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Does Monetary Policy Stabilise Food Inflation in Hungary?

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Abstract

This study examines the relationship between monetary policy and food price inflation in Hungary from January 2007 to December 2023 using the Nonlinear Autoregressive Distributed Lag (NARDL) model. Our analysis reveals that although the short-term impact of monetary policy on food prices is minimal, there is a notable long-term effect where implementing tighter monetary measures increases food price inflation over time. Policymakers must take a nuanced approach when dealing with food price shocks, considering both monetary and fiscal interventions. Our research highlights the significance of combining monetary policy actions with specific fiscal strategies and structural changes in the agriculture to reduce the negative effects of food inflation and protect the well-being of vulnerable populations.

Keywords

Food prices, inflation, monetary policy, Nonlinear ARDL, asymmetry.

JEL code: E31, E52, Q11, Q18

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Introduction

The efficacy of monetary policy in stabilising food prices has been called into question by policymakers in light of the recent high and volatile food inflation in developed and developing countries. The recent increase in both the unpredictability and scale of food price inflation in developed and developing countries has raised doubts about the efficacy of monetary policy in controlling food prices. A theoretical framework for determining the most effective monetary policy to affect food inflation may be found in the literature (Pourroy et al., 2016; Anand et al., 2015; Catao and Chang, 2015; Soto, 2003; and Aoki, 2001). There has been an extensive amount of study on the link between monetary policy and inflation, but less on food inflation.

Policymakers are struggling to address the challenge of reducing food price shocks, as there are concerns that conventional monetary tools may not be sufficient for this task. While monetary restrictions may not have a direct impact on food inflation, they can significantly affect non-food prices and the overall economic output. Policymakers are considering how monetary policy affects food shocks, especially with increased uncertainty and inflation expectations due to spikes in food inflation. In impoverished nations, food insecurity contributes to an increase in infant and child mortality as well as malnutrition (de Brauw, 2011; Kidane and Woldemichael, 2020). The rapid and uncontrolled acceleration of inflation has been one of the biggest challenges for farmers in the commodity, energy and food markets (Belinska et al., 2023). The need to understand the connection between monetary policy and food prices is becoming more urgent as rising food prices disproportionately affect lower-income households. Elucidating this connection not only enhances our comprehension of economic mechanisms but also enhances public policy discussions, directing actions aimed at reducing the negative impacts of food inflation.

Hungary serves as a case study because within the European Union, food prices in Hungary are also particularly high. For comparison, in June 2023, average inflation in the European Union was 5.5%, food price growth was 11.6%, while the Hungarian data for the same period for the general price level was 19.9%, and food price growth was 29.3% annualised. The current situation is not a temporary shock, with food price growth consistently above 10% since January 2022, and above 20% since June 2022, exceeding 40% for six months. Such a price increase will affect lower-income households much more severely than those on higher incomes (Figure 1).

This study aims to examine the effectiveness of monetary policy in stabilising food price inflation, with a specific focus on Hungary. We use the Nonlinear Autoregressive Distributed Lag (NARDL) model to analyse the intricate connection between monetary policy shocks and food inflation from January 2007 to December 2023. We aim to use thorough empirical analysis to gain insights into the factors influencing food price changes and provide useful guidance for policymakers dealing with the challenge of reducing the negative effects of rising food prices.

