015). In order to assess the potential long-term impact of a shock on the variable under study (in our case, $M0$), it is necessary to compare the slope of the trend line, looking for significant changes in this slope following the event. Before doing so, it is necessary to interpret the directional coefficient for the variable representing the slope of the trend in the post-event period (in our model, these variables will be `COVID_time` and `WAR_time`).

ITS was selected because the two analysed shocks occurred at clearly identifiable points in time, and the main objective of the study is to distinguish between their immediate effects and possible post-shock trend changes in $M0$. In this respect, segmented ITS offers a transparent framework for estimating both level shifts and slope changes following external events (Kontopantelis et al., 2015). Alternative approaches such as ARIMA are often useful when the primary objective is to model serial dependence or improve forecasting performance, while VAR models are more appropriate when the focus is on dynamic interdependence among several endogenous variables. In the present study, however, the central interest lies in assessing whether two exogenously dated shocks generated short-term increases in cash supply and altered its long-term trajectory. For

this reason, ITS was considered the most suitable and interpretable approach.

ITS analysis requires data collected regularly over time and ordered at equal intervals. A sufficient number of pre-and post-intervention time points are needed for interrupted time series analysis. A general recommendation is 12 pre-intervention and 12 post-intervention data points. However, a minimum of 100 observations is desirable to achieve an acceptable level of variability in the estimate at each time point (Mpofu, 2015). Taking this into account, we conclude that our dataset meets these requirements, being characterised by nearly 147 observations over time (for each variable) and examining much longer intervals than the 12 pre-intervention and 12 post-intervention periods (post-intervention for both COVID-19 and the war, in the case of our study, it was 24 periods). The equation of our model takes the following form:

$$M0_dif_t = \beta_0 + \beta_1 Time_t + \beta_2 COVID_t + \beta_3 WAR_t + \beta_4 COVID_time_t + \beta_5 WAR_time_t + \beta_6 CPI_t + \beta_7 WIBOR3M_dif_t + \beta_8 Salary_dif_t + \beta_9 Unemployment_dif_t + \beta_{10} USD/PLN_dif_t + \beta_{11} EUR/PLN_dif_t$$

Where:

- MO_t the outcome variable at time t .
- β_0 : intercept term, representing the baseline level of the outcome variable.
- $Time_t$: linear trend over time, capturing the underlying time-related changes in the outcome variable.
- $\beta_1, \beta_2 \dots \beta_{11}$ are the coefficients corresponding to each control independent variable.

It is worth highlighting that studies using the ITS method often do not include additional variables, focusing only on the explanatory variable and the given external shock expressed by the dummy variable and comparing the slope of the trend line before and after the event. Nevertheless, given that economic theory points to specific variables affecting the M0 money supply, we decided to include control variables (presented in Table 1) in the study.

4. EMPIRICAL RESULTS AND DISCUSSION

Using the ordinary least squares (OLS) method, we estimated the parameters of our model. These parameters are presented in Table 2.

Table 2. Coefficients of variables in the ITS method

Variable	Coefficients	Standard error	P-value
Intercept	9,9167	1,9010	<0,001***
Time	0,0041	0,0026	0,126
COVID	8,5177	0,6184	<0,001***
WAR	4,1125	0,6832	<0,001***
COVID_time	0,0130	0,0181	0,474
WAR_time	-0,0062	0,0179	0,728
CPI	-0,0930	0,0191	<0,001***
WIBOR3M_dif	-0,5868	0,3479	0,094
Salary_dif	0,0840	0,0173	<0,001***
Unemployment_dif	-1,5078	0,2935	<0,001***
USD/PLN_dif	0,0593	0,0290	0,043*
EUR/PLN_dif	0,1703	0,0412	<0,001***

Source: Authors' results. Significance designations of variables: '***' 0,001 '**' 0,01 '*' 0,05 '.' 0,1.

An F-statistic of 41.8 with a p-value well below 0.001 confirmed the model's significance. According to the obtained coefficient of determination (R^2), the proposed variables explained 74.5% of the changes in the M0 money supply. The quality of the model is also evidenced by the expected effects of the individual control variables on the money supply expressed by M0. For example, inflation's significant statistically negative effect on the money supply was noted. The effect of interest rates also turned out to be negative (however, in this case, the variable was only significant at the 0.1 significance level). For example, in results from a study by Chandrakamal and Kumar (2023), interest rates have been shown to have a strong negative impact on the money supply. Also, in the case of Slovenia, empirical studies confirmed the negative impact of interest rate levels on cash balances. Furthermore, similar to our results, the Angelovska and Valentinčič (2020) study also confirm a moderately statistically significant relationship between interest rates and cash outside monetary institutions. In our view, this may be due to the relatively high correlation

