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The impact of enterprise markups on changes in the CPI in Poland

Abstract

The aim of the study is to present the impact of enterprise markups by sections on changes in the CPI in Poland in the years 2008–2023. The VAR model was developed to reveal the interdependencies between changes in markups in nine major sections of non-financial corporations and changes in the CPI. The results of the model, the impulse response function and the variance decomposition confirmed the differentiated impact of markups on inflation changes. To the greatest extent, changes in the CPI, as much as 30%, were explained by the markups of enterprises in real estate services (L), and mining and quarrying (B) sections. The least pro-inflationary contribution to the CPI explanation was shown by markups from information and communication (J), water supply, sewage and waste management, reclamation (E), trade and repair of motor vehicles (G) and the generation and supply of electricity, gas, steam, and hot water D (less than 1%). The degree of explanation of the CPI by markups projected in the variance decomposition increased in the short term (to 26% in the 1st year), stabilizing at a higher level (35% in the years 3–5) in the medium and long term.

Keywords: inflation expectations, CPI, markups, NFC, VAR, impulse response functions, variance decomposition
JEL Classification: E51, E58, E63, J31, M21

Introduction

The variety of demand and supply shocks affecting price changes in the global economy, including Poland, is a challenging research task. Shocks additionally caused by the COVID-19 pandemic, armed conflicts, or energy crises increase the number of disruptions in the monetary and fiscal spheres, in the economic activities of businesses as well as households. These disruptions have been the source of numerous exogenous and endogenous shocks. And financial policy has a limited ability to overcome inflationary expectations in the short and medium term.

Enterprises seeking to hedge against expected increases in raw material and commodity prices (inventory renewals) and as well as wage demands are raising markups. The pressure to increase markups applies to both manufacturing and service companies, although enterprises raise markups differently, depending on the market in which they operate (oligopoly or monopolistic competition), the nature of demand (price elasticity) and so on. Pressure on enterprises to raise markups has been noticeable since the beginning of 2020 in many markets, such as in Europe and the US.

In assessing the relationship between changes in markups and prices, it is important to understand the mechanism of impact, determine the main sources of influence and the strength of this influence, as well as the period of the influence in theoretical and empirical terms. In terms of theory, it is important to indicate the main determinants, channels of influence and the nature of shocks (supply and demand) on changes in inflation. In the area of empirical research, inflation modelling methods are important. Therefore, it is important to model the CPI not only in aggregate terms (contribution of core inflation, fuel, energy, and food prices), but also in disaggregated terms (considering inflation impulses coming from the sector or individual types of economic activity).

Considering the numerous changes in markups in the enterprise sector, it is particularly justified (needed) to analyze the CPI on a disaggregated basis, e.g. from the level of markups of enterprises according to the main sections of the Polish Classification of Activities (PKD). Therefore, a VAR model was prepared, which attempts to analyze the determinants of the CPI from the level of the nine main sections, i.e.: mining and quarrying (B), industrial processing (C), generation and supply of electricity, gas, steam, and hot water (D), water supply, sewage and waste management, reclamation (E), construction (F), trade and repair of motor vehicles (G), transport and warehouse management (H), information and communication (J), and real estate market service (L). This means that changes in company markups in these sections cover most of the determinants of changes in the price of a basket of goods and services. The results of this model are intended to identify the sources of destabilizing changes in the CPI, as well as the markups from sections that stabilize the overall price level of a basket of goods and services [SP, 2023].

A disaggregated analysis of the inflation rate is particularly important for policymakers and market participants. Firstly, ddeterminant analysis and inflation forecasting are key tools for adjusting monetary policy around the world [Friedman, 1961]. Central banks forecast future inflation trends to justify interest rate decisions and to keep inflation close to their targets. A better understanding of future inflation dynamics at the component level can help implement an optimal monetary policy [Ida, 2020]. Secondly, predicting disaggregated inflation rates is important for fiscal authorities, investors, enterprises, and households in addition to monetary authorities [Binder, 2021; Goodhart et al., 2023, Kabundi, De Simone, 2022; Wang et al., 2013]. Forecasting the CPI is important for fiscal authorities, who want to forecast sectoral inflation dynamics to tailor social security payments and aid packages to specific industries. In the private sector, investors in fixed-income markets want to estimate future sectoral inflation to predict upcoming trends from discounted real returns. In addition, some private enterprises need to anticipate the specific components of inflation to forecast price dynamics and mitigate risk e.g. when making long-term investments or exporting or importing goods. Moreover, the costs of servicing government debt as well as private debt also depend on the expected path of inflation.

The aim of the study is to present the impact of enterprise markups by sections on changes in the CPI in Poland in the years 2008–2023.

Among the research methods, the analysis of studies in the field of monetary policy and statistical analysis based on data published by Statistics Poland (SP) were used. The impact of markups on changes in the CPI was assessed using the VAR model, the impulse responses, and the variance decomposition.

Literature review

Counteracting the effect of inflation while consolidating inflation expectations was particularly difficult, e.g. in the 1970s and 1980s, when the first and later the second energy crisis (1974–1975, 1979–1980) occured, the rate of economic growth slowed down and unemployment soared. At that time, it was difficult to overcome inflation by the traditional methods of economic policy and to analyze it scientifically [Friedman, 1959, 1961, 1970, 1984; Modigliani, 1977].

Among the main causes of inflation in the theoretical and empirical achievements, the following should be indicated:

- excess demand with an increase in the money supply or government spending (demand-pull inflation) or an increase in production costs (cost-push inflation) [Balke et al., 2000];
- supply and demand shocks – changes in domestic prices caused by external factors causing economic fluctuations [Blanchard, Jordi, 2007; Blinder, Rudd, 2008; Hamilton, 1983];
- supply shocks – in the form of changes in productivity, changes in oil reserves or changes in food stocks, caused by weather changes or disruptions in supply chains, altering both the quantities of goods and their prices delivered to the market [Dudek, 2008, pp. 71–84];

- demand shocks – reflecting changes in consumer behaviour on the demand side because of changes in preferences or resulting from consumer decisions [Dudek, 2008, pp. 85–92];
- the existing market structures of producers in the market or in the industry producing goods and services (e.g. monopoly, oligopoly, or other), determining the possibility of determining the price, supply, demand and, consequently, the number of surplus of producers and consumers in the market [Dąbrowski, 2016, pp. 108–112; De Loecker, Unger, 2020; Foster, Haltiwanger, Syverson, 2008, pp. 394–425; Perry, 1982, pp. 197–205; Reich, 2022; Traina, 2018];
- imports of inflation, i.e. the transfer of prices from the importing country to the domestic market through purchases of goods and services from abroad (the scale depends on the share of imports in GDP) [Wang, Wei, Zhu, 2013];
- risk of markup-price and wage-price spirals in the post-COVID-19 pandemic period [Boissay et al., 2022; IMF, 2022];
- the impact of CPI data on enterprises' inflation expectations and their nature in the short and long term [Goodhart et al., 2023; Kabundi, De Simone, 2022; Yotzov et al., 2023];
- the importance of enterprise markups in the economy and by sector for CPI changes [Barkan et al., 2023; Glover, Mustre-del-Río, Ende-Becker, 2023; Hall, 2023; Muntaz, et al., 2023];
- inflation expectations and changes in enterprise prices [Binder, 2021; Coibon et al., 2020; Coibon et al., 2023; Wernig, 2022].

In the fight against inflation, a particularly difficult problem is the impact of the dynamics and scale of price growth on the expectations of economic agents as to price dynamics in the future. This element is particularly important when there is a long-term price increase. It may turn out that because of the emergence and then consolidation of inflation expectations, the wage dynamics will 'overtake' the price dynamics, eliminating not only the possible positive impact of creeping inflation on changes in real economic categories, but even causing a regression [Barlevy, Luojia, 2023; Binder, 2020; Binder, 2021, Boissay, 2022, Glick, 2022; Gomes, 2023].

Among the detailed research results of Yotzov et al. [2023], it is worth highlighting the following: in 2022–23 we find that CPI data releases have a positive and significant effect on firms' own expected price growth in the days following a data release. This means that the nature of expectations formed by firms can have important implications for the path of inflation going forward. Indeed, inflation expectations play a key role in price setting behaviour in most modern macro models [Binder, 2021; Coibon et al., 2020; Coibon et al., 2023; D'Acunto, 2021, 2020; Wernig, 2022].

According to Hall`s research [2023], in times of a high volatility of price determinants – cost and productivity – inflation can jump upward and downward at a high speed, contrary to the uniformly sticky behaviour associated with traditional Phillips curves. The sectors with standard New Keynesian price stickiness are vulnerable to rapid transitions from stickiness to flexibility, as sellers choose to reset their prices and abandon anchoring. Moreover, the cross-industry volatility of price determinants grew substantially in the inflation episode accompanying the pandemic. Volatility remained elevated even in late 2022. The logic of the

New Keynesian model of the Phillips curve links inflation to volatility, because a larger fraction of sellers is pushed out of their regions of inaction when volatility is elevated. The New Keynesian Phillips curve becomes much steeper in volatile times.

An interesting study explaining the increase in markups by enterprises at the turn of 2021–2022 was conducted by Glover et al. [2023]. The activities of a monopolistic enterprise adjusting its activity and pricing policy to the increase in marginal costs and higher demand were analyzed.

The authors pointed out that companies raise prices (markups) because: they expect higher costs to replace their current inventory as it is sold; they anticipate higher marginal costs in the future, wanting to smooth out price increases over time, rather than raising them sharply and abruptly.

