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Inflation Dynamics in Southeast Europe: A Panel Econometric Analysis of Monetary Policy Transmission

Zoran Grubišić[1] | Ljubomir Obradović[2*] | Radoje Žugić[3]

[1] Union University in Belgrade, Belgrade Banking Academy – Faculty of Banking, Insurance and Finance, Belgrade, Serbia
[2] Serbian Armed Forces General Staff, Belgrade, Serbia
[3] Adriatic University, Faculty for Mediterranean Business Studies, Tivat, Montenegro

ABSTRACT
This paper investigates the relationship between monetary policy and consumer price inflation in nine Southeast European (SEE) economies, with the aim of identifying the key channels through which monetary policy influences inflation dynamics.
The analysis is based on an annual panel dataset covering the period 2007–2022. Static panel econometric techniques are applied, combining fixed-effects and random-effects estimators with robust standard errors. Model validity is assessed through cross-sectional dependence tests, panel unit-root tests and the Hausman specification test. The model includes lending interest rates, exchange rates and broad money (M3), alongside control variables such as producer price inflation, unemployment, adjusted net income per capita, domestic credit and foreign direct investment.
The results indicate that lending interest rates exert a strong positive and statistically significant effect on inflation, consistent with Neo-Fisherian dynamics under uncertainty. Producer price inflation, domestic credit and foreign direct investment also show positive and significant effects, while broad money (M3) displays a negative coefficient, reflecting structural characteristics and high collinearity with credit aggregates in SEE financial systems.
By providing a harmonized multi-country dataset and a comprehensive panel diagnostic framework, the study contributes new empirical evidence on the non-standard transmission of monetary policy in transition economies and offers policy-relevant insights for countries aligning their monetary frameworks with European Central Bank practices.

Keywords: *monetary policy transmission, inflation dynamics, panel data econometrics, Southeast Europe, Neo-Fisherian effect, interest rate channel, credit channel, transition economies*

JEL Classification: E31, E52, C23, E58

INTRODUCTION

This study analyzes how monetary policy affects inflation. Monetary policy, a set of instruments used by central banks to influence liquidity and interest rates, plays a central role in shaping inflation dynamics. The relationship between monetary policy and inflation is highly complex and a subject of ongoing debate among economists. The link between monetary policy and inflation is influenced by various factors, economic conditions, and contextual elements. According to some views, inflation is a monetary phenomenon directly determined by changes in the money supply.

* Corresponding author, e-mail: lj.obradovic@bba.edu.rs

This suggests that when the money supply grows faster than the economy itself, it leads to inflationary pressure or an increase in the inflation rate. In addition to this perspective, there is another view of inflation based on the excess demand model, which takes into account cost-related factors such as prices or wages. Proponents of this model argue that demand-side factors in labor or goods markets provide a better explanation of inflation than monetary variables.

Monetary policy effects are regime-dependent, producing only short-lived price responses at low inflation but stronger and more persistent impacts on both inflation and real activity when inflation is elevated (Gargiulo, Matthes, & Petrova, 2025). The relationship between monetary policy and inflation can be observed and analyzed through various economic variables, that is, elements of macroeconomic dynamics. If we understand macroeconomic dynamics as a set of changes and movements in economic variables at the level of the entire economy, then inflation can be tracked through the movement of monetary aggregates, production, unemployment and similar indicators.

Economists see economic growth as the main manifestation of macroeconomic dynamics (Stefanović, 2014), which primarily refers to the increase in the production of goods and services within the economy. Economic growth can be measured by changes in Gross Domestic Product (GDP) over time, most commonly expressed as a percentage. Inflation is a negative factor influencing the economy, as it reduces the value of the domestic currency in the short-term and, in the long term, hampers economic growth and adversely affects investment activity (Marcu, 2013). If inflation is viewed as a monetary phenomenon, that is, as a consequence of an increase in the money supply, then it is necessary to determine the role of the central bank in this process, given that it is responsible for controlling the money supply.

Monetary authorities may deliberately stimulate economic activity by increasing the money supply. This can also arise from challenges in managing public finances, where additional money is spent to cover budget deficits. Precisely this issue has highlighted the need for the independence and effective functioning of central banks in relation to the executive branch. In a broader economic context, technological innovations contribute to strengthening business performance and the development of sustainability initiatives (Velichkovska, Mitić, & Kojić, 2025), thereby supporting overall economic growth and reinforcing the conditions necessary for stable macroeconomic development. Within this broader framework, empirical evidence suggests that economic growth plays a significant role in stimulating the production of scientific knowledge, while no corresponding effect in the opposite direction has been identified (Vasilić & Veselinović, 2024).

Price increases can be caused by various factors, ranging from higher taxes, reduced inventories of raw materials, increased demand and so on. However, persistent and long-term inflation is most often associated with expansionary fiscal policy, a lack of monetary instruments, governments that are unable to effectively manage public finances or dysfunctional central banks that are subject to political pressures (Jørgensen & Ravn, 2022). What is certain is that economies with high inflation rates and fixed exchange rates are not competitive; in other words, they face slow economic growth. Furthermore, inflation leads to increased speculative activity in financial markets, where alternatives to actual business operations are sought.

Another characteristic of inflation is the spillover effect, where an increase in the price of one product leads to price increases in other products, which can, in turn, cause inflationary effects to spill over from one economy to another. The problem is not stable and controlled inflation, for which various monetary policy measures and instruments are developed and applied. The real issue is high and uncontrolled inflation, the intensity and direction of which cannot be predicted.

This research covers nine SEE countries[1]. Their selection is rooted in their shared geographic location, a region characterized by diverse institutional frameworks and exchange-rate regimes.

[1] Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Hungary, Montenegro, North Macedonia, Romania, and Serbia

The legacy of socialist governance followed by a post-conflict transition in many of these countries provides essential background for interpreting their current economic and monetary policy frameworks.

A key element of this study is the distinction between countries that are already members of the EU and those still on the path to accession. This distinction introduces a layered dynamic in which EU members tend to follow harmonized monetary policy frameworks, while candidate countries often undertake structural reforms to align with EU accession requirements. The gradual convergence of monetary strategies among these states reflects their shared objective of achieving institutional and policy compatibility with EU norms.

