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Does The Consumers' Predictive Accuracy of Inflation Depend On Consumer Income Level? The Case of Poland*

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Abstract

The aim of this paper is to recognize and analyze the heterogeneities in accuracy of one year ahead inflation expectations of consumers among different income groups in Poland under the different inflation environments: (1) high inflation environment, (2) low inflation environment, and (3) credible inflation environment. The time span covers May 2001-December 2023. The qualitative EC Business and Consumer Survey inflation expectations have been quantified with the use of Carlson and Parking method adjusted by Batchelorr and Orr. The accuracy of inflation expectations has been analyzed via forecasts errors and verified with the use of HLN test and Diebold-Mariano test. The main conclusion is that the non-credible inflation environment generates heterogeneity in inflation expectations accuracy among the opposite income groups.

Keywords: consumers' inflation expectations, inflation, income groups, forecast accuracy

Introduction

The recent geopolitical situation generates high economic anxiety. The research performed by Armantier et.al. (2020) shows the increase of disagreement about future inflation among U.S. household heads (Armantier et.al., 2020) in 2020. The disagreement about future inflation may provide to global uncertainty, cross-country heterogeneity of inflation expectations and also to the heterogeneity among the different groups of citizens within one country. Above this, to properly manage the short-term household's inflation expectations, it is necessary to recognize the effect of specific periods on the processes of forming the inflation expectations under the different economic conditions.

In this research we focus on the survey based one-year ahead consumers' inflation expectations, as their updates are in line with the economic choice mechanisms (Sousa and Yetman 2016), harmonize with the business cycle and react to economic shocks (Posen, 2011). The focus on consumers inflation expectations is dictated as the households determine the saving, spending, price and wage-setting decisions and are in close relations between inflation and economic activity (Sousa and Yetman 2016). The households are very difficult group to analyze, they are highly

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heterogenous agents who form the expectations under specific economic conditions and under the impact of cognitive mechanisms (Claus and Nguyen, 2018).

There is a lot of papers in the literature focusing on inflation expectations learning mechanisms, drivers and heterogeneities among the socio-economic groups. In this study we focus on heterogeneities in accuracy of inflation expectations among different income groups (High-income versus Low-income Groups) in Poland. The choice of the country has been made based on the high inflation experiences in the early 90's. Ehrmann and Tzamourani (2009) conducted research on the inflation aversion study indicating that the memories of high inflation affect agents' preferences about the importance attached to price stability. The inflation expectations of different income groups are interesting as their consumption baskets differ from each other (Especially High- and Low-income groups) (Madeirea and Zafar, 2012). It is also already proven in the literature that the majority of inflation expectations has a backward-looking nature (Gerberding, 2001). Similarly, it is also proven that despite the effect of other determinants, the most important driver of inflation expectations is the previous inflation rate (see: Carlson and Parkin, 1975; Ueda, 2009, Milani, 2009; Ciccarelli and Garcia 2009, 2017). According to this, the inflation expectations analysis in this study covers three different periods connected with the CPI inflation rate target range in Poland (2.5%+/-1%): (1) high inflation (inflation rate above 3.5%); (2) low inflation rate (below 1.5%), credible inflation (inflation rate within a range <1.5%; 3.5%>).

The aim of this paper is to recognize and analyze the heterogeneities in accuracy of inflation expectations of consumers among different income groups in Poland under the different inflation environments: (1) high inflation environment, (2) low inflation environment, and credible inflation (3). The time span covers May 2001-December 2023. The main research hypothesis states that non-credible inflation environment generates heterogeneity in inflation expectations accuracy among the income groups.

The inflation expectations have been quantified with the use of Carlson and Parking method (1975) adjusted by Batchelorr and Orr (1988). The accuracy of inflation expectations has been analyzed via forecasts errors. To test the significance in differences in accuracy among income groups, the HLN (Harvey, Leybourne, and Newbold, 1997) and Diebold-Mariano (Diebold and Mariano, 1995) tests have been performed.

