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Assessing reliability of aggregated inflation views in the European Commission Consumer Survey*

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Abstract

Using a novel approach based on micro-level survey responses, we assess the reliability of aggregated inflation expectations estimates in the European Commission Consumer Survey. We identify the share of consumers, whose qualitative and quantitative views on expected increase of prices do not match each other. Then we consider the impact of inconsistent survey responses on balance statistics and mean values of quantitative inflation expectations. We also analyze expectations' formation estimating the sticky-information models. The results, based on Finnish and Polish data, suggest that even if the fraction of inconsistent survey responses is non-negligible, it matters neither for the aggregated figures of inflation views, nor for understanding of the formation of inflation expectations by consumers. We conclude that micro-level inconsistencies do not reduce the reliability of the current EC Consumer Survey dataset. Our results also indicate that inconsistent responses are not important drivers of the inflation overestimation bias displayed in the data.

JEL: D12, D84.

Keywords: inflation expectations, European Union, consumer survey.

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1 Introduction

The European Commission (EC) Consumer Survey is conducted regularly in the member states of the European Union (EU). Every month, around 41,000 randomly selected EU consumers are interviewed by national institutes on behalf of the European Commission (DG ECFIN) as part of the "Joint Harmonized EU Programme of Business and Consumer Surveys".[1] The survey provides information about qualitative inflation perceptions and inflation expectations of EU consumers, which are typically aggregated using balance statistics. Corresponding aggregated quantitative estimates, i.e. mean values of individual numerical responses, are experimental and not published regularly. Using various methods, several authors have analyzed basic properties of the EC Consumer Survey. For example, Lindén (2005) and Biau et al. (2010) have examined views of euro area consumers and European Commission (2014) and Arioli et al. (2017) those of EU consumers.

Aggregated survey inflation estimates are widely used in economic and policy analysis. For central bankers, puzzling inflation developments, the effective zero lower bound and unconventional monetary policy measures in the post crisis years have emphasized the need to monitor and analyze inflation expectations, as they are important determinants of actual inflation and they affect monetary policy effectiveness. As recently pointed out by many policy makers, more analyses of inflation expectations of consumers are needed.[2] Inflation expectations of consumers are obviously important themselves, for understanding decisions related to consumption, saving and wage bargaining, but they have also been used to proxy firms' expectations (e.g. Coibion and Gorodnichenko, 2015; Friedrich, 2016).[3] Several authors have recently studied how inflation opinions of consumers in individual EU countries are formed and how they affect consumers' economic behavior (cf. D'Acunto et al., 2019a,b; Duca et al., 2018; Easaw et al., 2013; Łyziak, 2016; Premik and Stanisławska, 2017; Stanisławska, 2019; Vellekoop and Wiederholt, 2019).

Experimental quantitative inflation perceptions and expectations of EU consumers systematically overestimate current and future inflation rates. Compared to US consumer survey conducted by the Michigan University, overestimation bias is large in the EC Consumer Survey.[4] In line with similar findings for other economies, including US, the EU consumers' inflation views are quite heterogeneous depending on gender, age, income and education (Arioli et al., 2017; Biau et al., 2010; Lindén, 2005).

[1] See European Commission (2017) for description of the EC Consumer Survey.

[2] For example, the ECB Vice-President Vitor Constâncio pointed out in 2017: *"For policymakers, this [recent research] seems to suggest that there is an important role of the central bank in shaping the expectations of the general public, not only that of financial markets. It also suggests that more research is needed to understand the different factors that shape the inflation expectations of individual households… Only more detailed data that matches inflation expectations of households with their decisions will be able to shed more light on this issue".*

[3] Given some empirical results it seems questionable whether consumer inflation expectations constitute an adequate proxy for firms' inflation expectations – e.g. in the US (Bryan et al., 2015) and in Poland (Łyziak, 2013).

[4] Overestimation bias may be related to design and methodology of the EC Consumer Survey, as wording of inflation questions may be interpreted in various ways across survey respondents and over time. For example, the generic term "consumer prices", which does not specify a particular inflation measure, is potentially problematic, which, taken at face value, implies a reference to price levels and not to inflation rates. The content of consumer basket may also differ across consumers and substantial outliers may reflect open-ended quantitative questions without ranges and the lack of additional questions after unusual replies.

In this study we attempt to contribute to the discussion on the reliability of quantitative inflation perceptions and expectations. One way of validating these measures used in the literature concerns their consistency with respective qualitative dataset, i.e. whether under some specific criteria quantitative and qualitative survey data match each other. Some authors have already examined consistency of inflation estimates in the EC Consumer Survey, but only on the aggregate level, separately for consumer views on past and future inflation. In this perspective both types of survey responses of EU consumers (i.e. qualitative and quantitative views of inflation) seem broadly consistent with each other, which means that consumers declaring stronger price increases in qualitative terms have, on average, higher quantitative assessments (Arioli et al., 2017).

Our work is related also to literature examining relation between point forecasts and central tendencies of subjective distributions of experts reported as histograms. As the survey questions refer to the same variables and differ only with the type of questions, one expects consistency between responses. Nevertheless, Engelberg et al. (2009) document divergences between reported point forecasts and values implied from subjective distributions in the Philadelphia Fed Survey of Professional Forecasters, and show that inconsistent point forecasts of GDP growth and inflation rates represent more favorable scenarios than central tendencies of subjective distributions. Clements (2010) finds that point forecasts are more accurate than means based on histograms and test several hypotheses explaining existence of discrepancies between these two kinds of forecasts, while Clements (2014) compares the two sets of forecasts in terms of Bayesian learning model.

We propose a new approach how to define consistency of consumers' inflation views, which makes use of micro-level inflation perceptions and expectations – both in qualitative and quantitative terms. More specifically, we compare the strength of price increases expressed in the qualitative way and its counterpart based on quantitative assessments, i.e. a difference between individual expected and perceived inflation. To the best of our knowledge, such a detailed analysis of micro-level consistency of inflation views of consumers involving simultaneously different types of questions on perceived inflation and expected inflation, is still lacking in the literature.[5] Based on this approach, we evaluate whether the commonly used *balance statistics* and experimental mean values of *quantitative* estimates in the EC Consumer Survey are subject to substantial distortions due to inconsistent survey responses. Our analysis of micro-level consistency has the advantage that it is not subject to distortions related to overestimation bias, as in our consistency check set-up we focus on the *expected change in subjective inflation* (Duca et al., 2018). Thus, we examine a survey respondent's subjective inflation expectations over the next 12 months in relation to his/her subjective inflation perceptions over the past 12 months without paying any attention to current or lagged actual inflation rate.

