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European Union consumer inflation expectations in macro panels

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Abstract

Paper investigates the role of consumer inflation expectations in macroeconomic variable dynamics within select European Union countries from 2004Q1 to 2024Q3, employing a panel vector autoregression (PVAR) model. The empirical analysis compares two approaches: balance statistics and various configurations of the Carlson-Parkin quantification method, studying variations in inferred dynamics dependent upon methodological selection. The results indicate that consumer inflation expectations modestly influence aggregate demand and inflation, consistent with intertemporal substitution effects. However, the anticipated wage-price spiral was largely absent, and the relationship between unemployment and inflation was weaker than traditional Phillips curve frameworks would predict, suggesting structural factors or unemployment rates above the natural unemployment rate. Furthermore, macroeconomic relationships found, particularly concerning consumer sentiment are dependent on methodological choices. Lastly, heterogeneity in dynamics between different countries is analysed. This heterogeneity underscores the value of country-specific analysis for understanding the transmission of inflation expectations to macroeconomic outcomes.
Keywords: Consumer inflation expectations, balance statistics, Carlson-Parkin method, survey data.
Jel Codes: C49, D84, E58

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1. Introduction

Understanding inflation expectations has become critically important following the global inflationary episode that began in 2021, prompting renewed interest in their role within monetary policy frameworks. Traditionally viewed as crucial within modern macroeconomic frameworks, inflation expectations are theorized to influence actual inflation through aggregate demand and price-setting mechanisms. However, recent literature indicates significant ambiguity concerning the strength and persistence of these relationships, especially concerning the expectations of consumers. Therefore, this study addresses three interrelated research objectives. Firstly, the study aims to empirically assess how consumer inflation expectations influence key macroeconomic variables across EU countries using a panel vector autoregression (PVAR) framework. Secondly, this research addresses methodological gaps by comparing commonly used balance statistics and different specifications of quantified expectations (Carlson-Parkin approach). Specifically, it critically evaluates whether the relationships identified are sensitive to different configurations of the Carlson-Parkin method. By systematically comparing multiple quantification specifications, the study sheds new light on the robustness of empirical conclusions on macroeconomic relationship inference, especially concerning consumer sentiment channel, and underscores the importance of methodological rigor when incorporating consumer expectations into macroeconomic analysis and policy recommendations. Thirdly, heterogeneity of inflation expectations effects to economy is checked on individual country level. While some studies focus on aggregate region data, such as euro area or EU, other studies focus on individual countries. The results of this study suggest that there is a considerable amount of heterogeneity between different countries suggesting that aggregate approaches may obscure important cross-country differences.

2. Literature Review

In mid 2021 an inflation surge had countries experiencing highest levels of inflation seen in decades. Economists were attributing many reasons for this increase with the main ones revolving around covid supply chain disruptions, stimulus during the pandemic and, later, the war in Ukraine leading to high energy prices. Around the same time Rudd (2021) published a paper on inflation expectations which got a lot of attention not only in the academic community but also in the media. In this paper, the author explains how inflation expectations are paramount to modern macroeconomic and monetary policy theories. In addition to discussing the relevant theoretical aspects, Rudd also critically reviews empirical evidence for inflation expectations effect to actual inflation. The paper concludes that the theoretical foundations are not sound as there is not enough empirical evidence justifying the importance of inflation expectations. The relationship between inflation expectations and actual inflation is only circumstantial. In fact, academic literature predominantly modelled inflation expectations under rational expectations framework using multiple approaches. The early econometric approaches to estimating inflation expectations were centred around adaptive expectations and use vector autoregression models (Roberts, 1998). However, the use of such approach had its limitations, namely, such models could not explain non-linearities and volatility of expectations as well as changes in behaviours during turbulent periods. Another shortcoming of such approach was the limited treatment of perceived inflation in formation of consumer expectations. An alternative measure of consumer inflation expectations relied on survey-based methods. While these surveys provided valuable insights into heterogeneity in expectations, they often revealed persistent deviations from rationality, such as underreaction to new information and strong anchoring on past inflation (Carroll, 2003). This gap led to a stylized but incomplete understanding of expectation formation. Therefore, the need for research that incorporated behavioural elements and subjective perceptions combined with the relevancy of inflation expectations during an inflation surge period, spurred a number of research papers on inflation expectations.

Verbrugge and Zaman (2021) paper on US inflation expectations point out that consumer expectations have significant differences to professional forecasters and business expectations. They also show that consumer inflation expectations are a much worse predictor of actual inflation. Weber, Coibion and Gorodnichenko (2023) study household level data on US consumers to find a link between perceived and expected inflation challenging the link between consumer expectations and actual inflation. The researchers also indicate, that during the inflation surge, the heterogeneity of expectations also rises. Huber, Minina, Schmidt (2023) employ a RCT and establish a causal relationship between consumer inflation perceptions and expectations using data on German households. Since it is well documented