Beyond formal monetary frameworks, these countries engage in broader regional cooperation through various initiatives and organizations, facilitating coordinated responses to mutual economic challenges. Such collaboration fosters a climate of policy alignment and regional stability. Moreover, their active participation in global institutions such as the International Monetary Fund (IMF) and the World Bank provides both technical support and access to financial resources that further shape monetary policy decision-making. The analysis covers 2007–2022, a period marked by major global and regional disruptions, including the 2008 global financial crisis and the effects of the COVID-19 pandemic (Grabowski, Janus, & Stawasz-Grabowska, 2023). These episodes offer salient benchmarks for interpreting variation in monetary policy stances and macroeconomic outcomes.

The variable set operationalizes key monetary policy channels and standard controls within a panel framework. We estimate the model on data for SEE economies to quantify the extent to which monetary policy shapes inflation.

This article offers several novelties compared to prior research. First, it assembles a harmonized panel dataset, providing broader coverage than earlier studies, which typically focused on single countries or shorter time spans. Second, it incorporates an extended set of explanatory variables, including lending interest rates, exchange rates, broad money (M3), producer price inflation, unemployment, net income, domestic credit and foreign direct investment. Third, the empirical strategy applies panel FE and RE estimators, supported by a full set of diagnostic tests, ensuring robustness of the results. Finally, the study places its findings within the specific institutional and structural context of SEE, highlighting the non-standard transmission of monetary policy in small open transition economies. The results show that lending interest rates, producer price inflation and foreign direct investment exert positive and significant effects on consumer price inflation, whereas broad money (M3) enters with a negative coefficient, reflecting structural heterogeneity and high collinearity with domestic credit.

THEORETICAL BACKGROUND

This study draws on sources across economics, finance, and monetary economics; in addition to peer-reviewed journals, it uses books, reports, working papers, and government and international publications to provide a comprehensive, multidimensional evidence base.

The literature search imposed no temporal limits, allowing the inclusion of classic works to anchor the theoretical framework. Recent contributions were likewise incorporated to capture current trends and innovations in monetary policy. Selection proceeded through a carefully structured, multi-step approach. Only studies directly relevant to the research question were retained, yielding a comprehensive view of monetary policy's impact in the contemporary economic context.

A large body of research has clarified the mechanisms and transmission channels of monetary policy, providing a foundation for sound economic policymaking. Initial research efforts were primarily concerned with identifying the aims, tools and functions of monetary policy, particularly instruments like interest rates and open market operations and assessing their influence on liquidity and capital flows within the economy.

Research has extensively examined this interaction, yielding insights into price dynamics, inflation expectations and strategies for maintaining price stability.

Among the most transformative figures in economic thought was British economist John Maynard Keynes, whose 1936 work fundamentally reshaped modern economic theory. Challenging the prevailing classical paradigms of the time, Keynes emphasized the central role of interest rates and investment in stimulating economic growth (Keynes, 1936). His contributions provided the intellectual foundation for Keynesian economics and have had a lasting influence on both theoretical and practical aspects of monetary policy.

This review of the literature illustrates the progression of thought surrounding monetary policy, emphasizing its evolving role in guiding economic cycles and ensuring macroeconomic stability in the modern era.

Central banks employ various instruments and strategies to control inflation within an economy. There is a substantial body of literature dedicated to the study of monetary policy and inflation, indicating that this area of economics remains a subject of broad and ongoing research interest. Extensive research investigates how monetary policy relates to inflation in both theoretical and empirical work.

Recent theoretical and empirical work shows that when policy-rate increases are perceived as permanent, inflation tends to rise even in the short run, the so-called neo-Fisher effect (Williamson, 2018), (Uribe, 2022). Vector Autoregression (VAR)-based identification confirms short-run co-movement of nominal interest rates and inflation in the United States (US) data.

Inflation volatility, viewed through the lens of exchange rate fluctuations and output gap volatility (Özer, Grubišić, & Küçüksakarya, 2023) highlights the importance of implementing appropriate monetary policy. Central bank independence is discussed in a section of the book (Agoba, Fiador, Sarpong-Kumankoma, & Sa-Aadu, 2022), which focuses on price stability management in Africa.

Further empirical studies also identify a negative and statistically significant relationship between the perceived tone of monetary policy communication and expected inflation (Carotta, Mello, & Ponce, 2023), using panel data regression analysis. The study on fiscal backing for central banks (Del Negro & Sims, 2015) argues that such support would benefit banks with large balance sheets composed of long-duration nominal assets, such as long-term bonds or time deposits, thereby enhancing their ability to control inflation.

Research on the transmission of monetary policy shocks using relevant economic and financial variables (Gertler & Karadi, 2015) demonstrates that small changes in short-term interest rates can lead to large movements in credit costs. Additionally, this research shows that output and inflation are affected by shocks resulting from frequent surprises in policy announcements. A study conducted in the US since 1979 (Eleftheriou & Kouretas, 2023) reveals patterns in monetary policy characterized by a strong response to inflation and effective management of its fluctuations.

Another study (Flaccadoro & Landi, 2025), which included 27 developing countries, showed that inflation in these countries is dependent on US monetary policy. This suggests that the monetary policy of major economies can significantly influence inflationary trends in less developed countries, posing a challenge for monetary authorities in emerging markets.

Recent empirical advances have emphasized the importance of disentangling the nature of monetary policy shocks. Jarociński and Karadi (2020) show that policy surprises often conflate genuine monetary shocks with information effects, underscoring the need for precise identification strategies. Complementing this perspective, Boissay et al. (2025) examine how the effects of monetary tightening depend on whether inflationary pressures are supply or demand-driven, highlighting that policy transmission can differ substantially across contexts. Together, these studies provide a state-of-the-art framework for understanding the complex and heterogeneous responses of inflation to monetary interventions, which is particularly relevant for economies in SEE.

While global contributions have clarified the transmission of monetary policy across advanced economies, evidence from SEE remains relatively limited. Recent studies increasingly emphasize the unique institutional and structural features of the region. For instance, Jakšić (2022) employs a Global Vector Autoregressive (GVAR) model to show that inflation in Central, Eastern and Southeastern Europe (CESEE) countries is strongly affected by international shocks, but with heterogeneous responses depending on EU membership status. Similarly, Čaklovica and Efendić (2020), using a dynamic panel framework for 28 European transition economies, identify unemployment, wage dynamics and external shocks as key drivers of inflation, underscoring the sensitivity of transition economies to both domestic and global factors.

