



Correlation and Regression Modeling of the Influence of Money Supply on the Inflation Rate in Romania

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Abstract

The paper explores the relationship between the money supply and the inflation rate in Romania, focusing on the use of regression methods to model and analyze the influence. The main objective of the study is to assess to what extent changes in the money supply affect inflation in an emerging economy like Romania's. Using historical macroeconomic data, the regression analysis identifies significant correlations between the selected variables and quantifies the impact of the money supply on price dynamics. The results contribute to the understanding of the economic mechanisms governing monetary policy and provide relevant insights for policymakers in managing inflation and ensuring economic stability. The conclusions indicate a strong link between the growth of the money supply and inflation, with important implications for future monetary policy.

Keywords: *inflation, unemployment rate, exchange rate, economic growth, economic stability.*

JEL Classification: E31, E39.

Introduction

Inflation is a complex and persistent economic phenomenon that profoundly influences a country's economy, having a profound impact both on the purchasing power of the population and on sustainable economic development. Inflation control is one of the main objectives of monetary policy and is closely linked to macroeconomic factors and the financial policies adopted by central authorities. In this context, the money supply, i.e. the total amount of money in circulation in an economy, has a key role in determining the level of inflation. Romania, as an emerging economy, has experienced a number of significant economic changes in recent decades, including the transition to a market economy, the accession to the European Union and the management of global and local economic crises.

Under such circumstances, an understanding the relationship between money supply and inflation becomes crucial for the implementation of effective monetary policies. This relationship can be complex, influenced by many factors, including changes in money demand, fluctuations in the exchange rate and central bank policies.

According to the quantity theory of money, a significant increase in the money supply can lead to a higher level of inflation if it is not supported by an equal increase in economic output [1]. In this regard, analyzing the relationship between money supply and inflation becomes essential for understanding economic dynamics in emerging economies. According to the work of Dăianu and Lungu, the accession to the European Union brought important structural changes in the Romanian economy, including monetary policies, which had a direct impact on price stability [2]. Given these circumstances, the relationship between money supply and inflation has become an important subject of study, being influenced by internal and external factors, such as money demand, interest rates and exchange rates [3]. Isărescu emphasizes that the monetary policies implemented by the National Bank of Romania have consistently aimed at maintaining price stability, despite inflationary pressures from external sources [4].

Bodnari, Ionescu, and Vasilescu (2019) examined the relationship between money supply and inflation in Eastern Europe and concluded that in the post-crisis period, the link between these variables has become more complex, influenced by factors such as globalization and financial integration [5]. Furthermore, Anghelache and Manole argue that in Romania, the monetary policy of the NBR had to adapt to external shocks and global economic instability, which led to significant variations in money supply and inflation [6].

Siklos emphasizes that, in emerging economies, the effects of money supply on inflation can be more volatile, due to often uncoordinated monetary policies and global economic fluctuations [7]. This volatility is also confirmed by Lucas and Jaravel, who argues that unsustainable expansionary monetary policies can generate significant inflationary pressures unless accompanied by appropriate fiscal and structural measures accompanied by additional variables such as exchange rates or energy prices [8,9].

Woodford has shown that monetary policy has to be flexible to respond to the inflationary effects of money supply growth, and Blanchard and Johnson have shown that inflation in emerging economies can be strongly influenced by global factors such as commodity price shocks and capital market volatility [10,11]. In this regard, the use of econometric models to analyze the effect of money supply on inflation becomes essential. Sims and Zha (2006) suggest that vector autoregressive models (VAR) are useful for capturing the short-run and long-run dynamics between these two variables [12].

This study aims to investigate the correlation between money supply and inflation level in Romania, using econometric regression modeling methods. Isărescu, in his work, emphasizes the essential role of monetary policies and price stability for sustainable economic development, stressing the importance of a prudent monetary policy [13]. On this basis, the study will analyze the extent to which money supply fluctuations influence short and long-run inflation dynamics in Romania. The research results will contribute to a deeper understanding of the relationship between monetary policy and inflation, providing valuable recommendations for policy makers.