Markups may or may not contribute to inflation: when the monopolist's marginal costs increase, markups decrease, but when the demand for the monopolist's products increases, the margins expand [see also: Kosztowniak, 2023a, 2023b; Perry, 1982; Reich, 2022; Traina, 2018; Wang et al., 2013].

The finding that companies are increasing their margins at present to mitigate price increases they expect in the future seems more important. This means that future costs may increase inflation at present, through markups.

The empirical research by Glover et al. [2023] into the American market shows that in 2021 the increase in markups probably contributed to the rise in inflation by over 50%, which was a much higher contribution than in the previous decade.

As for the impact of wages and labour costs on inflation, it should be emphasized that they represent not only costs to businesses, but also household incomes. Specifically, a higher wage growth raises people's income and thus their willingness to pay for products or services. This increase in consumer demand ultimately could allow businesses to charge higher prices, fuelling inflation through the so-called demand channel. This contrasts with the supply channel, which reflects businesses simply passing their higher labour costs along to consumers in the form of higher prices. However, changes in labour costs do not necessarily influence service prices. Instead, companies can absorb such costs into their profit markups or, in some cases, substitute with automation or improved efficiency [Leduc, Liu, 2023].

The analyses point to the key role of the process of shaping expectations in shaping wage and price prospects. When wage and price expectations are more backward, monetary policy actions need to be more front-line to minimize the risk of inflation being unanchored. As monetary policy tightens aggressively and real price pressures ease, the scenario analyses assume that the risks of a persistent wage-price spiral over the current period are moderately contained, assuming that there are no longer persistent inflationary shocks or structural changes in wage and price formation processes (such as sharp increases in the price-to-wage transition or vice versa). The determination of the optimal monetary policy response depends on the situation, whether the central bank minimizes the welfare function, which balances out deviations in output and inflation, or whether it knows the process of shaping expectations and has full information about future cost shocks [IMF, 2022]. In the context of market disturbances caused by the COVID-19 pandemic and the period of the war in Ukraine, it is important to suppress high inflation expectations and diagnose the causes of changes in other price indices that determine the inflation felt by consumers.

Model description and research procedure

Markups set by non-financial corporations were calculated based on the data of Statistics Poland (SP), according to the nine main sections of PKD Code Classification. The gross markup was calculated as the difference between the enterprise`s total revenues and costs to its total revenues, i.e. the ratio of the income to revenue. To assess the impact of changes in markups on inflation, the consumer price index (CPI) was chosen, because this measure considers a wide range of cross-sectional price changes in the main sections of enterprises' activities. In addition, the CPI represents a wide range of changes in the prices of a basket of goods and services, measuring not only the feelings of households, but also of enterprises and institutions. To analyze the relationship between changes in the CPI and markups in the 2008. Q1–2023. Q2 (61 quarters), a final formula for the CPI function was developed:

$$d\_CPI_t = \alpha_0 + \alpha_1 d\_B_t + \alpha_2 d\_C_t + \alpha_3 d\_D_t + \alpha_4 d\_E_t + \alpha_5 d\_F_t + \alpha_6 d\_G_t + \alpha_7 d\_H_t + \\ + \alpha_8 d\_J_t + \alpha_9 d\_L_t + \xi_i \quad (1)$$

The explained variable: d_CPI_t – Consumer Price Index.
The nine explanatory variables as gross markups for activities by PKD sections:
d_B_t – mining and quarrying,
d_C_t – industrial processing,
d_D_t – generation and supply of electricity, gas, steam, and hot water,
d_E_t– water supply, sewage and waste management, reclamation,
d_F_t – construction,
d_G_t – trade and repair of motor vehicles,
d_H_t – transport and warehouse management,
d_J_t – information and communication,
d_L_t – real estate market service,
ξ_i – random component,
t – period.

Many explanatory variables, both micro- and macroeconomic, are used when modeling CPI changes. However, the analysis of CPI changes presented in the study was based only on variables explaining changes in markups by sector for several reasons. Firstly, the aim was to analyze in detail the differences in the impact of sector markups on CPI changes, i.e. to explain which sectors have a stronger and weaker impact on changes in the price level, unlike many analyses examining the overall impact of gross margins of the corporate sector. Secondly, the high but diversified dynamics of markups in various sectors, after the COVID-19 pandemic in 2020–2022, prompted an attempt to explain precisely the differences in the impact by sector. Thirdly, the diagnosis of differences in the sectoral impact of markups on CPI changes is of key importance for conducting targeted actions to reduce inflation, both on the part of monetary and financial policy as part of various policy mix tools.

The data came from SP [2023] database sources. All the variables expressed in terms of percent points are included in the form of the first difference variables. Empirical analysis was performed using EViews13.

The descriptive statistics of the analyzed variables show that in terms of the explained variables, markups from section B showed a greater variability (St. dev. 0.10645, C.V. 0.83468, Skewness 0.61312) than those from section J and D (Table 1).

Table 1. Summary statistics

Variable	Mean	Median	Minimum	Maximum	Std. Dev.	C.V.	Skewness
CPI	0.033146	0.028000	–0.015000	0.17300	0.040250	1.2143	2.1182
B	0.127540	0.11127	–0.057453	0.40746	0.10645	0.83468	0.61312
C	0.057885	0.058873	0.024293	0.07942	0.010766	0.18600	–0.60010
D	0.111550	0.114190	0.030212	0.18401	0.035026	0.31399	–0.037291
E	0.081235	0.079866	0.045299	0.13429	0.019516	0.24024	0.65782
F	0.038815	0.038317	–0.026892	0.09698	0.028952	0.74589	–0.16086
G	0.025232	0.023452	0.0098462	0.04497	0.008978	0.35581	0.90363
H	0.040335	0.043793	0.0008148	0.06103	0.014006	0.34724	–0.76666
J	0.115240	0.097409	0.059998	0.35149	0.055285	0.47972	2.06610
L	0.084989	0.083347	0.010661	0.16397	0.025242	0.29701	0.27161

Source*:* own calculations: EViews13.

Initial data verification concerned the verification of stationarity with the use of several tests (Tables 3–4). To verify the stationarity of the analyzed time series, the Augmented Dickey-Fuller (ADF) test is used, estimated by means of the regression equation in the following form:

$$\Delta_{yt} = \mu + \delta_{t-1} + \sum_{i=1}^{k} \delta_i y_{t-1} + \epsilon_t \qquad (2)$$

The value of the test statistic: $ADF = \frac{\hat{\delta}}{S_{\hat{\delta}}}$

Where: $\hat{\delta}$ means the parameter evaluation and $S_{\hat{\delta}}$ is the parameter estimate error.

The results of the ADF test were inconclusive: some variables were non-stationary and others stationary, although for all of them, a unit root appears a=1, process (1) (Table 2).

Table 2. The ADF stationarity test results

Variable	Null hypothesis: unit root appears	with constant		constant and trend	
		test statistic: τ_ct (1)	asymptotic *p*-value	test statistic: τ_ct (1)	asymptotic *p*-value
d_CPI_t	$a = 1$; process I (1)	–1.13238	0.70520	–2.00042	0.6005
d_B_t		–6.62963	3.542e-007	–6.64438	2.971e-006
d_C_t		–7.82251	6.393e-009	–7.76621	6.966e-008
d_D_t		–10.6301	3.065e-021	–4.74748	0.0005386
d_E_t		–3.86745	0.002298	–3.77737	0.01765
d_F_t		–2.71694	0.07108	–3.47529	0.04203
d_G_t		–2.17966	0.21390	–3.64173	0.02639
d_H_t		–3.36577	0.01222	–3.31761	0.06333
d_J_t		–10.5792	6.889e-012	–10.4856	5.838e-011
d_L_t		–5.60783	9.913e-007	–5.50609	1.619e-005

Source: own calculations: EViews13.

To verify the conclusions drawn based on the ADF test, the Kwiatkowski–Philips-Schmidt–Shin (KPSS) stationarity test is carried out, where the null hypothesis assumes sequence stationarity, whereas the alternative hypothesis assumes the occurrence of the unit root. The initial test model can take the following form:

$$\gamma_t = \beta_t + r_t + \xi_t \tag{3}$$

where: $r_t = r_t - 1 + u_t$, where ξ_t and u_t are a stationary and a white-noise random component, respectively. On the other hand, the KPSS test statistic is calculated with the use of the formula:

$$KPSS = T^{-2} \sum_{t=1}^{T} \left(\sum_{t=1}^{t} e_i \right) / \hat{\delta}^2 \tag{4}$$

where e_i denotes residuals, and $\hat{\delta}^2$ is a long-term variance estimator [Kufel, 2011].

An ultimate verification of stationarity requires an additional test, e.g. the KPSS. Most of the variables showed stationarity, as the test statistic was below the critical value, although for different levels of probability (Table 3).

Table 3. The KPSS stationary test results

Variables	d_CPI	d_B	d_C	d_D	d_E	d_F	d_G	d_H	d_I	d_L
Test statistic	0.566136	0.106455	0.0492639	0.0747809	0.0934187	0.123053	0.298399	0.0840072	0.0537113	0.1309
Critical values	0.351 (10%), 0.462 (5%), 0.728 (1%)									

Note: Lag truncation parameter = 3.

Source: own research.