Literature Review

The inflation expectations are heterogenous due to the different purchasing, choice habits (Ehrmann, Pfajfar and Santoro 2015) and savings attitudes (Acedański 2017). The heterogeneity among different socio-economic groups has been highlighted by Pfajfar and Santoro (2009).

In this study we are focused on accuracy of inflation expectations among different income groups. The income may generate the inflation expectations heterogeneities in few possible ways. It is connected with the chosen basket of goods. According to Madeira and Zafar (2014), lower-income households have a higher heterogeneity of expectations than the high-income households. Lower income households' baskets of goods may include with greater weight items with more volatile prices (Madeira and Zafar, 2014; Mankiw, Reis, and Wolfers, 2003). McGranahan and Paulson (2006) also confirmed that lower income groups have more variable inflation than higher income groups (Madeira and Zafar, 2014).

The inflation expectations heterogeneity among the income groups may be connected with the different sensitivity to inflation shocks. The lower income groups may be more sensitive to sharp changes in prices of more base products from the basket of goods (Madeira and Zafar, 2014; Doh et.al. 2024). There are several research on inflation expectations and income groups performed mainly on the US survey data. D'Acunto et al. (2022) found that low-income households tend to have higher inflation expectations and their within-group heterogeneity is greater. The tendency that low income groups tend to have higher inflation expectations have been confirmed also by Doh et.al. (2024) and by Bruine de Bruin et al. (2010). Additionally, Doh et.al. (2024) investigated the inflation expectations heterogeneity among different socio-economic groups with the use of conditional quantile regression based on the data from US Survey of Consumer Expectations. The studies confirmed that monetary policy shock tends to be more effective in stabilizing the upper quantile of inflation expectations in the low-income group than the high-income group (Doh et.al. 2024). The research on inflation expectations within income groups from European Union has been performed by Aprigliano and Di Nino (2024), and Allinger et al. (2023). The results are in line with these based on US survey data. It showed the differences in compensation for inflation among income groups and

indicated the country specific heterogeneities (Aprigliano and Di Nino, 2024), and that individuals with lower income levels tend to have higher inflation expectations (Allinger et al.,2023).

The inflation expectations forecasts errors have been analyzed by Souleles (2004) and Anderson (2008) indicating that lower income households make larger forecasts errors than average. Souleles (2004) based on the US households microdata from Michigan Consumer Sentiment Survey confirmed that households inflation forecasts errors are heterogenous, correlated with the households demographic characteristics and that economic shocks do not impact equally households with high and low income. Anderson (2008) performed a study on individual consumer year-ahead inflation expectations of US consumers based on SRC survey (Survey of Consumer Attitudes and Behavior managed by the Survey Research Centre at the University of Michigan) where the interaction of households income and age on the inflation expectations accuracy has been pronounced.

Data and Methodology

The study focuses on one-year ahead consumer inflation expectations in Poland. The time span covers May 2001-December 2023, monthly data. The consumer inflation expectations have been collected from EC Business and Consumer Survey. This is the general research conducted for economies in European Union and candidate countries by the Directorate-General for Economic and Financial Affairs (DG ECFIN) of the European Commission and covers five surveys: industry survey, services survey, retail trade survey, construction survey and consumer survey. The consumer survey is conducted on a monthly basis and includes questions on financial situation, perceived economic uncertainty, general economic situation, price trends, unemployment, major purchases and savings. The sample across all EU countries comprise about 32 000 consumers (DG ECFIN, 2024). The number of consumers contacted in Poland each month is around 18 000 with the respond rate 6% (around 1000 units is replying to the survey). The sampling method is quota sampling technique (DG ECFIN, 2023). The survey question on inflation expectations of consumers is as follow:

'*By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months? They will…, with six possible answers:*
(1) increase more rapidly (++),
(2) increase at the same rate (+),
(3) increase at a slower rate (=),
(4) stay about the same (-),
(5) fall (--),
(6) don't know'.