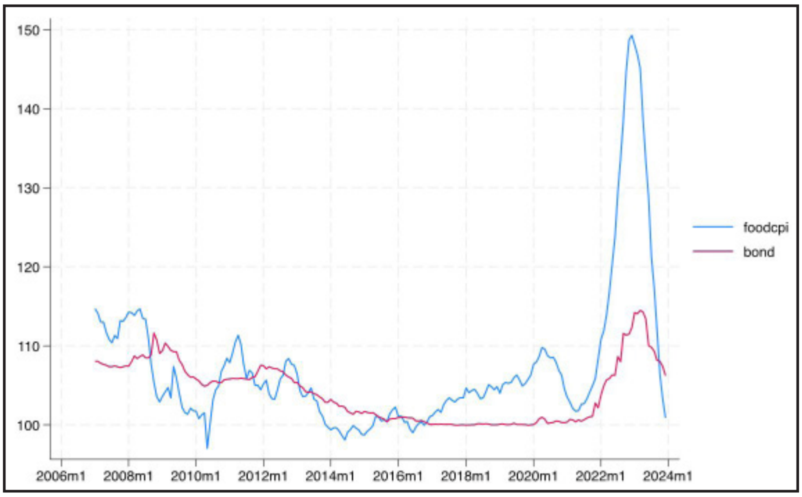
Review of related literature

Empirical studies on the impact of monetary policy on food inflation reveal a complex relationship, reflecting diverse outcomes across different countries and economic contexts. In India, research has directly examined the impact of monetary policy on food inflation. Anand et al. (2014) found that restrictive monetary policy effectively lowers food inflation. Kumar and Dash (2020) observed that monetary policy reduces inflation more in the industrial sector than in agriculture, and that tightening monetary policy promotes disaggregated food inflation. Höltemoller and Mallick (2016) reported that increasing interest rates reduces food price inflation in India, whereas Samal and Goyari (2022) indicated that monetary policy stabilizes food inflation. The transmission of monetary policy through exchange rate and asset price channels raises food inflation across all quantiles, while bank credit and interest rate channels reduce it at lower inflation rates in the lower and middle quantiles. Samal et al. (2022) found that per capita income, money supply, global food prices, and agricultural wages are positively and significantly impacted food price inflation in both the short and long-run.

Ali et al. (2022) investegated the impact of monetary policy on food inflation in Pakistan. They found that monetary policy and transportation prices remain highly significant across all quantiles, exhibiting a positive impact on food inflation. Thus restrictive monetary policy leads to higher flood inflation in the country. Their related paper found that monetary policy has limited short-term impact on food inflation in Pakistan due to inelastic food demand and supply constraints. However, in the long run, changes in money supply and interest rates significantly influence food prices (Ali et al., 2023).

In African context Iddrisu and Alagidede (2020) examined South African food prices, revealing that restrictive monetary policy increases food price uncertainty. Iddrisu and Alagidede (2021) found similar results for Ghana, where monetary policy tightening heightened food price uncertainty.

Bhattacharya and Jain (2020) expanded the scope to 16 advanced and emerging economies from 2006 to 2016, finding that unexpected monetary tightening increases food inflation via the cost of production channel.



Source: Hungarian Central Statistical Office and Hungarian National Bank

Figure 1: Evolution of food price inflation and 3-month bond rate.

In sum, empirical studies suggest that while tighter monetary policy generally reduces aggregate commodity prices, its effect on food inflation is more varied and context-dependent. Factors such as country-specific economic structures, the responsiveness of agricultural versus industrial prices, and the channels through which monetary policy operates (such as exchange rates, interest rates, and production costs) all play crucial roles in shaping the outcomes. Notice that there is no canonical theoretical background in the empirical literature, and studies using different empirical approaches including VAR (Vector Autoregressive models), quantile regression and NARDL models.

Materials and methods

The variables for empirical analysis are based on recent literature (Bhattacharya and Jain, 2020; Iddrisu and Alagidede, 2020, 2021; Samal et al., 2022). In studies examining the relationship between food inflation and monetary policy, economic output is frequently utilized as a key variable, with Gross Domestic Product (GDP) (e.g., Iddrisu and Alagidede, 2020; Kumar and Dash, 2020). Economic output levels serve as key indicators of a nation's economic health. In an economy, rising disposable incomes often spur increased inflation, including food inflation, as consumer demand grows. For a small, open economy such as Hungary, the strength of the national currency is an important macroeconomic variable. Hungary's external food trade is predominantly conducted with EU Member States and neighboring European nations, with transactions largely denominated in euros. Consequently, the Hungarian forint/euro exchange rate significantly influences imported food prices. Empirical models frequently incorporate foreign currency prices as variables (e.g., Holtemöller and Mallick, 2016; Umar and Umar, 2022; Ismaya and Anugrah, 2018). In many studies, the monetary policy variable is represented by the three-month government bond rate, which reflects changes in monetary policy (Bhattacharya and Jain, 2020; Iddrisu and Alagidede, 2020; Samal and Goyari, 2022).

