

IMPACT OF INFLATION, MARKUPS AND WAGES ON CHANGES IN THE PROFITABILITY OF ENTERPRISES IN POLAND

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IMPACT OF INFLATION, MARKUPS AND WAGES ON CHANGES IN THE PROFITABILITY OF ENTERPRISES IN POLAND

Abstract

The purpose of the study is to determine the impact of inflation, markups and wages on changes in the profitability of enterprises in Poland from 2008 to 2023, considering the effects in the short, medium and long term.

Methodology refers to the impact of CPI, markups and wages on changes in gross turnover profitability rates (GTPR) that were assessed using the VECM model, the impulse response function, and the variance decomposition.

Results of the research study show that the pillar of changes in the profitability of enterprises in Poland is its earlier changes with the increasing importance in the short term of markups, wages, and inflation (up to 10%) and gradually decreasing in the medium (up to 9%) and long term (7%). The importance of markups in the degree of explanation of changes in profitability is about 3–4 times stronger than that of wages. An increase in markups is an effective tool for stabilizing corporate profitability under inflation already in the short term, and can also be a tool to support an increase in such profitability in the medium and long term, if market conditions, including consumer demand, allow for it. The study fills a gap in the literature on the importance of markups and wages in shaping enterprises profitability in an inflationary condition, especially the use of markups as a tool that already produces expected effects in the short term.

Keywords: profitability, markups, wages, inflation, Poland, VECM.

JEL Class: M21, E52, E58, E63, E66, J31.

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INTRODUCTION

Exogenous crisis phenomena occurring in recent years, such as the COVID-19 pandemic, the war in Ukraine and the energy crisis have destabilized not only the economic sphere, but also the monetary sphere of many economies. As a result, price dynamics are on the rise in the European Union countries, as well as in the United States and other regions of the world (Goodhart et al., 2023; Drechsler et al., 2022). Inflation has many sources, and the consolidation of inflationary expectations makes it more difficult to fight (Reis, 2022; Piazzesi and Schneider, 2018).

Contributing to the current level of inflation and the consolidation of inflation expectations are, also, rising corporate markups starting in 2021 (Glover et al., 2023). Among the main reasons for the increase in markups, enterprises' prudential motives, i.e., the desire to hedge against expected increases in production costs, are pointed out. Additionally, there are motives to maintain corporate profitability at current levels, and in many industries to increase it. Moreover, the differential increases in the prices of energy commodities such as coal, natural gas, oil, as well as the increase in the price of CO₂ emission rights also determined the diverse and multifaceted impact on enterprises. As a result of these multiple turbulences, there are varying dynamics of markups and wages in different sectors of the economy.

The motive for undertaking the study of the impact of inflation, markups, and wages on changes in the profitability of enterprises is to focus on the side of enterprises and their decision-making process. It is important to verify the differences in the strength and timing of the effect of the studied variables on profitability. What should be evaluated is the importance of markup policies as a tool to hedge against inflation as well as guaranteed profitability. Can changes in markups be seen as a tool, giving quick effects in the short term, or a long-term tool with a permanent impact? The results of this research would have important practical significance in making current decisions as well as planning the financial result in the long term.

Therefore, the purpose of the study is to determine the impact of inflation, markups and wages on changes in the profitability of enterprises in Poland in 2008.Q1–2023.Q1, considering the effects in the short (< 1 year), medium (2–3 years) and long term (> 3 years).

The following two research hypotheses were proposed:

H1: Under conditions of high inflation, frequent changes in markups effectively neutralize its negative impact by sustaining the profitability of enterprises, due to the quickly revealed and maximized effects in the short term, while in the medium and long term, markups support the growth of profitability.

H2: Changes in markups more strongly influenced changes in profitability than changes in wages and inflation in Poland in 2008–2023.

Among the research methods used were an analysis of the business literature, monetary policy, and statistical analysis methods based on data published by the National Bank of Poland (NBP) and the Central Statistical Office (CSO). The effects of CPI, markups, and wages on changes in gross turnover profitability ratios (GTPR) were evaluated using the VECM model, impulse response function and variance decomposition.

1. LITERATURE REVIEW

In the fight against inflation, a particularly difficult problem is the impact of price increases 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 (Logue and Willett, 1976; Clements and Galvão, 2012). Counteracting the effect of inflation, while consolidating inflation expectations, was particularly difficult, e.g., in the 1970s and 1980s. In the 1970s., because of the first and later the second energy crisis (1974–1975, 1979–1980), the rate of economic growth slowed down and unemployment increased (Kosztowniak, 2022). At that time, it was difficult to overcome inflation by traditional methods of economic policy (Knight, 1921; Keynes, 1947) and to analyze it scientifically (Friedman, 1959; 1970; 1984; Modigliani, 1977).

The theoretical and empirical literature indicates that companies can undertake a variety of economic activities in an inflationary environment. According to Keynes' liquidity theory, the demand for money is determined by three motives: transactional, prudential, and speculative. An increase in markups on the part of businesses under conditions of uncertainty (price increases) can result, therefore, from the following motives:

- transactional, to maintain money resources and the current scale of operations, including the purchase of inventory;
- precautionary, to hedge against an unforeseen drop in income or an unforeseen increase in expenses;
- speculative, i.e., the tendency to accumulate capital with a view to future investment (Keynes, 1947).