The next step was to verify the cointegrating relationship. The time series y_1 and y_2 are cointegrated (of the order d, b) if they are integrated to degree d, while there is their linear combination, that is, of the order d – b:

$$y_1, y_2 \sim CI(d,b) \Leftrightarrow y_1 \sim I(d) \quad \wedge y_2 \sim I(d) \exists_{\beta \neq 0} \underbrace{y^T \beta}_{y_1\beta_1 + y_2\beta_2} \sim I(d-b) \tag{5}$$

Cointegration was verified using the Johansen test [Johansen 1991, 1992, 1995]. The stationarity of the residuals obtained at the first stage was tested. If the series of residuals is stationary, then the variables are integrated.

$$y_1, y_2 \sim CI \Rightarrow \widehat{\in_t} \sim I(0) \tag{6}$$

Test results confirmed the absence of cointegration. This is evidenced by the values of the test statistic τ_e, which are below the critical values of τ_critical, i.e. the ranks are stationary in the absence of cointegration, and by very low levels of asymptotic p-values (Table 4).

Table 4. Johansen test

Rank	Eigenvalue	Trace test p-value	Lmax test p-value	Trace test p-value
0	0.89124	722.82 [0.0000]	130.90 [0.0000]	722.82 [0.0000]
1	0.87043	591.93 [0.0000]	120.57 [0.0000]	591.93 [0.0000]
2	0.83605	471.36 [0.0000]	106.68 [0.0000]	471.36 [0.0000]
3	0.76994	364.67 [0.0000]	86.696 [0.0000]	364.67 [0.0000]
4	0.69893	277.98 [0.0000]	70.825 [0.0000]	277.98 [0.0000]
5	0.62955	207.15 [0.0000]	58.589 [0.0000]	207.15 [0.0000]
6	0.60755	148.56 [0.0000]	55.185 [0.0000]	148.56 [0.0000]
7	0.52806	93.379 [0.0000]	44.303 [0.0000]	93.379 [0.0000]
8	0.44344	49.076 [0.0000]	34.573 [0.0000]	49.076 [0.0000]
9	0.21793	14.503 [0.0001]	14.503 [0.0001]	14.503 [0.0002]

Note: Number of equations = 10, Lag order = 1, Estimation period: 2008: Q3–2023: Q2.

Source: own calculations: EViews13.

Due to the lack of cointegration between the model variables, it was not possible to extend and transform the structural Vector Autoregression Model (VAR) into a Vector Error Correction Model (VECM).

The general form of the VAR can be written as [Kufel, 2011]:

$$\begin{aligned} Y_{1t} &= a_{10} + \sum_{i=1}^{p} a_{11i}\, Y_{1\,t-1} + \sum_{i=1}^{p} a_{12i}\, Y_{2\,t-1} + \ldots + \sum_{i=1}^{p} a_{1ki}\, Y_{k\,t-1} + \varepsilon_{1t}, \\ Y_{2t} &= a_{20} + \sum_{i=1}^{p} a_{21i}\, Y_{1\,t-1} + \sum_{i=1}^{p} a_{22i}\, Y_{2\,t-1} + \ldots + \sum_{i=1}^{p} a_{2ki}\, Y_{k\,t-1} + \varepsilon_{2t}, \\ Y_{kt} &= a_{k0} + \sum_{i=1}^{p} a_{k1i}\, Y_{1\,t-1} + \sum_{i=1}^{p} a_{k2i}\, Y_{2\,t-1} + \ldots + \sum_{i=1}^{p} a_{kki}\, Y_{k\,t-1} + \varepsilon_{kt}. \end{aligned} \tag{7}$$

The VAR model is a multi-equation econometric model consisting of k equations. There are no simultaneous correlations (interdependencies) and the set of explanatory variables consists of time-delay processes. In addition, the order of the lag is assumed to be the same in all processes and is p. The right-hand side of the model is the same in each equation, i.e. in our case, the explanatory variables are the CPI dynamics and the explanatory variables (left-hand side markups by PKD section). Furthermore, the analysis uses the VAR model recommended for zonal (in our case quarterly) data, as the assumption of no contemporaneous relationship between quarterly data holds true for many economic categories.

The lag order for the VAR model was determined on the basis of an estimation of the following information criteria: the Akaike information criterion (AIC), Schwartz-Bayesian information criterion (BIC), and Hannan-Quinn information criterion (HQC). According to these criteria, at a maximum lag order 2, the best lag order 1 was accepted (Table 5).

Table 5. The values of the respective information criteria (AIC, BIC, and HQC)

Lag	loglik	p (LR)	AIC	BIC	HQC
1	1728.82990		–55.821721*	–51.913984*	–54.299578*
2	1803.51743	0.00101	–54.948877	–47.488652	–52.042969

Source: own calculations: EViews13.

To analyze the stability of the VAR model, a unit root test was applied. The VAR model is stable if the following condition is met:

$$y_t = A_1 y_{t-1} + u_t;\ A_{1^h} \to 0;\ h \to \infty \tag{8}$$

The test indicates that in the analyzed model equation roots in respect of the module are lower than one, which means that the model is stable and may be used for further analyses.

To analyze the causal relationship between changes in margins and CPI dynamics in Poland in the period 2008:Q1–2023:Q2 the VAR was used.

$$CPI_t = \sum_{k=1}^{p} \alpha_k CPI_{t-k} + \sum_{k=1}^{p} \beta_k MARKUPS\ B_{t-k} \ldots + \sum_{k=1}^{p} \beta_k MARKUPS\ L_{t-k} + \mu_t \tag{9}$$

where:

CPI – average inflation rate in Poland, measured by the consumer price index,

MARKUPS – for analysed PKD code sections, separately from B, C, D, E, F, G, H, J to section L,

μ – residual component,

t – analysis period,

k – number of lags of variables.

In the subsequent steps, the verification of the consistency of the VAR model parameters included an autocorrelation test (portmanteau Ljung-Box, to 4^{th} lags), a reliability quotient test (the significance of successive lags of all variables in each equation), a normality test of the distribution of the residuals (Jargue-Bera), and causality tests in the Granger sense. The results of the tests confirmed the validity of the use of the VAR model, the choice of variables, lags, and restrictions.

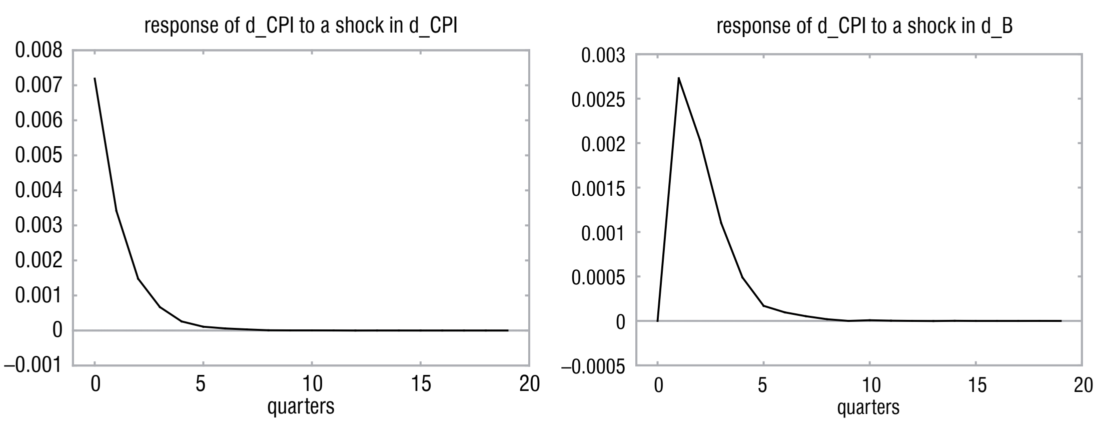
The results of the VAR model indicate that the highest contribution to explaining changes in the CPI came from the company's own previous CPI changes, followed by markups from the real estate (L) and mining and quarrying (B) sections. The model's R^2 explanation rate was 47.44%, with an adjusted R^2 of 36.49% and DW = 2.177 (Annex Table A.1).