that consumer inflation perceptions are highly heterogenous and biased, it raises serious concerns about the inflation expectations relation to and effect to actual inflation. Bachmann, Berg and Sims (2015) study on US household readiness to spend indicate that higher inflation expectations had negative effect on spending decisions in a near zero lower bound environment and had no effect otherwise. In other words, when operating at zero lower bound and increase in expected inflation results in lower aggregate demand exerting downward pressure to actual inflation. The authors indicated though that the results vary in accordance with the attributes of households. Those households whose inflation expectations were closer to actual ex-post inflation rate did operate more in line with economic theory and Euler's equation used in macroeconomic models. On the other hand, a study on euro area household by Duca, Kenny and Reuter (2021) found some contrary results. The authors find a positive relationship between inflation expectations and household spending. What is more, the effect is found to be stronger at when the interest rates are close to zero. Duca et al. (2021) postulate that increase in inflation expectations can lead to substantial increases in aggregate consumption, especially when the lower bound on interest rates is binding. Country level data is consistent with the study on households; however, researchers indicate that there is a degree of heterogeneity among countries that could arise due to differences in economic structure and consumer behaviours. Rondinelli and Zizza (2020) research on Italian households indicate that the effect of inflation expectations might depend on the inflation level itself. The authors found that during high inflation regime, consumers with higher inflation expectations are more likely to increase their current spending compared to future spending. This suggests that the main channel through which inflation expectations affect aggregate demand was dominated by intertemporal substitution effect. However, during a low inflation regime, households with higher inflation expectations had lower propensity to spend, indicating that income effect was the dominant mechanism. While the body of work on consumer inflation expectations is growing, there is still ambiguity on the effects of it to inflation. The aim of this paper is to shed some light on the relationship of consumer inflation expectations to other macroeconomic variables in EU countries.

What is more, the study of consumer inflation expectations presents inherent challenges that complicate empirical analysis due to the nature of how consumers expectations are measured. The primary method for obtaining data on consumer inflation expectations are surveys with the most famous ones being University of Michigan Surveys of Consumers for US households and European Commission Consumer Surveys for EU households. Households are asked questions of both qualitative and quantitative nature pertaining to their beliefs about inflation in 12 months time. While the quantitative responses are ready to use in studies, issues concerning these responses have long been documented in the literature. Firstly, households consistently overestimate inflation with their quantitative responses (both the expectations and the perception of it); hence, it might not be a reliable measure and some researchers prefer qualitative responses (Arioli et al., 2017; Rutkowska and Szyszko, 2021). What is more, response rate of qualitative responses are generally higher allowing for a more comprehensive survey data (Pesaran and Weale, 2005). However, qualitative responses cannot be directly utilized for studying and modelling inflation expectations in the same manner as quantitative responses. Therefore, researchers usually need to quantify the qualitative expectations data by utilizing mapping methods. The most commonly employed methods in research are the balance method (i.e. balance statistics) and the probability method (e.g. Carlson-Parkin, Batchelor-Orr methods). Although there are studies examining specific methods and their underlying assumptions, there is a lack of academic literature comparing the implications of method selection. Therefore, in this study I aim to use both methods, namely, balance statistics and quantified expectations using Carlson-Parkin approach, and compare whether this choice has any significant implications on the relationship found between inflation expectations and other macroeconomic variables as well as dynamics of it.

Lastly, while some studies (e.g. Duca et al., 2021) focus on multi-country research, some studies focus on single country data. However, a question remains whether study of inflation expectations on multi-country data is beneficial as there is evidence in the academic literature emphasising country differences in inflation as well as inflation expectations dynamics (Kucerova, Paksi and Konarik, 2024; Panagiotis and Argyrios, 2023; Szyszko and Rutkowska, 2019). Therefore, it is beneficial to test whether studying individual country data can produce considerably different results to a study in a panel data setting.

3. Method

To analyse the dynamic relationships between macroeconomic variables, especially inflation expectations relation to other variables, I employ a Panel Vector Autoregression (PVAR) model. The choice of the method is motivated by the fact that the variables analysed are interdependent and the use of VAR allows modelling of such intertemporal dependencies. At first, PVAR with Fixed Effects is estimated using OLS, however, it has been documented that such models can suffer from endogeneity issues, namely, Nickell bias (Nickell, 1981). This bias is especially critical in cases when the longitudinal dimension (T) is small. While the data used in this research is quarterly from 2004Q1 to 2024Q3 for 26 countries , some of the countries do not record observations for some of the variables from the beginning of the sample and the panel is unbalanced. The maximum T observations per country are 79 with the average of 65 observations. The choice of the countries is motivated by the fact that survey questions within them are harmonised and allow for comparability when assessing consumer inflation expectations. Nickell bias should not be substantial due to sufficient observations, yet it will be tested by evaluating a second PVAR model using the two-step Generalized Method of Moments (GMM) as described by Sigmund and Ferstl (2017). The specific form of the model estimation is system GMM, first described by Blundell & Bond (1998). Comparing the coefficients of the two models allows to assess the severity of endogeneity problem with the OLS model. The use of GMM does have its' own issues. The method uses lagged variables as instruments and can generate a large quantity of them leading to overfitting. In order to check for it, Hansen J test is performed to check the instrument validity. What is more, GMM is iterative making the method computationally intensive and given the sample, the lags included in the model need to be limited. Lastly, if the bias in the OLS PVAR model is not significant, GMM model can have significantly larger standard errors of the coefficients, making the variance-bias trade-off not a worthwhile one. General form of the PVAR model is given by:

$$Yi,t = \Gamma 1 Yi,t\text{-}1 + \Gamma 2 Yi,t\text{-}2 + \cdots + \Gamma p Yi,t\text{-}p + \Phi Xi,t + \alpha i + \varepsilon i,t \quad (1)$$

where: Yi,t is a vector of endogenous variables for country i at time t; Γj represents the coefficient matrices for lagged endogenous variables up to lag p; Xi,t is a vector of exogenous control variables (if included); Φ is the coefficient matrix associated with exogenous variables; αi captures country-specific fixed effects; εi,t is the error term.