As Koenigsberg (2022) notes, in the short term, companies tend to cope with inflation by raising prices, accepting higher markups, or reducing spending on

products (and often their quality). In the longer term, companies may consider more complex strategic responses to inflation, e.g., making changes to the product portfolio, repositioning the brand, or revamping the pricing model.

According to Friedman (1977) and Holland (1984), emerging uncertainty has a negative impact on the conduct of business, for example, in the phenomenon of inflationary uncertainty, referring to the consequences of the impact of future inflation on economic activity. An example of this is the phenomenon of entrepreneurs withdrawing from tenders for a new project, which is caused by difficulties in assessing the future cost of implementing investments. In periods of higher inflation and greater inflationary uncertainty, it is also possible to shorten the length of contracting, as greater inflationary uncertainty shortens the average duration of contracts (Ball and Cecchetti, 1990; Ball, 1992).

It is worth noting that the analysis of the impact of inflation on economic and financial decisions of enterprises may be difficult (Goodhart et al., 2021). This is the case because the most common measure of inflation related to a basket of goods and services (CPI) calculated by the Central Statistical Office (CSO) does not consider all, but a specific basket of goods and services. As noted by Dudek (2008), the CPI does not include changes in all final goods. In particular, the CPI does not include variable prices of capital goods. For example, the increase in (new) house prices in recent years is not included in the CPI. Therefore, economic decisions made by enterprises are based not only on changes in the CPI, but also on changes in the prices of other production factors.

Under inflationary conditions, there is also a change in consumer behaviour. Consumers often prefer cheaper substitute products and want to reduce spending on purchases due to a decrease in their purchasing power of disposable income. The drop in demand often concerns services such as catering and tourism.

Inflation (especially at a higher level, e.g., above 10%) also means a change in the value of the enterprise, through a change in the valuation of its assets and the possibility of generating added value. This happens because the impact of inflation on company valuation boils down to the analysis of how inflation affects expected operating profits and their growth, and the accompanying risks (Hafer and Heyne-Hafer, 1981). High and volatile inflation has a negative impact on all financial assets, such as stocks, corporate bonds, and treasury bonds, and a neutral or positive impact on gold, collectibles and real estate. This means that the impact of inflation on the valuation of individual companies can be very different. When the inflation rate is higher than expected, the value of some companies increases, some lose little, and others feel it more strongly. In an environment where finding a hedge against inflation becomes a priority for most investors, companies with less exposure to high and rising inflation are sought. The experience of investors from the 1970s shows that raw materials companies and companies with high

price power (having the ability to regulate the demand for their products with a price policy) cope well in the conditions of inflation.

Moreover, inflation expectations formulated by representatives of enterprises, consumers or people professionally involved in forecasting economic processes (in the case of mainly confirmation of the credibility of monetary policy) have a difficult meaning (Holland, 1984; Joyce, 1997). An important role in this regard is played primarily by the information policy of the central bank regarding inflation projection and the tools of restrictive monetary policy used (Shannon, 1948; Theil, 1967).

2. HYPOTHESIS FORMULATION

In the context of market disturbances caused by the COVID-19 pandemic and the period of war in Ukraine, it is important to decrease high inflation expectations and diagnose the causes of changes in other price indices that determine the inflation felt by consumers. Since the beginning of 2021, the core inflation and CPI indices in Poland (as well as in the world) have shown a clear upward trend. Finally, in Q1 of 2023, these indicators reached the following levels: CPI and core inflation excluding administrative prices reaching 17%, core inflation 15%, mean trimmed 16%, respectively, excluding most volatile prices 15% and food and energy prices 12%. The main components determining the level of CPI were core inflation, prices of food and non-alcoholic beverages and energy prices (CSO, 2023; NBP, 2023).

A strong inflation impulse caused by the increase in the cost of energy raw materials affects the increase in the prices of many goods and services, determining the increase in production expenditures, and in subsequent stages may cause a markup-wage spiral as well as a price-wage spiral (especially from 2021.Q2). The problem of sharp increases in commodity prices particularly covered the period from 2020.Q3 to 2022.Q3, at which time the price increases were significant, i.e., coal (about 400%), natural gas (900%) and oil (about 300%). In the following years, after the outbreak of war in Ukraine, prices for other energy commodities rose, as did the price of CO₂ emission rights, stimulating the rise in global inflation in subsequent years.

Important conclusions in the context of the sources of inflation in 2021 and subsequent years, as well as the consequences for enterprises, are provided by numerous studies of economists and international financial institutions. These studies include, among others:

- market structure and legal organizational forms in the context of markup policy (Glover et al., 2023); under monopoly or oligopoly conditions, it is easier for enterprises to raise markups, due to the existing producer

surplus, with high consumer demand; in view of the limited possibilities of raising markups in more competitive markets, where their increase by individual companies can mean their bankruptcy and push them out of the market;

- the relationship between wage growth and inflation growth, the wage-price spiral mechanism (Boissay et al., 2022);
- the relationship between inflation, unemployment, changes in wages and expenditures incurred by enterprises as well as inflation expectations and the situation on the labour market (IMF, 2022).

The interesting studies explaining the increase in markups by enterprises at the turn of 2021–2022 in the American economy is the study 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 enterprises raise prices (markups) because:

- expect higher expenditures to replace current inventory as it is sold;
- or in anticipation of higher marginal costs expenditures in the future, wanting to smooth out price increases over time, rather than raising them sharply and abruptly.