The data from the survey are aggregated into four groups dependably on the income: (1) 1st Quartile, (2) 2nd Quartile, (3) 3rd Quartile, (4) 4th Quartile. Income groups in the EU Business and Consumer Survey's are defined according to net household income and the exact income thresholds are defined by each national institute (DG ECFIN, 2023a). As the answers have qualitative nature, they have been quantified with the use of Carlson Parkin procedure (1975) adjusted to more answers by Batchelorr and Orr (1988). To obtain as objective as possible measure, we use as a scaling factor, the CPI inflation rate. The recent monthly inflation data are published with the delay. Due to that we lagged our proxy by one month. According to that procedure, we have obtained the aggregated quantitative inflation expectations of consumers in four income groups. The descriptive statistics of the whole sample are shown in Table 1.

Table 1. Descriptive Statistics of the sample, time span May 2001-Dec. 2023, monthly data.

All sample, N=272	Average	Median	Min.	Max.	Std.dev.	Skewness	Kurtosis
CPI(t-1)	3.21	2.50	-1.60	18.40	3.68	2.23	5.58
InflExpQ1IncomeG.	3.03	2.18	-1.12	16.92	3.28	2.37	6.06
InflExpQ2IncomeG.	3.05	2.15	-0.46	17.33	3.29	2.44	6.47
InflExpQ3IncomeG.	2.98	2.20	-0.95	16.94	3.24	2.51	7.05
InflExpQ4IncomeG.	3.02	2.20	-0.51	17.28	3.26	2.47	6.61
CPI(t+12)	3.18	2.40	-1.60	18.40	3.67	2.26	5.71

Source: Authors own calculations.

To obtain the inflation expectations accuracy among the income groups we compared the one-year ahead inflation expectations with the realized inflation (*t+12)*. The main analysis has been divided into two steps. As a first step, we analyzed the inflation expectations errors: Mean Error (ME), Mean Average Error (MAE), Mean Squared Error (MSE), and Root Mean Squared Error (RMSE). They have been used to examine the expectations accuracy and bias. As a second step, we have performed Diebold-Mariano test (Diebold and Mariano, 1995) and HLN test (Harvey, Leybourne, and Newbold, 1997) to verify whether the accuracy of inflation forecasts differ significantly among the most opposite income groups (Q1 Low-income Group versus Q4 High-income Group). The tests as well as forecasts errors have been calculated for the time span May 2001 and December 2023, and for the subsamples: high inflation, low inflation, inflation within the inflation target range. By the inflation environment we understand the CPI inflation which was recorded in time (t-1) when the expectation was formed.

Analysis Results

The EC Business and Consumer Survey inflation expectations among for Income groups (InflExpQ1IncomeG., InflExpQ2IncomeG., InflExpQ3IncomeG., InflExpQ4IncomeG.) have been quantified with the use of inflation rate CPI(t-1) proxy. The main descriptive statistics of CPI(t-1), the inflation expectations among four different income groups and the realized inflation CPI(t+12) under low, high and credible inflation environment in Poland have been shown in Table 2. The results of parametric tests for differences in averages and variances of inflation expectations of Lowest-income Q1 group and Highest-income Q4 group for these three subsamples are shown in Table 3.

Our main focus is put on the opposite income groups Q1 and Q4. The average and median inflation expectations under the high inflation environment seem to be larger in lowest-income group than in the highest-income group. However, under the low inflation and credible inflation environment the average and median inflation expectations of lowest-income group seem to be smaller than in the highest-income group. The dispersion in inflation expectations is higher in lowest-income Q1 group than in the highest-income Q4 group. The differences in averages and variances of inflation expectations in lowest-income Q1 group and highest-income Q4 group are statistically not significant under the 0.1 significance level (see: Table 3).

Table 2. Descriptive statistics of the samples, monthly data.