We use monthly data from the Hungarian Central Statistical Office and the Hungarian National Bank for the period January 2007 to December 2023. The main variables are the Hungarian food inflation (CPIfood), the Hungarian economic output (GDP), the Hungarian forint/euro exchange rate (Euro), and the monetary policy variable (Policy), which is the three-month Hungarian government bond yield. All variables in the empirical analysis are included in the natural logarithm. Descriptive statistics of variables are shown in Table 1. lnPolicy exhibits the least variability, implying stable monetary policy. lnCPIfood also shows low variability, suggesting stable food inflation. In contrast, lnGDP has the highest standard deviation, indicating greater variability in economic output. lnGDP has the widest range, reflecting significant fluctuations in economic output. lnEuro shows moderate range and variability, pointing to exchange rate volatility. lnCPIfood and lnPolicy have narrower ranges, indicating relative stability in food inflation and bond yields, respectively (Table 1).

Variable	Obs	Mean	Std. dev.	Min	Max
lnCPIfood	204	4.672	0.082	4.575	5.006
lnGDP	204	15.997	0.308	15.487	16.823
lnEuro	204	5.732	0.128	5.447	6.037
lnPolicy	204	4.645	0.036	4.605	4.740

Source: own calculation

Table 1: Descriptive statistics.

Unit root tests are the first step in the NARDL analysis process. Financial and macroeconomic variables frequently show non-stationarity or trending behaviour in the mean. Unit root tests are statistically used to test the variables used in this study for (non)stationarity. We employ three unit root tests: Elliott-Rothenberg-Stock (1996), Phillips-Perron (1988) test and Zivot-Andrews (2002) unit root test with structural breaks. The optimal lag structure of the Elliott-Rothenberg-Stock test is chosen based on the Akaike Information Criterion. The optimal lag structure of the Phillips–Perron test is chosen based on the Newey–West bandwidth with Bartlett weights. The optimal lag structure of the Zivot and Andrews (2002) test was selected based on the Akaike information criterion. As can be seen from Figure 1, taking into account the breaks in the time series improves the estimation accuracy.

The analysis used a NARDL (Nonlinear AutoRegressive Distributed Lag) model to examine the research problem. The NARDL is a statistical model used to analyse the relationship between time series data when the relationship between variables is non-linear and asymmetric. To check for non-linearity, we employ the BDS (Brock-Dechert-Scheinkman) test. The BDS test tests the time series for deviations from the assumptions of independence and identity of distribution (IID).

The NARDL model includes both autoregressive (AR) and moving average (MA) terms. The NARDL model can be used to separate positive and negative effects on the dependent variable in both the short and long run. The NARDL model is assuming stationarity, which has been verified by unit root tests. The most common application of NARDL is to understand the relationships between different macroeconomic time series. Examining the asymmetric effect between variables provides a way to measure how the dependent variable changes as each variable decreases and increases. When relationships are not symmetric, economic and monetary policy makers need to take this effect into account. The asymmetric long-run equilibrium can be defined as follows:

$$y_t = ß^+ x_t^+ + ß^- x_t^- + \varepsilon_t \quad (1)$$

where y_t is the dependent variable, x_t^+ and x_t^- are the partial cumulative sum processes of positive and negative changes in the dependent variables (x_t), $ß^+$ and $ß^-$ represent the asymmetric long-run parameter, ε_t is the random error term. The NARDL model can be posed as follows when we combine model (1) with the unconstrained linear ARDL (p, q) specification:

$$\Delta y_t = \alpha_0 + r y_{t-1} + \theta^+ x_{t-1}^+ + \theta^- x_{t-1}^- + \\ + \sum_{j=1}^{p-1} \tau_j \Delta y_{t-j} + \sum_{j=0}^{q-1} (\pi_j^+ \Delta x_{t-j}^+ + \pi_j^- \Delta x_{t-j}^-) + \varepsilon_t \quad (2)$$

where y_t is the dependent variable (lnCPIfood), x_t represents the independent variables (lnGDP, lnEuro, lnPolicy), and the superscripts + and - denote positive and negative partial sum processes, respectively. The lag lengths p and q are chosen based on the Akaike Information Criterion (AIC).