Focusing more narrowly on the Western Balkans, Minasyan et al. (2023) apply an augmented Phillips curve and structural VAR approach, finding that inflation in the subregion is predominantly driven by demand shocks and that convergence with euro area inflation is limited. Complementing this, Durguti et al. (2021) employ panel Generalized Method of Moments (GMM) techniques to analyze Western Balkan economies and report that GDP growth, remittances, and Foreign Direct Investments (FDI) exert a significant influence on inflation dynamics. Together, these studies demonstrate that SEE countries face distinct inflationary mechanisms, reflecting their post-transition development trajectories and partial integration into EU monetary structures.

Inflation expectations are a critical factor to consider in the conduct of monetary policy. A significant survey explored consumers' willingness to increase spending in relation to their anticipated inflation expectations (Breitenlechner, Geiger, & Scharler, 2024), also taking into account monetary policy shocks. The role of monetary policy in the context of inflation is examined in the work (John, Kumar, & Patra, 2022), who argue that fighting inflation must be pursued through monetary policy instruments regardless of the nature of inflationary pressures.

The study (Rangarajan & Nachane, 2021), which explores the role of monetary aggregates in various macroeconomic theories, challenges the view that monetary aggregates generally cannot explain inflation, except when inflation is linked to the output gap. Additionally, the literature includes works that explain the measures undertaken by central banks of major global economies in response to rising or high inflation (Shapran & Britchenko, 2022).

Recent studies, such as Lukmanova and Rabitsch (2023), which distinguish between interest rate shocks and inflation target shocks and Bouakez and Kano (2024), which propose an alternative empirical identification of the Neo-Fisher effect without assuming cointegration, expand the methodological toolkit used in this literature. These works highlight that the Neo-Fisher effect may manifest differently depending on how permanent shocks are defined and identified.

Building on these findings, the present paper advances the literature by a) extending the sample to nine SEE economies over 2007–2022; b) incorporating a broader set of explanatory variables, including foreign direct investment and adjusted net income; c) applying comprehensive panel diagnostics (unit root, cross-sectional dependence, and Hausman testing), and d) explicitly distinguishing between EU member states and accession countries. This approach allows for a more nuanced assessment of monetary policy's role in shaping inflationary outcomes in a heterogeneous regional setting.

Data and Methodology

A rigorous assessment of monetary policy transmission requires both reliable data and an appropriate methodological design. The empirical analysis is therefore grounded in carefully selected materials and supported by econometric techniques that ensure validity and robustness of the results.

Empirical Settings

The empirical setting reflects the specific structural and institutional features of SEE economies, which shape the transmission of monetary policy to consumer prices. In this context, the dataset captures the interaction between financial variables and inflation dynamics over time, ensuring that the analysis accounts for both cross-country diversity and regional commonalities.

The model specification draws on previous studies but adapts them to the context of SEE. For instance, Coibion and Gorodnichenko (2025) emphasize the role of expectations and interest rates in shaping inflation dynamics, while Salunkhe and Patnaik (2017) incorporate growth considerations in the analysis of inflation control. Other research, such as Roberts (2006) highlighted the role of unemployment and output volatility, whereas Cioran (2014) applied regression methods to explore the relationship between inflation, unemployment and interest rates. Building on this literature, the present study selects variables not only for their theoretical relevance but also for their data availability and suitability for econometric modeling. By combining demand-side and supply-side indicators, the model provides a balanced framework for analyzing inflation dynamics in transition economies.

A recurring limitation in the cited literature is the lack of standardization in terms of country coverage, sectoral scope, variable definitions and sample periods, which often leads to inconsistent or even conflicting results. Methodological diversity further complicates comparisons, ranging from qualitative approaches to various quantitative techniques. Moreover, many studies overlook soft institutional factors such as expectations formation, regime stability, institutional capacity, rule-of-law quality and trust in authorities, all of which influence the effectiveness of monetary policy. Recognizing these limitations is instructive, as it motivates improvements in research design and the construction of richer empirical frameworks.

Against this backdrop, the present study assembles a panel of nine SEE economies observed annually over sixteen years. This multi-country longitudinal dataset provides distinct advantages: it increases variability, reduces collinearity among variables and enhances the degrees of freedom available for estimation. It also enables the analysis of both temporal dynamics and country-specific effects, thus offering a more nuanced perspective than purely cross-sectional or purely time-series approaches. The dataset was compiled primarily from internationally recognized sources such as the World Bank, IMF and Eurostat, and was supplemented by national central bank statistics and official country publications. In cases where no consistent series were available, observations were omitted, resulting in an unbalanced panel. No artificial interpolation or smoothing was applied, preserving comparability and reliability across countries. Details of variable definitions, series codes and data sources are presented in the Appendix.

The use of annual data was dictated by availability and cross-country comparability. While higher-frequency data (quarterly or monthly) could, in principle, allow for more precise identification of monetary policy shocks, such series are incomplete or inconsistent across the SEE sample, limiting their feasibility in a panel setting.

The study period is particularly instructive, spanning the global financial crisis, the recovery phase and the COVID-19 shock, all of which significantly influenced monetary frameworks. During this time, SEE economies also underwent important political and economic transformations, including EU accession progress and institutional reforms. Financial stability, increasingly recognized as a central concern in the formulation of monetary policy since the global financial crisis, further underscores the importance of analyzing SEE economies under heterogeneous conditions. These developments provide a valuable context for assessing monetary policy effectiveness, thereby enriching the understanding of its role in safeguarding stability and supporting long-term development.

Empirical Strategy

The econometric approach is designed to capture both the time-series and cross-sectional dimensions of the dataset while addressing potential challenges such as non-stationarity, cross-sectional dependence and heterogeneity across countries. To this end, the analysis employs panel estimation techniques that allow for valid inference in the presence of unobserved country-specific effects and ensure the robustness of results through a sequence of diagnostic tests and specification checks. In addition to unobserved heterogeneity, institutional differences, such as whether a country is an EU member or an accession candidate, may also shape the transmission of monetary policy. While this study does not explicitly incorporate EU membership as a dummy or interaction term, acknowledging such distinctions highlights an important avenue for future research (Obradović, 2024)[2].