Inflation environment: CPI(t-1)>3.5%, N=94							
Variable	Average	Median	Min.	Max.	Std.dev.	Skewness	Kurtosis
CPI(t-1)	6.59	4.50	3.40	18.40	4.30	1.57	1.03
InflExpQ1IncomeG.	**6.06**	**4.20**	**2.79**	**16.92**	**3.89**	**1.58**	**1.15**
InflExpQ2IncomeG.	6.06	4.16	2.93	17.33	3.96	1.60	1.32
InflExpQ3IncomeG.	5.93	4.09	2.78	16.94	3.91	1.72	1.72
InflExpQ4IncomeG.	**5.97**	**4.04**	**2.61**	**17.28**	**3.96**	**1.61**	**1.29**
CPIt12	5.08	3.35	0.20	18.40	5.05	1.47	0.78
Inflation environment: CPI(t-1) <1.5%, N=83							
CPI(t-1)	0.30	0.60	-1.60	1.40	0.86	-0.52	-1.06
InflExpQ1IncomeG.	**0.57**	**0.67**	**-1.12**	**1.38**	**0.53**	**-0.64**	**-0.03**
InflExpQ2IncomeG.	0.60	0.73	-0.46	1.36	0.48	-0.30	-1.01
InflExpQ3IncomeG.	0.57	0.69	-0.95	1.36	0.52	-0.66	-0.06
InflExpQ4IncomeG.	**0.60**	**0.70**	**-0.51**	**1.34**	**0.49**	**-0.41**	**-0.89**
CPI(t+12)	0.99	0.90	-1.60	4.60	1.60	0.38	-0.60
Inflation environment: CPI(t-1) <1.5%;3.5%>, N=99							
CPI(t-1)	2.42	2.40	1.30	3.50	0.64	0.16	-1.23
InflExpQ1IncomeG.	**2.20**	**2.08**	**1.23**	**3.44**	**0.65**	**0.37**	**-1.13**
InflExpQ2IncomeG.	2.21	2.08	1.23	3.63	0.61	0.36	-1.04
InflExpQ3IncomeG.	2.16	2.10	1.26	3.56	0.59	0.43	-0.88
InflExpQ4IncomeG.	**2.22**	**2.15**	**1.26**	**3.56**	**0.61**	**0.35**	**-1.09**
CPI(t+12)	3.11	3.00	0.30	9.40	1.86	0.86	1.23

Source: Authors own calculations.

Table 3. Parametric tests results

Inflation environment	Test value: Averages*	Test value: Variances**
CPI(t-1)>3.5%	0.16 (0.87)	1.03 (0.86)
CPI(t-1) <1.5%	-0.37(0.7)	1.17 (0.48)
CPI(t-1) <1.5%;3.5%>	-0.22(0.83)	1.07 (0.75)

*Test results for the difference in average inflation expectations of consumers in lowest Q1 income group and highest income Q4 Group in Poland under different inflation environments. The null hypothesis assumes that the averages are equal. **Test results for the difference in variance of inflation expectations of consumers in lowest Q1 income group and highest income Q4 Group in Poland under different inflation environments. The null hypothesis assumes that the variances are equal. p-values in parentheses.

Source: Authors own calculations.

At the next stage, we calculate the accuracy of inflation expectations in four income groups under different inflation environments. Under the low inflation and credible inflation environment the inflation expectations in all income groups are generally overestimated (according to ME forecast errors), and underestimated under the high inflation environment. The inflation expectations of lowest-income Q1 group are less accurate that the expectations of the highest-income Q4 group under the credible inflation and high inflation environments. This result is not pronounced under the low inflation environment. The inflation expectations among income groups under different inflation environments are shown in Table 4.