where $\sum_{j=0}^{q-1} \pi_j^+$ and $\sum_{j=0}^{q-1} \pi_j^-$ represent the short-run asymmetry of Δx_t, and the parameterizations of the long-run asymmetry are as follows:

$$ß^+ = -\frac{\theta^+}{r} \; and \; ß^- = -\frac{\theta^-}{r} \quad (3)$$

Diagnostic tests for heteroskedasticity, autocorrelation, and model stability are performed to ensure the robustness of the estimates. The natural logarithms of all variables were used in the modelling, as shown in the descriptive statistics (Table 1).

The statistical method chosen has several advantages over OLS estimation: (1) First, the relationship between most macroeconomic variables is non-linear; (2) Second, heteroskedasticity is better handled, and therefore the estimation is more reliable; (3) Last but not least, autocorrelation is better handled than the traditional OLS model. The estimation were done with STATA MP 17.

Results and discussion

The various unit root test results for the variables utilised in the analysis, both at the level and at first difference, are shown in Table 2. The Elliott-Rothenberg-Stock unit root test is based on the Akaike information criterion lag. Results show that, the first difference of all variables can be considered as stationary, which is important for NARDL modelling.

Table 3 shows the results of the Zivot-Andrews unit root test with structural break (intercept and trend). The results of the Zivot-Andrews unit root test are the same as the results of the Elliott-Rothenberg-Stock and Phillips-Perron tests in Table 2, i.e. the first difference of the variables is stationary. Hereafter, the first differences are used in the models. The results of the structural break test (break date) can be used for modelling. A dummy variable can be created, denoted by 1 from the time series break date, to measure the effect of the time series break and to separate it.

After testing for unit root tests, we estimated the linear model and employed BDS independence test Broock et al. (1996) on residuals to check non-linearity. The results confirm that of the series is not identically and independently distributed which confirms the presence of asymmetries (Table 4). Therefore, it is necessary to the employ dynamic asymmetric framework for the analysis of the nonlinear relationship between food inflation and macroeconomic variables in Hungary.

	Elliott-Rothenberg-Stock (AIC)				Phillips-Perron			
	intercept		intercept, trend		intercept		intercept, trend	
	Level	First diff.	Level	First diff.	Level	First diff.	Level	First diff.
lnCPIfood	-1.258	-3.508***	-1.322	-3.800***	-2.312	-6.680 ***	-2.427	-6.658***
lnGDP	2.718	-1.578*	-0.353	-3.146 **	0.020	-5.644***	-4.012 ***	-5.648***
lnEuro	2.145	-4.196***	-1.912	-6.116***	-1.077	-11.417***	-3.950 ***	-11.388***
lnPolicy	-1.140	-3.958***	-1.605	3.457***	-1.497	-13.178***	-1.207	-13.225***

Note: *** p<0.01; ** p<0.05; * p<0.1
Source: own calculation

Table 2: Unit-root tests.

	Level		First diff.	
	min. t-statistics	break date	min. t-statistics	break date
lnfoodcpi	-5.256***	2013m7	-5.106***	2021m6
lnGDP	-6.729***	2012m1	-7.378***	2020m9
lneuro	-5.292**	2016m8	-11.538**	2011m12
lnPolicy	-3.180	2018m6	-5.039***	2021m6

Note: Critical values: 1%: -5.57; 5%: -5.08; 10%: -4.82
*** p<0.01; ** p<0.05; * p<0.1
Source: own calculation

Table 3: Zivot-Andrews unit root test with structural break (intercept and trend).

	BDS statistic at different dinemsions				
	2	3	4	5	6
lnCPIfood	23.968***	25.192***	26.773***	29.108***	32.339***
lnGDP	53.919***	56.341***	59.551***	64.592***	71.669***
lnEuro	39.435***	41.637***	44.498***	48.779***	54.625***
lnPolicy	48.287***	51.389***	55.215***	60.761***	68.280***

Source: own calculation

Table 4: BDS tests.

The results of the unit root tests show that the first difference of all variables can be considered stationary, the BDS tests show that asymmetry is present in the data, therefore, we can thoroughly estimate the NARDL model.