We examine inconsistency of consumer inflation perceptions and expectations in two quite different states of the European Union, i.e. Finland and Poland, using two confidential, fully

[5] Analyses of this kind have been done before (Buiten and Rooijakkers, 2003; Łyziak and Stanisławska, 2006), but they have been more general, as the authors have focused on individual economies and have not checked the quantitative importance of the identified inconsistencies.

comparable, anonymized micro-level datasets starting in May 2003. Finland has belonged to the EU since 1995 and to the euro area since 1999. Poland joined the EU in May 2004 and has not adopted euro yet. Even if inflation developments in both these economies have been quite similar since 2013, the overestimation bias of Finnish consumers' inflation perceptions and expectations has been much smaller than that of Polish consumers. In general, taking the longer time perspective, Finland is among EU economies displaying the lowest overestimation bias of inflation, while Poland belongs to typical EU economies, in which overestimation bias is substantial (Arioli et al., 2017). In the paper we discuss variation of the degree of inconsistency over time and across both EU member states. We also investigate how micro-level inconsistency, consumers' socioeconomic characteristics and formation of inflation expectations are related. Finally, using aggregated data, we estimate sticky-information models in order to examine to what extent micro-level inconsistency affects our understanding of formation of consumer inflation expectations.

Our analyses indicate that the share of inconsistent responses is non-negligible in Finland and Poland. This share seems to be very similar in both economies, which may suggest that the inconsistencies are related rather to the construction of the survey than to economic factors. In spite of non-negligible share of inconsistent survey responses, we provide evidence that both the commonly used balance statistics based on qualitative survey responses and experimental mean values of quantitative inflation estimates are reliable.

In both economies the degree of inconsistency in individual fractions varies with inflation, while the probability of giving inconsistent responses depends on some socioeconomic characteristics of the respondent, i.e. his/her education and income. Consumers, who give inconsistent responses, seem less affected by experts' forecasts than consumers, whose qualitative and quantitative match each other. Based on sticky-information model estimations with aggregated data, we report that the differences between original and adjusted measures of quantitative inflation expectations are too small to change our understanding of how consumers form their inflation expectations.

Even if the results based on Finnish and Polish data suggest that the EC Consumer Survey does not suffer from the micro-level inconsistency problem, it does not necessarily refer to other EU economies. Therefore, in order to confirm the results based on the two quite different economies in the EU, it would be useful to extend this pilot project to cover all EU member states.

The paper is structured as follows. The Finnish and Polish datasets of consumer inflation perception and expectations are described in Section 2. The concept of internal inconsistency of micro-level survey responses is presented and examined in Section 3. The reliability of aggregated survey responses is investigated in Section 4 and concluding remarks are provided in Section 5.

2 Qualitative and quantitative survey questions on inflation

Every month, Statistics Finland conducts the Consumer Survey for Finland and GfK Polonia conducts Consumer Sentiment Survey for Poland as a part of the European Commission's harmonized consumer survey program.[6] We use these surveys as a source of micro data on consumer inflation perception and inflation expectations. The Finnish dataset covers the period since May 2003 till December 2017, while the Polish dataset covers the period since May 2003 till September 2018. The survey contains four questions on consumer opinions concerning consumer price developments over the last 12 months (inflation perception) and over the next 12 months (inflation expectations), asked in the following order: qualitative question on past changes in consumer prices (Q5), quantitative question on past changes in consumer prices (Q51), qualitative question on expected change in consumer prices (Q6) and quantitative question on expected change in consumer prices (Q61).

2.1 Qualitative survey questions on inflation

Qualitative questions indicate directional change of consumers' views on perceived or expected developments in consumer prices, but not the magnitudes of these changes. In the case of consumers' inflation perception, the qualitative question in the EC Consumer Survey has the following form:

> Q5: *"How do you think that consumer prices have developed over the last 12 months? They have: 1. risen a lot; 2. risen moderately; 3. risen slightly; 4. stayed about the same; 5. fallen; 6. don't know."*

The above response categories are denoted by [P1], [P2], … and [P6]. The qualitative question related to consumers' inflation expectations has the following form:

> Q6: *"By comparison with the past 12 months, how do you expect that consumer prices will develop over the next 12 months? They will: 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 above response categories are denoted by [E1], [E2], … and [E6]. Qualitative survey responses are typically aggregated using so-called balance statistics, defined as the weighted sums of the relative frequencies of different categories. The European Commission and other institutions often use weights of subsequent categories equal to 1, 0.5, 0, -0.5, -1, respectively. Under the assumption that the above weights, selected on an *ad hoc* basis, reflect properly distances between subsequent groups of respondents in terms of their perceived or expected inflation,

[6] Further details on the Finnish survey are available at http://www.tilastokeskus.fi/til/kbar/index_en.html and on Polish survey – at https://ec.europa.eu/info/files/business-and-consumer-survey-poland-consumers_en.

the balance statistics indicate direction of change of inflation perceptions and expectations. Alternatively, qualitative views on inflation might be translated to a scale directly comparable to inflation figures by applying some statistical methods. This approach also relies on some arbitrary assumptions (see Nardo, 2003, for overview).

2.2 Quantitative survey questions on inflation

Within the same survey questionnaire, respondents, who declare their qualitative views on consumers price developments, are asked the corresponding quantitative questions:

> Q51: *"By how many percent do you think that consumer prices have gone up/down over the past 12 months? (Please give a single figure estimate): Consumer prices have increased by……,…% / decreased by……,…%."*
>
> Q61: *"By how many percent do you expect consumer prices to go up/down over the next 12 months? (Please give a single figure estimate): Consumer prices will increase by……,…% / decrease by……,…%."*

If a survey participant expects in qualitative terms that consumer prices will *"stay about the same"*, quantitative inflation expectations are assumed to be zero.