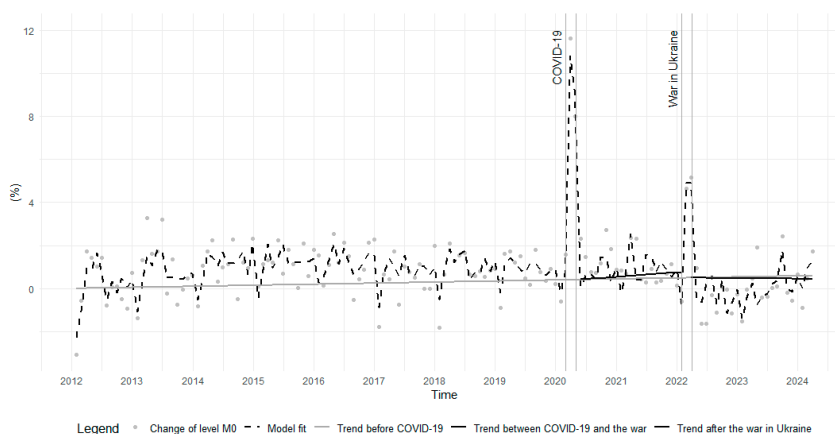
between inflation and interest rates. For example, by excluding the level of inflation from the model, the level of WIBOR3M becomes statistically significant (albeit the exclusion of one of these variables negatively affects the quality of the model). Moreover, according to the results of Frömmel et al. (2011), the depreciation of the domestic currency had a significant positive impact on the money supply. An increase in the USD/PLN and EUR/PLN exchange rate levels increased the money supply. Furthermore, in line with our expectations, the rise in unemployment levels had a negative impact on the money supply. In contrast, an increase in the average wage level positively affected the money supply. Both of these variables proved to be statistically significant at the <0.001 level.

Finally, the model also met the formal assumptions of no autocorrelation of the residuals (Breusch-Godfrey test p -value = 0.6), no heteroskedasticity of the residuals (Breusch-Pagan test p -value = 0.7), and the assumption of a normal distribution of the residuals, confirmed by the Shapiro-Wilk test (p -value = 0.08).

Once the model has been diagnosed and its robustness confirmed, it becomes legitimate to interpret the results regarding the short- and long-term impact of COVID-19 and the war in Ukraine on the M0 money supply. Both dummy variables, COVID and WAR, had a significant and very strong positive effect on changes in the money supply (M0), confirming that both shocks increased cash demand in the short term. These results are consistent with the findings of Guttmann et al. (2021), confirming the significant short-term impact of external shocks on the money supply. At the same time, the effect of COVID-19 was stronger than that of the war, which may reflect the broader and more synchronised nature of the pandemic shock. This result also contrasts with the findings of Shirai and Sugandi (2019), who showed that crisis-related dummy variables were not statistically significant for the United States, the euro area and Japan. Against this background, the Polish case suggests a stronger short-term precautionary response of cash demand to external shocks. According to economic theory, this impact can be interpreted primarily in terms of the precautionary motive. These findings are also relevant to the transition towards a cashless society. They suggest that even as digital payments expand, external shocks may temporarily restore the importance of cash as a precautionary and confidence-based means of payment.

To confirm the long-term impact of external shocks on the money supply, it is essential to assess the slope of the trend line before and after the external shocks—in this case, COVID-19 and the war in Ukraine. Figure 1 presents the analysis of these results in graphical form.

Figure 1. Graphical presentation of model results and slope of trend lines—including control variables



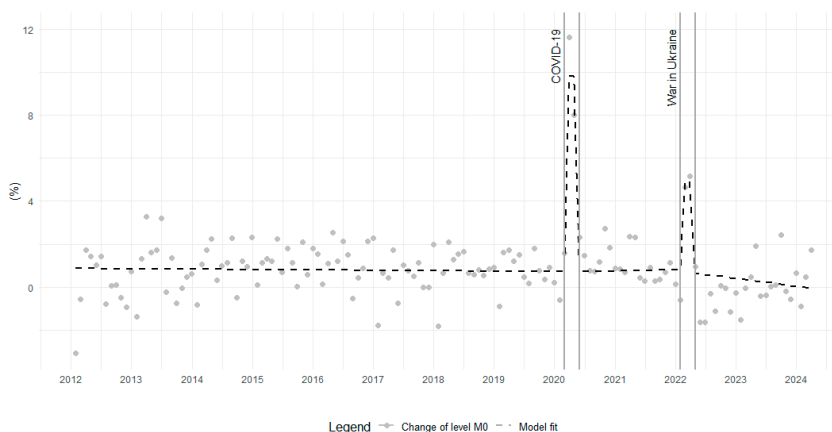
Source: Authors' results.