The NARDL short-run coefficients of the inflation equation are presented in Table 5, while the computed long-run coefficients and asymmetric tests are presented in Table 6. The Bounds-test for Nonlinear Cointegration rejects the null hypothesis of no cointegration. In the long run, food prices show a downward trend ($lncpifood_{t-1}$), while in the short run, the stickiness of inflation is typical, with positive coefficients ($Dlncpifood_{t-1}$; $Dlncpifood_{t-3}$) The fall in GDP in period t-1 ($lnGDP_{t-1}^{-}$; $lnGDP_{t-1}^{+}$) also reduces food prices. In the short run, GDP growth ($DlnGDP^{+}$) decreases food prices. In the case of the HUFEUR exchange rate ($DlnEuro_{t-2}^{-}$), a fall in the exchange rate (strengthening of the forint) increases food prices, an effect that is the same in the short and long run. An increase in the monetary policy variable ($lnPolicy_{t-1}^{+}$) increases food prices in the long run, indicating inefficiency of monetary policy, as prices do not fall during the monetary policy tightening period. The effects of monetary policy tightening in African countries contrast with the trends observed in Hungary and globally (e.g., Iddrisu and Alagidede, 2020; 2021). Despite efforts to manage monetary policy, both food prices and overall price levels have escalated. This phenomenon can be attributed to several factors, including rising costs on the supply side and inflation expectations, which undermine the efficacy of monetary policy.

A significant factor influencing this dynamic is Hungary's role in foreign trade. As a net exporter of basic food commodities like wheat and maize, Hungary imports a substantial amount of processed food products. This trade structure affects the domestic food inflation response to monetary policy changes.

Contrary to common findings in similar studies, monetary policy in Hungary appears to have a neutral impact on food inflation in the short run. Most research typically finds that tightening monetary policy suppresses price increases (e.g., Kumar and Dash, 2020; Anand et al., 2014). Several reasons may explain this neutrality. First, as a small and open economy, Hungary's capacity to counteract international trends is limited. The economies examined in the literature where restrictive monetary policy successfully curbs food inflation are generally more powerful than Hungary's. Moreover, the inelastic demand for food and the higher proportion of food in Hungarian household consumption compared to the EU average further diminish the impact of monetary policy on food inflation.

We also estimated the model incorporating structural break identified by the Zivot-Andrews unit root test as dummy variable. We find that the structural break dummy variables were not significant, and the model did not show cointegration within the NARDL framework. The insignificance of the structural break dummy variables and the lack of cointegration within the NARDL framework suggest that structural breaks do not meaningfully impact the relationship between the variables in our model. This indicates that the observed dynamics are stable over time, and the effects of monetary policy on food inflation are not influenced by these structural changes.

	Coefficient
lncpifood t-1	-0.133***
$\ln GDP^{+}$ t-1	-0.036**
$\ln GDP^{-}$ t-1	-0.077**
$\ln Euro^{+}$ t-1	-0.009
$\ln Euro^{-}$ t-1	0.067
$\ln Policy^{+}$ t-1	0.168**
$\ln Policy^{-}$ t-1	0.137
Dlncpifood t-1	0.375***
Dlncpifood t-2	0.129
Dlncpifood t-3	0.304***
$DlnGDP^{+}$	-0.202**
$DlnGDP^{+}$ t-1	0.212
$DlnGDP^{+}$ t-2	-0.168
$DlnGDP^{+}$ t-3	0.017
$DlnGDP^{-}$	-0.039
$DlnGDP^{-}$ t-1	0.179
$DlnGDP^{-}$ t-2	-0.046
$DlnGDP^{-}$ t-3	0.087
$DlnEuro^{+}$	0.046
$DlnEuro^{+}$ t-1	-0.086
$DlnEuro^{+}$ t-2	-0.071
$DlnEuro^{+}$ t-3	-0.028
$DlnEuro^{-}$	-0.117
$DlnEuro^{-}$ t-1	0.122
$DlnEuro^{-}$ t-2	0.335***
$DlnEuro^{-}$ t-3	0.125
$DlnPolicy^{+}$	0.266
$DlnPolicy^{+}$ t-1	0.399
$DlnPolicy^{+}$ t-2	0.451*
$DlnPolicy^{+}$ t-3	0.32
$dlnPolicy^{-}$	0.065
$dlnPolicy^{-}$ t-1	0.412
$dlnPolicy^{-}$ t-2	-0.33
$dlnPolicy^{-}$ t-3	0.114
constant	0.630***
N	200
R^2	0.6408
Bound test	Value
F- statistics	-4.5976***
t-statistics	5.5643***