Contrary to many other consumer surveys, quantitative questions in the EC Consumer Survey do not include predefined ranges and the interviewer does not ask additional questions in the case of implausible inflation opinions. The use of ranges would rule out extreme opinions and decrease dispersion of responses, but on the other hand, they would potentially limit views of consumers.

Since some quantitative survey responses are extremely high or extremely low, institutions conducting surveys use certain criteria to delete outliers. In our baseline analysis, we follow Statistics Finland and apply a rule based on standard deviation.[7] For comparison, we also consider winsorizing (i.e. we limit extreme observations to 5th and 95th percentile) and the original dataset.[8]

2.3 Overview of aggregated inflation expectations estimates

Figure 1 plots average subjective inflation views of consumers based on quantitative survey responses, and the actual inflation rate. In both countries inflation perception and expectations

[7] Statistics Finland removes inflation perception and expectations if their absolute value exceeds 15%, which corresponds to about 3 standard deviations (Kangassalo and Takala, 2005). Employing the same criteria to the Polish dataset leads to removing observations below -25% and above 50%.

[8] These results are not shown (available on request).

are strongly correlated with the current inflation rate, measured by CPI or HICP (Table 1).[9] As expected, the linear correlation coefficients are higher for inflation perception than expectations.

One striking difference between the two economies lies in the level of inflation perception and expectations, despite broadly similar levels of inflation (Table 2). Finnish consumers overestimated current inflation on average by about 1.8 perc. points, and future inflation by about 1.4 perc. points, comparing, respectively, to 9.4 perc. points and 8.0 perc. points for Polish consumers (Figure 2). As reported by Arioli et al. (2017), Finland belongs to countries with the lowest bias in quantitative inflation perception and expectations (together with Sweden and Denmark), while Poland is ranked among countries with high values of these statistics.[10]

Inflation expectations are strongly correlated also with inflation perception, which suggests that they have mostly backward-looking character. The linear correlation coefficients, 0.87 for Finland and 0.91 for Poland, are higher than for CPI or HICP inflation. This finding is in line with the literature showing that inflation expectations are affected by subjective opinions about current situation rather than by official price statistics (e.g. Bryan and Venkatu, 2001b; Easaw et al., 2013; Jonung, 1981).

Another interesting observation is that inflation perception on average exceeds inflation expectations, i.e. consumers expect inflation rate to go down. In Finland inflation expectations were higher than perception only since the beginning of 2015 (low inflation period). In Poland such a situation took place only at the beginning of the sample, just before the accession to EU. Such pattern is common also in other countries (Duca et al., 2018).

Having opinions on current and expected inflation allows conducting more in-depth analysis how these opinions are related to each other. For example, for the euro area as a whole Arioli et al. (2017) find that quantitative mean perceptions for different qualitative categories [P1]-[P3] have reasonable orders, meaning that consumers reporting that prices have risen a lot declare higher quantitative perceptions (on average) than consumers reporting that prices have risen moderately. In addition, consumers stating that prices have risen slightly declare on average lower quantitative perceptions than those who believe that prices have risen moderately. The same applies to the corresponding pairs of questions on inflation expectations. Also in Finland and Poland the order of conditional mean perceptions and mean expectations is reasonable during almost all the time in sample period (see Table A.1, Figures A.1 and A.2 in the Appendix).

Another dimension of interrelation between the survey questions results from the fact that three first qualitative categories of inflation expectations refer to expected change in inflation: "prices will increase more rapidly" (category [E1]), "prices will increase at the same rate" (category [E2]) and "prices will increase at slower rate" (category [E3]). Therefore one might check whether consumers in these categories declare in quantitative terms inflation expectations being, respectively, higher than inflation perception, equal to inflation perception or lower than inflation

[9] In Poland CPI and HICP inflation are almost the same, so it doesn't matter which measure we apply, whereas in Finland CPI inflation is more volatile than HICP.

[10] On average, the bias in the European Union countries amounts to about 8 perc. points for inflation perception and about 4 perc. points for inflation expectations (see Arioli et al., 2017, Table 3.1).

perception. Difference between quantitative expected inflation and quantitative perceived inflation informs about subjective expected change in inflation. Such a measure was employed by Duca et al. (2018) in studying the link between inflation expectations of the euro area consumers and their propensity to consume. In general, in both countries, the expected change in inflation is positive for [E1] and negative for [E3] (Figure 3). However, consumers expecting no change in inflation ([E2]), systematically declare quantitative expected inflation lower than perceived inflation. On average, the expected change in inflation in this group of respondents amounted to -0.3 perc. points in Finland and -0.6 perc. points in Poland. The consistency of expected change in inflation (based on quantitative survey responses) with qualitative opinions about expected inflation is examined in detail in the rest of the paper.

3 Inconsistency analysis on a micro level

Analyzing relations between quantitative and qualitative survey responses at aggregate level is not fully satisfactory as averages might mask some problems in the data and completely ignore heterogeneity. Therefore, in this section we exploit the Finnish and Polish micro datasets to investigate inconsistencies in individual inflation views.

3.1 Definition of inconsistent responses

We assess internal inconsistency of individual responses by taking advantage of the construction of the qualitative question on inflation expectations (Q6), in which the strength of expected price increases is expressed relative to the perceived inflation rate. It allows assessing whether the pairs of quantitative declarations related to currently perceived inflation (Q5a) and expected inflation (Q6a) match the responses to the qualitative survey question.

It should be underlined that we assess internal inconsistency of responses only for a subset of consumers. Firstly, we are not able to evaluate inconsistency of individual qualitative responses in categories [E4] and [E5] as they do not refer to perceived inflation. Secondly, responses [E1]-[E3] implicitly assume that there was an increase in prices during last 12 months, so we can consider only consumers who declared in inflation perception question (Q5) that prices have risen, i.e. categories [P1]-[P3]. As a result, the property of internal inconsistency might be tested only for consumers who perceive positive inflation over the past 12 months and at the same time expect positive inflation over the next 12 months. In Finland this subset of individual responses amounts to 58%, while in Poland to 74% of total responses (Table A.2 in the Appendix).