In general, a profit-maximizing monopolist chooses a price that equates marginal revenue with marginal cost, and any change in price leads to a loss of profits. Changes in firms' current marginal costs or demand for their products can contribute to inflation as firms adjust their prices to maximize profits. Total price change can always be understood as the combined effects of changes in a firm's marginal cost of production and changes in its margins. Markups may or may not contribute to inflation:

- when the monopolist's marginal cost increases – markups decrease;
- but when demand for the monopolist's products increases – markups also increase.

More important conclusions include the finding that firms increase their markups in the present to mitigate the price increases they expect in the future. This means that future spending can increase inflation in the present, through markups.

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

The risk of the expected wage-price spiral may vary in intensity in individual EU countries. According to Boissay et al. (2022), the correlation between wage growth and inflation has decreased in recent decades, and those other institutional factors, such as a high degree of firm pricing power, declining bargaining power,

and declining trade union membership, seem to limit the risk of a wage-price spiral developing.

As regards the growing wage pressure, important conclusions were also presented by the International Monetary Fund (IMF) in the World Economic Outlook report from 2022. It indicated that rising inflation, growth in nominal wages, falling real wages and falling unemployment characterized the macroeconomic situation in 2021 in many economies around the world. Although unusual, such conditions are not "unprecedented" because there have been 22 similar episodes in the group of developed economies analyzed over the past 40 years (and in several over the past 60 years). According to the IMF, many economies have seen price inflation skyrocket since 2021 as adverse "supply shocks" hit the global economy and labor markets were tense in the wake of the severe COVID-19 shock. Determining the optimal response of monetary policy depends on the situation whether the central bank minimizes the welfare function that balances output and inflation deviations, or knows the process of shaping expectations and has full information on future cost shocks (IMF, 2022).

The analysis of statistical data for Poland for the period 2005.Q1–2023.Q1 shows that the revenues and expenditures of non-financial corporations (NFC) showed a constant increase, which was related to the development of the enterprise sector, regardless of the level of inflation. However, with the dynamic growth of CPI since 2019.Q1, revenues and expenditures have been growing rapidly. At the same time, this resulted from the more difficult conditions for doing business caused by the COVID-19 pandemic and the war in Ukraine. When comparing profitability, it should be noted that after a period of decline in gross profitability to 4% and net profitability to 3% in 2020.Q1, they increased, also as a reaction to the increase in CPI to 4%. However, the upward trend in profitability, faster than inflation, continued until 2021.Q1, which was a consequence of the increase in markups. However, it is worth noting that almost throughout the period of 2021.Q2–2022.Q2, the net profitability of enterprises was around 6%, i.e., it was on average 1–2 p.p. higher than e.g., in 2013–2020. This means that enterprises hedged themselves against further price increases. However, since the second half of 2022, a decrease in profitability has been noticeable, despite the dynamically growing inflation. Nevertheless, the 1% difference between gross and net profitability for the enterprise sector was maintained throughout the analysed period (Chart 1).

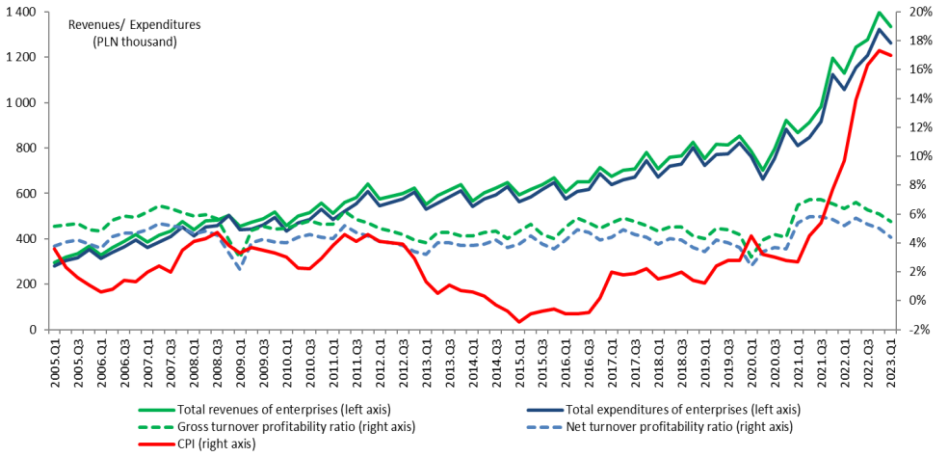


Chart 1. Total revenues and expenditures as well as gross and net turnover profitability in Poland in 2005.Q1–2023.Q1 (q/q, y/y, %)

Source: The author's own calculations based on CSO (2023).

It is also worth noting that interest in researching the phenomenon of markup growth among enterprises has been noticeable for several years. It started in the US economy with the works of Barkai (2020) and De Loecker et al. (2020), both indicating a significant rise of markups of price over marginal costs (Caballero et al., 2017; Hall, 2018). Simultaneously, there is evidence that in the U.S. the rise of markups is accompanied by rising concentration (Gutiérrez and Phillippon, 2017; Bajgar et al., 2019). In the European countries the evidence on markups is scarcer – Calligaris et al. (2018) or De Loecker and Eeckhout (2018) find rather heterogeneous but generally upward trends. Bajgar et al. (2019) show that in many European countries concentration also rises, although to a lesser extent than in the US. As discussed by Syverson (2019), concentration is sometimes used as a proxy measure for markups, as a standard Cournot oligopoly model implies a positive relationship between the market concentration and the average market power.