The findings of the study will be relevant for the National Bank of Romania and other regulators, with the main aim of ensuring macroeconomic stability and preventing uncontrolled increases in inflation in the context of a changing global economy [14]. Thus, the paper aims to provide both a theoretical perspective on the relationship between money supply and inflation, as well as practical solutions for the effective management of monetary policies in Romania.

1. Theoretical framework

According to previous research, there is a significant and direct link between money supply and inflation rate [15,16]. This economic correlation is well grounded in monetary theory, which states that inflation occurs when the money supply increases faster than the real growth of economic output [17,18,19,20]. Milton Friedman, one of the leading proponents of monetarist theory, famously stated that “inflation is always and everywhere a monetary phenomenon”, emphasizing that excessive money supply growth without commensurate output growth will lead to generalized price increases [21].

Several later studies have confirmed this relationship. For example, Feldstein showed that excessive monetary expansion can lead to inflation in the long run, even though in the short run it may stimulate growth [22]. Similarly, Rapach and Weber found that in emerging economies the effect is even stronger, with inflation often caused by excessively loose monetary policies [23]. Thus, according to their findings, as the money supply increases, inflation levels tend to rise correspondingly, leading to a decline in purchasing power and destabilizing the economy.

Other researchers have continued to demonstrate the importance of the money supply in determining inflation, confirming classical monetarist theories but also adapting them to the new global economic context. For example, Fischer and Modigliani have emphasized that in advanced economies, increases in the money supply have remained a key factor in price increases, especially during periods of rapid economic expansion [24]. Moreover, De Grauwe and Polan showed that in emerging economies the link between inflation and money supply is even more obvious, as these economies tend to be more vulnerable to accelerating money supply growth [25].

Another study by Keating and Valcarcel analyzed the link between money supply expansion and inflation in the long run, showing that while in the short run there may be lags in price increases, in the long run the effect is inevitable [26]. More recently, Cukierman and Meltzer have emphasized that expansionary monetary policies used by central banks in times of crisis, such as the 2008 crisis, have had moderate inflationary effects at first, but in the long run can put significant upward pressure on prices, especially if combined with large budget deficits [27]. These recent studies confirm that the relationship between inflation and money supply remains strong, although external economic variables, such as globalization and technological innovations, may temporarily alter the dynamics of this relationship [28, 29].

2. Data and sources

The data set used will include economic information relevant for Romania, obtained from official sources such as the National Bank of Romania, the National Institute of Statistics, Eurostat and the database of the International Monetary Fund, as well

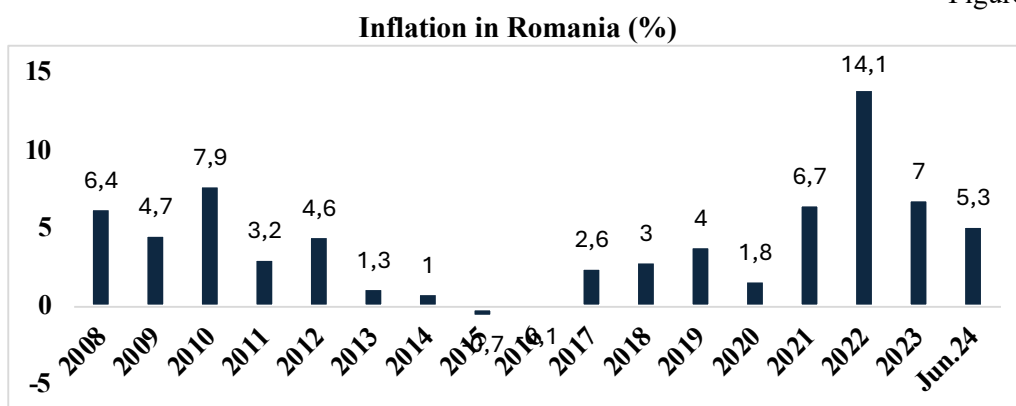
as from other international economic databases. The main indicators analyzed will be the money supply (M2), which reflects the amount of money in the economy, and inflation, measured by the consumer price index (CPI). The analysis will cover the 2008-2023 period, in order to observe economic trends and fluctuations during this period.