We define that a consumer's inflation views are inconsistent in the following cases:

- he/she expects in qualitative terms that *"consumer prices will increase more rapidly"* (category [E1]), but his/her quantitative inflation expectation is lower than or equal to his/her quantitative perception (expected change in inflation is non-positive);
- he/she expects in qualitative terms that *"consumer prices will increase at a slower rate"* (category [E3]), but his/her quantitative inflation expectation is higher than or equal to his/her quantitative perception (expected change in inflation is non-negative);
- he/she expects in qualitative terms that *"consumer prices will increase at the same rate"* (category [E2]), but the difference between his/her quantitative inflation expectation and perceptions is considerable, i.e. his/her expectation is outside the tolerance interval (sensitivity interval) surrounding the perceived rate of inflation.[11]

[11] In other words, introducing a tolerance interval means that if a consumer reports quantitative inflation perception and expectations that are not identical, but close enough to each other, we consider such response as consistent. For example, if consumers A and B expect in qualitative terms that "prices will increase at the same rate" and consumer's A (B) inflation perceptions is 2 per cent (5 per cent), a consumer's A (B) inflation expectations between 1.8 and 2.2 per cent (between 4.5 and 5.5 per cent) are treated as consistent in the case of 10 per cent tolerance interval.

Assessing inconsistency of survey responses in category [E2] of qualitative expectations, we examine tolerance intervals of different widths. Given large cross-sectional dispersion of individual quantitative responses we determine this width in relation to the level of individual inflation perception, i.e. $\pm\alpha\pi_i^p$, where π_i^p denotes quantitative inflation perception of i-th respondent, and α equals 0, 0.1, 0.2, 0.3, 0.4 or 0.5. Below we refer to these tolerance intervals using symbols: *t0*, *t1*, *t2*, .., *t5*. In the most restrictive case ($\alpha = 0$), any difference between inflation expectations and perception means that a given response is treated as inconsistent, while in the least restrictive case ($\alpha = 0.5$), the difference between inflation expectations and inflation perception must be larger than 50% of individual perception to categorize this response as inconsistent.

3.2 Interpretation of inconsistent responses

Inconsistency of individual qualitative and quantitative responses described above refers to the whole record of survey declarations, i.e. to a combination of four questions on subjective views on developments in consumer prices.[12] Having inconsistent responses identified an important questions is how to interpret them and which part of the survey – qualitative or quantitative – is more likely to be blamed for this inconsistency. In general there are several potential reasons for inconsistency, like lack of motivation, poor cognitive skills or poor financial literacy of the survey participant.[13] First, the whole record (i.e. all four individual responses) may be erroneous. Second, a quantitative survey responses may be reasonable, while the qualitative responses are implausible. Third, a quantitative response may reveal "true" opinions of a consumer, while the qualitative one is erroneous.

It is difficult to discriminate among these possibilities. Pesaran and Weale (2006) claim that it is easier to obtain reliable responses to less precise qualitative survey questions than to more precise quantitative questions (truth vs. precision elicitation problem). This opinion is supported by empirical findings by Jonung (1986), who shows that when asked for numerical estimates of the perceived and expected rate of inflation, uncertainty of consumers increases considerably. In addition, quantitative survey question can be potentially interpreted by respondents in various ways. Some of consumers may misunderstand the concept of percentages or their quantitative responses have qualitative features due to digit preference (Bryan and Palmqvist, 2005; Curtin, 2009).[14] The reliability of the results from qualitative survey can be constrained too. Similarly as in the case of quantitative survey questions, consumers can interpret qualitative questions in different ways. For example, the meaning of words "moderately" and "slightly" may differ across consumers and over time and some consumers may think that the expression "stay about the same" is related to inflation rate rather than to price levels (Arioli et al., 2017).

[12] Assessing consistency we directly use only 3 survey questions (Q6, Q51, Q61), however responses to Q6 refer to price changes over last 12 months that are expressed also in Q5.

[13] See Bruine de Bruin et al. (2010) for the analysis of financial literacy and D'Acunto et al. (2019a,b) for the analysis of cognitive abilities and inflation expectations.

[14] Digit preference is the empirical regularity that respondents, when asked to express their opinions quantitatively, tend to declare specific numbers, such as 5%, 10%, 15%, 20% (e.g. Baker, 1992; Binder, 2017; Curtin, 2009; Łyziak and Stanisławska, 2006).

The above discussion suggests that we are not able identify the exact reason for inconsistent views of an individual consumer. Therefore, we construct alternative dataset, in which all four responses of inconsistent consumers have been removed. Then, we compare whether aggregated inflation measures and formation of inflation expectations based on the original dataset are clearly different from those based on the alternative dataset.

3.3 Scale of inconsistency problem

Table 3 reveals that significant share of responses are classified as inconsistent according to the criteria proposed above. In the most restrictive case, i.e. assuming zero tolerance interval, as much as approximately one-fourth of consumers for which we are able to test for consistency, have internally inconsistent views of consumer prices (31% in Finland and 27% in Poland). Even assuming the widest tolerance interval for responses in category [E2], the share of inconsistent responses falls only to about 13% in both countries.

If we focus on single categories of qualitative expectations, it turns out that 39% of Finnish consumers and about 35% of Polish consumers expecting prices to increase more rapidly over the next 12 months declared lower quantitative inflation expectations than perceived inflation. Among consumers expecting qualitatively lower inflation rate over the next 12 months, the shares of inconsistent quantitative assessments amount to 21% in Finland and 27% in Poland. Assuming zero tolerance interval, about 33% of Finnish consumers and 26% of Polish consumers expecting the same inflation rate in the qualitative terms, declared different expected inflation than perceived inflation in quantitative terms. This share is reduced to about 5-6%, when we apply the least restrictive criteria.

It is interesting to notice that the shares of inconsistent responses are very similar in both economies, despite large differences in the level of inflation expectations and perceptions as well as features of economies. This suggests that the inconsistencies are related rather to the construction of the survey, especially to the wording of the questions, which is harmonized across the EU countries, than to economic factors.

Next we look at evolution of the share of inconsistent responses over time (Figure 4). In both countries the fractions of inconsistent responses (i.e. the total fraction in three categories) vary over time. It seems that the share of inconsistent responses in categories [E1] and [E2] grows with inflation rate, while the share of inconsistent responses in [E3] falls when inflation is higher (Table 4). The correlations are the strongest if we assume zero tolerance interval in [E2]. In Finland the results are not fully robust to the choice of inflation index (CPI or HICP).