Panel methods are applied to data covering nine economies over a sixteen-year horizon. Using a longitudinal design with repeated country observations, we follow the same economies across years. Formally, the baseline panel specification is given by Baltagi (2021), Hsiao (2015) and Greene (2012):

$$y_{\{it\}} = \alpha_{\{i\}} + X'_{\{it\}}\beta + \varepsilon_{\{it\}}, i = 1, \dots N; t = 1, \dots T$$

Here, $y_{\{it\}}$ denotes the dependent variable (consumer price inflation), $X'_{\{it\}}$ is a K-dimensional vector of explanatory variables, β the parameter vector of interest, $\alpha_{\{i\}}$ unobserved country-specific heterogeneity, and $\varepsilon_{\{it\}}$the idiosyncratic error term. In this study, N=9 and T=16. This structure increases variability, reduces collinearity among regressors and improves the degrees of freedom relative to pure time-series or cross-sectional.

Estimation results in such settings are sensitive to the properties of the data-generating process. Unaddressed heteroskedasticity, autocorrelation or cross-sectional dependence may compromise inference. Therefore, a sequence of diagnostic tests was implemented prior to estimation: a) Pesaran-type tests to detect cross-sectional dependence across countries (Pesaran, 2021); b) panel unit-root tests to establish the stationarity of the variables (Levin, Lin, & Chu, 2002) and c) specification tests to decide between FE and RE estimators, with the Hausman test serving as the criterion (Hausman, 1978). The Hausman specification test evaluates whether the coefficient vectors estimated under FE and RE differ systematically. The test statistic is given by:

$$H = (\{\hat{}\beta\}_{\{FE\}} - \{\hat{}\beta\}_{\{RE\}})^T \left[Var(\{\hat{}\beta\}_{\{FE\}}) - Var(\{\hat{}\beta\}_{\{RE\}}) \right]^{\{-1\}} (\{\hat{}\beta\}_{\{FE\}} - \{\hat{}\beta\}_{\{RE\}}); H \sim \chi^{2(k)}$$

In this expression $\{\hat{}\beta\}_{\{FE\}}$ and $\{\hat{}\beta\}_{\{RE\}}$ denote the coefficient vectors estimated using the fixed effects and random effects models, respectively, while $Var(\{\hat{}\beta\}_{\{FE\}})$ and $Var(\{\hat{}\beta\}_{\{RE\}})$ represent the corresponding covariance matrices. The superscript T indicates vector transposition and (k) denotes the number of parameters being tested. Under the null hypothesis, the RE estimator is both consistent and efficient, whereas the FE estimator is consistent but inefficient. Rejection of the null hypothesis suggests that the regressors are correlated with the unobserved individual effects, in which case the FE estimator should be preferred. It should be noted that the static FE and RE estimators employed here do not allow for explicit identification of exogenous monetary policy shocks. The focus is therefore on describing associations between monetary variables and inflation, with causal identification beyond the scope of the present econometric design.

[2] Part of the dataset and preliminary empirical analyses are derived from the author's doctoral dissertation (Obradović, 2024), while the present study extends the analysis through discussion of the results.

To quantify the effect of monetary policy on inflation, we estimate a RE panel model and report robust (clustered by country) standard errors. All estimations and diagnostics were performed in Stata.

We distinguish the following types of panel datasets (Beck & Katz, 1995), cross-section–dominant designs (CSTS - Cross Sectional Time Series, N > T) contrast with time-series–dominant designs (TSCS - Time Series Cross Sectional, T > N). Our sample falls into the latter. In such settings, pooled Ordinary Least Squares (OLS) is rarely defensible: country-specific unobservables confound coefficient estimates, regressors may not be exogenous and series often display non-stationary behavior. These departures from the classical assumptions motivate the use of FE/RE estimators with robust inference.

While the focus of this study is on static panel estimators, it is important to note that dynamic specifications, such as VAR; ARDL or System GMM, could in principle address endogeneity and capture richer dynamics. However, the relatively short time dimension of the dataset constrains their applicability. Future research may extend the analysis using these approaches as longer time series become available.

RESULTS AND DISCUSSION

The choice of interest rates, exchange rates and the broad money (M3) supply as proxies for the impact of monetary policy on inflation is firmly grounded in the central role these variables play in shaping price dynamics. Interest rates remain the primary instrument through which central banks influence inflation, consumption and investment: lower rates encourage borrowing and stimulate aggregate demand, while higher rates restrain credit activity, moderating spending and investment to prevent overheating.

The exchange rate, reflecting the relative value of domestic currency against others, directly affects trade flows, capital movements and ultimately consumer prices. An appreciating currency reduces the cost of imports and exerts downward pressure on inflation, but it can simultaneously weaken export competitiveness, whereas a depreciating currency has the opposite effect, boosting exports while increasing import prices and inflationary pressures. In parallel, the broad money (M3) supply captures the liquidity available in the economy and serves as an important barometer of monetary conditions, linking monetary expansion or contraction to inflationary trends. Taken together, these indicators provide a comprehensive lens through which the effectiveness of monetary policy in influencing inflation, particularly in open and financially integrated economies, can be assessed with greater accuracy.

The broad money (M3) supply serves as a comprehensive indicator of the volume of liquid assets circulating within the economy and reflects the broader stance of monetary policy. An expansion in broad money (M3) signals an increase in liquidity, which typically stimulates consumption and investment, thereby exerting upward pressure on inflation. In contrast, a contraction in broad money (M3) reduces the flow of money and credit, helping to cool an overheated economy and contain rising prices.

By analyzing the interactions between broad money (M3), interest rates and exchange rates, this study captures the concrete channels through which monetary policy shapes inflationary dynamics. This framework not only underscores the appropriateness of these indicators but also provides a more nuanced understanding of the complex mechanisms by which monetary policy influences both price stability and the broader contours of economic performance.

Sample Characteristics and Composition

The descriptive statistics presented in Table 1 reveal that the dataset is unbalanced, as shown in the observation column. The dataset takes the form of an unbalanced panel, as certain time

series are not available for all countries and years under observation. Such gaps are common in studies covering transition economies over longer time horizons.

Nevertheless, this structure does not undermine the reliability of the findings, since modern panel econometric methods allow for valid estimation under these conditions. Missing values relate to the variable adjusted net national income per capita.