Research results conducted by Gradzewicz and Mućk (2020) for Poland in the period 2004–2016 (i.e., before the COVID-19 pandemic and the war in Ukraine) showed that measures of industry structure affect both the demand elasticity and markups, but in an inverse way. Moreover, their analysis suggests that most relations are non-linear. Moreover, their econometric results indicate that the share of intermediates in gross output exhibits a U-shaped relationship with demand elasticity (and is predominantly negative).

The policy of setting markups by enterprises is determined mainly by the situation of concentration on the market, price flexibility and customer calculations.

Nevertheless, in the years 2021–2023 in Poland and in the world, due to numerous disturbances in supply chains, changes in raw material prices, fluctuations in the dynamics of markups were significant. In addition, the dynamics of markups was strongly diversified between sectors of the economy and types of economic activity. According to data from the CSO, the following industries recorded the highest markup dynamics: mining and quarrying (B), production and supply of energy, gas, steam, and hot water (D) or water supply, sewage and waste management, reclamation (E) – Chart 2.

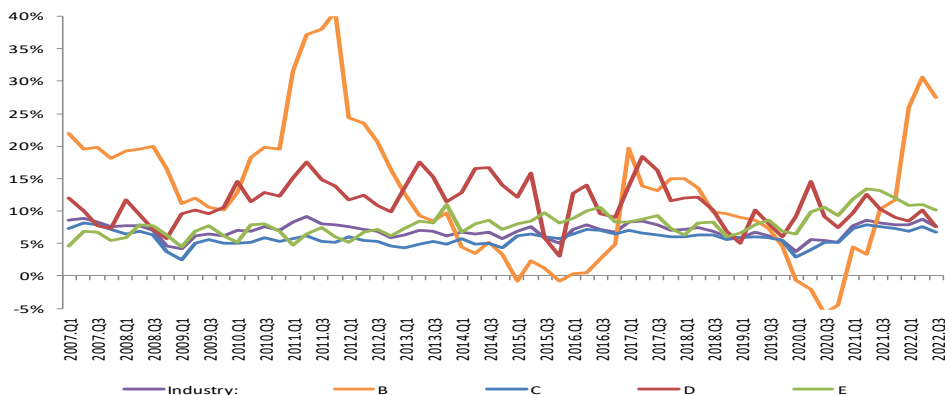


Chart 2. Gross markups in the industry and other sectors of NFC in Poland in 2007–2022 (%)

Notice: Industry: B mining and quarrying, C industrial processing, D generation and supply of electricity, gas, steam and hot water, E water supply; sewage and waste management.

Source: The author's own calculations based on CSO (2023).

This high markup dynamics was primarily due to the increase in global energy commodity prices following the outbreak of the COVID-19 pandemic, then the outbreak of war in Ukraine and the aftermath of the energy crisis, or the increase in the price of CO₂ emission rights. But also, it may have been related to the structure of monopolistic or oligopolistic type industries, providing opportunities for freer markup policies. In the indicated industries, there was also a high dynamics of wages, because of high dynamics of markups as well as an increase in production and the demand for employees (Chart 3).

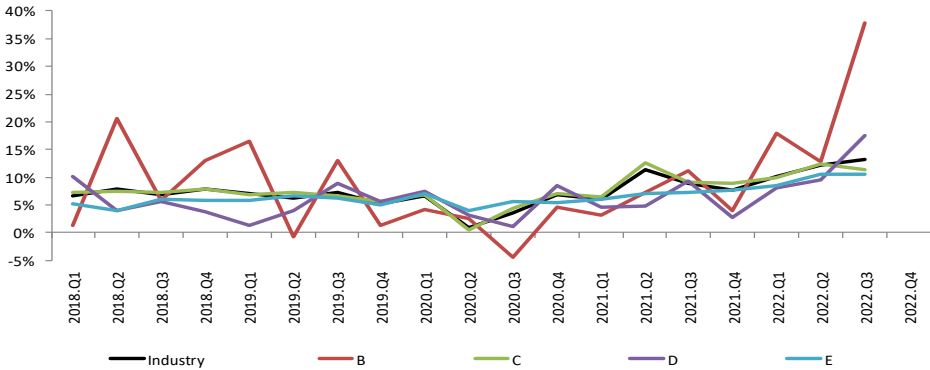


Chart 3. The average monthly gross nominal wages in the industry and other sectors of NFC in Poland in 2008–2022 (q/q, y/y, %)

Notice: Explanation as shown in Chart 2.

Source: The author's own calculations based on CSO (2023).

In the context of the presented review of literature and research results (Glover et al., 2023; Boissay et al., 2022; IMF, 2022; Gradzewicz and Mućk, 2020), it is important to assess the situation in Poland at the beginning of 2023.

The following two research hypothesis were proposed:

H1: In a high inflation environment, frequent changes in markups effectively neutralize its negative impact by sustaining the profitability of enterprises, due to the quickly revealed and maximized effects in the short term, while in the medium - and long term, markups support profitability growth.

H2: Changes in markups more strongly influenced changes in profitability than changes in wages and inflation in Poland in 2008-2023.