3.4 Demography of inconsistent responses

Many studies document differences in inflation perception and expectations related to demographic characteristics of consumers (e.g. Bruine de Bruin et al., 2010; Bryan and Venkatu,

2001b,a; Easaw et al., 2013; Jonung, 1981; Lindén, 2005; Malgarini, 2008). Table 5 shows shares of inconsistent responses in the groups of consumers categorized according to gender, income, education and age. In line with intuition, in both economies consumers having higher income and better education hold inconsistent inflation views less frequently than those with lower income and educational level. In Poland differences between women and men as well between younger and older consumers, are negligible, while in Finland these characteristics seem to play some role.

In order to confirm these conclusions, we employ individual survey responses to estimate a binary outcome model in which dependent variable takes 1 if a response is inconsistent and 0 otherwise.[15] The set of explanatory variables includes gender, income, education level and age (grouped into four categories). Due to the structure of the dataset (repeated cross-sections), we also add time dummies as regressors in order to control for time specific factors which could affect the inconsistency. Table 6 reports marginal effects of respondent's individual characteristics on probability of declaring inconsistent inflation view based on estimated probit models, as well as results of tests for significance of socioeconomic characteristics.[16] Marginal effects show impact of given characteristic comparing to the reference respondent. Reference respondent is female, 30 to 49 years old, with secondary education and high income (4th quartile).[17] Each column in Table 6 corresponds to a different tolerance interval. The model results corroborate conclusions based on frequencies of inconsistency occurrence presented in Table 5. In Finland, all individual characteristics matter regardless of the assumed width of the tolerance interval. Men, respondents with higher education and higher income are less prone to give inconsistent responses to the questions about inflation. The youngest and older respondents (more than 50 years old) have also greater tendency to have inconsistent view. In Poland, only income and education matter for all tolerance intervals. As in Finland, higher income and higher education affect probability of inconsistent view negatively, but the magnitudes of the marginal effects are lower.

3.5 Model of expectations formation

In this section we continue our analysis on micro level and try to assess differences, if any, between consistent and inconsistent responses from the point of view of expectations' formation. The survey does not have a structure of panel, but only repeated cross-sections, so we are not able to study dynamic relationships or fully control for cross-section heterogeneity. However, similar to Easaw et al. (2013), we can regress individual inflation expectations (π_i^e) on individual inflation perception (π_i^p), expectations of professional forecasters (π^{exp}) and socioeconomic characteristics of a respondent (P_i). Such a specification draws on empirical observation that inflation expectations are under strong influence of perceived inflation (e.g. Jonung, 1981, Bryan

[15] We still consider only responses for which we are able to assess consistency, namely in [E1]-[E3] and [P1]-[P3].

[16] Choice of the functional form (logit vs. probit) does not affect the outcome (both models have the same implications for the impact of socioeconomic characteristics). Value of the log likelihood function is almost the same for both functional forms giving no guidance on the choice.

[17] The reference respondent corresponds to the most frequent categories in the Polish dataset.

and Venkatu, 2001b) as well as on theory of epidemiology of expectations formation (Carroll, 2003), indicating important role of experts' forecast. Data on expert forecasts comes from Consensus Economics for Finland and Thomson Reuters survey for Poland.

We start from a simple model (1) in which demographic characteristics affect only the level of expectations, and then augment it by allowing heterogenous reaction to inflation perception and expert forecasts – model (2). In additional estimations, as a robustness check, we add time dummies to capture time specific factors. The estimated models are as follows:

$$\pi_i^e = c + \alpha\pi_i^p + \beta\pi^{exp} + \sum_k \gamma_k P_i^k + \varepsilon_i \tag{1}$$

$$\pi_i^e = c + \alpha\pi_i^p + \sum_k \alpha_k P_i^k \pi_i^p + \beta\pi^{exp} + \sum_k \beta_k P_i^k \pi^{exp} + \sum_k \gamma_k P_i^k + \varepsilon_i \tag{2}$$

Our main interest lies in possible differences in formulating expectations by consumers who have consistent and inconsistent inflation views. Therefore, we add additional dummy variable, indicating whether the response is inconsistent ($I_i = 1$) or consistent ($I_i = 0$), and interact model parameters with it (models 3 and 4). We estimate these models with alternative definitions of inconsistent responses (i.e. alternative tolerance intervals in qualitative category [E2]).

$$\pi_i^e = c + c^* I_i + \alpha\pi_i^p + \alpha^* I_i \pi_i^p + \beta\pi^{exp} + \beta^* I_i \pi^{exp} + \sum_k \gamma_k P_i^k + \sum_k \gamma_k^* I_i P_i^k + \varepsilon_i \tag{3}$$

$$\begin{aligned} \pi_i^e = c + c^* I_i + \alpha\pi_i^p + \alpha^* I_i \pi_i^p + \sum_k \alpha_k P_i^k \pi_i^p + \beta\pi^{exp} + \beta^* I_i \pi^{exp} + \\ + \sum_k \beta_k P_i^k \pi^{exp} + \sum_k \gamma_k P_i^k + \sum_k \gamma_k^* I_i P_i^k + \varepsilon_i \end{aligned} \tag{4}$$

Table 7 summarizes the most important results. In the baseline specification (columns (1) and (2)) we do not distinguish consistent and inconsistent responses. In both countries inflation perception significantly affects inflation expectations. For the average Finnish consumer in the dataset, rise in inflation perception by 1 perc. point results in increase in expected inflation by 0.72 perc. points.[18] In Poland the reaction of expectations is very similar and amounts to 0.77 perc. points. The consumers in both countries differ with respect to reaction to experts forecasts. In Finland increase in experts' forecasts by 1 perc. point is followed by increase in consumer inflation expectations by 0.07 perc. points, while in Poland by 0.90 perc. points. Allowing for more heterogeneity in expectations formation (specification 2) does not clearly change the estimation results.[19]

[18] We have to keep in mind that we are considering only a subset of responses, [E1]-[E3] and [P1]-[P3], so we should not interpret them as the average responses in the population.

[19] Parameter estimates for models 2 and 4 presented in Table 7, describe the reaction of the reference respondent to a change in inflation perception and expert forecasts. The reference respondent for both counties is the same as in the binary outcome model in section 3.4. and corresponds to the most frequent categories of demographic characteristics in the Polish dataset.