The graphical analysis presented in Figure 1 illustrates the trends in the money supply (M0) before and after the external shocks of COVID-19 and the war in Ukraine. Figure 1 supports the interpretation of Table 2. Although both shocks generated visible short-term level shifts, the slopes of the trend lines remained similar. This is consistent with the non-significance of the interaction terms *COVID_time* and *WAR_time* (with p-values of 0.474 and 0.728, respectively), which suggests the absence of a statistically significant long-term effect on M0. This result differs from the interpretation proposed by Reimers et al. (2020), who linked the persistence of cash demand in the euro area partly to the role of the shadow economy. In the Polish case, the estimated effects appear to be more short-lived, which may suggest that the analysed shocks primarily activated precautionary cash holdings rather than structurally strengthening long-term cash demand.

To ensure additional robustness of the results, the model parameters were calculated using the traditional model for ITS analysis

without using control variables. Also, in this variant, the short-term impact of COVID and WAR in M0 was positive and statistically significant, with the slope of the trend lines not being significant (Figure 2).

Figure 2. Graphical presentation of model results and slope of trend lines—excluding control variables



Source: Authors' results.

The obtained results and graphic analysis confirm the conclusions made from the model with control variables. However, as expected, such a model had a much lower coefficient of determination ($R^2 = 52.1\%$) while meeting all formal assumptions.

5. CONCLUSION

The study employed a novel approach, the Interrupted Time Series (ITS) analysis method, to assess the impact of external shocks, specifically COVID-19 and the war in Ukraine, on Poland's money supply (M0). This method allowed us to evaluate various factors influencing the money supply and isolate external shocks' short—and long-term effects on M0. The findings provide valuable insights into the dynamics of the money supply under extraordinary conditions and offer implications for the future of a cashless society.

Our results revealed several significant results. Firstly, the dummy variables for COVID-19 and the war in Ukraine had a substantial and statistically significant positive impact on the money supply (M0) in the short term. On the other hand, the comparison of trend lines before and after the shocks showed no significant differences in slopes. This finding was further supported by the lack of statistical significance for the interaction terms (COVID_time and WAR_time), indicating that neither COVID-19 nor the war in Ukraine had a lasting impact on the money supply trends in Poland. These results suggest that the immediate responses to these shocks were absorbed without altering the long-term trajectory of the money supply. Furthermore, we confirm the significance of other control variables on money supply, such as inflation and interest rate (negative impact), exchange rates (positive impact of the depreciation of the domestic currency), salary (positive impact), and unemployment (negative impact).

The results of this study allow for some practical implications. The resilience of the money supply to external shocks, as evidenced by the gentle slopes and non-significant long-term trends, suggests that the financial system can absorb substantial disruptions without compromising stability, but only in the long run. The short-term impacts of such shocks may result in substantial changes in the money supply. The strong positive effects observed during the COVID-19 pandemic and the war indicate a precautionary increase in cash holdings, reflecting public confidence in cash as a reliable medium during crises. This behaviour suggests that maintaining some level of cash availability may remain important for public confidence and financial stability during unforeseen events. In increasingly digitalised payment systems, this role of cash may also be viewed through the lens of operational resilience, as electronic payment channels remain exposed to technical disruptions, power outages, and cyber risks (Khiaonarong et al., 2021). From this perspective, cash continues to serve as a universally accessible fallback instrument in periods of systemic stress. While digital payments offer convenience and efficiency, they are no substitute for cash as a 'currency of trust' (unlike Bitcoin, called by Harari 'a currency of distrust') (Redman, 2024), especially in severe external shocks. Based on the conclusions reached, a completely cashless

society can work, but only in a world without volatility and ‘black swans’.

An important limitation of the study is that the two analysed shocks occurred relatively close to each other in time, which may have partially complicated the separation of their effects. Another limitation concerns the possible endogeneity between M0 and selected macro-economic control variables, especially inflation and interest rates. Although these variables were introduced as controls rather than as the primary object of causal interpretation, future research could address this issue more explicitly by applying instrumental-variable techniques or 2SLS estimation. The empirical framework could also be extended by incorporating variables directly related to non-cash payments, such as card transactions or other indicators of payment digitalisation. Moreover, comparative studies covering different regions, particularly Central and Eastern Europe and Western Europe, could deepen our understanding of how external shocks affect the money supply under different economic and institutional conditions. Such an approach could also help to explain how cultural and institutional factors shape public confidence in cash and influence the resilience of the money supply to external shocks. Future research could also combine the ITS framework with microeconomic data, such as household survey evidence, in order to better capture behavioural responses to crises and the heterogeneity of cash-holding motives across social groups. A further promising direction would be to examine how anti-cash policies, transaction limits, and broader regulatory efforts supporting the cashless transition in the European Union affect the demand for M0, particularly in the context of Central and Eastern Europe.

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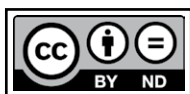
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