3. DATA AND RESEARCH METHODOLOGY

To identify the impact of changes in CPI, markups, and wages on changes in the profitability of non-financial enterprises in Poland in the years 2008.Q1–2023.Q1 (61 quarters), we used quarterly statistical data from the website of the Central Statistical Office (CSO). A short description of the variables is presented in Table 1.

Table 1. Variables description

Variables	Variables	Source
GTPR	Gross turnover profitability ratio (GTPR) of NFC	CSO (2023)
CPI	Consumer Prices Indicators (CPI)	
Markups	Gross markups in the sector of NFC	
Wages	Gross wages in the sector of NFC	

Source: own research.

To analyse the relationship between changes in GTPR and CPI, markups, and wages in the 2008.Q1–2023.Q1 (61 quarters), a final formula for the GTPR function was developed:

$$d_GTPR_t = \alpha_0 + \alpha_1 d_CPI_t + \alpha_2 d_Markups_t + \alpha_3 d_Wages_t + \xi_i \quad (1)$$

where:

d_GTPR_t – Gross Turnover Profitability Ratio (y/y, q/q, %),

d_CPI_t – Consumption Price Index (%),

$d_Markups_t$ – Gross markups in the economy (y/y, q/q, %),

d_Wages_t – Gross wages in the economy (y/y, q/q, %)

ξ_i – random component,

t – period.

Dates came from the CSO database sources. All variables expressed in terms of percent points are included in the form of the first differences variables. Empirical analysis was performed using the Eviews13. The impact of markups, wages, and CPI on changes in gross turnover profitability (GTPR) were assessed using the Vector Error Correction Model (VECM), the impulse responses and the variance decomposition.

The descriptive statistics of the analyzed variables shows that in terms of explained variables, GTRP and markups showed greater variability than wages and CPI (Table 2).

Table 2. Summary Statistics (2008.Q1–2023.Q1)

Variable	Mean	Median	Minimum	Maximum
d_GTPR	-0,0059955	-0,19562	-1,6000	2,2000
d_CPI	0,0021500	-0,00042000	-0,016000	0,042000
d_Markups	-7,2795e-005	0,00097298	-0,052631	0,041484
d_Wages	0,00070000	0,00000	-0,039000	0,031000

Variable	Std. Dev,	C,V,	Skewness	Ex, kurtosis
d_GTPR	0,64207	107,09	0,75209	2,6298
d_CPI	0,0099186	4,6133	1,4474	3,2293
d_Markups	0,015954	219,16	-0,25679	1,1301
d_Wages	0,013657	19,510	-0,26479	0,70875
Variable	5% Perc,	95% Perc,	IQ range	Missing obs,
d_GTPR	-1,2236	1,1850	0,60000	0
d_CPI	-0,0099500	0,022850	0,0097500	0
d_Markups	-0,026878	0,027642	0,019645	0
d_Wages	-0,023950	0,027700	0,014750	0

Source: own research.

The results of the Pearson correlation show that there were positive relationships between the GTPR and the examined variables. GTPR changes were more strongly explained by markups changes (70,01 %) than wages (1,06%) and CPI (0,35%). There was a weak but negative relationship between changes in markups and wages (-3,61%). This shows that the increase in markups was not accompanied by a strong increase in wages, but by a weakening of wage dynamics.

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:

$$\Delta y_t = \mu + \delta_{t-1} + \sum_{i=1}^k \delta_i y_{t-1} + \epsilon_t \quad (2)$$

where:

δ – means the parameter evaluation and

s_{δ} – is the parameter estimate error.

The value of the test statistic: $ADF = \frac{\bar{\delta}}{s_{\delta}}$

Table 3. The Augmented Dickey–Fuller (ADF) stationary test results

Variables	Null hypothesis: unit root appears	with constant		constant and trend	
		test statistic: $\tau_{ct}(1)$	asymptotic p -value	test statistic: $\tau_{ct}(1)$	asymptotic p -value
d_GTPR_t	$a = 1$; process I (1)	-4,05954	0,001131	-4,04602	0,007479
d_CPI_t		-1,13238	0,7052	-2,00042	0,6005
d_Makups_t		-3,88776	0,002136	0,01287	-0,071
d_Wages_t		-9,45945	6,437e-011	-10,6117	4,675e-011

Source: own research.

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:

$$\gamma t = \beta t + r t + \xi t \quad (3)$$

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:

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

where:

e_i – residuals,

$\hat{\delta}^2$ – is a long-term variance estimator (Kufel, 2011).

An ultimate confirmation of stationarity requires an additional test, e.g., KPSS (Table 4).

Table 4. The KPSS stationary test results

Variables	$GTPR_t$	CPI_t	$Makups_t$	$Wages_t$
Test statistic	0,0402567	0,0417049	0,0499994	0,0340563
Critical values	10% 5% 1%			
P-value > .10	0,121 0,149 0,214			

Note: T = 59, Lag truncation parameter = 3.

Source: own research.

Co-integration was verified using two tests: the Engle-Granger and Johansen tests (Johansen, 1991, 1992, 1995). Their results comprehensively confirmed co-integration for lag 1. This is proved by the values of the test statistic τ_e which are lower than critical values $\tau_{critical}$, levels of asymptotic p -values and integrated processes $a = 1$ and $I(1)$, at the significance level $\alpha = 0.05$ (Table 5).