Table 1. Descriptive statistics

Variable	Observations	Mean	Std. deviation	Min	Max
ICP	144	3.326	3.639	-1.584	15.325
OER	144	56.907	81.609	0.679	372.596
BM	144	114.164	155.191	32.248	647.638
PPI	144	4.127	7.464	-7.233	44.710
LIR	144	7.754	3.377	1.471	17.572
UnE	144	14.278	7.714	3.420	35.230
AdjNIpc	135	3.139	4.837	-14.821	16.387
DCPS	144	92.149	132.645	24.623	524.515
EI	144	-6.285	7.827	-49.647	4.552
FDI	144	7.493	13.509	-40.086	106.594

Source: Authors based on Obradović (2024)

The values of these descriptive statistics, especially considering the minimum and maximum values, indicate that the sample includes economies at different levels of development. The sample consists mainly of developing countries but also includes developed economies. The wide range of minimum and maximum values for certain variables, alongside the covered research period, is influenced by the varying levels of development of the observed economies.

Fluctuations are particularly pronounced in broad money (M3) supply (ranging from 32.24 to 647.64), producer price inflation (from -7.23 to 44.71), domestic credit to the private sector (from 24.62 to 524.52) and foreign direct investment (from -40.08 to 106.59).

The standard deviation, as an indicator of dispersion, reflects the extent to which data values deviate from the mean. Larger values of the standard deviation signify higher variability within the dataset, whereas smaller values denote greater concentration around the average. Among the variables under consideration, the highest degree of variability is recorded for domestic credit to the private sector (132.64), followed by broad money (M3) (155.19) and the official exchange rate (81.61), underscoring the pronounced fluctuations in these dimensions of monetary and financial activity.

Statistical Examination

Using panel data regression analysis with both FE and RE models, an empirical study was carried out to investigate how monetary policy influences economic growth across nine countries in SEE. The estimation results indicate that monetary policy variables play a decisive role in shaping consumer price inflation in SEE. Lending interest rates show a strong and statistically significant positive effect, with a coefficient of 0.442 ($p < 0.01$), suggesting that higher borrowing costs are systematically associated with rising consumer prices. Producer price inflation is also positively related to consumer price inflation (0.077, $p = 0.036$), confirming the relevance of cost-push channels. Similarly, domestic credit to the private sector (0.073, $p = 0.005$) and adjusted national income per capita (0.139, $p = 0.012$) exert statistically significant positive effects, while

foreign direct investment, though relatively modest in magnitude, is also positive and significant (0.033, p = 0.018). In contrast, broad money (M3) enters with a negative and statistically significant coefficient (−0.033, p = 0.044), reflecting its high collinearity with domestic credit and the structural features of SEE financial systems. Other variables, such as the exchange rate and employment index, are not statistically significant at conventional levels, while unemployment shows a positive but insignificant association with inflation.

The robustness of these findings is reinforced by the results reported in Table 2, where the coefficients across FE and RE specifications remain similar in magnitude and direction, thereby justifying the choice of the RE estimator based on the Hausman test $\chi^2 = (b - B)^T[Var(b) - Var(B)]^{-1}(b - B) = 2.40,\ p - value = 0.9835$. Taken together, these results confirm that the main transmission mechanisms of monetary policy in the region operate through interest rates, producer prices and domestic credit, while highlighting the structural complexities associated with broad money (M3) and capital inflows.

The results also underscore the importance of considering specific economic conditions and extraordinary events that characterized the period under review. This consideration enables a more precise interpretation of monetary policy impacts and sheds light on the possible shortcomings of traditional modeling approaches. Furthermore, acknowledging these unique circumstances supports the creation of more flexible and robust policy frameworks moving forward.

Empirical Evidence from Panel Regression Analysis

To assess the stationarity properties of the dataset, both the Im, Pesaran, and Shin (IPS) and the Cross-sectionally Augmented IPS (CIPS) tests were applied, with specifications that included and excluded a deterministic trend (Appendix). The inclusion of a trend accounts for systematic upward or downward movements in the series, whereas the specification without a trend assumes the absence of such long-term deterministic components. Evidence of stationarity in the presence of a trend indicates that, despite underlying directional movements, the series fluctuates within bounded limits around its trend path, rather than exhibiting unrestrained growth or decline.

Conversely, non-stationarity in the presence of a trend indicates persistent movements in the data, reflecting potential long-term shifts or systematic increases and decreases over time. Results from the first-generation IPS test revealed that only three variables, adjusted net income per capita, the export-to-import ratio and foreign direct investment, could be considered stationary. The remaining variables exhibited unit roots, which required appropriate transformations, such as differencing, to ensure validity in subsequent estimation. Nevertheless, the final assessment of stationarity relied on the second-generation CIPS test, which provides more robust evidence by accounting for cross-sectional dependence within the panel. To address the issue of non-stationarity, the affected variables were transformed through differencing, yielding stationary series suitable for empirical analysis. Once stationarity was confirmed, panel estimation techniques were applied to account for unobserved heterogeneity across countries, specifically the FE and RE models.

The Hausman specification test produced a probability value of 0.9835, suggesting no systematic differences between the two estimators and thereby supporting the use of the RE specification. Nevertheless, Table 2 also reports the FE results. Although coefficient magnitudes vary slightly, the overall direction and statistical significance of the key variables remain consistent across both estimators. Notably, lending interest rates and producer price inflation retain their positive and significant influence on consumer price inflation under both FE and RE, underscoring the robustness of the findings.

Thus, while the Hausman test favors the RE model, presenting the FE estimates enhances comparability and confirms that the main conclusions are not dependent on estimator choice.

While techniques such as Autoregressive Distributed Lag (ARDL) or its panel variants, Pooled Mean Group Autoregressive Distributed Lag (PMG-ARDL) could, in principle, help address dynamic interactions and potential endogeneity, the relatively short time dimension of the dataset (annual frequency, 2007–2022) constrains their applicability. For this reason, the paper relies on static panel estimators, but acknowledges that future research could employ ARDL or System GMM approaches as more data become available.