$$Y_{i,t} = \begin{bmatrix} C_{i,t} \\ Y_{i,t} \\ G_{i,t} \\ L_{i,t} \\ \pi_{i,t} \\ U_{i,t} \\ \pi^{e}_{i,t} \\ i_{i,t} \\ D_{i,t} \\ W_{i,t} \\ E_{i,t} \\ S_{i,t} \end{bmatrix} \quad (2)$$

where Ci,t is YoY percentage change in real consumption (CONS_YOY); Yi,t – YoY percentage change in real GDP (RGDP_YOY); Gi,t - YoY percentage change in government spending (GS_YOY); Li,t - YoY percentage change in loans (LOANS_YOY); πi,t – YoY change in inflation rate (PI_YOY); Ui,t - YoY change in unemployment rate (UN_YOY); πei,t - YoY change in inflation expectations (BS_YOY or PI_EXP_YOY); ii,t - YoY change in interest rate, EURIBOR 3M or equivalent for non-euro area countries (i_YOY); Di,t - YoY percentage change in household deposits (DEPOSITS_YOY); Wi,t - YoY percentage change in average wage (WAGES_YOY); Ei,t - YoY percentage change in

energy prices (ENERGY_YOY); Si,t - YoY change in consumer confidence index (CCI_YOY). While the use of Year-over-Year (YoY) change variables ensure stationarity (Table 2 for Choi's modified unit root test), such choice is also beneficial in reducing the lags required to include in the computationally intensive GMM model to ensure appropriate residual serial correlation. The motivation is also supported by the AIC of the models (Lag 1 model AIC -640.18, Lag 2 model AIC -616.77). The choice of the variables is motivated by the channels through which inflation expectations are theorized or measured to affect economies. For inflation expectations two different measures will be used – change in balance statistics of qualitative consumer responses to European Commission survey and quantitative year-ahead consumer inflation expectations quantified using canonical form of Carlson-Parkin method (See Berk (1999); Millet (2006); Lyziak (2013) for elaborate description of the method). The lag order of one is used and the system of equations are as per below:

$$
\begin{aligned}
Ci,t &= \gamma 11 Ci,t\text{-}1 + \gamma 12 Yi,t\text{-}1 + \cdots + \gamma 1,12 Si,t\text{-}1 + \alpha 1i + \varepsilon 1,t \\
Yi,t &= \gamma 21 Ci,t\text{-}1 + \gamma 22 Yi,t\text{-}1 + \cdots + \gamma 2,12 Si,t\text{-}1 + \alpha 2i + \varepsilon 2,t \\
Gi,t &= \gamma 31 Ci,t\text{-}1 + \gamma 32 Yi,t\text{-}1 + \cdots + \gamma 3,12 Si,t\text{-}1 + \alpha 3i + \varepsilon 3,t \\
Li,t &= \gamma 41 Ci,t\text{-}1 + \gamma 42 Yi,t\text{-}1 + \cdots + \gamma 4,12 Si,t\text{-}1 + \alpha 4i + \varepsilon 4,t \\
\pi i,t &= \gamma 51 Ci,t\text{-}1 + \gamma 52 Yi,t\text{-}1 + \cdots + \gamma 5,12 Si,t\text{-}1 + \alpha 5i + \varepsilon 5,t \\
Ui,t &= \gamma 61 Ci,t\text{-}1 + \gamma 62 Yi,t\text{-}1 + \cdots + \gamma 6,12 Si,t\text{-}1 + \alpha 6i + \varepsilon 6,t \,\# \qquad (3) \\
\pi\text{^e } i,t &= \gamma 71 Ci,t\text{-}1 + \gamma 72 Yi,t\text{-}1 + \cdots + \gamma 7,12 Si,t\text{-}1 + \alpha 7i + \varepsilon 7,t \\
ii,t &= \gamma 81 Ci,t\text{-}1 + \gamma 82 Yi,t\text{-}1 + \cdots + \gamma 8,12 Si,t\text{-}1 + \alpha 8i + \varepsilon 8,t \\
Di,t &= \gamma 91 Ci,t\text{-}1 + \gamma 92 Yi,t\text{-}1 + \cdots + \gamma 9,12 Si,t\text{-}1 + \alpha 9i + \varepsilon 9,t \\
Wi,t &= \gamma 10,1 Ci,t\text{-}1 + \gamma 10,2 Yi,t\text{-}1 + \cdots + \gamma 10,12 Si,t\text{-}1 + \alpha 10i + \varepsilon 10,t \\
Ei,t &= \gamma 11,1 Ci,t\text{-}1 + \gamma 11,2 Yi,t\text{-}1 + \cdots + \gamma 11,12 Si,t\text{-}1 + \alpha 11i + \varepsilon 11,t \\
Si,t &= \gamma 12,1 Ci,t\text{-}1 + \gamma 12,2 Yi,t\text{-}1 + \cdots + \gamma 12,12 Si,t\text{-}1 + \alpha 12i + \varepsilon 12,t
\end{aligned}
$$

4. Results

The first results discussed are when using balance statistics of consumer responses (BS_YOY). The coefficients obtained after estimating OLS fixed effects PVAR can be found in Table 3 and impulse response functions are provided in Figures 1-12. However, before discussing the results it is important to assess whether OLS estimated are affected by endogeneity. Therefore, the coefficients can be compared to GMM PVAR model (Table 4).