Note: *** p<0.01; ** p<0.05; * p<0.1
Source: own calculation

Table 5: Results of NARDL model.

Table 6 displays the outcomes of the short- and long-term asymmetry tests as well as the long-term impacts of the positive and negative shocks. The proxy variable for monetary policy (lnPolicy) is positive and significant for the long-run positive shocks, meaning that tightening monetary policy over time raises food prices which is in line with Samal et al. (2022). Negative shocks do not significantly have the same effect. On the other hand, for the long-run negative shocks, at 95% confidence level, food inflation rises with a decline in GDP, at 90% confidence level, food inflation decreases with an increase in GDP in the long run. The results show that there is no statistically proven relationship between food prices and the EUR exchange rate. Results on asymmetry imply that over the long term, asymmetry affects GDP and exchane rate; for example, the direction of a shock affects how food prices respond to it. This effect is only seen for exchange rate (lnEUR) in the short run.

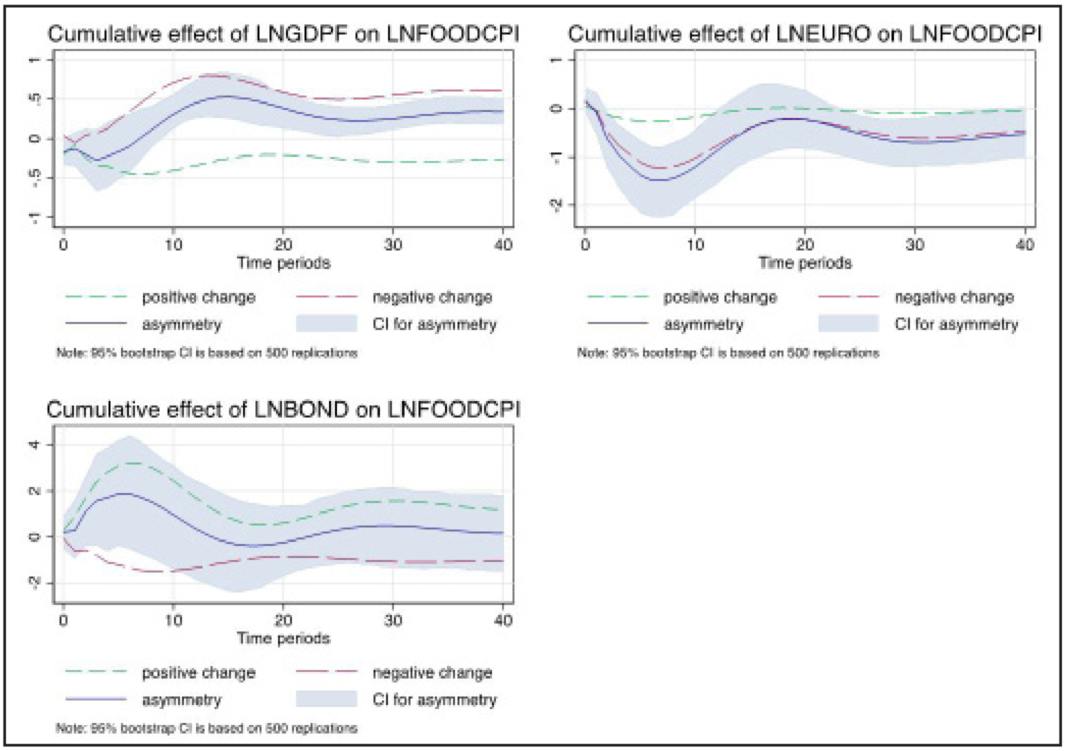
The monetary policy variable was found to be symmetric, while the variable was significant only for long-run positive shocks, i.e. positive shocks (tightening) increase food prices in the long run. In a high or rising inflation environment, monetary policy tightening is found to have the opposite effect on food prices. With rising food prices, lower income households are at risk. High general inflation causes the real value of wages to fall while food prices rise due to tightening monetary policy. The situation is not improved by the asymmetric effect, the results suggest that monetary policy easing does not reduce food prices in the long run.