3. Methodology

3.1. Descriptive analysis of inflation in Romania in the post-2008 period

The global financial crisis triggered in 2007-2008 and the one generated by the COVID-19 pandemic had major consequences both on the world economy and on Romania. In the Romanian economy these crises have manifested in a significant economic downturn, high budget deficit and pressures on the labor market. Domestic economic activity was severely affected, especially in the financial and real estate sectors. This economic turmoil had a direct effect on price dynamics, leading to increased inflation volatility in the following years. In Romania, in the post-2008 period, the inflation rate peaked at over 14.1% at the end of 2022, amid the energy crisis and global economic problems, while from 2023, inflation started to decline, reaching around 5.3% in June 2024 [30].

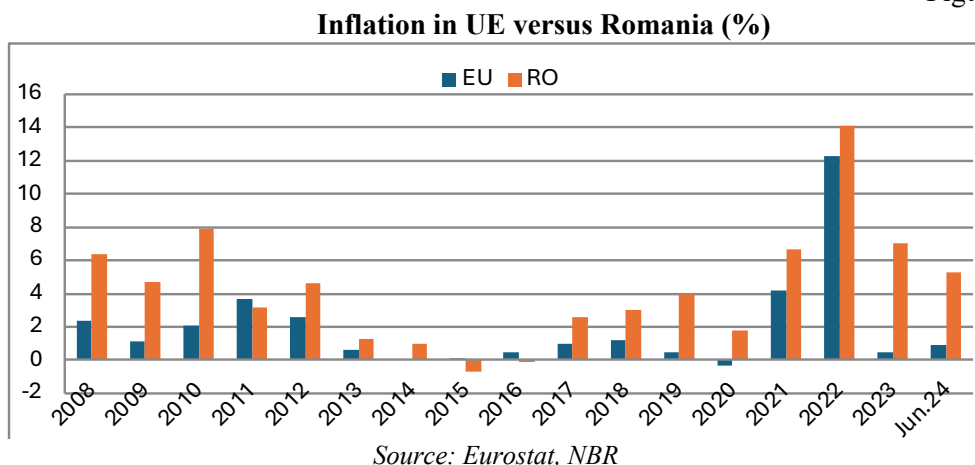
Figure 1.



Source: The Finance Ministry, NBR

In Europe, inflation has been more variable. After the 2008 financial crisis, the rate fell, bottoming out in 2015-2016. However, since 2021, inflation has risen sharply, reaching 8-9% in 2022, before gradually returning to below 3% in 2024 [30].

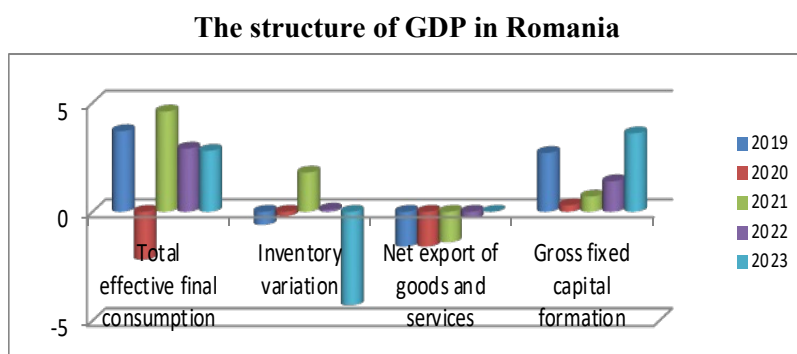
Figure 2.