Table 5. Results of the Engle-Granger co-integration test

Specification	d_GTPR	d_CPI	d_Markups	d_Wages
Unit root appears	$a = 1$, process $I(1)$			
test statistic τ_c τ_e (Asymptotic p -value)	-3,16752 (0,02197)	-2,55185 (0,1033)	-3,13146 (0,02434)	-3,11475 (0,02551)

Source: own research.

Testing cointegration aimed to find a long-term relationship between variables. Using the strong testing methods Johansen cointegration, cointegration relationship variables if it can be concluded there is a long-term relationship between variables. Results of the Johansen test (including trace and eigenvalue) show that at the significance level of 0,05, co-integration to the order of one occurs (Table 6).

Table 6. Johansen test

Rank	Eigenvalue	Trace test [p-value]	Lmax test [p-value]	Trace test [p-value]
0	0,53872	99,160 [0,0000]	43,330 [0,0016]	99,160 [0,0004]
1	0,38152	55,829 [0,0065]	26,908 [0,0581]	55,829 [0,0183]
2	0,27896	28,922 [0,0635]	18,315 [0,1213]	28,922 [0,0906]
3	0,16800	10,606 [0,2410]	10,300 [0,1965]	10,606 [0,2660]
4	0,00546	0,307 [0,5798]	0,307 [0,5798]	0,307 [0,5942]

Source: own research.

The lag order for the VAR/VECM model was determined based on estimation of the following information criteria: the Aikake information criterion (AIC), Schwartz-Bayesian information criterion (BIC), and Hannan-Quinn information criterion (HQC). According to these criteria, the best, that is, minimal values of the respective information criteria are: AIC = 3, BIC = 1 and HQC = 3, with the maximum lag order 8. Ultimately, the lag order 3 was accepted (Table 7).

Table 7. Values of the respective information criteria (AIC, BIC and HQC)

Lag	loglik	p(LR)	AIC	BIC	HQC
1	486,61318		-17,946661	-17,196183*	-17,658945
2	508,76646	0,00018	-18,183325	-16,832464	-17,665437
3	533,99136	0,00002	-18,538129*	-16,586885	-17,790068*

Source: own research.

4. RESULTS

4.1. VECM

Due to the occurrence of unit element in all the time series and the existence of cointegration between the model variables, it was possible to extend and transform the model into vector error correction models (VECM).

Interferences can be drawn from the evaluation of the vector correction model component (EC1) representing the mechanism of short-term adjustments which serves attainment of the long-term model balance. Evaluation of the EC1 indicates that the strongest correction of the deviation from long-term equilibrium occurs in the case of the own GTPR equation. Here, around 24,17% of the imbalance from the long-term growth path is corrected by a short-term adjustment process. Weaker deviation adjustments occur for markups (2,79%), wages (0,37%) and negative deviation for CPI (-3,32%). The values of the coefficient of determination R^2 reveal adjustment matching of the VECM model equations to empirical data, i.e., for GTRP (61,15%), CPI (21,13%), markups (81,77%), and wages (73,10%). To analyze stability of the VAR/VECM model, a unit root test was applied. 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 (Figure 1).

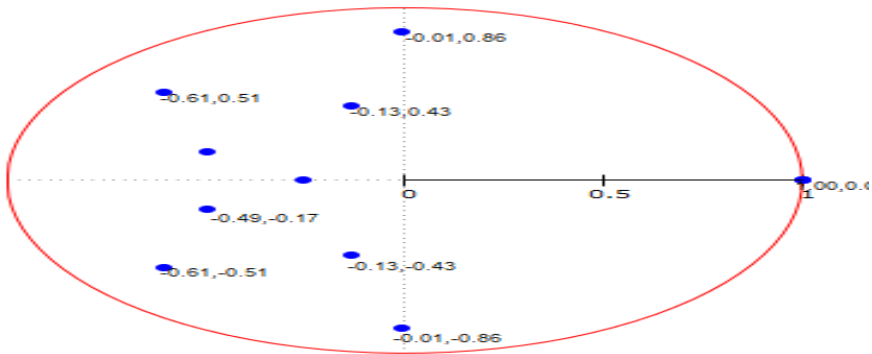


Figure 1. VAR inverse roots in relation to the unit circle

Source: own research.

To verify the correctness of the VECM model results, two tests were carried out verifying occurrence of autocorrelation, i.e., Autocorrelation Ljung-Box Q' test, lag order for test = 3, and ARCH test = lag order for test = 34 Ljung-Box tests (LMF, LM, Q) were conducted to verify autocorrelation for the lag order 4. The verifying statistic using the autocorrelation coefficient function (ACF) in the form Q' and empirical p-value levels higher than the nominal $\alpha = 0,05$ let us conclude that there is no autocorrelation in the residual process (Kufel, 2011).

The ARCH test results indicate that in the examined model of the residual-based process (four variables), the ARCH effect was not observed because LM test statistics are lower than the levels of χ^2 . This means that there is no autoregressive changeability of the conditional variance and there is no need to estimate model parameters by means of weighted least squares method. Thus, the results of both the tests confirm credibility of the VECM model and allow for conclusions drawn on their basis.

4.2. Impulse response function

The analysis of GTPR responses to changes in the examined variables indicates that the strongest positive impulses came from own changes in GTPR (from earlier periods) and weaker ones from changes in wages. GTPR responses to changes in these variables stabilized around the 10th period (2,5 years). The effect of CPI on GTPR changes was variable over time, from positive to negative, also stabilizing after the 10th period.