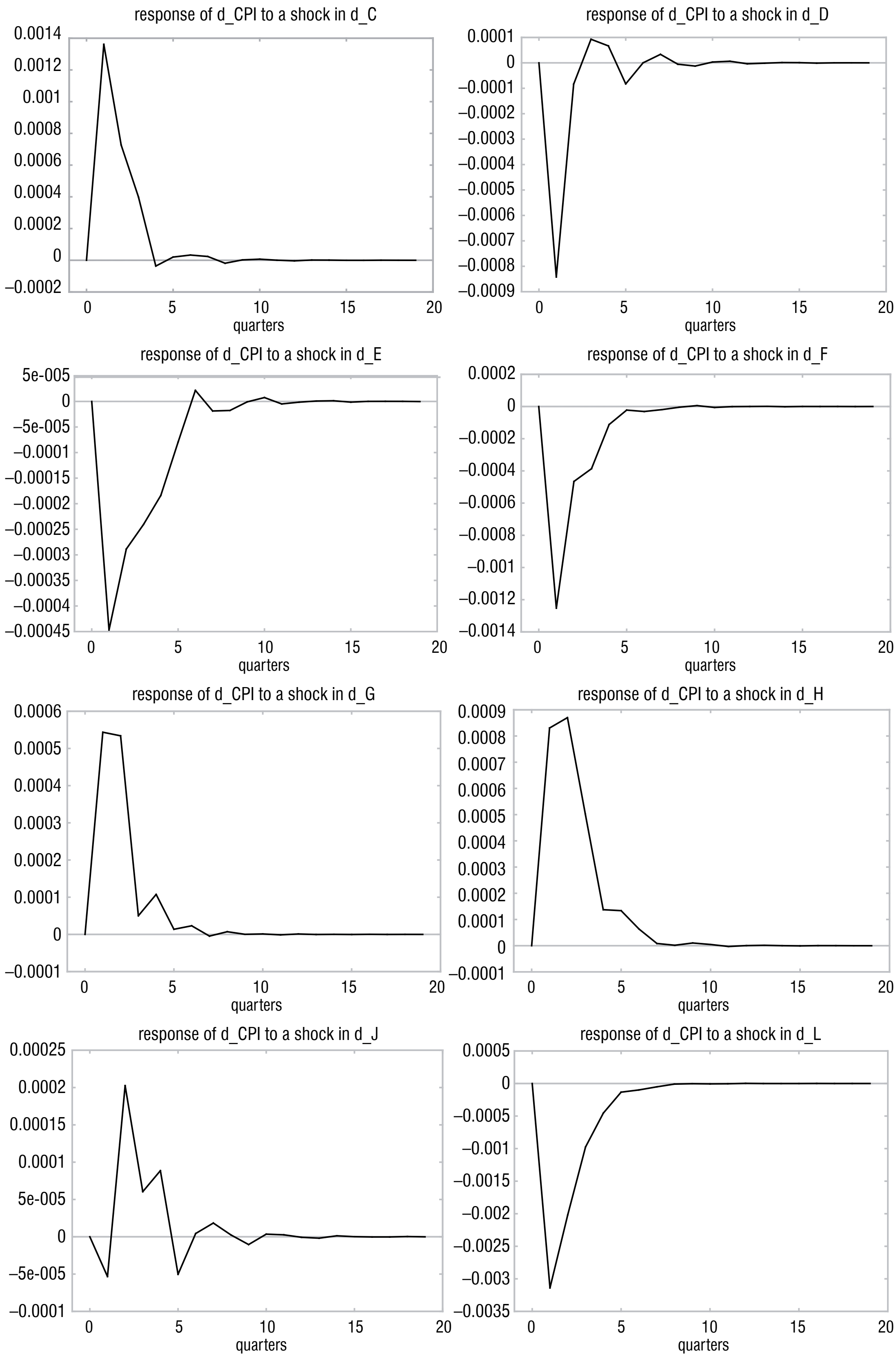
Results

A tool for the economic interpretation and evaluation of the way the variables in the model will change after 1,2, 3… periods after the occurrence of a unit disturbance ε_1 (ε_2, ε_3) is used to analyze the impulse response function (IRF).

The analysis of the CPI's response to its own CPI-derived shocks indicates positive and declining impulses after the 5th quarter forecast. CPI responses to shocks derived from markups reveal that these responses are positive to impulses from the markups of B, C, G, H, and J sections, but negative to impulses from D, E, F, and L sections. The strongest positive CPI response occurred to shocks originating from the H and G sections, i.e. activities including services and fuel price sensitive and interrupted supply chains (like during the COVID-19 pandemic). The responses of the CPI to the markups surveyed indicate that their impact was short-lived, although the figures indicate they were sharp around the 2nd–3rd quarter of the analysis, declining very quickly in the 4th–5th quarter, and stabilising in the 6th quarter. This means that the impact of the change in markups on the CPI continues for about one year (Figure 1).

Figure 1. Impulse responses to a one-standard error shock in CPI and markups





Source: own calculations: EViews13.

Another evaluation tool is the forecast error variance decomposition (FEVD), which is used to interpret and evaluate in what proportions individual shocks account for the development of forecast errors at time horizons. For each h (forecast horizon), k (variable y_k) and I (shock ε_I), the FEVD presents the contribution of the I-th component to the total, i.e., the relative contribution of the k-th shock to the error variance for the k-th variable.

$$FEVD(k, I, h) = \Theta^2_{h-s,k,I} / \sum_{I=1}^{K} \Theta^2_{h-s,k,I} \tag{10}$$

The CPI and markups were analyzed by means of variance decomposition in the forecast horizon of 20 quarters (5 years). The results of CPI decomposition indicate that in the 1st period, these changes are fully (100%) accounted for by their own forecast errors. In period 2, their own changes decrease (73.7%) and there is a growing degree of clarification from the section markups, especially L (11.5%) and B (8.7%). In the 20th period, the CPI's own changes decrease (to 64.6%) and the degree of its explanation with total markups increases (35.4%), including mainly the part of markups in sections: L (14.8%), B (12.8%), C (2.5%), and F (1.9%) These four sections were the pillars of explanations to CPI changes, in total close to 32%. Moreover, only two sections, L (real estate market service) and B (mining and quarrying), explained about 27.6% changes of the CPI. The lowest level of explanation to CPI changes was shown by markups in sections: J, G, E, D (below 1%) (Annex Table A.2).

Summary

The period of high markup dynamics in the enterprise sector and rising inflation fell in Europe, including Poland, in the period 2020–2022. Price and markup pressure resulted from high inflation expectations in the market and the prudential pricing policy of enterprises. The reactions of enterprises resulted from the increase in production costs due to numerous disruptions (COVID-19 pandemic, the war in Ukraine, and the effects of the energy crisis). These conditions were also accompanied by an increased money supply in the market, as a result of additional financial resources being directed to the enterprise sector in 2020–2022 (so-called anti-crisis and anti-COVID shields, i.e. government funds to support companies).

The results of the empirical research confirm that changes in markups in Poland in the examined years were strongly differentiated in individual sections. Differences in the dynamics and levels of markup changes resulted from differences in marginal costs, connections with other industries, as well as the degree of competitiveness in a given section and demand elasticity. Inflation expectations of enterprises also influenced the dynamics and magnitude of changes in margins. In this sense, at the level of normative economics, the research results confirm the thesis about nominal rigidities, the importance of price elasticity in shaping inflation expectations and the persistent nature of inflation.

From an econometric perspective, the aim of the study is to present the impact of enterprise markups by section on changes in the CPI in Poland in the years 2008–2023. The results of the VAR model, impulse reactions, and variance decomposition confirmed the differential impact of margins on changes in inflation. The CPI changes were explained in as much as 30% by changes in the markups of enterprises in the real estate services (L) and mining and quarrying (B) sections. The least CPI was explained by changes in markup in the sections of information and communication (J), water supply, sewage and waste management, recultivation (E), trade and repair of motor vehicles (G) and energy generation and supply electricity, gas, steam, and hot water (D) (less than 1%). According to the variance decomposition forecast, the degree to which CPI was explained by markups increased in the short term (up to 26% in the first year), stabilizing at a higher level (35% in the third and fifth years) in the medium and long term.

At the level of positive economics, the added value of the study is the identification of the business sections that most strongly explain (L, B) and weakly explain (J, G, E, D) the changes in inflation in Poland in 2008–2023. The importance of the markup policy of enterprises conducting multidimensional activities, such as real estate (L), i.e. activities requiring cooperation with many others, was confirmed. This means that the real estate market affects many entities (side effects) and can accumulate changes in markups from many cooperating activities, therefore, it has a strong impact on CPI changes. In the case of mining and quarrying (B), the impact of the increase in markups on the CPI was influenced by the numerous effects of the energy crisis and the increase in prices of energy raw materials, especially after 2020.

Given the practically important results regarding the importance of section-level markup changes on CPI changes, future research should focus on even more disaggregated data. Therefore, the analysis of the impact of markups on CPI changes should be carried out at the level of 4^{th} PKD codes, which will bring interesting results.

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Annex

Table A.1. VAR system

Determinant of covariance matrix = 5.8974262e-039 AIC = –55.9187; BIC = –52.0453; HQC = –54.4067			Portmanteau test: LB (14) = 1428.88, df = 1300 [0.0069]		
Equation 1: d_CPI	Coefficient	Std. Error	t-ratio	p-value	
const	0.000848962	0.00107873	0.7870	0.4352	
d_CPI_1	0.439887	0.126381	3.481	0.0011	***
d_B_1	0.0645287	0.0265653	2.429	0.0189	**
d_C_1	0.174748	0.186327	0.9379	0.3530	
d_D_1	−0.0240342	0.0352119	−0.6826	0.4982	
d_E_1	0.0379985	0.0957396	0.3969	0.6932	
d_F_1	−0.0241605	0.0694050	−0.3481	0.7293	
d_G_1	0.143002	0.315686	0.4530	0.6526	
d_H_1	0.153060	0.128661	1.190	0.2400	
d_J_1	0.000450602	0.0313263	0.01438	0.9886	
d_L_1	−0.143016	0.0467669	−3.058	0.0036	***
Mean dependent var	0.002153		S.D. dependent var	0.010004	
Sum squared resid	0.003050		S.E. of regression	0.007972	
R-squared	0.474469		Adjusted R-squared	0.364983	
F (10, 48)	4.333610		P-value (F)	0.000246	
rho	−0.094192		Durbin-Watson	2.177152	

