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THE ROLE OF CONSUMER PRICE EXPECTATIONS IN SHAPING INFLATION

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Abstract

The purpose of the study is to assess the role of consumer price expectations in shaping inflation, taking into account changes in the economic environment. The analysis will be carried out on the example of Poland for a period of relatively good economic prosperity and periods of its collapse due to the occurrence of the 2007+ financial crisis and the COVID-19 pandemic and the war in Ukraine. The adopted objective and the related main areas of analysis determined the layout and empirical nature of the article, which consists of three parts and a conclusion. The first reviews the literature on the impact of price expectations on the economy. Then, the subject and temporal scope of the study conducted are presented, and the research method used is discussed. The results of the empirical analysis of the role of price expectations in driving inflation on the example of Poland are included in the third part of the article. The conclusion of the paper formulates the most important conclusions resulting from the analysis. The obtained results of the conducted research are also discussed in the context of the challenges of developing artificial intelligence.

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1. Literature review on the analysis of the role of expectations in shaping inflation

Expectations of economic agents are one of the key factors in shaping the oscillation of economic activity, as they translate into such important decisions as those regarding the direction and scale of consumption, saving, or investment, as well as price setting and wage negotiations (Jankiewicz and Urbanowicz, 2023, p. 205; Albrizio and Bluedorn, 2023, p. 49). They also provide an estimator of future price dynamics and can be a source of valuable information useful for making forecasts used in monetary policy. Inflation expectations of various actors are also an indicator of the credibility of the central bank and determine the degree of confidence in its policies (Łyziak, 2011, p.114-115). For this reason, the inflation expectations of consumers, businesses and professional forecasters, are of keen interest to monetary authorities, including the National Bank of Poland, which uses a direct inflation targeting strategy in conducting its monetary policy. In the literature, many authors focus on the analysis of price expectations. Some publications focus on analyzing the mechanism of expectation formation (Szyszko, 2016; Angeletos et al., 2020), others on the methodology of their measurement (D'Acunto, 2023; Angelico et al., 2022). The study conducted for this article is part of the analyses whose authors attempt to explain the role of price expectations in influencing the economy according to its state. For example, Albrizio and Bluedorn (2023, p. 50) found that short-term price expectations are the most important driver of price increases, and then citing the findings of Coibion et al. (2020) and Reis (2021), they pointed out that the role of expectations in shaping inflation varies depending on the level of inflation in a given period. For example, in an environment of low and stable inflation, economic agents reduce their interest in the state and development of the economy, and thus, the informational value of the expectations they form decreases (Coibion et al., 2020). Such a state of affairs characterized the situation in many developed economies before the COVID-19 pandemic (Reis, 2021). In contrast, when inflation rises sharply or becomes volatile, economic agents become more attentive, and their expectations can become an important driver of actual inflation. A similar conclusion was reached by M. Weber et al. (2023), who also found that as inflation rises in developed economies, both households and firms pay more attention to the state of the economy and are better informed about, for example, the level of inflation. Binder and Kamdar (2022) concluded that a prolonged period of elevated inflation could first trigger an increase in short-term inflation expectations, which in turn could translate into an increase in the long-term expectations of firms and consumers, which in turn could translate into inflation remaining at elevated levels over the long term. Such a course of events can highly complicate the primary task of the monetary authorities.

2. The subject, time scope of the empirical analysis and the research method

The cited research results were the inspiration for the study and analysis of the role of consumers' price expectations in shaping inflation during periods of relative economic calm, during the 2007+ crisis and the COVID-19 pandemic and Russia's aggression against Ukraine, using Poland as an example. The analysis covers the period from January 2004 to September 2023. Due to the desire to capture the specificity of the relationship between the formation of inflation and the price expectations of Polish consumers during the above-mentioned periods of special conditions for the Polish economy, consumer expectations were analyzed in three „sub-periods”:

- during the time of relative "peace and quiet" – from 01.2004 to 06.2007 and from 01.2011 to 02.2020,
- during the financial crisis 2007+ – from 07.2007 to 12.2010³,
- during the COVID-19 pandemic and the war in Ukraine – from 03.2020 to 09.2023⁴.