The remaining columns in Table 7 refer to the specifications, in which we allow consumer expectations to react differently to inflation perception and expert forecasts depending on the consistency of the response. As in the case of the baseline specification, we consider two cases. In specification (3) parameters on perceived inflation and on expert forecasts are homogenous across consumers with the same socioeconomic characteristics, while in specification (4) they might be different.

As expected, the inconsistent responses are less linked to perceived inflation (estimate of interaction between the perceived inflation and I_i dummy is negative and statistically significant for all tolerance intervals). On the Finnish dataset for all tolerance intervals and on the Polish dataset for narrow tolerance intervals (*t0*, *t1*, *t2*) we get negative and statistically significant estimate of interaction between expert forecast and I_i dummy. This indicates that consumers who give inconsistent responses pay less attention to the expert forecasts. The difference in reaction to expert forecasts between consumers declaring consistent and inconsistent numbers is quite large. For example, in Finland, if we assume zero tolerance interval, the estimated coefficient on expert forecast for consistent responses is 0.11, while for inconsistent is 0.03. In Poland these figures amount to, respectively, 1.0 and 0.61. The results are robust in the specification, which allows the reaction of expectations to perceived inflation and expert forecast to differ across socioeconomic groups. Also adding time dummies, instead of expert forecasts, does not change the results (not shown). In Poland, if we consider wider tolerance intervals (*t3*, *t4*, *t5*), the estimates of interaction between expert forecasts and inconsistency dummy is negative, but not statistically significant (or statistically significant at 10%).

Summing up, micro-level analysis shows that consumers who have inconsistent responses differ somewhat from the others in terms of expectations formation. Specifically, their inflation expectations are to a lesser degree linked to the experts' forecasts.

4 Robustness of aggregated inflation views to individual inconsistency problem

4.1 Methods

The aim of this section is to find out how strong the impact of inconsistent responses on aggregate statistics is. Therefore, we consider the whole dataset, i.e. responses in all categories [P1]-[P5] and [E1]-[E5], and not only responses for which we are able to assess internal consistency. As motivated above, due to the fact that for inconsistent responses we are not able to assess which survey question – qualitative or quantitative – is "correct" and which is "false", we construct alternative dataset, in which all four responses of inconsistent consumers have been removed.

We focus on two features of aggregated series. Firstly, we compare various aggregate statistics calculated on original micro dataset based on all survey responses with the dataset covering only consistent responses. We consider all monthly statistics that are typically in use: balance statistics, mean values of perceived and expected inflation, as well as measures of disagreement among consumers (standard deviation of quantitative responses). Computing aggregate series we apply sampling weights. We assess the differences between the original and adjusted series using standard statistics, i.e. mean difference (MD), root mean square difference (RMSD) and mean absolute difference (MAD).

Secondly, we complement our analysis of the reliability of the current Consumer Survey dataset by focusing on the formation of inflation expectations based on aggregated figures. Our aim is to test to what extent the model of inflation expectations that uses only internally consistent survey responses differs from the model, in which all survey responses are considered. The model we apply is rooted in the sticky-information paradigm (Mankiw and Reis, 2002) and epidemiological models of expectations' formation (Carroll, 2003), providing micro foundations for the Mankiw-Reis model. We assume that due to limited resources and costs of updating information consumers are inattentive in forming their expectations, i.e. they update their expectations infrequently. Instead of assuming that consumers form rational expectations, we assume that when forming inflation expectations, they take into account experts' views on future inflation, as reported in the media. As a result, the aggregated measure of consumer inflation expectations (π^e) depends on their previous expectations and current-period expert forecasts (π^{exp}):

$$\pi_t^e = \lambda \pi_t^{exp} + (1-\lambda)\,\pi_{t-1}^e + \varepsilon_t \tag{5}$$

The parameter λ indicates the share of consumers updating their expectations in a given period (propensity to follow experts), while $(1-\lambda)$ measures the degree of information rigidity. The canonical epidemiological model assumes that in the long run consumer inflation expectations are not different from the expert forecasts. However, using quantitative survey data from the EC Consumer Survey to estimate the epidemiological model of expectations we must be aware

of the fact that compared to professionals, there seems to be a significant overestimation bias in quantitative measures of consumer inflation expectations. Consumers and experts, especially in Poland, seem to use different scales in expressing their expectations. We control for this bias either by including the constant term in the estimated model or by rearranging the model in two different ways.

First, we estimate a traditional epidemiological model (5) with the constant term, reflecting a persistent difference between inflation predictions by consumers and professional forecasters:

$$\pi_t^e = \gamma + \lambda \pi_t^{exp} + (1 - \lambda)\, \pi_{t-1}^e + \varepsilon_t \tag{6}$$

Consumer inflation expectations in the above model can permanently stay away from expert forecasts – the long-run solution of this model is the following: $\pi^e = \pi^{exp} + \frac{\gamma}{\lambda}$. However, the model does not take into account changes in the inflation perception gap, i.e. a difference between subjectively perceived current price dynamics (π^p) and the most recent official inflation rate (π), which seem substantial in both economies (Figure 2). In the second version of the model we replace original survey measures of inflation expectations with measures corrected for the current inflation perception gap.[20] After taking into account this bias, the estimated equation takes the following form:

$$\pi_t^e - (\pi_t^p - \pi_{t-1}) = \gamma + \lambda \pi_t^{exp} + (1 - \lambda) \left[\pi_{t-1}^e - \left(\pi_{t-1}^p - \pi_{t-2}\right)\right] + \varepsilon_t \tag{7}$$

The constant term is still maintained in the model to make it more flexible. In this way the bias in quantitative measures of consumer inflation expectations does not necessarily have to be equal to the bias in inflation perceptions. The long-run solution of the above model is the following: $\pi^e = \pi^{exp} + (\pi^p - \pi) + \frac{\gamma}{\lambda}$.

Thirdly, instead of correcting the measures of consumer inflation expectations used in the sticky-information model, we express this model in terms of the expected change in inflation proposed by Duca et al. (2018), i.e. the difference between consumers' subjective inflation expectations and perceptions. In this case, when assessing future change in inflation, consumers take into account experts' opinions on future change in inflation instead of pure inflation forecasts in the following manner:

$$\pi_t^e - \pi_t^p = \gamma + \lambda \left(\pi_t^{exp} - \pi_{t-1}\right) + (1 - \lambda) \left(\pi_{t-1}^e - \pi_{t-1}^p\right) + \varepsilon_t \tag{8}$$

The long-run solution of the above model, $\pi^e = \pi^{exp} + (\pi^p - \pi) + \frac{\gamma}{\lambda}$, is the same as in the model (7).