cont. Table A.1

Determinant of covariance matrix = 5.8974262e-039 AIC = –55.9187; BIC = –52.0453; HQC = –54.4067			Portmanteau test: LB (14) = 1428.88, df = 1300 [0.0069]		
Equation 2: d_B	Coefficient	Std. Error	t-ratio	p-value	
const	−0.00177874	0.00628681	−0.2829	0.7784	
d_CPI_1	0.590936	0.736540	0.8023	0.4263	
d_B_1	0.196151	0.154822	1.267	0.2113	
d_C_1	−0.0388472	1.08590	−0.03577	0.9716	
d_D_1	0.0641314	0.205213	0.3125	0.7560	
d_E_1	−0.519473	0.557965	−0.9310	0.3565	
d_F_1	0.408092	0.404489	1.009	0.3181	
d_G_1	−0.205154	1.83980	−0.1115	0.9117	
d_H_1	1.46285	0.749832	1.951	0.0569	*
d_J_1	−0.0973558	0.182568	−0.5333	0.5963	
d_L_1	−0.714620	0.272555	−2.622	0.0117	**
Mean dependent var	0.000730		S.D. dependent var	0.048642	
Sum squared resid	0.103606		S.E. of regression	0.046459	
R-squared	0.245012		Adjusted R-squared	0.087723	
F(10, 48)	1.557719		P-value (F)	0.148670	
rho	−0.027422		Durbin-Watson	2.051310	
Equation 3: d_C	Coefficient	Std. Error	t-ratio	p-value	
const	0.000128999	0.00123142	0.1048	0.9170	
d_CPI_1	−0.0878365	0.144268	−0.6088	0.5455	
d_B_1	0.00905828	0.0303254	0.2987	0.7665	
d_C_1	−0.0457377	0.212699	−0.2150	0.8307	
d_D_1	0.0404840	0.0401957	1.007	0.3189	
d_E_1	0.0725560	0.109290	0.6639	0.5099	
d_F_1	−0.0968611	0.0792285	−1.223	0.2275	
d_G_1	−0.00221119	0.360367	−0.006136	0.9951	
d_H_1	−0.0704782	0.146872	−0.4799	0.6335	
d_J_1	0.0330357	0.0357602	0.9238	0.3602	
d_L_1	−0.0401676	0.0533863	−0.7524	0.4555	
Mean dependent var	−0.000153		S.D. dependent var	0.008947	
Sum squared resid	0.003975		S.E. of regression	0.009100	
R-squared	0.143834		Adjusted R-squared	–0.034534	
F(10, 48)	0.806389		P-value (F)	0.623452	
rho	0.002705		Durbin-Watson	1.970868	
Equation 4: d_D	Coefficient	Std. Error	t-ratio	p-value	
const	0.000856329	0.00393926	0.2174	0.8288	
d_CPI_1	−0.210507	0.461510	−0.4561	0.6504	
d_B_1	0.0431006	0.0970099	0.4443	0.6588	
d_C_1	0.367396	0.680418	0.5400	0.5917	
d_D_1	−0.0386689	0.128585	−0.3007	0.7649	

Determinant of covariance matrix = 5.8974262e-039 AIC = –55.9187; BIC = –52.0453; HQC = –54.4067			Portmanteau test: LB (14) = 1428.88, df = 1300 [0.0069]		
d_E_1	−0.375751	0.349616	−1.075	0.2879	
d_F_1	−0.144349	0.253449	−0.5695	0.5716	
d_G_1	−2.24213	1.15280	−1.945	0.0577	*
d_H_1	−1.04706	0.469839	−2.229	0.0306	**
d_J_1	0.172612	0.114396	1.509	0.1379	
d_L_1	0.0348721	0.170781	0.2042	0.8391	
Mean dependent var	−0.000614		S.D. dependent var	0.032843	
Sum squared resid	0.040678		S.E. of regression	0.029111	
R-squared	0.349794		Adjusted R-squared	0.214334	
F(10, 48)	2.582271		P-value (F)	0.013696	
rho	−0.090755		Durbin-Watson	2.169827	
Equation 5: d_E	Coefficient	Std. Error	t-ratio	p-value	
const	0.000446614	0.00164960	0.2707	0.7878	
d_CPI_1	0.0183294	0.193262	0.09484	0.9248	
d_B_1	−0.0289766	0.0406238	−0.7133	0.4791	
d_C_1	0.291570	0.284931	1.023	0.3113	
d_D_1	0.214818	0.0538461	3.989	0.0002	***
d_E_1	−0.126245	0.146405	−0.8623	0.3928	
d_F_1	−0.0762813	0.106134	−0.7187	0.4758	
d_G_1	−0.763621	0.482747	−1.582	0.1203	
d_H_1	−0.149190	0.196749	−0.7583	0.4520	
d_J_1	0.110058	0.0479042	2.297	0.0260	**
d_L_1	−0.0943534	0.0715161	−1.319	0.1933	
Mean dependent var	−0.000059		S.D. dependent var	0.015172	
Sum squared resid	0.007133		S.E. of regression	0.012190	
R-squared	0.465720		Adjusted R-squared	0.354412	
F(10, 48)	4.184053		P-value (F)	0.000341	
rho	−0.156042		Durbin-Watson	2.287548	
Equation 6: d_F	Coefficient	Std. Error	t-ratio	p-value	
const	0.000264493	0.00258852	0.1022	0.9190	
d_CPI_1	0.108376	0.303262	0.3574	0.7224	
d_B_1	0.00353033	0.0637459	0.05538	0.9561	
d_C_1	−0.389771	0.447108	−0.8718	0.3877	
d_D_1	0.0476294	0.0844940	0.5637	0.5756	
d_E_1	0.665733	0.229736	2.898	0.0056	***
d_F_1	−0.457631	0.166543	−2.748	0.0084	***
d_G_1	−0.516944	0.757516	−0.6824	0.4983	
d_H_1	0.769314	0.308735	2.492	0.0162	**
d_J_1	0.0493302	0.0751702	0.6562	0.5148	
d_L_1	0.0264328	0.112221	0.2355	0.8148	

cont. Table A.1

Determinant of covariance matrix = 5.8974262e-039 AIC = –55.9187; BIC = –52.0453; HQC = –54.4067			Portmanteau test: LB (14) = 1428.88, df = 1300 [0.0069]		
Mean dependent var	0.000173		S.D. dependent var	0.025960	
Sum squared resid	0.017564		S.E. of regression	0.019129	
R-squared	0.550661		Adjusted R-squared	0.457048	
F (10, 48)	5.882346		P-value (F)	9.88e-06	
rho	−0.171792		Durbin-Watson	2.326945	
Equation 7: d_G	Coefficient	Std. Error	t-ratio	p-value	
const	0.000210056	0.000483227	0.4347	0.6657	
d_CPI_1	0.0149065	0.0566131	0.2633	0.7934	
d_B_1	0.00221515	0.0119001	0.1861	0.8531	
d_C_1	0.191403	0.0834664	2.293	0.0263	**
d_D_1	0.0190111	0.0157734	1.205	0.2340	
d_E_1	0.125336	0.0428872	2.922	0.0053	***
d_F_1	0.0323694	0.0310904	1.041	0.3030	
d_G_1	−0.575904	0.141414	−4.072	0.0002	***
d_H_1	0.109523	0.0576348	1.900	0.0634	*
d_J_1	−0.00550608	0.0140328	−0.3924	0.6965	
d_L_1	−0.0184453	0.0209496	−0.8805	0.3830	
Mean dependent var	0.000236		S.D. dependent var	0.005149	
Sum squared resid	0.000612		S.E. of regression	0.003571	
R-squared	0.601966		Adjusted R-squared	0.519042	
F (10, 48)	7.259278		P-value (F)	7.49e-07	
rho	−0.201386		Durbin-Watson	2.401484	
Equation 8: d_H	Coefficient	Std. Error	t-ratio	p-value	
const	0.000426270	0.00157802	0.2701	0.7882	
d_CPI_1	0.00587502	0.184875	0.03178	0.9748	
d_B_1	0.0137127	0.0388609	0.3529	0.7257	
d_C_1	0.269417	0.272567	0.9884	0.3279	
d_D_1	0.139382	0.0515094	2.706	0.0094	***
d_E_1	0.0396014	0.140052	0.2828	0.7786	
d_F_1	0.00649042	0.101528	0.06393	0.9493	
d_G_1	−0.496442	0.461798	−1.075	0.2877	
d_H_1	−0.379797	0.188211	−2.018	0.0492	**
d_J_1	0.0404862	0.0458254	0.8835	0.3814	
d_L_1	−0.0958338	0.0684126	−1.401	0.1677	
Mean dependent var	0.000280		S.D. dependent var	0.012422	
Sum squared resid	0.006528		S.E. of regression	0.011661	
R-squared	0.270660		Adjusted R-squared	0.118714	
F (10, 48)	1.781293		P-value (F)	0.089924	
rho	−0.033092		Durbin-Watson	2.060412	

Determinant of covariance matrix = 5.8974262e-039 AIC = –55.9187; BIC = –52.0453; HQC = –54.4067			Portmanteau test: LB (14) = 1428.88, df = 1300 [0.0069]		
Equation 9: d_J	Coefficient	Std. Error	t-ratio	p-value	
const	0.000586062	0.00584044	0.1003	0.9205	
d_CPI_1	−0.683143	0.684245	−0.9984	0.3231	
d_B_1	−0.0399974	0.143829	−0.2781	0.7821	
d_C_1	0.134193	1.00880	0.1330	0.8947	
d_D_1	0.141608	0.190643	0.7428	0.4612	
d_E_1	−0.311219	0.518349	−0.6004	0.5511	
d_F_1	−0.0984856	0.375770	−0.2621	0.7944	
d_G_1	−0.875090	1.70917	−0.5120	0.6110	
d_H_1	0.501034	0.696593	0.7193	0.4755	
d_J_1	−0.329274	0.169606	−1.941	0.0581	*
d_L_1	0.116073	0.253204	0.4584	0.6487	
Mean dependent var	−0.001403		S.D. dependent var	0.044238	
Sum squared resid	0.089416		S.E. of regression	0.043161	
R-squared	0.212237		Adjusted R-squared	0.048120	
F (10, 48)	1.293205		P-value (F)	0.261202	
rho	−0.047737		Durbin-Watson	2.074682	
Equation 10: d_L	Coefficient	Std. Error	t-ratio	p-value	
const	−0.000722258	0.00378329	−0.1909	0.8494	
d_CPI_1	0.353091	0.443237	0.7966	0.4296	
d_B_1	−0.0342190	0.0931689	−0.3673	0.7150	
d_C_1	0.795954	0.653478	1.218	0.2292	
d_D_1	0.171583	0.123494	1.389	0.1711	
d_E_1	0.102969	0.335774	0.3067	0.7604	
d_F_1	0.0593373	0.243414	0.2438	0.8084	
d_G_1	−1.52345	1.10716	−1.376	0.1752	
d_H_1	−0.254850	0.451236	−0.5648	0.5749	
d_J_1	−0.0375229	0.109866	−0.3415	0.7342	
d_L_1	−0.325124	0.164019	−1.982	0.0532	*
Mean dependent var	0.000067		S.D. dependent var	0.028742	
Sum squared resid	0.037520		S.E. of regression	0.027958	
R-squared	0.216918		Adjusted R-squared	0.053776	
F (10, 48)	1.329628		P-value (F)	0.242344	
rho	−0.092547		Durbin-Watson	2.113393	

Note: Lag order 1, maximum likelihood estimates, observations 2008:3–2023:2; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: own calculations: EViews13.