The basis for the empirical analysis of the relationship between inflation and consumer price expectations was a model in which:

- the response variable was: the CPI inflation rate,
- the explanatory variables were: inflation expectations of consumers analyzed separately by means of a zero-one variable for each of the distinguished „sub-periods”.

CPI data were obtained from the Statistics Poland database. The source of information on inflation expectations formulated by consumers was the results of consumer surveys, which are also provided by the Statistics Poland⁵. Consumer expectations are analyzed through a survey and are reflected in the balance statistic. It represents the difference between the percentage of consumers expecting price increases and the percentage of consumers expecting no change or a decrease in prices. An increase in the balance statistic is interpreted as a shift in respondents' opinions toward stronger price increases (and vice versa).

³ It is difficult to clearly define the timeframe of the financial crisis 2007+. For the purposes of this analysis, it was assumed that the crisis lasted from mid-2007 to the end of 2010. However, the authors realize that there is no consensus among economists on its duration.

⁴ Although the pandemic in Poland has ended up, the war in Ukraine continues. However, the study covers the period until 09.2023.

⁵ Statistics Poland (2023): <https://stat.gov.pl/obszary-tematyczne/inne-opracowania/informacje-o-sytuacji-spoleczno-gospodarczej/biuletyn-statystyczny-nr-112023,4,144.html> (access: 05.09.2023).

In order to capture the specifics of the role of consumers' price expectations in shaping inflation in the highlighted „sub-periods,” a zero-one variable, the so-called binary variable, was used. This variable shows whether a certain condition is met or not met. In the first case it is assigned the value „1”, and in the second case the value „0”, which explains the name of this variable (Maddala, 2000, p. 558). The study introduced three binary variables, each defined as follows:

- 1, for months that reflect a given „sub-period”,
- 0, for the other months.

The binary variables for each of the three highlighted time intervals were then multiplied by a variable reflecting consumer price expectations, and the explanatory variables thus constructed were entered into the model⁶.

In modeling the relationship between inflation and price expectations, the assumption was made that the level of the response variable depends on the current value of the explanatory variables and their values from earlier periods. In addition, the level of the response variable in the current period depended on its value in previous periods⁷. Adding the lags of the response variable to the model makes it possible to capture significant inertia in many economic phenomena, as well as to obtain better measures of the fit of the estimated models. The basis of the econometric analysis was therefore an Autoregressive Distributed Lags Model (ARDL model):

$$y_t = \mu + \sum_{i=0} \alpha x(1)_{t-i} + \sum_{i=0} \gamma x(2)_{t-i} + \sum_{i=0} \varrho x(3)_{t-i} + \sum_{j=1} \beta y_{t-j} + \varepsilon_t \quad (1.1)$$

where:

- y_t, y_{t-j} – the response variable and its lags: the inflation rate,
- $x(1)_{t-i}$ – the first explanatory variable and its lags: „expectations during economic silence”,
- $x(2)_{t-i}$ – the second explanatory variable and its lags: „expectations during the 2007+ crisis”,
- $x(3)_{t-i}$ – the third explanatory variable and its lags: „expectations during the COVID-19 pandemic and the war in Ukraine”,
- μ – intercept in the model,
- $\alpha, \beta, \gamma, \varrho$ – regression parameters,
- ε_t – residual component.

⁶ For more on this subject, see.: Welfe (2009, p. 174-180), Osińska (2007, p. 176-178), Maddala (2008, p. 350-359), Aczel (2000, p. 558-570).

⁷ Lags of up to 12 months for the response and explanatory variables were introduced into the model. The procedure is presented in detail in: Charemza i Deadman (1997, p. 75-80). In addition, it has been applied in the work: Kozłowska i Szczepkowska-Flis (2010).