Thus, euro area headline inflation reached a historical low of 0.9% in June 2024, significantly influenced by price variability in some key sectors such as energy and services. Managing inflation is important for maintaining a healthy economy and growing GDP. Inflation has a complex impact on GDP, affecting both aggregate demand and general economic conditions. While moderate inflation can stimulate growth, excessive inflation can lead to significant adverse effects on the economy.

Romania registers an important GDP growth in the first quarter of 2022, due to the elimination of sanitary restrictions caused by the COVID-19 pandemic and due to positive global developments, making the quarterly dynamics among the highest in the European Union. This development of the economy in the first part of 2022 took place under certain conditions when large companies resorted more to bank lending (+25.0%, i.e. the annual rate of increase in lending to non-financial companies in September 2022).

Figure 3.



Based on this energy crisis, which was aggravated by the escalation of geopolitical tensions on a global scale, as well as the war in Ukraine, and the increase in financing costs, the broad fiscal consolidation process became exceedingly difficult. Therefore, this sustained fiscal effort, which was imposed on account of adverse developments in previous years, led to an increase in public debt, which is close to the debt sustainability limit (47.6% of GDP).

This increase in public debt in the first nine months of 2022 was achieved by an increase in the amounts recorded in long-term (+13%) and in foreign currency (+17%) respectively, being attracted from non-resident investors (+16%) [33].

3.2. Descriptive analysis of money supply in Romania in the post-2008 period

The analysis of money supply in Romania after 2008 was marked by the global financial crisis and the monetary policy measures adopted by the National Bank of Romania (NBR) to maintain price stability and stimulate economic growth. In the following chart we present an evolution of money supply between 2018 and 2023, the analysis of money circulation allowing to highlight the following aspects.

Table 1.

The analysis of money supply in Romania after 2008

Period	M3(%GDP)	M3	M2	M1	Money circulation	Demand deposits
2008	33.8	174.0	173.0	92.0	25.0	67.0
2009	38.1	189.0	188.0	79.0	23.0	55.0
2010	38.2	202.0	199.0	81.0	26.0	54.0
2011	37.4	216.0	212.0	85.0	30.0	55.0
2012	37.4	222.0	221.0	89.0	31.0	57.0
2013	37.9	241.0	241.0	100.0	34.0	65.0
2014	39.2	261.0	261.0	118.0	39.0	78.0
2015	40.2	286.0	286.0	149.0	46.0	103.0
2016	40.9	314.0	314.0	179.0	54.0	125.0
2017	40.8	350.0	350.0	210.0	63.0	147.0
2018	40.1	381.0	381.0	235.0	67.0	167.0
2019	37.4	422.0	422.0	276.0	74.0	202.0
2020	46.3	487.0	487.0	337.0	88.0	249.0
2021	49.04	564.0	564.0	406.0	96.0	310.0
2022	45.5	603.0	569.0	408.0	99.0	309.0
2023	63,1	666.0	666,0	409,0	110,0	299,0
June 2024	-	684,0	684,0	414,0	116,0	297,0

Source: NBR- Periodical publication

The financial crisis led to a significant slowdown in money supply growth. The National Bank of Romania (NBR) implemented tighter monetary policies to counter the effects of the crisis, including higher interest rates. After the crisis, the Romanian economy entered a period of moderate expansion and the money supply continued to grow at a stable pace. Monetary policies were loosened to stimulate investment and consumption.

The COVID-19 pandemic and the 2022 energy crisis led to an increase in money supply in response to economic shocks. The NBR has implemented monetary easing measures, including reducing the policy rate and supporting liquidity in the financial system.