Rapid responses of GTPR showed changes in markups, especially in the period up to 5–7th first quarters from the change in markups. GTPR's responses to

changes in markups varied over time, from positive to negative, finally stabilizing after the 15th period (i.e., after 3rd years) at a low, albeit negative, level. Summing up, this means that GTPRs are very sensitive in the short term to changes in markups on the part of enterprises. It is only in the longer term (approximately 2–15th quarters, i.e., over 1st year) that GTPR's reaction to changes in markups weakens (Figure 2).

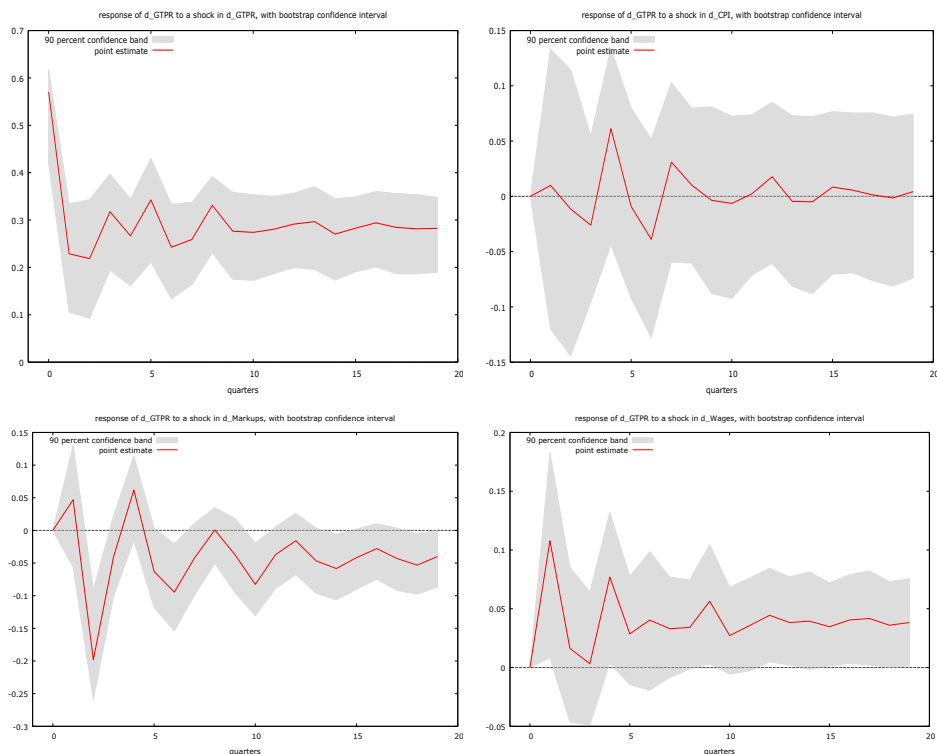


Figure 2. Response of GTPR to a shock in GTPR, CPI markups and wages

Source: own research.

4.3. Variance decomposition

The variance decomposition analysis for a period of 20 quarters (5th years) indicates that future GTPR changes depend mainly on earlier own changes (100,0% for 1st quarter and 93,2% for 20th quarter). The GTPR explanation rate drops to 88,8% in for 3rd quarter but increases gradually in the following quarters. Of the three analysed variables, the extent to which GTPR is explained by markup

changes increases initially (0,0% for 1st quarter to 8,6% for 3rd quarter) and decreases gradually to 4,4% for 20th quarter. The share of wages in explaining changes in the GTPR remains stable, ranging from nearly 3,0% for 2nd quarter to 2,0% for 20th quarter. The share of CPI changes in the GTPR is very low, not exceeding 1,0% throughout the forecast period. In summary, the results of the GTPR explanation degree indicate that the level of profits in earlier periods and the importance of markups in maintaining them are of key importance (Table 8).

Table 8. Decomposition of variance for d_GTPR

Period	d_GTPR	d_CPI	d_Markups	d_Wages
1	100,0000	0,0000	0,0000	0,0000
2	96,4414	0,0252	0,5624	2,9710
3	88,8073	0,0482	8,6599	2,4845
4	90,3944	0,1563	7,4030	2,0463
5	89,5879	0,6979	7,0391	2,6750
6	90,5828	0,6004	6,4523	2,3645
7	89,9545	0,7271	6,9592	2,3592
8	90,3103	0,7747	6,6183	2,2967
9	91,2197	0,7024	5,9140	2,1640
10	91,4438	0,6529	5,6125	2,2908
11	91,3987	0,6115	5,7950	2,1949
12	91,7360	0,5733	5,5355	2,1552
13	92,0775	0,5596	5,2012	2,1616
14	92,3233	0,5261	5,0244	2,1263
15	92,3875	0,5010	4,9918	2,1197
16	92,5907	0,4797	4,8439	2,0857
17	92,8322	0,4567	4,6382	2,0729
18	92,9684	0,4354	4,5240	2,0723
19	93,0610	0,4162	4,4736	2,0492
20	93,1966	0,3996	4,3664	2,0375

Source: The author's own calculations.