The use of an ARDL model makes it possible to conduct a multiplier analysis, describing the short- and long-term relationship of a given exogenous variable with a given endogenous variable (Verbeek, 2004, p. 310-311 after Kozłowska i Szczepkowska-Flis, 2010, p. 212). The effect of a change in „x” for current changes in „y” is reflected by the short-run multiplier: $m_{xsr} = \alpha_0$. If the change in „x” persists in subsequent periods, its long-run effect on the „y” variable is described by the long-run multiplier: $m_{xlr} = \sum \alpha / (1 - \sum \beta)$, which determines the strength and direction of the long-term relationship between the analyzed variables (Welfe, 2009, p. 203; Kozłowska and Szczepkowska-Flis, 2010, p. 212). Multipliers for the other explanatory variables are determined analogously, using the parameters estimated for them (Welfe, 2009, p. 174-176; p. 202-203).

The Classical Least Squares Method (KMNK) was used to estimate regression coefficients. The diagnostic usefulness of the estimated models was evaluated by analyzing the coefficient of determination R^2 . The statistical significance of individual parameters was determined using the Student's t-test at a significance level of $p = 0.05$ (Wooldridge, 2001, pp. 116-134 after Kozłowska and Szczepkowska-Flis, 2010). The normality of the distribution of the residual component was tested using the Doornik-Hansen test (Maddala, 2006, p. 244-245, p. 292-293). The model was estimated using a method that was robust to standard errors, so it did not require checking for heteroskedasticity and autocorrelation of the residual component⁸.

3. Results of the analysis of the role of consumer price expectations in shaping inflation in Poland

Estimation of the econometric model was preceded by decomposition of the source material. Seasonal and random fluctuations were removed from the output data series by applying the TRAMO/SEATS procedure, recommended by Eurostat. Stationarity tests were then performed on the series adopted for analysis. Stationarity was tested by applying the ADF test (ang. *Augmented Dickey-Fuller test*) at a significance level of 0,05. All of the series adopted for the analysis proved to be non-stationary and it was necessary to transform them (Table 1)⁹.

⁸ On the procedure of verifying an econometric model, see: Kufel (2011, p. 57-67).

⁹ In addition, outlier observations were removed from two series in order to obtain better measures of the goodness of fit of the statistical model. One observation from 01.2013 was removed from the CPI series, while three observations from 11.2014 to 01. 2015 were removed from the x (1) series.

Table 1. The p-value for the ADF test for the analyzed variables

	CPI inflation rate	Consumer price expectations (without dividing into "sub-periods")	Consumer price expectations during economic silence	Consumer price expectations during the 2007+ crisis	Consumer price expectations during the COVID-19 pandemic and the war in Ukraine
Variable name	y: CPI	OCZ_KONS	x(1): OCZ_C	x(2): OCZ_KRY	x(3): OCZ_COV_UKR
Transformation method	logarithm increment	logarithm increment	= variable 0-1 * „OCZ_KONS” variable, where "1" is assigned for the intervals: from 01.2004 to 06.2007 and from 01.2011 to 02.2020, and "0" for the other months	= variable 0 - 1 * „OCZ_KONS” variable, where "1" is assigned for the interval: from 07.2007 to 12.2010, and "0" for the remaining months	= variable 0 - 1 * „OCZ_KONS” variable, where "1" is assigned for the interval: from 03.2020 to 09.2023, and "0" for the other months
ADF without intercept	6,031e-007	7,294e-011	1,243e-017	2,009e-008	0,00225
ADF with intercept	1,301e-005	1,476e-009	4,987e-017	4,54e-007	0,02226
ADF with intercept and trend	0,0002442	1,038e-008	3,9e-017	3,853e-006	0,04519
Conclusion	Stationary series	Stationary series	Stationary series	Stationary series	Stationary series

Source: own study.