Table A.2. The variance decomposition

d_CPI										
	d_CPI	*d_B*	*d_C*	*d_D*	*d_E*	*d_F*	*d_G*	*d_H*	*d_J*	*d_L*
1	100.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	73.6929	8.6607	2.1561	0.8245	0.2324	1.8242	0.3438	0.8023	0.0033	11.4598
3	66.6901	11.7845	2.4236	0.7284	0.2881	1.8163	0.5908	1.4724	0.0447	14.1610
4	65.0014	12.6007	2.5030	0.7136	0.3359	1.9053	0.5744	1.6735	0.0468	14.6453
5	64.6828	12.7606	2.4895	0.7138	0.3670	1.9063	0.5824	1.6821	0.0542	14.7613
6	64.6355	12.7771	2.4876	0.7198	0.3728	1.9051	0.5820	1.6980	0.0567	14.7653
7	64.6202	12.7825	2.4880	0.7196	0.3732	1.9055	0.5824	1.7015	0.0567	14.7706
8	64.6153	12.7840	2.4883	0.7206	0.3735	1.9057	0.5824	1.7014	0.0570	14.7718
9	64.6146	12.7842	2.4886	0.7207	0.3738	1.9056	0.5824	1.7014	0.0570	14.7717
10	64.6143	12.7842	2.4886	0.7208	0.3738	1.9057	0.5824	1.7015	0.0571	14.7717
11	64.6142	12.7842	2.4887	0.7208	0.3738	1.9057	0.5824	1.7015	0.0571	14.7717
12	64.6141	12.7842	2.4887	0.7209	0.3738	1.9057	0.5824	1.7015	0.0571	14.7717
13	64.6141	12.7842	2.4887	0.7209	0.3738	1.9057	0.5824	1.7015	0.0571	14.7717
14	64.6141	12.7842	2.4887	0.7209	0.3738	1.9057	0.5824	1.7015	0.0571	14.7717
15	64.6140	12.7842	2.4887	0.7209	0.3738	1.9057	0.5824	1.7015	0.0571	14.7717
15	64.6140	12.7842	2.4887	0.7209	0.3738	1.9057	0.5824	1.7015	0.0571	14.7717
17	64.6140	12.7842	2.4887	0.7209	0.3738	1.9057	0.5824	1.7015	0.0571	14.7717
18	64.6140	12.7842	2.4887	0.7209	0.3738	1.9057	0.5824	1.7015	0.0571	14.7717
19	64.6140	12.7842	2.4887	0.7209	0.3738	1.9057	0.5824	1.7015	0.0571	14.7717
20	64.6140	12.7842	2.4887	0.7209	0.3738	1.9057	0.5824	1.7015	0.0571	14.7717
d_B										
	d_CPI	*d_B*	*d_C*	*d_D*	*d_E*	*d_F*	*d_G*	*d_H*	*d_J*	*d_L*
1	4.2177	95.7823	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	5.3629	75.7895	0.0319	0.0050	3.2561	0.4410	0.0125	3.7778	0.3810	10.9424
3	5.3169	75.3796	0.0309	0.0852	3.4695	0.4895	0.1843	3.7918	0.5278	10.7245
4	5.4090	74.4977	0.1611	0.1921	3.6385	0.4881	0.2177	3.8143	0.5522	11.0295
5	5.3936	74.4108	0.2033	0.1991	3.6378	0.5117	0.2458	3.8031	0.5965	10.9982
6	5.3934	74.3321	0.2091	0.1989	3.6662	0.5242	0.2506	3.8049	0.6230	10.9976
7	5.3902	74.3036	0.2091	0.2014	3.6840	0.5333	0.2543	3.8047	0.6283	10.9912
8	5.3899	74.2835	0.2112	0.2080	3.6905	0.5349	0.2559	3.8039	0.6288	10.9935
9	5.3895	74.2768	0.2132	0.2099	3.6910	0.5362	0.2567	3.8035	0.6296	10.9936
10	5.3893	74.2738	0.2135	0.2100	3.6917	0.5374	0.2569	3.8033	0.6306	10.9935
11	5.3891	74.2721	0.2135	0.2101	3.6925	0.5381	0.2571	3.8033	0.6310	10.9932
12	5.3891	74.2711	0.2135	0.2104	3.6930	0.5382	0.2571	3.8033	0.6311	10.9933
13	5.3890	74.2706	0.2136	0.2105	3.6931	0.5383	0.2572	3.8032	0.6311	10.9933
14	5.3890	74.2704	0.2137	0.2105	3.6931	0.5384	0.2572	3.8032	0.6312	10.9933
15	5.3890	74.2703	0.2137	0.2106	3.6931	0.5384	0.2572	3.8032	0.6312	10.9933
15	5.3890	74.2702	0.2137	0.2106	3.6932	0.5384	0.2572	3.8032	0.6312	10.9933

17	5.3890	74.2702	0.2137	0.2106	3.6932	0.5384	0.2572	3.8032	0.6312	10.9933
18	5.3890	74.2702	0.2137	0.2106	3.6932	0.5384	0.2572	3.8032	0.6312	10.9933
19	5.3890	74.2702	0.2137	0.2106	3.6932	0.5384	0.2572	3.8032	0.6312	10.9933
20	5.3890	74.2702	0.2137	0.2106	3.6932	0.5384	0.2572	3.8032	0.6312	10.9933
d_C										
	d_CPI	*d_B*	*d_C*	*d_D*	*d_E*	*d_F*	*d_G*	*d_H*	*d_J*	*d_L*
1	0.0402	5.1860	94.7737	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.5793	6.0649	86.8366	2.0407	0.1143	1.7808	0.0496	0.4694	1.0112	1.0531
3	0.8992	6.3774	83.9370	1.9625	1.1831	2.4604	0.0871	0.7428	0.9877	1.3630
4	0.9687	6.3560	82.4103	2.5794	1.3966	2.4159	0.1016	0.8778	1.1020	1.7917
5	0.9669	6.3548	82.1842	2.7160	1.4144	2.4208	0.1210	0.8801	1.0972	1.8446
6	0.9675	6.3690	82.0467	2.7252	1.4118	2.4611	0.1222	0.8934	1.1503	1.8528
7	0.9672	6.3930	81.9368	2.7252	1.4466	2.4914	0.1232	0.8956	1.1695	1.8514
8	0.9672	6.3894	81.8841	2.7415	1.4717	2.4925	0.1248	0.9033	1.1688	1.8568
9	0.9679	6.3876	81.8645	2.7547	1.4719	2.4920	0.1261	0.9038	1.1685	1.8631
10	0.9680	6.3885	81.8593	2.7545	1.4717	2.4931	0.1264	0.9042	1.1702	1.8641
11	0.9680	6.3898	81.8538	2.7546	1.4727	2.4946	0.1265	0.9041	1.1719	1.8640
12	0.9679	6.3898	81.8514	2.7548	1.4743	2.4949	0.1266	0.9043	1.1719	1.8640
13	0.9680	6.3897	81.8501	2.7555	1.4745	2.4949	0.1267	0.9044	1.1719	1.8643
14	0.9680	6.3897	81.8498	2.7556	1.4745	2.4949	0.1267	0.9044	1.1720	1.8644
15	0.9680	6.3898	81.8496	2.7556	1.4745	2.4950	0.1267	0.9044	1.1720	1.8644
15	0.9680	6.3898	81.8495	2.7556	1.4746	2.4950	0.1267	0.9044	1.1721	1.8644
17	0.9680	6.3898	81.8494	2.7556	1.4746	2.4950	0.1267	0.9044	1.1721	1.8644
18	0.9680	6.3898	81.8494	2.7556	1.4746	2.4950	0.1267	0.9044	1.1721	1.8644
19	0.9680	6.3898	81.8494	2.7556	1.4746	2.4950	0.1267	0.9044	1.1721	1.8644
20	0.9680	6.3898	81.8494	2.7556	1.4746	2.4950	0.1267	0.9044	1.1721	1.8644
d_D										
	d_CPI	*d_B*	*d_C*	*d_D*	*d_E*	*d_F*	*d_G*	*d_H*	*d_J*	*d_L*
1	3.8771	5.2004	0.0577	90.8648	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	3.6186	4.4034	1.0414	75.7466	3.1547	0.2778	2.2763	6.8312	2.5795	0.0706
3	3.2247	4.8940	5.5546	67.9086	3.2158	0.9901	3.1546	6.1759	3.4755	1.4063
4	3.0829	4.7251	7.5122	64.7804	4.3477	0.9916	3.2349	6.3196	3.6602	1.3454
5	3.0227	4.9815	7.3039	63.8710	4.2530	1.4061	3.1599	6.1843	4.2397	1.5779
6	3.0014	4.9654	7.3675	63.3002	4.6991	1.4686	3.1538	6.2537	4.2105	1.5798
7	2.9936	4.9461	7.3652	63.2191	4.7131	1.4614	3.1599	6.2765	4.2249	1.6402
8	2.9944	4.9374	7.4505	63.1228	4.7203	1.4594	3.1614	6.2683	4.2178	1.6675
9	2.9915	4.9531	7.4451	63.0795	4.7156	1.4769	3.1590	6.2691	4.2440	1.6662
10	2.9902	4.9575	7.4478	63.0480	4.7329	1.4852	3.1577	6.2672	4.2474	1.6660
11	2.9896	4.9563	7.4460	63.0419	4.7395	1.4851	3.1577	6.2693	4.2467	1.6677
12	2.9897	4.9558	7.4486	63.0391	4.7390	1.4849	3.1578	6.2686	4.2463	1.6702
13	2.9897	4.9563	7.4490	63.0369	4.7389	1.4854	3.1577	6.2687	4.2471	1.6703