Table 2. Analysis of individual effects (Hausman test)

Variable	**(b)**	**(B)**	**(b-B)**	$\sqrt{\mathbf{diag(v_b - v_B)}}$
	fixed	random	difference	S.E.
ICP				
dOER	-0.029	0.009	-0.038	.
dBM	-0.032	-0.033	0.001	.
dPPI	0.064	0.077	-0.013	.
LIR	0.469	0.442	0.027	0.009
dUnE	0.162	0.173	-0.011	.
AdjNIpc	0.149	0.139	0.011	.
dDCPS	0.072	0.073	-0.001	.
dEI	-0.070	-0.075	0.005	.
FDI	0.028	0.033	-0.005	.

[1] Ho: difference in coefficients not systematic. $\chi^2 = (b - B)^T[\,Var(b) - Var(B)]^{-1}(b - B) = 2.40,\ p - value = 0.9835$; When the p-value is greater than 0.05, we fail to reject the null hypothesis that the FE model is more appropriate and accept the alternative hypothesis. Given the result and the p-value, we accept the hypothesis that the RE model is suitable.

Source: Authors based on Obradović (2024)

Based on the mentioned Hausman test result, the model is explained using the RE method (Table 3).

Table 3. Random effect model

ICP	**Coefficient**	**Std. error**	**z**	**P>z**	**(95% confidence interval)**	
	dependent variable					
OER	0.009	0.026	0.360	0.719	-0.042	0.061
dBM	-0.033	0.016	-2.010	0.044	-0.064	-0.001
dPPI	0.077	0.0368	2.100	0.036	0.005	0.149
LIR	0.442	0.062	7.190	0.000	0.322	0.563
dUnE	0.173	0.136	1.270	0.204	-0.094	0.439
AdjNIpc	0.139	0.055	2.520	0.012	0.031	0.247
dDCPS	0.073	0.026	2.810	0.005	0.022	0.125
dEI	-0.075	0.053	-1.410	0.158	-0.179	0.029
FDI	0.033	0.014	2.370	0.018	0.006	0.061
_cons	-1.276	0.572	-2.230	0.026	-2.397	-0.156

[2] $R^2 = 0.4705$; ICP =-1.276-0.033dBM+0.077dPPI+0.442LIR+0.139AdjNNIpc+0.073dDCPS+0.033FDI.

Source: Authors based on Obradović (2024)

The RE estimation identified several variables as statistically significant determinants of inflation. The first difference of broad money (M3) was significant at the 5% level, with a coefficient of –0.032, while consumer price inflation, also differenced, showed significance at the same level with a positive coefficient of 0.077. The interest rate on loans emerged as the strongest predictor, statistically significant at the 1% level, with a coefficient of 0.442. In addition, adjusted net national income per capita proved significant at the 5% level, with a coefficient of 0.139. The first difference of the ratio of domestic credits to deposits in the banking sector was significant at the 1% level, carrying a coefficient of 0.073, and foreign direct investment also contributed positively, significant at the 5% level, with a coefficient of 0.033.

Overall, the RE model produced an R^2 value of 0.4487, indicating that approximately 44.87% of the variation in inflation can be explained by the included variables. This relatively high explanatory power, combined with the statistical significance of the estimated coefficients, confirms that the selected independent variables capture important aspects of the dynamics of inflation and are relevant for understanding its variability.

Changes in these independent variables have a significant impact on inflation, which can be useful for forecasting inflationary trends. However, it is important to note that R^2 does not guarantee that all relevant factors have been included in the model or that the independent variables are described in sufficient detail. Therefore, while R^2 provides valuable insight, additional research and analysis are necessary to gain a deeper understanding of the drivers of inflation and improve the accuracy of inflation forecasting.

Discussion

In this study, we note several findings regarding how monetary policy affects inflation. First, the official exchange rate shows no statistically significant influence on inflation in the nine SEE economies over the 2007-2022 sample period. Several factors may explain this. Most of the countries maintained relatively stable exchange-rate regimes, so the limited variability in that variable muted its impact. Moreover, other forces appear to have exerted a stronger pull on prices, especially given that the period 2007-2022 spans disparate business cycles, crises and policy shifts. Hence, any exchange-rate effect is highly contingent on the prevailing economic environment; in this particular sample and period, it is simply not detectable.

Second, the estimated signs on the loan interest rate and on the first difference of broad money (M3) run counter to what standard textbooks predict. The negative coefficient of broad money (M3) observed in the RE model is contrary to theoretical expectations. This anomaly is primarily explained by the strong overlap between broad money (M3) and domestic credit, which are almost perfectly correlated in the SEE sample, and by structural heterogeneity across countries. In several cases, monetary expansion coincided with stabilization measures and foreign exchange interventions, which muted the expected inflationary effect. The data transformation into first differences further reduced variation in broad money (M3), reinforcing this outcome. Thus, the negative sign should not be interpreted as evidence of a causal inverse relationship, but rather as a statistical artifact arising from multicollinearity and country-specific monetary regimes.

A setting in which higher policy rates are followed by higher inflation contradicts conventional monetarist intuition but is consistent with Neo-Fisherian monetary theory. Our results show a strong and positive coefficient for lending interest rates, which is in line with the Neo-Fisher hypothesis as explored in Lukmanova and Rabitsch (2023), who find that shocks to the inflation target or persistent changes in nominal rates can lead to short-run positive co-movement with inflation. Similarly, Airaudo and Hajdini (2023) argue that under certain wealth or markup configurations, such co-movements are more likely, suggesting that contextual institutional and market structure differences in SEE may explain the magnitude of the effect in our estimates.

In the very short run, tighter money can even push prices upward. Markets that already expect inflation may react to a rate hike by front-loading price increases. Long-term and fixed-rate

contracts slow the pass-through of higher financing costs; firms and consumers face adjustment costs that temporarily raise prices while the economy adapts.

Similarly, Airaudo and Hajdini (2023) argue that under certain wealth or markup configurations, such co-movements are more likely, suggesting that contextual institutional and market structure differences in SEE may explain the magnitude of the effect in our estimates.

Near-zero policy rates and large-scale quantitative easing, deployed after both the 2008 and 2020 shocks, may have weakened or reversed the usual relationships between interest rates, liquidity and inflation. Investment demand remained tepid and broad-money (M3) surges met slack aggregate demand. Non-linear effects and atypical economic dynamics common in crisis periods can lead standard models astray.