[20] As the dependent variable, we use consumer inflation expectations corrected for the current inflation perception gap. Correspondingly, we correct the second explanatory variable, i.e. lagged inflation expectations, using lagged inflation perception gap.

4.2 Aggregated inflation views

Table 8 summarizes differences between aggregated estimates in the original and adjusted datasets in the full sample (see Figures A.3-A.7 in the Appendix for details). In Finland, removing inconsistent responses from the dataset leads to lower aggregated expected and perceived inflation for all tolerance intervals under consideration. In Poland, the adjusted aggregated expected inflation and inflation perception are lower, on average, only if we assume zero tolerance interval or very narrow tolerance interval. For the widest tolerance interval the adjusted aggregated estimates slightly exceed the original ones, on average. Also, the adjusted balance statistics systematically take lower values.

The absolute magnitude of differences is not large. It is greater for series related to the current than future price changes, e.g. the mean difference between alternative measures of inflation perception (assuming zero tolerance interval) in Finland (Poland) amounts to 0.31 (0.85) perc. points, while the corresponding difference for expected inflation it is equal to 0.20 (0.63) perc. points. The two series become more similar if we apply less restrictive criteria for accessing consistency.

The differences in relative terms are more pronounced. The mean absolute percentage difference (MAPD) for Finnish inflation perception and expectations varies from 4 to 17%, while in the Polish case – from 3 to 8%.

Inconsistent responses affect also measures of disagreement in consumer opinions. Adjusted standard deviation suggests less disagreement than the original one. As in the case of other aggregate statistics, the difference is larger for disagreement about current than about future price changes.

All in all, while the share of inconsistent consumers is non-negligible, aggregated inflation estimates seem mainly reflect views of internally consistent consumers. Removing inconsistent responses in most of the cases contributes to reduced bias in quantitative inflation perceptions and, to lesser degree, in quantitative inflation expectations.

4.3 Epidemiological models of expectations formation

Estimation results for the epidemiological model seem useful in describing formation of consumer inflation expectations (Tables 9, 10 and 11). In both economies, the statistical fit across alternative model specifications is very robust with respect to the choice of the tolerance interval. The models allowing for the variation of the consumer perception bias over time, i.e. models (7) and (8), suggest that the degree of information rigidities in Poland is smaller than in Finland. It can be related to the fact that historically inflation rates in Poland have been higher and more volatile than in Finland. This finding seems consistent with evidence based on consumer inflation expectations quantified on the basis of qualitative EC Consumer Survey data. Referring to results by Carroll (2006) and Döpke et al. (2008), Łyziak (2013) shows that

Polish consumers update professional inflation forecasts less frequently than consumers in the United States, but more frequently than in the large economies of the European Union (France, Germany, Italy, United Kingdom).[21]

The choice of the dataset has only limited impact on the estimated parameters. In none of the cases, we are able to reject the hypothesis that the propensity to follow professional forecasters estimated on the basis of only consistent survey responses is equal to its value in the benchmark model. We conclude that the original dataset is reasonable to analyze formation of consumer expectations. Using adjusted instead of the original dataset does not change our understanding of how consumers form their inflation expectations at the aggregate level.

[21]Interestingly, the frequency of updating information seems larger for quantitative survey data used in this study than for the measures of expectations quantified on the basis of qualitative survey data. It would be an interesting area for future research.

5 Conclusions

Problems with understanding recent inflation developments, the effective zero lower bound reached by many central banks and unconventional monetary policy measures adopted since the beginning of the global financial crisis have provoked a new wave of interest in empirical measures of inflation expectations. Economists, including monetary policy makers, have realized that inflation expectations of enterprises and consumers, i.e. the private sector agents directly involved in wage- and price-setting, can be more important for understanding actual price developments than expectations of professional forecasters (e.g. Forsells and Kenny, 2004; Łyziak and Paloviita, 2017). Existing evidence suggests that the latter ones influence the former ones in different economies – in line with predictions of theoretical sticky-information and noisy-information models – but their role in affecting actual inflation is rather limited.

The European Union economies enjoy the European Commission Consumer Survey, a rich dataset of survey-based information on consumers' inflation perception and expectations in individual countries. This dataset contains the results from qualitative questions, usually summarized with simple balance statistics that do not show expected percentage change in the price level. Even if there exist quantification methods used in empirical literature , allowing to derive expected inflation rate on the basis of qualitative responses, such methods require strong and rather untestable assumptions. Therefore, the interest in survey-based measures of consumer inflation expectations in the EU economies has recently moved from qualitative to quantitative questions. Even if the results of quantitative measures display substantial biases and as such are treated as experimental and not released on regular basis, they offer the advantage of being more precise than qualitative survey data.

This study attempts to contribute to the discussion on the reliability and usefulness of quantitative measures of inflation perception and expectations of consumers in the EU economies. We propose a novel method – more detailed than used so far in the literature – of checking internal consistency of quantitative and qualitative data on inflation views. Our approach makes use of micro-level inflation perceptions and expectations – based both on qualitative and quantitative survey questions. To our best knowledge, such a detailed analysis of micro-level consistency of inflation views of consumers constitutes a novel contribution to the literature.

Trying to verify whether the frequency and magnitudes of inconsistent responses undermine reliability of aggregated measures of inflation perceptions and expectations commonly used in economic and policy analysis (i.e. balance statistics and means of quantitative perceptions and expectations), we rely on the EC Consumer Survey data for Finland and Poland. Considering these two economies, even if dictated basically by the data availability, can – in our view – be instructing given that these economies had quite different inflation experiences and are very different from each other in terms of the inflation overestimation bias.

Our findings suggest that even if the share of inconsistent responses is non-negligible in both economies, it has a limited impact on aggregated inflation expectations estimates and does not affect our understanding of the formation of inflation expectations by European consumers.