cont. Table A.2

d_D										
	d_CPI	*d_B*	*d_C*	*d_D*	*d_E*	*d_F*	*d_G*	*d_H*	*d_J*	*d_L*
14	2.9896	4.9567	7.4489	63.0355	4.7393	1.4860	3.1577	6.2685	4.2475	1.6703
15	2.9896	4.9567	7.4489	63.0350	4.7398	1.4860	3.1577	6.2686	4.2475	1.6703
15	2.9896	4.9567	7.4489	63.0349	4.7398	1.4860	3.1577	6.2686	4.2475	1.6704
17	2.9896	4.9567	7.4490	63.0348	4.7398	1.4860	3.1577	6.2686	4.2475	1.6704
18	2.9896	4.9567	7.4489	63.0347	4.7398	1.4861	3.1577	6.2686	4.2475	1.6704
19	2.9896	4.9567	7.4489	63.0347	4.7398	1.4861	3.1577	6.2686	4.2475	1.6704
20	2.9896	4.9567	7.4489	63.0347	4.7398	1.4861	3.1577	6.2686	4.2475	1.6704
d_E										
	d_CPI	*d_B*	*d_C*	*d_D*	*d_E*	*d_F*	*d_G*	*d_H*	*d_J*	*d_L*
1	3.8655	2.2568	8.7462	0.9392	84.1923	0.0000	0.0000	0.0000	0.0000	0.0000
2	2.6559	1.6804	7.9335	20.1105	57.6822	1.6197	0.5239	0.8682	4.5825	2.3431
3	3.0402	1.6400	12.4472	18.1678	52.1037	1.6494	0.4828	2.2998	4.0122	4.1569
4	2.9248	2.5974	11.7366	19.0678	49.2088	2.0535	0.4579	2.7104	4.9570	4.2858
5	2.8850	2.6240	12.0959	18.8771	48.9904	2.1539	0.4503	2.6902	4.9516	4.2815
6	2.8608	2.6175	11.9893	19.0978	48.7087	2.1443	0.4558	2.8294	5.0135	4.2828
7	2.8644	2.6201	12.0812	19.1430	48.5140	2.1483	0.4588	2.8170	5.0074	4.3458
8	2.8604	2.6311	12.0803	19.1427	48.4679	2.1531	0.4582	2.8384	5.0281	4.3398
9	2.8589	2.6394	12.0839	19.1490	48.4324	2.1625	0.4578	2.8358	5.0376	4.3426
10	2.8581	2.6386	12.0844	19.1479	48.4318	2.1620	0.4579	2.8411	5.0370	4.3414
11	2.8580	2.6389	12.0848	19.1537	48.4218	2.1622	0.4581	2.8410	5.0377	4.3439
12	2.8580	2.6389	12.0863	19.1528	48.4207	2.1621	0.4581	2.8416	5.0377	4.3439
13	2.8579	2.6393	12.0859	19.1533	48.4189	2.1625	0.4581	2.8416	5.0384	4.3440
14	2.8579	2.6393	12.0861	19.1531	48.4189	2.1626	0.4581	2.8417	5.0384	4.3439
15	2.8579	2.6393	12.0860	19.1533	48.4186	2.1626	0.4581	2.8418	5.0384	4.3440
15	2.8579	2.6393	12.0861	19.1533	48.4185	2.1626	0.4581	2.8418	5.0384	4.3440
17	2.8579	2.6394	12.0861	19.1533	48.4185	2.1626	0.4581	2.8418	5.0384	4.3440
18	2.8579	2.6394	12.0861	19.1533	48.4185	2.1626	0.4581	2.8418	5.0384	4.3440
19	2.8579	2.6394	12.0861	19.1533	48.4185	2.1626	0.4581	2.8418	5.0384	4.3440
20	2.8579	2.6394	12.0861	19.1533	48.4185	2.1626	0.4581	2.8418	5.0384	4.3440
d_F										
	d_CPI	*d_B*	*d_C*	*d_D*	*d_E*	*d_F*	*d_G*	*d_H*	*d_J*	*d_L*
1	4.8665	5.0581	2.2530	6.2439	13.5827	67.9958	0.0000	0.0000	0.0000	0,0000
2	3.7838	6.7999	4.7300	5.3095	11.4130	60.7692	0.0540	6.6992	0.3709	0.0000
3	3.0615	5.7416	4.3867	8.8181	12.4438	51.4169	0.2064	11.4662	0.7369	0.0706
4	2.9839	5.2682	4.9121	11.7570	11.4348	47.3544	0.3906	11.1892	0.7716	1.7219
5	2.9580	5.5229	5.2393	11.5690	11.1955	46.7844	0.4451	10.9509	1.0963	3.9384
6	2.9121	5.8298	5.1718	11.4296	11.2472	46.5181	0.4562	10.7815	1.4721	4.2385
7	2.8902	5.8614	5.1535	11.4051	11.5191	46.2621	0.4720	10.7654	1.4932	4.1817
8	2.8889	5.8434	5.1556	11.5341	11.5369	46.0792	0.4880	10.7446	1.4868	4.1782

d_F										
	d_CPI	*d_B*	*d_C*	*d_D*	*d_E*	*d_F*	*d_G*	*d_H*	*d_J*	*d_L*
9	2.8901	5.8480	5.1862	11.5431	11.5220	46.0243	0.4946	10.7292	1.4948	4.2425
10	2.8884	5.8635	5.1842	11.5349	11.5204	46.0091	0.4962	10.7220	1.5145	4.2678
11	2.8872	5.8684	5.1826	11.5306	11.5325	45.9983	0.4971	10.7185	1.5191	4.2668
12	2.8869	5.8681	5.1817	11.5345	11.5367	45.9898	0.4979	10.7176	1.5189	4.2658
13	2.8870	5.8681	5.1830	11.5361	11.5363	45.9860	0.4984	10.7167	1.5190	4.2677
14	2.8870	5.8687	5.1832	11.5358	11.5361	45.9851	0.4985	10.7163	1.5198	4.2694
15	2.8869	5.8691	5.1831	11.5355	11.5364	45.9846	0.4986	10.7160	1.5202	4.2696
15	2.8869	5.8692	5.1830	11.5356	11.5368	45.9842	0.4986	10.7160	1.5202	4.2695
17	2.8869	5.8692	5.1830	11.5357	11.5368	45.9840	0.4987	10.7159	1.5202	4.2696
18	2.8869	5.8692	5.1831	11.5357	11.5368	45.9839	0.4987	10.7159	1.5202	4.2696
19	2.8869	5.8692	5.1831	11.5357	11.5368	45.9839	0.4987	10.7159	1.5203	4.2697
20	2.8869	5.8692	5.1831	11.5357	11.5368	45.9839	0.4987	10.7159	1.5203	4.2697
d_G										
	d_CPI	*d_B*	*d_C*	*d_D*	*d_E*	*d_F*	*d_G*	*d_H*	*d_J*	*d_L*
1	1.4090	1.9584	2.1707	4.4993	16.1085	30.1661	43.6880	0.0000	0.0000	0.0000
2	0.9856	2.1177	26.6384	4.0880	10.0738	21.5162	30.6343	2.9755	0.1247	0.8457
3	0.8957	2.2323	26.2493	7.6829	8.8682	17.4236	25.7372	6.0345	3.6643	1.2120
4	0.9650	2.9541	24.3326	9.2719	9.0289	16.6428	23.9373	5.6418	4.7023	2.5234
5	0.9515	2.9122	23.9868	9.2793	9.8753	16.4056	23.6988	5.7609	4.6429	2.4868
6	0.9654	2.8954	24.0354	9.6446	9.7687	16.2342	23.5080	5.7257	4.6481	2.5746
7	0.9690	2.8976	24.1295	9.6119	9.7746	16.1899	23.4417	5.7416	4.6601	2.5842
8	0.9678	2.9386	24.0731	9.6454	9.7595	16.1985	23.3876	5.7334	4.7102	2.5860
9	0.9671	2.9418	24.0622	9.6373	9.7993	16.1948	23.3685	5.7369	4.7085	2.5837
10	0.9676	2.9403	24.0517	9.6583	9.8009	16.1862	23.3581	5.7393	4.7078	2.5898
11	0.9681	2.9400	24.0552	9.6603	9.7995	16.1835	23.3546	5.7384	4.7071	2.5932
12	0.9680	2.9418	24.0535	9.6603	9.7987	16.1840	23.3527	5.7384	4.7094	2.5930
13	0.9680	2.9425	24.0527	9.6599	9.8001	16.1842	23.3516	5.7382	4.7099	2.5929
14	0.9680	2.9424	24.0522	9.6605	9.8007	16.1839	23.3512	5.7384	4.7098	2.5931
15	0.9680	2.9424	24.0522	9.6608	9.8006	16.1837	23.3510	5.7383	4.7097	2.5933
15	0.9680	2.9425	24.0522	9.6608	9.8006	16.1837	23.3509	5.7383	4.7098	2.5933
17	0.9680	2.9425	24.0521	9.6608	9.8006	16.1837	23.3508	5.7383	4.7098	2.5933
18	0.9680	2.9425	24.0521	9.6608	9.8006	16.1837	23.3508	5.7383	4.7098	2.5933
19	0.9680	2.9425	24.0521	9.6608	9.8006	16.1837	23.3508	5.7383	4.7098	2.5933
20	0.9680	2.9425	24.0521	9.6608	9.8006	16.1837	23.3508	5.7383	4.7098	2.5933
d_H										
	d_CPI	*d_B*	*d_C*	*d_D*	*d_E*	*d_F*	*d_G*	*d_H*	*d_J*	*d_L*
1	1.0258	2.7044	39.7504	0.0221	0.0357	8.4972	0.1901	47.7744	0.0000	0.0000
2	0.8130	2.8273	31.5729	9.2358	0.0564	6.7552	0.7267	44.0738	0.7707	3.1681
3	1.0198	2.6822	31.7149	9.5818	0.8123	6.4436	0.8618	41.8110	0.8398	4.2329