Producer price inflation cannot be ignored either. Higher input costs cascade through the supply chain to consumers, a pass-through visible in the positive link we find between the producer-price index and consumer price inflation. Monetary policy can influence these costs indirectly through several channels. Taken together, the results underscore the need for additional work to untangle the precise mechanisms at play. Future research might explore shifts in market structure, the behavior of firms and households and the specific unconventional measures adopted by central banks during turbulent periods, all of which shape the inflation process.

It should be emphasized that the static panel estimators applied in this study capture correlations rather than strict causal effects. Establishing causality would require isolating exogenous monetary policy shocks. One standard approach is the use of panel VAR models, where each variable is regressed on its own lags and the lags of other variables, thereby capturing dynamic interactions. To identify exogenous shocks within such a framework, researchers often impose timing assumptions through Cholesky restrictions (Love & Zicchino, 2006), which assume that some variables react contemporaneously to shocks, while others respond with a lag. Although such techniques are beyond the scope of this paper, they represent a promising avenue for future research aimed at disentangling the causal transmission channels of monetary policy in SEE.

Based on the empirical results, several policy implications can be drawn for stakeholders in SEE economies. First, the significant impact of lending interest rates and producer price inflation on consumer prices highlights the need for central banks to carefully calibrate monetary tightening, as abrupt increases in borrowing costs may amplify rather than dampen inflationary pressures. Second, the positive role of domestic credit underscores the importance of strengthening banking sector supervision and macroprudential tools to mitigate excessive credit growth while ensuring financial stability. Third, the negative effect of broad money (M3), largely driven by its collinearity with domestic credit, suggests that policymakers should place greater emphasis on credit aggregates rather than traditional monetary aggregates when designing policy frameworks. Furthermore, the evidence of inflationary effects from foreign direct investment points to the necessity of aligning investment promotion policies with macroeconomic stabilization goals, ensuring that capital inflows foster sustainable growth without generating excessive demand-side pressures. Collectively, these insights emphasize the importance of coordinated monetary, fiscal, and financial sector policies in enhancing price stability and supporting long-term development in the region.

CONCLUSION

This paper examined the transmission of monetary policy to consumer price inflation in nine SEE countries over the period 2007–2022 using panel econometric techniques. The empirical results provide several important insights. Lending interest rates display a strong and statistically significant positive association with inflation, a result that diverges from conventional monetary theory but aligns with correlations highlighted in the Neo-Fisherian perspective. Producer price inflation emerges as a robust determinant of consumer price dynamics, confirming the

importance of cost-push channels. In addition, foreign direct investment and domestic credit exhibit positive and statistically significant effects, indicating that financial intermediation and capital inflows play a notable role in shaping inflation dynamics in transition economies. By contrast, broad money (M3) shows a negative coefficient, which should be interpreted with caution as it mainly reflects multicollinearity with domestic credit and structural heterogeneity across countries.

These findings carry several policy implications. Monetary authorities in SEE should carefully assess the potential inflationary consequences of interest rate adjustments, particularly in environments characterized by structural rigidities and evolving financial markets. Strengthening monetary credibility, institutional quality and the coordination between fiscal and monetary policies is therefore essential for effective inflation control. The strong pass-through from producer to consumer prices highlights the need to monitor production costs as leading indicators of inflationary pressures. Furthermore, the observed role of domestic credit highlights the importance of maintaining financial sector stability and prudent lending practices, while the positive relationship between foreign direct investment and inflation underscores the need to coordinate investment policies with broader macroeconomic stabilization objectives.

Despite these contributions, several limitations should be acknowledged. First, the analysis relies on annual data covering the period 2007–2022, which restricts the ability to capture short-term dynamics and rapid monetary policy adjustments that may occur within shorter time intervals. Second, the relatively small cross-sectional dimension of the panel limits the application of more complex dynamic estimators. Third, the static panel framework employed in this study identifies statistical associations rather than strictly causal relationships, as it does not isolate exogenous monetary policy shocks.

While static FE and RE models provide consistent evidence, they cannot isolate exogenous monetary policy shocks; as such, the findings should be interpreted as correlations rather than strict causal effects. Future research could address these limitations by expanding the dataset to include quarterly or monthly observations, which would allow for a more precise examination of short-term monetary transmission mechanisms. In addition, the application of dynamic econometric approaches, such as panel VAR, GMM, ARDL or PMG-ARDL models, could provide deeper insights into causal relationships and endogeneity issues. Further research could also explore the role of institutional factors, monetary policy credibility, and financial market development in shaping inflation dynamics across Southeast European economies.

Overall, the paper contributes to the literature by offering new empirical evidence on the non-standard transmission of monetary policy in SEE, a region where institutional fragility and external vulnerabilities challenge conventional theories. By combining empirical results with theoretical debates and outlining directions for future research, the study provides a nuanced perspective on inflation dynamics in transition economies.

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APPENDIX

The model measuring the impact of monetary policy on inflation includes one dependent and nine independent variables (Table 4.).

Table 4. Variable explanation

Variable Name	Abbreviation	Variable Explanation	Unit of measure	Source
Inflation, consumer prices	ICP	Annual change in the cost of goods and services purchased by the consumer (annual change in consumer spending costs or annual change in consumer prices).	Percentage	World Bank, national publications
Official exchange rate	OER	The exchange rate determined by national authorities or the rate established on a legally authorized foreign exchange market.	Local currency against the US dollar	World Bank, Eurostat
Broad money (M3)	BM	The sum of currency outside banks; demand deposits excluding those of the central government; time, savings, and foreign currency deposits of the resident sector excluding the central government; bank and traveler's checks; and other securities such as certificates of deposit and commercial papers.	Percentage	World Bank
Producer price inflation	PPI	Annual change in the prices of raw materials, intermediate goods, and other costs relevant to the production of goods or the provision of services.	Percentage	World Bank, IMF, national publications
Lending interest rate	LIR	The standard loan rate charged on credit extended to the private sector for short- to medium-term purposes.	Percentage	World Bank, national publications
Unemployment	UnE	The proportion of the labor force that remains without employment while being available for work and actively engaged in job search.	Percentage of total workforce	World Bank
Adjusted net income per capita	AdjNIpc	Gross national income minus consumption of fixed capital and depletion of natural resources.	Annual growth rate	World Bank
Domestic credit to private sector by banks	DCPS	Financial resources provided by banks to the private sector, such as loans, purchases of non-government securities, and trade credits and other accounts receivable that establish a claim for repayment.	Percentage of GDP	World Bank
Export-Import	EI	The ratio of the value of exports to imports of goods and services, essentially representing the trade balance.	Percentage of GDP	World Bank
Foreign direct investment	FDI	The balance of inward investment flows designed to secure long-term managerial influence, typically represented by holdings of 10 percent	Percentage of GDP	World Bank

Variable Name	Abbreviation	Variable Explanation	Unit of measure	Source
		or more of voting equity, in firms located outside the investor's domestic economy.		