Between 2018 and 2023 we note an upward trend of the monetary aggregate M_1 from 235,126.3 million RON in 2018 to 409,346.7 million RON in 2023 due to the increase in the liquid components included in M_1 , i.e. cash outside the banking system, which in the analyzed period shows a downward trend (28.82%-26.92%) in favor of the second liquid component of M_1 - cash on sight, which is higher than cash outside the banking system in 2018-2023 by about 2%.

The share of liquid components (M_1) in the M_2 aggregate in the analyzed period decreased from 11.7% in 2018 to 2.8% in 2023, on account of the increase in the share of near money in M_2 in the analyzed period from 27% in 2018, respectively 329 673.6 Bil. RON to 35.5%, respectively 573 951.1 Bil. RON.

The components of near money increased from 27% in 2018 to 35.5% in 2023, amounting to 573,951.1 Bil. RON, due to the growth of deposits at a much lower pace than the growth of savings of the population, which increased significantly, the share of the latter in the near money increased from 7.9% in 2018 to 22.4% in 2023.

The structure of the money supply shows an uneven increase in the liquid components (M_1) and near money, which are less liquid than the components included in M_1 , with the aim of protecting assets from the effects of inflation. The broad money supply, M_2 , increased from one year to the next, from 381,161.0 million RON (2018) to 666,387.1 million RON (2023), but the pace of growth was below inflation.

3.3. Descriptive analysis of the NBR's monetary policy

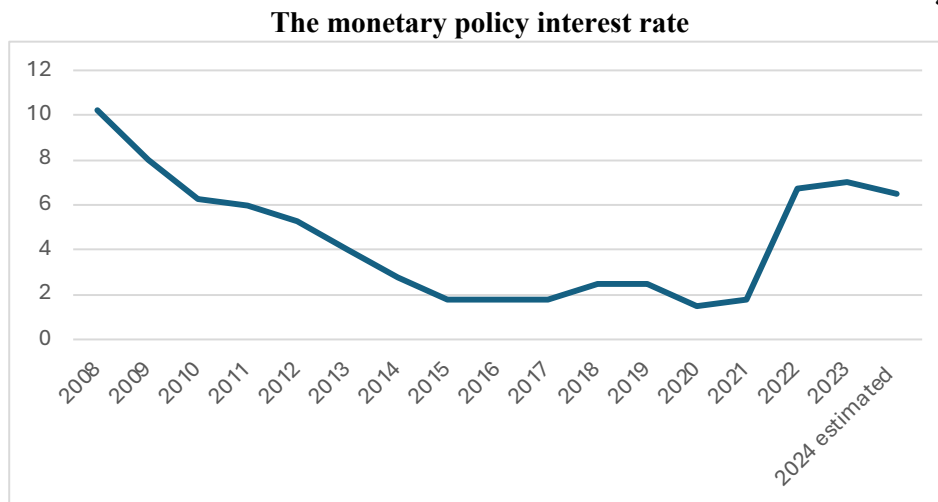
In this context, the National Bank of Romania (NBR) has implemented monetary policies aimed at cushioning the economic effects of the pandemic and strengthening liquidity in the banking system, thus ensuring the smooth functioning of the money market and other segments of the financial market. It also aimed at supporting the efficient financing of the real economy and the public sector.

The measures included the reduction of the monetary policy rate by 0.50 percentage point to 2.00% p.a.; the narrowing of the corridor of interest rates on standing facilities to ± 0.5 percentage point from ± 1.0 percentage point; decisions on repo operations to provide liquidity to credit institutions; and purchases of RON government securities on the secondary market.

The chart below shows that the reference interest rate has fluctuated over the years. Between 2015 and 2017, it fell from 2% to 1.75%, before rising to 2.25% in 2018. This rapid increase, in just a few months, had the effect of stimulating savings and affected all holders of variable-rate loans, leading to higher rates for loans in RON.

Subsequently, a decrease of one percentage point is noted between February 2018 and October 2021, stimulating consumption and investment, but also increasing inflation and facilitating access to credit. Starting in May 2022, the monetary policy interest rate steadily increased, reaching 7 percent in January 2023.