The results of estimating the regression equation (1.1) indicated the existence of a relationship between inflation and consumer expectations in the analyzed research period (Table 2).

Table 2. Estimation results of the ARDL model for inflation in Poland based on equation 1.1.

Explanatory variables	Regression parameters	t - Statistics	p value
OCZ_COV_UKR	0,0191395	3,735	0,0002
OCZ_COV_UKR_1	-0,0264970	-3,309	0,0011
OCZ_COV_UKR_2	0,0280780	4,583	8,07e-06
OCZ_COV_UKR_3	-0,0102841	-2,844	0,0049
OCZ_COV_UKR_8	-0,00802329	-3,620	0,0004
OCZ_KRY_3	0,00526045	3,118	0,0021
OCZ_KRY_11	-0,00726841	-2,758	0,0064
CPI_1	1,90925	28,99	1,51e-073
CPI_2	-2,48610	-19,47	4,80e-048
CPI_3	2,78610	15,59	2,10e-036
CPI_4	-2,72972	-12,75	1,19e-027
CPI_5	2,51047	10,54	5,90e-021
CPI_6	-2,07468	-9,155	6,45e-017
CPI_7	1,77459	8,684	1,36e-015
CPI_8	-1,32109	-7,862	2,30e-013
CPI_9	0,904739	7,372	4,34e-012
CPI_10	-0,402204	-6,779	1,33e-010
Intercept	2,23024e-05	1,499	0,1354
R ² =0,918786, \hat{R}^2 =0,911882; F=262,9897, p=1,0e-126; Doornik-Hansen test: statistics=2,74819, p=0,253068.			

Source: own study.

The reduced form of the model was the basis for determining the short-term (m_{sr}) and long-term (m_{lr}) multipliers for consumer price expectations in the sub-periods highlighted. Their summary is shown in the Table 3.

Table 3. Summary of values of short- and long-term multipliers for consumer price expectations

Response variable: CPI		
Multipliers for explanatory variables:	m_{sr}	m_{lr}
OCZ_C	Variable not statistically significant	
OCZ_KRY	0	-0,00059
OCZ_COV_UKR	0,0191395	-0,00531

Source: own study.

The obtained values of multipliers revealed that consumers' price expectations can play a differentiated role in influencing inflation depending on whether or not there is accompanying economic turmoil. Indeed, the obtained values of multipliers indicated that:

- consumers' price expectations did not translate in a statistically significant way into inflation during periods of relatively good economic conditions,
- consumer price expectations, on the other hand, were statistically significant for the formation of inflation in periods of economic collapse due to the consequences of the 2007+ crisis or the COVID-19 pandemic and the war in Ukraine.

An explanation for this may be the increased interest of economic agents in the state of the economy under conditions of its threat. This increased interest may cause some deviation (up or down) from a certain "normal" level in terms of formulated expectations. These deviations may, in turn, have important implications for current inflation.

The results obtained suggest that in the short term, the relationship between consumers' price expectations during the 2007+ financial crisis and during the pandemic and war in Ukraine was not equal. Well, during the crisis, a change in consumers' price expectations was not accompanied by a change in the inflation rate during the same period. In contrast, during the pandemic and war in Ukraine, rising consumer price expectations were accompanied by an increase in inflation in a given month (and vice versa). An explanation for this differential nature of the short-term relationship between consumers' price expectations during the crisis and the pandemic and war across Polish eastern border, perhaps, was the great unknown about the further course of the pandemic and its possible end, as well as concerns about the not entirely expected outbreak of war in Ukraine. These "exceptional" events having their economic and political effects of unprecedented magnitude, among others, may therefore have translated into an increased role of expectations in shaping inflation in the short term. In addition, the 2007+ crisis period and the period of the pandemic and war in Ukraine are distinguished by the accompanying inflation levels. In Poland, during the pandemic and war