First of all, comparison of the results reveals some significant differences in coefficients. OLS fixed effects PVAR model coefficient estimates are larger for several of the equations. The difference in magnitude is substantial enough that the coefficient becomes statistically insignificant in GMM model for some variables. Examples of this can be found with lagged real GDP growth (RGDP_YOY) effect on inflation expectations (BS_YOY) (0.5080, significant at $p < 0.001$ vs. 0.0466, significant at only $p < 0.05$) and government spending (GS_YOY) (0.1383, significant at $p < 0.01$ vs. -0.0156 with $p > 0.05$). As the focus of this research is on inflation expectations, notable differences in coefficient estimates can be found in lagged inflation expectations effect on other macroeconomic variables as well. While OLS estimates significant effect for consumption, loans, unemployment rate, interest rates and consumer confidence index, GMM estimates are insignificant; however, the effects in the OLS model are rather limited and the change in significance level can be attributed to higher standard errors in the GMM model. Mainly, OLS models variables as more persistent than GMM, but GMM model estimates have significantly higher standard errors as expected. Hansen J test for GMM model fails to reject H0 (p-value > 0.1) suggesting that the instruments used in GMM estimation are valid. However, this test should be taken with a grain of salt as the amount of variables used leads to a large number of

instruments that can weaken the reliability of the estimates. Impulse response functions of GMM model can be found in Figures 13-24. Both the results of IRFs and coefficient significance point toward overparameterization, suggesting that GMM approach might not be more reliable than OLS results in this case where a model contains more than a few endogenous variables.

The impulse of the indicated variable is of one standard deviation impulse of the indicated variable. As per OLS model results, a shock in real consumption growth exhibits an immediate and strong positive response of approximately 3.67 p.p. in the first period and is quite persistent with the positive effect gradually decreasing to near-zero after about 6 quarters in the OLS model. Substantial responses are also found in real GDP growth increase (2.2 p.p.) with the effect lasting around 4 quarters, a decline in unemployment (-0.22 p.p.) converging to previous level in about 5-6 quarters, a mild but persistent (> 8 quarters) hump shaped positive response in inflation (0.56 p.p.) peaking at 4 quarters past the initial shock and a hump shaped response in energy prices reaching the peak (2.37 p.p.) in about 2-3 quarters. These responses to the real consumption growth shock are not surprising as they are in line with demand-side theories. Household loans experience a slight increase as a response to shock, however, it might be that households finance increased consumption via borrowing channel. When it comes to changes in consumer inflation expectations and confidence index, it can be observed that inflation expectations experience a hump shaped response with an initial increase (1.37 units) peaking with a one quarter delay (2.32 units) with the effect approaching zero in around 5 quarters. The effect, however, turns negative and significant in the longer horizon (>6 quarters). Such response suggests that consumer inflation expectations react to the shock with a bit of a delay to initial shock. This can happen due to several reasons. One of the possible explanations could rely on delay in information publicly available where some of the consumers react with a lag compared to others thus resulting in a hump shaped response. This could also happen if the consumer responses on inflation expectations react sensitively to increases in price levels, namely, change in inflation and energy prices in the case of this model. The return to previous expectations levels might indicate adjustment to the persistent increase in both of those price level variables. Both reasons are valid as they are widely discussed in the economic literature. Consumer confidence index reacts to the shock in a similar fashion, but there is not hump in the reaction of it and the initial effect (1.64 units) tapers off at around second quarter. There is also a slight negative effect in the long term (> 4 quarters), but it is negligible. The GMM model, however, does not suggest such persistence of most of the variables. While the initial effect of one standard deviation shock to real consumption growth is stronger in GMM model (4.35 p.p.) it is not as persistent as it diminishes to zero in 2-3 quarters. Similar situation is indicated with real GDP growth – stronger initial reaction (3.41 p.p.) but the effect tapers off in 2-3 quarters. Overall, the IRFs of GMM model have large standard errors, therefore, the 95% confidence interval for the responses of other variables includes zero, meaning that the effect found is not statistically significant. Consumer inflation expectations and confidence index are a bit more persistent than the OLS model suggests, but as mentioned, insignificant at the 5% level. The dynamics of responses to a shock in real GDP growth are analogous to responses to a shock in real consumption growth in both models. Slight differences arise in the magnitude of the responses. OLS model suggests that a shock to RGDP_YOY results in a 2.87 p.p. initial response in real consumption and 2.81 p.p. in real GDP growth lasting up to 6-7 quarters. Response of change in consumer inflation expectations are 1.34 units in the initial period, peaking at 2.6 units. GMM model suggests an initial response to the change in real consumption growth of 2.38 p.p. and 6.25 p.p. for real GDP growth.