CONCLUSIONS

The results of the empirical and econometric analysis of the impact of inflation, markups, and wages on the profitability of enterprises in Poland allow for the following conclusions and recommendations:

1. Under conditions of high inflation or inflationary expectations, enterprises' hedging motives may be stronger and manifest themselves in a faster increase in markups. Enterprises raise markups to maintain profitability at the current level or to increase profitability, which is driven by transactional, pre-term and speculative motives and depends on the degree of competition in the market or industry. Empirical data confirm that the highest dynamics of markups and wages occurred in the industries of mining and quarrying (B) and the production and supply of energy, gas, steam, and hot water (D). These high dynamics were due to the increase in global energy commodity prices following the outbreak of the COVID-19 pandemic, the war in Ukraine, the aftermath of the energy crisis, or the increase in the price of CO₂ emission rights. In addition, the structures of the industries (B, D), i.e., monopolistic, and oligopolistic types, also provided opportunities for free markup policies. Although, as noted clearly, the increases in these industries were primarily justified by high increases in the prices of coal, natural gas, oil, and CO₂ emission rights.
2. The results of econometric studies confirm that the pillar of changes in the profitability of enterprises in Poland was the earlier changes in this profitability (about 90%), with the increasing importance in the short term of markups, wages, and inflation (up to 10%) and gradually declining impact in the medium term (up to 9%) – and long term (7%).
3. Changes in markups are one of the tools to hedge against inflation and guarantee the maintenance and growth of corporate profitability. In the short term, the impact of markups on corporate profitability increases (maximizing its impact around Q3), weakening in the medium – and long term (to about 6–4% around Q20), due to the fading of revenues and the difficulty of maintaining high markups in the face of changing consumer attitudes.
4. The importance of markups in the degree of explaining changes in profitability was about 3–4 times stronger than wages.

In summary, the results of the study confirm that changes in markups under inflationary conditions are an effective tool to support the profitability of enterprises already in the short term. Because the impact of markups on enterprise profitability is maximized in the short term, maintaining its impact in the medium and

long term, although slightly weaker. It is worth adding that the favourable situation of maintaining the adequacy of price and wage mechanisms in the face of changes in the CPI has enterprises in monopolistic or oligopolistic industries, where there is the possibility of maintaining a producer surplus, with high consumer demand. Industries with a higher degree of competitiveness may find it difficult to adequately increase markups in the face of rising inflation.

The results of the empirical and econometric analysis presented in the study allow for positive verification of the hypotheses.

H1: In a high inflation environment, frequent changes in markups effectively neutralize its negative impact by sustaining the profitability of enterprises, due to the quickly revealed and maximized effects in the short term, while in the medium - and long term, markups support profitability growth.

H2: Changes in markups more strongly affected changes in profitability than changes in wages and inflation in Poland in 2008–2023.

Among the main recommendations for enterprises there are the following ones:

1. Under conditions of high inflation dynamics or rapidly rising inflation expectations, enterprises should raise markups, as this is a relatively quick and effective tool for neutralizing inflation and sustaining profitability already in the short term (about 9%).
2. Markups should also be considered as a tool to support the profitability of enterprises, due to the impact maintained in the medium to long term (about 6–4%).
3. Enterprises should constantly take care of the appropriate level of profitability, not allowing it to fall, because it is a pillar for maintaining profitability in the future as well, including in an inflationary environment.

The conclusions presented have important practical aspects and can be helpful in the implementation of markup and wage policies and in planning the financial result of enterprises. The study fills a gap in the literature on the importance of markups and wages in shaping the profitability of enterprises under conditions of inflation, including in particular the use of markups as a tool that already gives expected results in the short term.

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DECLARATION BY THE AUTHORS

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WPŁYW INFLACJI, MARŻ I WYNAGRODZEŃ NA ZMIANY RENTOWNOŚCI PRZEDSIĘBIORSTW W POLSCE

Streszczenie

Celem artykułu jest określenie wpływu inflacji, marż i wynagrodzeń na zmiany rentowności przedsiębiorstw w Polsce w latach 2008–2023, z uwzględnieniem efektów w krótkim, -średnim i -długim okresie.

Metodyka dotyczy wpływu inflacji, marż i wynagrodzeń na zmiany wskaźników rentowności obrotu brutto, które oceniano za pomocą modelu VECM, funkcji reakcji na impuls i dekompozycji wariancji.

Wyniki badania wskazują, że filarem zmian rentowności przedsiębiorstw w Polsce są wcześniejsze zmiany tej rentowności, przy rosnącym znaczeniu w krótkim okresie marż, wynagrodzeń i inflacji (do 10%) i stopniowo malejącym w średnim (do 9%) i długim okresie (7%). Znaczenie marż w stopniu wyjaśnienia zmian rentowności jest około 3–4 razy silniejsze niż płac. Wzrost marż jest skutecznym narzędziem stabilizacji rentowności przedsiębiorstw w warunkach inflacji już w krótkim okresie, a także może być narzędziem wspierającym wzrost tej rentowności w średnim i -długim okresie, o ile pozwolą na to warunki rynkowe, w tym popyt konsumpcyjny. Badanie wypełnia lukę w literaturze na temat znaczenia marż i wynagrodzeń w kształtowaniu rentowności przedsiębiorstw

w warunkach inflacji, w szczególności wykorzystania marż jako narzędzia, które już w krótkim okresie przynosi oczekiwane efekty.

Słowa kluczowe: rentowność, marże, płace, inflacja, Polska, VECM.

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