Figure 4.



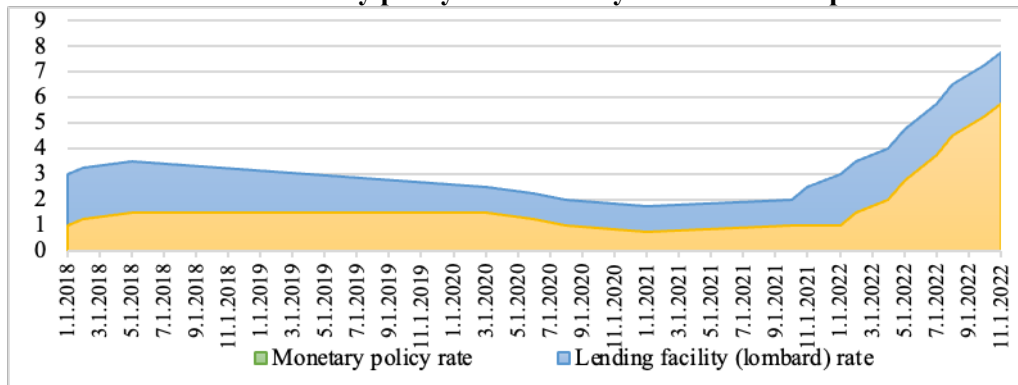
Source: www.bnr.ro

Through its decisions, the central bank aimed to support the recovery of economic activity after the pandemic-induced contraction, with a view to bringing and consolidating the annual inflation rate in line with the inflation target of 2.5 percent ± 1 percentage point over the medium term, while maintaining financial stability.

In figure 5, it is very easy to see that all three reference rates of the NBR have seen a considerable increase in recent years. The year 2022 marked a historic high point, with the value of these rates very high compared to all the other years considered in the analysis of the paper, reaching 6.75 percent for the monetary policy rate, 7.75 percent for the lending facility (lombard) rate and 5.75 percent for the deposit facility rate in November.

Figure 5.

The evolution of the monetary policy rates used by the NBR in the period 2018-2022



Source : <https://www.bnr.ro/Rata-dobanzii-de-politica-monetara-1744-Mobile.aspx#>

After keeping interest rates at very low levels for several years, interest rates have been kept at very low levels since August 2021, and interest rates have shifted trajectory to rebalance the economy as much as possible, as inflation has been at a 13-year high. There are three main reasons for this development: the rapid recovery of the national economy (amid the unwinding of a growing number of restrictive measures), the

rise in energy prices, which has fueled the rise in inflation, and the emergence of a mechanism that statisticians call the "base effect". Interest rates are a mechanism through which the NBR tries to restore the economy and market prices, so if inflation rises, rates rise, precisely to rebalance the economy.

Moreover, in correlation with the current and future evolution of structural liquidity surpluses in the banking system, the NBR has kept the reserve requirement rate for credit institutions' deposits in RON unchanged at 8% since 2017.

At the same time, the reserve requirement rate applicable to credit institutions' liabilities in foreign currency has remained unchanged at 5% since January 2021, in the context of specific developments in international reserve ratios.

3.4. Correlation between inflation rate, money supply and monetary policy interest rate

Through the following econometric study, we aim to determine the extent to which the inflation rate is influenced by the monetary supply rate. For this purpose, we used the data provided by the BNR on the level of the exchange rate and the rate of non-performing loans, between 2008 and 2024.

The calculation of the Pearson correlation coefficient between money supply, monetary policy interest rate and inflation is essential to determine the strength and direction of the relationship between these two variables.

Table 2.