The results in Table 6 demonstrate that the asymmetry persists over an extended period of time, as shown the graphs in Figure 2. The asymmetric effect for GDP shows a decline in the very short run (3-4 months), then increases steadily until months 13-14 and stabilises around months 17-18 with low volatility. That is, in the long run, GDP growth increases food prices more than GDP decline reduces them. The exchange rate asymmetry is negative throughout the period. Up to months 8-9, asymmetry increases, the negative shock reduces food prices, but this trend reverses and at month 18 asymmetry is at its lowest, but still negative. Thereafter, asymmetry settles to a broadly stable level. Monetary policy asymmetry (LNBOND on LNFOODCPI) increases in the short run, peaks around months 6-7 and then steadily decreases and staticizes around 0, i.e. there is no asymmetry in the long run.

	Long-run effect [+]			Long-run effect [-]		
	coef.	F-stat	P value	coef.	F-stat	P value
lnGDP	-0.271	3.646	0.058	0.583	6.624	0.011
lnEuro	-0.065	.07426	0.786	-0.501	2.063	0.153
lnPolicy	1.270	9.713	0.002	-1.030	1.212	0.273
		Long-run asymmetry			Short-run asymmetry	
		F-stat	P value		F-stat	P value
lnGDP		11.26	0.001		2.696	0.103
lnEuro		3.818	0.052		3.519	0.062
lnPolicy		0.065	0.8		1.85	0.176

Note: *** p<0.01; ** p<0.05; * p<0.1
Source: own calculation

Table 6: Results of asymmetric effects.



Source: own calculation

Figure 2: Cumulative effects on food price index.

Conclusion

Our study using the NARDL model provides detailed insights into the complex connection between monetary policy and food price inflation, offering important guidance for policymakers dealing with the task of managing food price fluctuations. Our main findings are following. Estimations indicate that monetary policy exerts a positive and significant impact on long-run positive shocks, suggesting that tightening monetary policy elevates food prices, corroborating prior research. Conversely, negative shocks do not yield the same effect. In the long run, food inflation rises with GDP declines and decreases with the strengthening of the Hungarian forint against the euro, although the relationship between food prices and the EUR exchange rate is not statistically significant.

The monetary policy variable demonstrates symmetry, with asymmetric effects only observed for long-run positive shocks. In environments characterized by high or rising inflation, monetary policy tightening paradoxically increases food prices. This asymmetric effect persists over an extended period, with GDP growth driving food prices up more than GDP declines bring them down. The exchange rate asymmetry remains negative throughout the period, increasing until months 8-9 and decreasing by month 18, while the exchange rate shows no long-run asymmetry.

Our results offers some policy implications. These findings suggest that policymakers should exercise caution when tightening monetary policy to control food price inflation, as it may inadvertently elevate food prices, particularly in the long term. This counterintuitive response emphasizes the need for a balanced approach to avoid exacerbating food inflation. Effective management of food price inflation necessitates an integrated strategy combining monetary and fiscal policy measures. Given the substantial share of disposable income that Hungarian households allocate to food, targeted fiscal interventions are essential to mitigate the adverse effects of food inflation. Addressing structural issues within the agricultural sector, enhancing productivity, and building resilience against external disruptions are imperative. Investments in agricultural infrastructure, research and development, and social safety nets are crucial for bolstering food security and reducing household vulnerability to food price volatility. he impact of monetary policy on food inflation is influenced by global economic conditions, exchange rate fluctuations, and supply chain interruptions. Thus, policy responses must be adaptable to these external factors.

Finally, future research directions could include examining inter-country food trade and incorporating additional variables to measure the robustness of monetary policy effects. Comparing Hungary's outcomes with those of similarly sized countries could yield further valuable insights into managing food price inflation.

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