When considering a positive shock to government spending, the responses of the other macroeconomic variables are much less pronounced. OLS PVAR model results indicate that in the case of a one standard deviation shock to GS_YOU, real consumption growth responds with around 0.37 p.p. initial increase with the effects peaking in 2-3 quarters (0.5 p.p.) after the shock and lasting up to 6 quarters. This suggests that increased government spending has a stimulative effect on consumer demand. Real GDP growth exhibits a comparable response dynamic with a slightly lower magnitude. The government spending growth itself is indicated as persistent with the initial response of 3.87 p.p. and lasting around 8 quarters. There is a minor effect of the shock on wages growth peaking in 2-3 quarters (0.7 p.p.), however such results are most likely obtained since part of the government spending is associated with wages of employees in the public sector rather than the mechanism of the shock transmission itself. Growth of household loans appear to have a significant response as well. Yet, the confidence interval is rather wide implying that the effect of government spending on household debt might vary. Other

variables do not have statistically significant responses suggesting limited transmission mechanisms of government spending shocks. GMM model results indicate that that a shock in government spending only significantly affects wage growth.

OLS model results show that a shock in YOY inflation is indicated as highly persistent lasting longer than 8 quarters. Responses from real consumption growth and real GDP growth are more likely to be one of the causes for the inflation increase through aggregate demand channels rather than responding to an increase in price level. Similar can be said about energy prices – it is more likely that an unexpected increase in the energy prices is the cause of inflation shock rather than the other way around. Wages do not initially respond to a shock in inflation – significant responses are only indicated in about 3-4 quarters after then initial shock. However, even then the response is very mild (around 0.25 p.p.) and far less than the inflation shock. This suggests that in the time period analysed the wage-price spiral was not a prominent shock transmission mechanism. These results are corroborated by response in household deposits. There is no initial response in the change of household deposits after the shock, but a significant negative effect appears in about 2-3 quarters (-0.25 p.p.) and persists long term (about -0.67 p.p. 8 quarters after the shock). This hints that unexpected rise in prices is offset by household savings. Initially consumer inflation expectations increase (3.39 units) as a response to the shock, but after 3 quarters from the initial shock expectations come back to the level before it. In the longer horizon this shock has a negative impact on expectations (-2 units) suggesting that consumers adjust to new price level quickly and expect it to return to previous levels in the long term. Consumer confidence index reacts negatively (-1.1 unit) to a positive inflation shock but returns to previous levels in 6 quarters.

An unexpected increase in the unemployment level is persistent and lasts up to 8 quarters. As expected in economic theory, such shock has strong negative responses of real consumption and real GDP growth (-1.28 p.p. and -1.1 p.p. initial responses, respectively). The YoY growth rates of both the variables return to previous levels in around a year and a half. The shock does not have an initial effect on the wage growth rate, however, 2 quarters after initial shock wage growth rate experiences a negative persistent effect (up to -0.45 p.p.). What is unexpected, is that inflation does not have a noteworthy response to this shock. The response (0.1 – 0.16 p.p.) is barely significant at 95% level. Such findings are not in line with the economic theory. Theoretically, Phillipps curve and a reduction in aggregate demand should pressure price level downwards, however, the results do not suggest that. This could, however, indicate that the countries analysed had unemployment levels higher than inflation accelerating level throughout the time period in consideration. Both consumer inflation expectations and confidence index respond similarly. An initial minor contraction (-0.92 units and -1.28 units), returning to previous levels in 3 quarters.

A one standard deviation increase in consumer inflation expectations balance statistics has some minor positive effects on real consumption growth with the initial effect of 0.42 p.p. but decreasing and diminishing in 3 quarters. However, in the longer term (5-8 quarters) the effect turns negative with similar magnitudes. This is in line with the economic theory, suggesting that consumers expecting higher inflation levels in a year's time move part of their future consumption to the present. Similar effect can be observed in changes of the real GDP growth. The shock has effect on the changes in balance statistics of consumer inflation expectations itself for about 4 quarters which is expected due to the nature of how the expectations data is collected, namely, the nature of the question to respondents having a reference level of current inflation. What is interesting, is that after 5 quarters of the response turns negative but of much lower magnitude than the shock itself. This suggests once the shock has happened, balance statistics remain on a higher level for a prolonged time, i.e. while consumers expect the inflation to decrease, they believe it will take some time before it returns to previous levels. Inflation reacts with an immediate 1.11 p.p. increase to a shock that decreases over time but is highly persistent with the effects indicated to last > 8 quarters. Supporting the previous findings on inflation shock, wages growth rate does not react to an expectations shock as well. This corroborates, that wage-price spiral was not a present shock transmission mechanism in the period analysed. Consumer confidence react negatively to the shock and the effect lasts for about two years.

A shock to consumer confidence index indicates positive effects to aggregate demand and displays responses generally expected from economic theory standpoint. The balance statistics of consumer inflation expectations initially respond with a decline (-3.87 units) but in the second quarter after the shock the effect is insignificant and onwards the effect turns positive, i.e. inflation expectations increase, peaking (2.63 p.p.) 4 quarters after initial shock. Such results might be influenced by the response of energy prices found with the model though, which is more likely to be influenced by the period as it is hard to believe energy prices would decrease after consumer confidence index hike. A one-way relationship the other way around is more likely.