Pearson's Correlations			Pearson's r	p
Inflation rate	-	Money supply M2	-0.434	0.082
Inflation rate	-	Monetary policy rate	0.588	0.013
Money supply M2	-	Monetary policy rate	-0.850	< .001

Source: own calculations

The correlation coefficient between:

- inflation rate and money supply is negative at -0.434, indicating a moderate influence between the two variables.
- the inflation rate and the monetary policy interest rate is positive at 0.588, indicating a moderate influence between the two variables, which supports the monetarist theory.
- money supply and monetary policy interest rate is negative the value being - 0.850, which indicates a strong influence between the two variables.

Table 3.

Linear regression					
Model		Unstandardized	Standard Error	Standardized t	p
H ₀	(Intercept)	4.282	0.866	4.944	< .001
H ₁	(Intercept)	31.483	14.620	2.153	0.048

Model	Unstandardized	Standard Error	Standardized	t	p
Monetary supply M2	-25.282	13.568	-0.434	-1.863	0.082

Source: own calculations

Based on the results, we could say that an increase in the money supply can support the economy in the short term, but in the long term it can create inflation. The central bank may not want to use expansionary monetary policy to avoid the inflation scenario.

Conclusions

In conclusion, the money supply (M_3) growth in Romania between 2008 and 2023 was marked by a steady expansion, driven by monetary policies aimed at supporting both liquidity and economic growth. This money supply growth has been correlated with inflationary pressures, particularly in times of crisis, such as the 2008 global financial crisis and the COVID-19 pandemic. The National Bank of Romania (NBR) has implemented constant interest rate adjustments and other instruments to manage these inflationary pressures and to maintain price stability, a key objective of its monetary policy, harmonized with that of the European Central Bank (ECB). Despite the increase in money supply, the NBR has adopted additional liquidity control measures, including the establishment of repo lines with the ECB to counter liquidity risks and market dysfunctions.

The COVID-19 pandemic and the 2022 energy crisis had a significant impact on monetary policy, forcing the NBR to adopt more loose measures, such as cutting interest rates and ensuring the necessary liquidity in the banking system. While these actions helped stabilize the economy in difficult times, they led to a further increase in the money supply, fueling long-term inflationary risks. However, in the medium to longer term, monetary measures, while effective in the short run, have been found to be insufficient without proper coordination with fiscal and income policies. In the absence of a coherent macroeconomic policy mix, there is a risk that economic vulnerabilities and inflation could increase, undermining long-term stability.

Based on these conclusions, it is recommended that the NBR should maintain a flexible and proactive monetary policy, constantly adjusting interest rates and using monetary instruments such as reserve requirements and repo operations to manage the money supply and control inflation. Better coordination between monetary and fiscal policy is also essential to prevent macroeconomic imbalances and ensure long-term economic sustainability.