in Ukraine, the CPI inflation rate (y/y) reached, a record level in years, namely 18,4% (!). Contributing to this, among other things, was the erroneous monetary and information policy of the National Bank of Poland, whose actions and their explanation failed to convince the public that inflation was „under control". Arguably, the result was growing fears and expected price increases, which certainly did not help stabilize inflation in the short term. In a different way, during the 2007+ crisis, the CPI inflation rate (y/y) recorded also an increase, but a moderate one, reaching a peak of 4,8%, and the NBP's monetary policy pursued at that time did not receive a wave of criticism, as it did during the pandemic and the war in Ukraine. Perhaps this inflationary environment and the monetary policy actions carried out provide explanations for the different nature of the relationship between consumers' price expectations during the 2007+ crisis and during the COVID-19 pandemic and the war in Ukraine.

In the longer term, the relationship between Polish consumers' price expectations during the 2007+ financial crisis and during the pandemic and war in Ukraine was the same. The results noted suggest that:

- the relationship between expectations and inflation emerged over time during the 2007+ crisis,
- the relationship between expectations and inflation did not disappear with the passage of time during the pandemic and war in Ukraine.

However, its direction changed from positive to negative.

In the case of the two "sub-periods" analyzed, a negative value of the long-run multiplier means that the result of an increase in consumer price expectations was a postponed reduction in inflation, and vice versa. Such a result, perhaps, explains the behavior of economic agents who, expecting price increases, did not increase consumer demand for fear of, as a consequence, possible even higher price increases. In this way, it was actually possible to prevent even higher inflation increases in the long term during the 2007+ crisis and during pandemics and war.

Conclusion

The results of the study indicated that the role of consumer price expectations in shaping inflation can vary depending on the state of the economy. In times of prosperity, it was found that consumers' price expectations do not translate into inflation in a statistically significant way. In contrast, during periods of dangerous economic turmoil, it appears that the role of price expectations in shaping inflation increases and can impede the stabilization of inflation. Thus, it seems that during a downturn the monetary authorities should try to influence the process of their formulation with extreme accuracy and caution. However, one should be aware that economic agents form their expectations not only on the basis of the central bank's announcement. To a large extent, they search

for information „on their own” on the Internet, and this is often the basis on which they form their expectations. What sources do they come across? For example, on financial and business websites or economic blogs. It is important to consider to what extent the information obtained from such sources is reliable and what consequences they carry. This question is particularly relevant in a reality in which artificial intelligence is gaining importance, which can be, and even already is, used to create „information content”. Using a tool like artificial intelligence, for example, it is possible to amplify the public's fears and even create panic that can raise inflation for a longer time. This is because tools like Chat GTP „derive their knowledge” from information from the network, and if „fed” with the right amount of fake news, this can cause a spike in price expectations. Thus, the world has gained a tool that, if maligned, can strongly destabilize the economy. In the ongoing discussion on this topic, there is also the question of who is responsible for any destabilization caused by false information getting into the public domain. Such a situation occurred on January 1, 2024: the quotation of the Polish zloty (PLN) for 1 euro (EUR), according to charts published by Google, broke through the 5 PLN barrier. Visible on the Google chart, the exchange rate was rising from about 5:40 pm, and a few minutes after 8 pm the service showed a price of 5,06 PLN (!) per euro. (Money.pl). This confusion about the Polish zloty exchange rate turned out to be a consequence of a „data source error”. This „error” certainly proved costly for many business entities. Who bears responsibility for it? This question remains unanswered to this day. In view of the research results obtained, being aware of the role of consumers' price expectations in influencing the state of the economy, it can therefore be assumed that, with the help of artificial intelligence, it is relatively easy to bring about a collapse of the economy or a deepening of its collapse, without any responsibility. The task of conducting monetary policy in bad economic times becomes even more difficult in this context. This is therefore a further argument in favor of absolutely preventing inflation from fluctuating outside the band established by the adopted inflation target.

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