Overall, the results indicate several findings. Firstly, notable discrepancies are recorded in OLS and GMM models with OLS suggesting higher degree of persistence and stronger relationships between the variables whereas GMM estimates find significantly higher standard errors leading to statistical insignificance. Impulse response functions indicate that shocks in real consumption and real GDP positively impact aggregate demand indicators aligning well with economic theory. Government spending shock results, however, suggest limited and less significant effects across multiple macroeconomic variables. Shocks to inflation expectations initially boost real consumption and inflation but eventually generate negative feedback, suggesting consumers shift their consumption forward anticipating future price increases. Wage-price spirals were notably absent as a transmission mechanism during the analysed period, highlighting weak responsiveness of wages to inflationary pressures. This indicates that public sector wage increases should not be viewed as significantly contributing to higher inflation expectations or inflation when considering fiscal policy changes. What is more, it supports Rudd's claims that the wage growth is driven more by the labour market conditions rather than worker demands in anticipating higher levels of inflation. Lastly, unemployment shocks exhibited strong negative effects on consumption and GDP growth but surprisingly limited effects on inflation, challenging traditional Phillips curve predictions, potentially indicating structural unemployment conditions above inflation-accelerating levels in the studied economies. These findings underscore the nuanced interplay between macroeconomic indicators and consumer sentiment, highlighting the need for careful model selection and interpretation when analysing macroeconomic policy implications.

4.1. Carlson-Parkin Method and Panel Vector Autoregression

The following are results when qualitative consumer inflation expectation responses are quantified using Carlson-Parkin method. Normal distribution is assumed, and three scaling parameters are used. The first scaling parameter is actual YoY inflation. While this scaling parameter is popularly used in the literature (Berk, 1999, Forsells and Kenny, 2002, Lolic and Soric, 2017, etc.), it does have its' drawbacks. The use of this scaling parameter implies that consumers correctly perceive current rate of inflation. However, studies suggest that it is not always the case. The second scaling parameter used is running average rate of inflation. It assumes that consumers approximate inflation rate from the information available but are not always up to date in their views on what the current inflation rate is. In other words, consumers possess a general awareness of past inflation developments and adjust their expectations accordingly, albeit in an imprecise and delayed manner. This parameter relaxes the strict unbiasedness assumption inherent in the Carlson-Parkin method, while still presuming that consumers broadly perceive past inflation accurately, though with a greater degree of inertia or inattention. Two years period for running average calculation is used in this study for the second scaling parameter. The third approach involves the estimation of consumers' perceived inflation by applying the Carlson-Parkin method to qualitative survey responses regarding perceptions of year-on-year inflation. This procedure necessitates the use of a scaling parameter to represent a "moderate" rate of inflation, as consumers are asked in reference to such a rate. The most commonly adopted proxies for this moderate inflation rate in the literature are either the central bank's inflation target (Lolic and Soric, 2017) or a running average of past inflation (Szyszko and Rutkowska, 2019, Lyziak, 2010, Szyszko, Rutkowska and Kliber, 2019, etc.). This approach has been the most popular in recent studies utilizing Carlson-Parkin method. What is more, recent studies (Weber et al. (2023); Huber et al. (2023)) have found strong linkage between perceived and expected inflation rates. Therefore, it may be of critical importance to consider consumer perceptions when quantifying their expectation responses. Accordingly, in this study, the third scaling parameter is defined as the quantified consumer perceived inflation rate, calculated using a two-year

running average of actual inflation. The running average of inflation acts as a moderate inflation rate, presuming that consumers base their decisions on historical information. This third approach can be considered the least restrictive in terms of how accurately consumer perceptions and expectations reflect actual inflation rates.

Figures 25–30 represent impulse response functions from PVAR models when the expected inflation used is quantified using Carlson-Parkin method. To limit the discussion of results, only response of other macroeconomic variables to inflation expectations shock and inflation expectations response to other variable shocks will be presented.