References

1. Friedman, M. A theoretical framework for monetary analysis. *J. Polit. Econ.* **1970**, 78, 193–238.

2. Dăianu, D.; Lungu, A. The impact of EU accession on the Romanian economy: Structural changes and monetary policy. *Journal of Economic Integration* **2014**, *29*, 113–147.
3. Dardac, N.; Barbu, T. *Instituții de credit*, a 3-a ediție; Editura ASE: Bucharest, Romania, 2012; pp. 298–301.
4. Isărescu, M. Monetary policy and price stability: The Romanian experience. *Central Bank Review* **2010**, *10*, 7–22.
5. Bodnari, A.; Ionescu, I.; Vasilescu, L. Monetary expansion and inflation in Eastern Europe: Post-crisis dynamics. *Economic Systems* **2019**, *43*, 100713.
6. Anghelache, G.; Manole, A. Adapting monetary policy to external shocks: The case of Romania. *International Journal of Financial Studies*. **2020**, *8*, 62.
7. Siklos, P. The role of monetary policy in emerging economies. *International Journal of Finance and Economics*. **2000**, *5*, 343–354.
8. Lucas, R. E. Methods and problems in business cycle theory. *Journal of Monetary Economics* **1980**, *6*, 117–137.
9. Jaravel, X. Inflation inequality: Measurement, causes, and policy implications. *Annual Review of Economics* **2021**, *13*, 599–629.
10. Woodford, M. A theory of monetary policy. *Interest and Prices: Foundations of a Theory of Monetary Policy*; Princeton University Press: Princeton, New Jersey, Statele Unite ale Americii, 2003; pp. 50–100.
11. Blanchard, O.; Johnson, D. R. *Macroeconomics*; Pearson: Boston, Massachusetts, United States of America, 2013; pp. 635–670.
12. Sims, C. A.; Zha, T. Were there regime switches in U.S. monetary policy? *American Economic Review* **2006**, *96*, 54–81.
13. Isărescu, M. Monetary policy and price stability: The Romanian experience. *Central Bank Review* **2021**, *21*, 9–25.
14. Dăianu, D. *Banca Națională și provocările economice globale*; Editura Economică: Bucharest, Romania, 2018; pp. 45–60.
15. Cheng, H.; Tan, W. Money supply and inflation: Evidence from China. *China Economic Review* **2002**, *13*, 115–130.
16. Ramayah, T. The Impact of Monetary Policy on Inflation: A Study of Malaysia. *Asian Economic Policy Review* **2016**, *11*(2), 200–214.
17. Dardac, N.; Barbu, T. *Monedă, bănci și politici monetare*; Editura Didactică și Pedagogică: Bucharest, Romania, 2005; pp. 298–301.
18. Manolescu, G. *Monedă și credit*; Editura Fundației Romania de Măine: Bucharest, Romania, 2003; pp. 271–273.
19. Băcescu, M.; Băcescu-Cărbunaru, A. *Macroeconomie și politici macroeconomice*; Editura ALL Educational: Bucharest, Romania, 1998; pp. 450–470.
20. Tugui, A. *Inflația: concepte, teorii și politici*; Editura Economică: Bucharest, Romania, **2000**; pp. 45–60.
21. Friedman, M. Inflation: Causes and Consequences. *The Journal of Political Economy* **1963**, *71*(5), 115–150.
22. Feldstein, M. *The Costs and Benefits of Fiscal Policies in the United States*; National Bureau of Economic Research: Cambridge, MA, Statele Unite ale Americii, **1997**; Working Paper No. 6200.
23. Rapach, D. E.; Weber, C. E. Forecasting Inflation: The Role of Monetary Policy. *International Journal of Forecasting* **2004**, *20*(4), 447–460.

24. Fischer, S.; Modigliani, F. The Role of Monetary Policy in the Economy. *Journal of Economic Perspectives* **2003**, 17(4), 3–22.
25. De Grauwe, P.; Polan, M. *Monetary Economics in an Integrated World*; Oxford University Press: Oxford, United Kingdom, **2005**; pp. 112–135.
26. Keating, J.; Valcarcel, S. The Long-Term Effects of Monetary Expansion on Inflation. *Economic Inquiry* **2012**, 50(3), 733–749.
27. Cukierman, A.; Meltzer, A. H. A New View of the Monetary Policy Transmission Mechanism: A New Approach to Empirical Analysis. *Journal of Money, Credit and Banking* **2020**, 52(4), 805–825.
28. Blanchard, O.; Johnson, D. R. *Macroeconomics*, 6th edition; Pearson: Boston, United States of America, **2013**; pp. 120–145.
29. Rudd, J. B. Why do we think that inflation expectations matter for inflation? (And should we?) *Review of Keynesian Economics* **2022**, 10(1), 25–45.
30. Banca Națională a României – Publicații periodice (National Bank of Romania, Periodical Publications) available at <https://www.bnr.ro>
31. European Central Bank - Inflation Statistics available at <https://www.ecb.europa.eu>
32. Eurostat - Price Statistics available at <https://ec.europa.eu/eurostat/data/database>
33. Institutul Național de Statistică - INSSE available at <https://insse.ro/cms/>