Source: Authors based on Obradović (2024)

Preliminary analysis (Table 5) reveals a strong correlation between inflation (measured by consumer prices) and producer price inflation (0.7787), with statistical significance at the 1% level. A somewhat weaker correlation is found between inflation and the lending interest rate (0.2454), also statistically significant at the 1% level, followed by the correlation between inflation and the trade balance (–0.2943), with the same level of significance as the previous two. All other correlations between explanatory variables and the dependent variable do not exhibit satisfactory statistical significance.

From the preliminary analysis of the correlation matrix, it can also be observed that domestic credit to the private sector is highly correlated with broad money (M3) (0.9762), and to a lesser extent with the official exchange rate (–0.32434). The high correlation between domestic credit to the private sector and the broad money (M3) aggregate (0.976) is not the result of a methodological error, but rather reflects the structural characteristics of SEE financial systems, where bank lending constitutes the dominant component of the money supply.

Despite their interrelation, both variables were retained in the model as they capture different aspects of the monetary policy transmission mechanism: broad money (M3) reflects overall liquidity in the economy, while domestic credit measures the intensity of banking intermediation.

Table 5. Correlation coefficients

Variable	ICP	OER	BM	PPI	LIR	UnE	AdjNIpc	DCPS	EI	FDI
ICP	1.000									
p value										
OER	0.102	1.000								
p value	0.223									
BM	-0.118	-0.208	1.000							
p value	0.161	0.012								
PPI	0.779	0.054	-0.610	1.000						
p value	0.000	0.523	0.468							
LIR	0.245	-0.185	-0.119	0.033	1.000					
p value	0.003	0.026	0.155	0.691						
UnE	-0.197	-0.244	-0.156	-0.196	0.213	1.000				
p value	0.170	0.003	0.061	0.018	0.010					
AdjNIpc	0.116	-0.098	-0.091	0.286	-0.122	-0.083	1.000			
p value	0.180	0.258	0.294	0.001	0.158	0.341				
DCPS	-0.117	-0.324	0.976	-0.084	-0.036	0.099	-0.123	1.000		
p value	0.163	0.003	0.000	0.316	0.668	0.283	0.154			
EI	-0.294	0.202	0.255	-0.125	-0.373	-0.211	-0.067	0.202	1.000	
p value	0.000	0.015	0.002	0.136	0.000	0.011	0.441	0.015		
FDI	0.098	0.243	-0.097	-0.039	-0.045	-0.105	-0.049	-0.092	-0.254	1.000
p value	0.245	0.003	0.246	0.636	0.591	0.213	0.567	0.273	0.002	

Source: Authors based on Obradović (2024)

If the data are found to be stationary without the presence of a trend, it means there is no systematic change in the data level over time. However, if a trend is included in the model, it suggests that the mean of the time series may vary over time. Stationarity testing in this manner is used to assess whether the data exhibit stable fluctuations around a trend. If the data are found to be stationary with a trend, it indicates that there is a systematic change in the level of the data over time, but that the fluctuations around that trend are stable.

The shaded variables in Table 6 indicate non-stationarity. However, to make an appropriate decision regarding data transformation, a second-generation stationarity test (the CIPS test) was applied (Table 7).

Table 6. IPS test

Variable	without trend		with trend	
	ADF	t-statistics	ADF	t-statistics
ICP	-0.151	0.440	5.946	1.000
OER	0.853	0.803	-1.085	0.139
BM	-0.461	0.322	-1.911	0.028
PPI	-1.155	0.124	3.163	0.999
LIR	1.109	0.866	-0.659	0.255
UnE	1.342	0.910	-3.980	0.000
AdjNIpc	-4.032	0.000	-3.672	0.000
DCPS	0.276	0.609	0.224	0.589
EI	-7.373	0.000	-4.253	0.000
FDI	-10.022	0.000	-8.829	0.000

Source: Authors based on Obradović (2024)

Table 7. CIPS test

Variable	without trend		with trend		significance
	CIPS	Critical values	CIPS	Critical values	
ICP	-3.316	-2.150	-3.842	-2.730	10%
		-2.290		-2.890	5%
		-2.560		-3.200	1%
OER	-0.466	-2.180	-1.265	-2.820	10%
		-2.330		-3.020	5%
		-2.640		-3.460	1%
BM	-1.189	-2.180	-2.635	-2.820	10%
		-2.330		-3.020	5%
		-2.640		-3.460	1%
PPI	-1.946	-2.180	-2.680	-2.730	10%
		-2.330		-2.890	5%
		-2.640		-3.200	1%
LIR	-2.831	-2.180	-4.129	-2.730	10%
		-2.330		-2.890	5%
		-2.640		-3.200	1%
UnE	-2.017	-2.180	-2.693	-2.820	10%
		-2.330		-3.020	5%

Variable	without trend		with trend		significance
	CIPS	Critical values	CIPS	Critical values	
		-2.640		-3.460	1%
AdjNIpc	-3.273	-2.220	-3.709	-2.890	10%
		-2.400		-3.110	5%
		-2.760		-3.610	1%
DCPS	-1.607	-2.180	-2.228	-2.820	10%
		-2.330		-3.020	5%
		-2.640		-3.460	1%
EI	-1.921	-2.180	-2.948	-2.820	10%
		-2.330		-3.020	5%
		-2.640		-3.460	1%
FDI	-3.882	-2.150	-3.454	-2.820	10%
		-2.290		-3.020	5%
		-2.560		-3.460	1%

[3] Consequently, differencing of the non-stationary variables is applied as a common method of data transformation when non-stationarity is identified in the panel. After re-testing, no further modification of the variables is necessary.

Source: Authors based on Obradović (2024)