The impulse response analysis comparing models using the change in balance statistics (BS_YOY) and those using quantified consumer inflation expectations (PI_EXP1_YOY) reveals broadly similar macroeconomic dynamics across most variables. As expected, the behaviour of the inflation expectations variable itself differs notably between the two specifications, reflecting the differing measurement of the variables. Beyond this, no substantial differences in the dynamic responses of other variables are observed. Although subtle divergences can be noted. The first one can be seen in the response of the consumer confidence index (CCI_YOY) to a shock in unemployment. Although the initial response is comparable across both models, the specification using quantified inflation expectations indicates a positive long-term effect—beginning after approximately five quarters—with magnitudes reaching 0.3 to 0.4 units. Another notable difference occurs in the response of year-on-year changes in household deposits to a shock in inflation expectations. In the BS_YOY model, the response is statistically insignificant. In contrast, the PI_EXP1_YOY model produces a significant negative effect, with deviations of up to –0.7 percentage points appearing after the fourth quarter. Minor differences in the magnitude of responses are also observed in selected variables, though these do not indicate substantial changes in direction or persistence. When comparing the BS_YOY model to the model using quantified expectations constructed with a scaling parameter equal to the running average of actual year-on-year inflation (PI_EXP2_YOY), the overall dynamics again remain largely similar. However, some additional differences do arise. Specifically, the responses of energy prices (ENERGY_YOY) and consumer confidence (CCI_YOY) exhibit greater persistence in the PI_EXP2_YOY model. The relationships between energy prices, inflation, and inflation expectations are more prolonged, indicating that the inflation transmission channel through energy prices may be more strongly activated when using quantified expectations. Additionally, CCI_YOY responses to several shocks are of greater magnitude and return to pre-shock levels more slowly, suggesting that consumer sentiment dynamics may be affected by the specification of inflation expectations. This observation is further corroborated by findings from the final model, which uses perceived inflation expectations to quantify consumer views (PI_EXP3_YOY). In this specification, consumer confidence does not respond significantly to a shock in inflation expectations, diverging from the earlier models. Moreover, a positive shock to CCI_YOY results in a positive and persistent response of inflation expectations, whereas previous models exhibited an initial negative response under the same shock. This reversal implies that the sentiment channel is particularly sensitive to both the measurement and quantification specification of inflation expectations. The final model also demonstrates that although the broader dynamics remain similar, actual year-on-year inflation (PI_YOY) reacts with roughly half the intensity to a shock in inflation expectations compared to previous specifications. This finding underscores that the nature and intensity of macroeconomic adjustment processes are meaningfully influenced by the formulation of the expectations channel. Among all observed channels, consumer sentiment appears to be the most sensitive, with implications for the responsiveness of other variables. In sum, these results highlight the importance of how inflation expectations are modelled in empirical macroeconomic research. The findings suggest that the choice of expectations proxy—whether qualitative or various forms of quantified expectations—can shape the inferred strength and persistence of macroeconomic relationships, particularly through the sentiment channel. This can have important consequences for both inflation forecasting and the interpretation of expectations in research and policy.

4.2. Forecast Error Variance Decomposition

The forecast error variance decomposition analysis of our model, which utilizes business statistics as a proxy for consumer inflation expectations (as depicted in Figures 31-33), reveals several key insights into the dynamics of macroeconomic variables. The variance in real consumption, government

spending, household loans, and household deposits is predominantly explained by shocks to the respective variables themselves, with more than 85% of the variance accounted for within an eight-quarter horizon following the initial shock. In the case of real GDP growth, a significant proportion of its variance is influenced by shocks to consumption. Initially, this effect is substantial at 61.1%, although it diminishes over time to approximately 43% by the eighth quarter. Conversely, the explanatory power of real GDP growth itself increases from an initial 38.9% to about 44.8% over the same period, highlighting persistent self-influence. Additionally, the consumer confidence index becomes increasingly relevant, contributing up to 6.9% of the variance by the eighth quarter. The variance decomposition of inflation (PI_YOY) is initially dominated by its own shocks. However, as the horizon expands, consumption and consumer inflation expectations become more critical in explaining the variance, contributing 20.2% and 15.2%, respectively. Changes in the unemployment rate are largely driven by exogenous shocks to itself initially. Over time, however, shocks to consumption (14.4%) and real GDP (17.5%) increasingly influence unemployment dynamics, underscoring strong interactions between labour market conditions and overall economic activity. Consumer confidence also emerges as a significant factor, contributing 10.4% of the variance, indicating its psychological and behavioural influence on employment decisions. The consumer response balance statistics are initially heavily influenced by exogenous shocks to themselves. However, the explanatory power of real consumption growth, actual inflation, and consumer confidence grows over time, reaching 5%, 9.1%, and 9.7%, respectively, by the eighth quarter. Similarly, wages are increasingly influenced by real consumption and real GDP, with contributions of 8.4% and 4.5% at the eighth quarter. Government spending also plays a role, maintaining an explanation power of around 12% one year after the shock. As expected by economic theory, interest rate changes are primarily influenced by macroeconomic variables over longer horizons. Real consumption explains 6% of the variance, real GDP accounts for 14.4%, and inflation explains 8.2%, while consumer expectations contribute up to 5.8%. The variance in energy prices is closely tied to actual inflation levels both initially and over time, with real consumption becoming a more important factor in the longer term. Lastly, the variance in the consumer confidence index is primarily driven by its own shocks. However, consumer attitudes towards future price developments can explain up to a quarter of the variance starting from the fourth quarter. Inflation and real consumption also become more significant over longer horizons, explaining 6.4% and 4.8% of the variance, respectively. This suggests that consumer sentiment is sensitive to price levels and overall consumption patterns.

4.3. Vector Autoregression on Individual Countries

A central methodological question in the empirical literature is whether panel data analysis or country-specific estimation provides more informative insights into macroeconomic dynamics. In this study, the same model specification utilized in the panel setting is applied to individual countries in order to examine potential heterogeneity in responses. Specifically, for each country, a vector autoregression (VAR) model is estimated, and impulse response functions (IRFs) with associated 95% confidence intervals are computed. Given the focus of this research on consumer inflation expectations, the analysis centers on the principal transmission channels through which expectations, treated as an exogenous shock, affect macroeconomic outcomes. Table 1 summarizes the country-specific IRFs for the percentage change in real consumption (CONS_YOY), change in inflation (PI_YOY), wage growth (WAGES_YOY), and variation in the Consumer Confidence Index (CCI_YOY) in response to a one standard deviation shock in consumer inflation expectations response balance statistics (BS_YOY).

Table 1. Summary of VAR impulse response functions of select macroeconomic variables to a positive shock of inflation expectations (BS_YOY) for individual countries.