cont. Table A.2

d_H										
	d_CPI	*d_B*	*d_C*	*d_D*	*d_E*	*d_F*	*d_G*	*d_H*	*d_J*	*d_L*
4	0.9949	3.2399	30.8527	9.7623	0.7927	6.8009	0.8616	40.7654	1.7909	4.1388
5	0.9840	3.3495	30.6278	9.6645	1.3130	6.9256	0.8584	40.2409	1.9437	4.0926
6	0.9828	3.3297	30.4364	9.8487	1.5077	6.8879	0.8720	40.0815	1.9392	4.1142
7	0.9929	3.3200	30.4320	9.9346	1.5032	6.8677	0.8799	39.9646	1.9342	4.1708
8	0.9929	3.3344	30.4225	9.9275	1.5030	6.8747	0.8808	39.9380	1.9559	4.1703
9	0.9924	3.3456	30.4060	9.9266	1.5150	6.8841	0.8806	39.9127	1.9689	4.1681
10	0.9922	3.3457	30.3989	9.9280	1.5285	6.8841	0.8810	39.9054	1.9685	4.1678
11	0.9925	3.3452	30.3962	9.9338	1.5292	6.8831	0.8815	39.9000	1.9684	4.1703
12	0.9926	3.3455	30.3965	9.9336	1.5291	6.8831	0.8816	39.8984	1.9687	4.1708
13	0.9926	3.3461	30.3957	9.9335	1.5293	6.8836	0.8816	39.8974	1.9695	4.1707
14	0.9926	3.3462	30.3954	9.9334	1.5299	6.8837	0.8816	39.8969	1.9695	4.1707
15	0.9926	3.3462	30.3952	9.9337	1.5301	6.8837	0.8817	39.8967	1.9695	4.1707
15	0.9926	3.3462	30.3952	9.9337	1.5301	6.8837	0.8817	39.8966	1.9695	4.1708
17	0.9926	3.3462	30.3951	9.9337	1.5301	6.8837	0.8817	39.8966	1.9696	4.1708
18	0.9926	3.3463	30.3951	9.9337	1.5301	6.8837	0.8817	39.8965	1.9696	4.1708
19	0.9926	3.3463	30.3951	9.9337	1.5301	6.8837	0.8817	39.8965	1.9696	4.1708
20	0.9926	3.3463	30.3951	9.9337	1.5301	6.8837	0.8817	39.8965	1.9696	4.1708

d_J										
	d_CPI	*d_B*	*d_C*	*d_D*	*d_E*	*d_F*	*d_G*	*d_H*	*d_J*	*d_L*
1	6.4901	3.9348	27.6838	0.4691	9.5828	2.7903	1.9947	0.0006	47.0537	0.0000
2	5.5741	3.6375	24.0662	2.3182	12.0129	4.4393	2.4172	0.8289	44.3412	0.3645
3	5.9031	3.6034	23.3856	2.2755	11.5793	5.3755	2.3172	2.6580	42.5065	0.3959
4	5.8060	3.6545	23.0158	2.4785	11.3903	5.3686	2.2792	3.1945	42.0747	0.7379
5	5.7811	3.6432	22.9461	2.5798	11.3979	5.3808	2.2756	3.2856	41.9084	0.8014
6	5.7764	3.6490	22.9298	2.5780	11.3921	5.4118	2.2744	3.2826	41.8869	0.8192
7	5.7720	3.6663	22.9157	2.5774	11.3941	5.4340	2.2732	3.2839	41.8649	0.8185
8	5.7699	3.6660	22.9072	2.5842	11.4051	5.4357	2.2733	3.2884	41.8483	0.8218
9	5.7693	3.6656	22.9048	2.5928	11.4041	5.4351	2.2738	3.2888	41.8398	0.8260
10	5.7691	3.6662	22.9049	2.5931	11.4034	5.4357	2.2739	3.2886	41.8380	0.8271
11	5.7689	3.6671	22.9040	2.5931	11.4035	5.4365	2.2739	3.2885	41.8374	0.8271
12	5.7688	3.6673	22.9036	2.5931	11.4043	5.4367	2.2739	3.2886	41.8367	0.8272
13	5.7687	3.6673	22.9033	2.5935	11.4044	5.4367	2.2739	3.2886	41.8362	0.8273
14	5.7687	3.6673	22.9034	2.5936	11.4043	5.4367	2.2739	3.2886	41.8360	0.8274
15	5.7687	3.6674	22.9033	2.5936	11.4043	5.4368	2.2739	3.2886	41.8360	0.8274
15	5.7687	3.6674	22.9033	2.5936	11.4044	5.4368	2.2739	3.2886	41.8360	0.8274
17	5.7687	3.6674	22.9033	2.5936	11.4044	5.4368	2.2739	3.2886	41.8360	0.8274
18	5.7687	3.6674	22.9033	2.5936	11.4044	5.4368	2.2739	3.2886	41.8359	0.8274
19	5.7687	3.6674	22.9033	2.5936	11.4044	5.4368	2.2739	3.2886	41.8359	0.8274
20	5.7687	3.6674	22.9033	2.5936	11.4044	5.4368	2.2739	3.2886	41.8359	0.8274

d_L										
	d_CPI	*d_B*	*d_C*	*d_D*	*d_E*	*d_F*	*d_G*	*d_H*	*d_J*	*d_L*
1	0.8045	2.6744	10.5762	0.2524	5.3801	3.7151	0.2132	0.6129	0.0328	75.7384
2	1.6880	2.6385	9.0718	3.1360	5.6128	4.2387	1.5258	1.3430	0.2030	70.5425
3	1.7141	2.8865	10.1853	3.4057	5.3320	4.0507	2.3356	1.4931	1.0527	67.5442
4	1.7005	3.1848	10.1625	3.5595	5.2812	4.0869	2.4501	1.8114	2.1806	65.5824
5	1.6781	3.3967	10.0379	3.5469	5.7122	4.1897	2.4857	1.7869	2.4378	64.7281
6	1.6784	3.3875	9.9957	3.6533	5.9239	4.1810	2.5126	1.8039	2.4280	64.4356
7	1.6832	3.3835	10.0464	3.7270	5.9185	4.1738	2.5258	1.8001	2.4229	64.3188
8	1.6835	3.3958	10.0598	3.7238	5.9140	4.1836	2.5282	1.8031	2.4400	64.2681
9	1.6826	3.4078	10.0542	3.7231	5.9230	4.1954	2.5282	1.8021	2.4520	64.2317
10	1.6822	3.4091	10.0517	3.7251	5.9343	4.1975	2.5286	1.8036	2.4521	64.2157
11	1.6824	3.4089	10.0517	3.7303	5.9354	4.1974	2.5290	1.8039	2.4518	64.2092
12	1.6825	3.4093	10.0525	3.7307	5.9352	4.1978	2.5292	1.8038	2.4522	64.2069
13	1.6824	3.4099	10.0523	3.7306	5.9354	4.1984	2.5292	1.8038	2.4528	64.2052
14	1.6824	3.4101	10.0521	3.7306	5.9359	4.1986	2.5292	1.8038	2.4529	64.2042
15	1.6824	3.4101	10.0521	3.7308	5.9361	4.1986	2.5292	1.8039	2.4529	64.2038
15	1.6824	3.4101	10.0521	3.7309	5.9361	4.1986	2.5292	1.8039	2.4529	64.2037
17	1.6824	3.4102	10.0521	3.7309	5.9361	4.1987	2.5292	1.8039	2.4530	64.2036
18	1.6824	3.4102	10.0521	3.7309	5.9361	4.1987	2.5292	1.8039	2.4530	64.2035
19	1.6824	3.4102	10.0521	3.7309	5.9361	4.1987	2.5292	1.8039	2.4530	64.2035
20	1.6824	3.4102	10.0521	3.7309	5.9361	4.1987	2.5292	1.8039	2.4530	64.2035

Source: own calculations: EViews13.