Table 4. The inflation expectations among income groups under different inflation environments

Inflation environment	Income groups			
CPI(t-1) <1,5%, N=83	**Q1**	Q2	Q3	**Q4**
ME	**0.42**	0.39	0.42	**0.39**
MAE	**1.22**	1.24	1.24	**1.26**
MSE	**2.23**	2.25	2.27	**2.30**
RMSE	**1.49**	1.50	1.51	**1.52**
CPI(t-1)>3,5%, N=94	**Q1**	Q2	Q3	**Q4**
ME	**-0.98**	-0.98	-0.84	**-0.89**
MAE	**3.26**	3.32	3.24	**3.21**
MSE	**19.82**	20.41	20.04	**19.85**
RMSE	**4.45**	4.52	4.48	**4.46**
CPI(t-1) <1,5%; 3,5%>, N=99	**Q1**	Q2	Q3	**Q4**
ME	**0.91**	0.91	0.95	**0.90**
MAE	**1.55**	1.52	1.52	**1.50**
MSE	**4.03**	3.97	3.99	**3.91**
RMSE	**2.01**	1.99	2.00	**1.98**

Source: Authors own calculations. The data analysis for this paper was generated using the Real Statistics Resource Pack software (Release 8.9.1). Copyright (2013 – 2023) Charles Zaiontz. www.real-statistics.com.

Under our main considerations are the differences in shaping inflation expectations by the consumers from opposite income groups (Lowest Q1 versus Highest Q4). We are analyzing the heterogeneities among these income groups via its accuracy. The comparison of the inflation expectations errors is not enough. To verify which income group (Lowest Q1 or Highest Q4) is better in predicting the one-year ahead inflation we use the Diebold Mariano test (Diebold and Mariano, 1995) and Harvey, Leybourne, and Newbold (HLN) test (Harvey, Leybourne, and Newbold, 1997). Diebold Mariano test based on the MSE error statistic and HLN test have been used to determine the significance of the differences in predictions. The null hypotheses in both tests assumes that there is no significant difference between the accuracy of inflation expectations of consumers from lowest-income group Q1 and highest income group Q4. In our results interpretations we are more focused on the HLN test, as it is more sensitive to small samples. The testing results among inflation expectations formed by consumers from lowest income Q1 group and highest income Q4 group under the different inflation environments are shown in Table 5. The results indicate that there is no significance difference in accuracy among lowest and highest income groups under the credible inflation environment. However, the significant difference in accuracy has been noticed between these income groups under the low and high inflation environment (See: HLN tests results, chosen significance level is 0.1).

Table 5. D-M and HLN tests results within the inflation expectations of consumers from Q1 and Q4 income groups

Inflation environment	Diebold Mariano Test Value	HLN Test Value
CPI (t-1) <1.5%;3,5%>, N=99	1.37 (0.17)	1.39 (0.14)
CPI(t-1)>3,5%, N=84	1.51 (0.13)	**1.66* (0.1)**
CPI(t-1) <1,5%, N=83	1.57 (0.11)	**1.73 *(0.09)**

The null hypothesis assumes that there is no significant difference between the two forecasts. p-values in parentheses. *Hypothesis has been rejected under 0.1 significance level. The data analysis for this paper was generated using the Real Statistics Resource Pack software (Release 8.9.1). Copyright (2013 – 2023) Charles Zaiontz. www.real-statistics.com.
Source: Authors own calculations.

Conclusions and Further analysis

In this study we analyzed the heterogeneities in accuracy of inflation expectations of consumers among different income groups in Poland under the different inflation environments: (1) high inflation environment, (2) low inflation environment, and credible inflation (3). The main conclusion covers two areas. First, the average short-term inflation expectations of consumers from lowest-income group in Poland did not differ significantly from the inflation expectations of consumers from highest-income group. This result does not depend on the inflation environment when the expectations were formed. Second, under the inflation non-credible environment (inflation out of the inflation target range) the accuracy of predicting the one year ahead inflation differs significantly between lowest- and highest-income groups. This provides to the main conclusion that the non-credible inflation environment generates heterogeneity in inflation expectations accuracy among the opposite income groups of consumers. Keeping the inflation within the target range makes consumers more trusting and accurate about the future inflation and constrains the heterogeneities.

This result has its implications in the saving, spending, price and wage-setting decisions made by consumers and their further economic activity. The heterogeneities among the income groups on the national level and also cross-country level disturbs the proper management of inflation expectations by central bank and generates more anxiety. This study is a part of further research on heterogeneities in accuracy of inflation expectations among income groups in European Union.

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