	Negative response	Delayed negative response	No significant response	Delayed positive response	Positive response
Real Consumption growth (CONS_YOY)	-	-	AT, BE, BG, CZ, ES, FR, GR, HR, HU, IT, LT, LU, NL, PL, PT, RO, SI, SK	-	CY, DE, EE, FI, IE, SE
Inflation (PI_YOY)	-	-	NL, SI	CZ, HU, IT	AT, BE, BG, CY, DE, EE, ES, FI, FR, GR, HR, IE, LT, LU, PL, PT, RO, SE, SK
Wage growth (WAGES_YOY)	-	ES	AT, BG, CY, CZ, DE, FI, FR, GR, HR, IE, IT, LT, LU, NL, PL, PT, RO, SE, SI, SK	BE	EE, HU
Consumer Confidence Index (CCI_YOY)	AT, BE, BG, CY, CZ, DE, ES, FR, GR, HR, HU, IT, LT, LU, PL, PT, RO, SI, SK	FI, NL, SE	IE	-	EE

The results indicate that only a minority of countries display a positive consumption response to an inflation expectations shock, with Finland being the sole country to exhibit a persistent effect beyond the initial period. In contrast, the panel model suggests a modest positive consumption effect lasting up to three quarters, yet most country-level VAR estimates do not support a statistically significant or sustained increase in consumption in response to heightened inflation expectations. Turning to inflation dynamics, the majority of country-specific responses are consistent with the aggregate panel findings. A positive expectations shock is generally associated with an increase in YoY inflation, typically following a hump-shaped trajectory of similar duration. However, some exceptions are observed, notably in the Czech Republic, Hungary, and Italy, where inflation responses are delayed, and in the Netherlands and Slovenia, where the estimated effects are statistically insignificant. Analysis of wage growth reveals that most countries do not exhibit systematic responses to changes in inflation expectations. However, in the cases of Estonia and Hungary there is a positive response in wages while in the case of Belgium there is a delayed positive effect. Conversely, Spain demonstrates a significant negative relationship, which may be attributable to structural labour market conditions, such as persistently high unemployment relative to the EU average. Nonetheless, the magnitude of these wage responses remains limited. With respect to consumer sentiment, as proxied by the Consumer Confidence Index, most countries mirror the negative response observed in the panel analysis. However, these effects are generally less persistent at the country level, with significant negative impacts persisting beyond the third period in only about half of the sample. Notably, Finland, the Netherlands, and Sweden exhibit delayed responses, while Estonia displays a short-lived positive effect. Collectively, these findings highlight substantial heterogeneity in the intensity, statistical significance, and persistence of macroeconomic responses to inflation expectation shocks across countries. This heterogeneity underscores the value of country-specific analysis for understanding the transmission of inflation expectations to macroeconomic outcomes, suggesting that aggregate panel approaches may obscure important cross-country differences.

5. Conclusions

This study presents the critical importance of accurately modelling consumer inflation expectations in macroeconomic analysis, highlighting several key points. Notable differences are found in OLS and GMM models with OLS suggesting higher degree of persistence and stronger relationships between the variables whereas GMM estimates find significantly higher standard errors leading to statistical insignificance. GMM approach might not be optimal due to the various channels that need to be considered when modelling the effects of inflation expectations and OLS approach was preferred in this case. The results indicate that there is a significant relationship between inflation expectations and consumer spending behaviour consistent with the intertemporal substitution effects asserted in theoretical models. The impulse response analyses revealed theoretically consistent, yet empirically modest effects of inflation expectations on aggregate demand and actual inflation. A critical observation was the persistent absence of the wage-price spiral during the analysed period, indicating limited transmission from inflation expectations to wage dynamics. This indicates that public sector wage increases should not be viewed as significantly contributing to higher inflation expectations or inflation when considering fiscal policy changes. What is more, it supports Rudd's claims that the wage growth is driven more by the labour market conditions rather than worker demands in anticipating higher levels of inflation. Furthermore, contrary to conventional Phillips curve expectations, unemployment shocks exhibited only marginal effects on inflation, suggesting structural labour market dynamics such as unemployment rate above the natural rate of unemployment. The results could also indicate that during the period analysed inflation was prominently influenced by supply side shocks rather than demand. Therefore, reduction of public spending as fiscal policy tool might be limited when attempting to reduce inflationary pressures. Furthermore, the sensitivity analysis utilizing different quantification methods for qualitative inflation expectation responses illustrated that macroeconomic relationships found, particularly concerning consumer sentiment and spending behaviour, are dependent on methodological choices. This study highlights that consumer sentiment dynamics display substantial sensitivity to the specific method employed for quantifying inflation expectations. Therefore, research focusing on consumer sentiment should exercise caution when selecting methods to quantify consumer inflation expectations, or alternatively, should verify the robustness of results by testing multiple quantification approaches. What is more, consumer inflation expectations dynamics and effects have considerable heterogeneity between the countries. Hence, most accurate results can be found studying the effects of consumer behaviour to macroeconomics in the context of individual countries. Future research should focus on studying individual country consumers, ideally, taking into account the heterogeneity of consumers and their behaviour patterns with regards to their beliefs about future prices, i.e. focus on different types of consumers could also benefit the research on the effects of changes in inflation expectations.

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