Depending on the restrictiveness of our approach, as much as 15%-25% of consumers for which we are able to test for consistency display internally inconsistent views on expected changes in consumer prices. Interestingly, this share is very similar in both economies, which may suggest that the inconsistencies are related rather to the construction of the survey than to economic factors. At the same time, in both economies the degree of inconsistency in individual fractions varies with inflation, while the probability of giving inconsistent responses depends on some socioeconomic characteristics of the respondent, i.e. his/her education and income. Consumers, who give inconsistent responses, seem less affected by experts' forecasts than consumers, whose qualitative and quantitative opinions match each other.

Comparing quantitative inflation perceptions and expectations based on the original dataset to analogous measures based consistent responses only we find that the differences between them are not large. It means that the aggregated inflation estimates seem not to be dominated by inconsistent consumers, rather they reflect views of internally-consistent consumers. Also from the point of view of formation of consumer inflation expectations with the sticky-information model and aggregated survey estimates, we conclude that using original and adjusted measures of quantitative inflation expectations does not make any statistically significant difference.

Summing up, the results of our new approach of assessing consistency of qualitative and quantitative survey data on consumer inflation views suggest that micro-level inconsistencies do not matter too much in practice. This positive conclusion indicates that the current datasets of EC Consumer Survey are reliable. But a more disappointing side of this finding is that after removing inconsistent responses we are still not able to explain and reduce the inflation overestimations bias – a typical feature of quantitative survey measures of inflation perception and expectations. Obviously, the results based on Finnish and Polish do not have to necessarily hold for other EU economies. Theretofore, it would seem useful to extend this pilot project to all EU economies, after having access to fully comparable micro level datasets.

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Tables and figures

Table 1: Correlations

(a) Finland

	CPI	HICP	Inflation perception	Inflation expectations
CPI	1.00			
HICP	0.88	1.00		
Inflation perception	0.82	0.81	1.00	
Inflation expectations	0.74	0.69	0.87	1.00

(b) Poland

	CPI	HICP	Inflation perception	Inflation expectations
CPI	1.00			
HICP	0.98	1.00		
Inflation perception	0.86	0.87	1.00	
Inflation expectations	0.82	0.84	0.91	1.00

Table 2: Mean values

	CPI	HICP	Inflation perception	Inflation expectations	Equality test, t-prob.[1]
Finland	1.43	1.57	3.25	2.82	0.002***
Poland	1.98	2.01	11.35	9.95	0.001***

Notes: [1]– The results of t-test for equal means of inflation perceptions and expectations.

Table 3: Share of inconsistent individual responses (in %)

	Finland	Poland
in all categories, *t5*[1]	13.3	12.8
in all categories, *t0*[1]	31.3	27.0
in category: *prices will increase more rapidly*[2]	39.0	34.6
in category: *prices will increase at a slower rate*[2]	21.2	26.9
in category: *prices will increase at the same rate, t0*[2]	33.5	26.5
in category: *prices will increase at the same rate, t1*[2]	31.9	25.6
in category: *prices will increase at the same rate, t2*[2]	25.4	20.4
in category: *prices will increase at the same rate, t3*[2]	20.3	16.5
in category: *prices will increase at the same rate, t4*[2]	12.5	10.1
in category: *prices will increase at the same rate, t5*[2]	6.2	4.7

Notes: [1]– Number of inconsistent responses is expressed in relation to the total number of responses in categories [E1]-[E3].
[2]– Number of inconsistent responses is expressed in relation to the total number of responses in given qualitative category. Only responses for which we are able to assess consistency are taken under consideration, i.e. [E1]-[E3] and [P1]-[P3].

Table 4: Correlation between a share of inconsistent responses and inflation

	Finland, CPI	Finland, HICP	Poland, CPI
in all categories, *t5*[1]	-0.06	0.07	-0.02
in all categories, *t0*[1]	0.07	0.22***	0.37***
in category: *prices will increase more rapidly*[2]	-0.06	0.17**	0.28***
in category: *prices will increase at a slower rate*[2]	-0.41***	-0.45***	-0.38***
in category: *prices will increase at the same rate, t0*[2]	0.22***	0.42***	0.45***
in category: *prices will increase at the same rate, t1*[2]	0.18**	0.39***	0.45***
in category: *prices will increase at the same rate, t2*[2]	0.12	0.31***	0.45***
in category: *prices will increase at the same rate, t3*[2]	0.06	0.24***	0.37***
in category: *prices will increase at the same rate, t4*[2]	0.01	0.16**	0.23***
in category: *prices will increase at the same rate, t5*[2]	-0.03	0.05	0.11

Notes: [1]– Number of inconsistent responses is expressed in relation to the total number of responses in categories [E1]-[E3]. [2]– Number of inconsistent responses is expressed in relation to the total number of responses in given category. Only responses for which we are able to assess consistency are taken under consideration, i.e. [E1]-[E3] and [P1]-[P3]. *, ** and *** represent statistical significance at the 10%, 5% and 1% levels, respectively.

Table 5: Share of inconsistent responses in demographic groups

	Finland		Poland	
	max (*t0*)	min (*t5*)	max (*t0*)	min (*t5*)
Gender				
- male	11.6	29.4	12.9	27.4
- female	14.2	32.4	12.7	27.1
Income				
- 1st quartile	16.5	34.1	15.1	29.6
- 2nd quartile	14.8	33.9	13.7	28.3
- 3rd quartile	12.3	30.6	13.0	27.9
- 4th quartile	8.9	26.0	11.0	25.0
Education				
- primary	17.2	35.8	14.3	28.5
- secondary	13.4	31.9	12.7	27.3
- further	9.0	26.1	11.1	25.4
Age				
- 16-29	15.3	31.5	13.2	27.2
- 30-49	10.6	27.8	12.3	27.1
- 50-64	12.5	31.5	12.6	27.0
- 65+	15.7	36.7	13.6	28.0
Total	**13.3**	**31.3**	**12.8**	**27.0**

Notes: Number of inconsistent responses is expressed in relation to the total number of responses in categories [E1]-[E3]. Only responses for which we are able to assess consistency are taken under consideration, i.e. [E1]-[E3] and [P1]-[P3].

Table 6: Average marginal effects of socioeconomic characteristics on the probability of declaring inconsistent response based on model estimates

(a) Finland

	t0	*t1*	*t2*	*t3*	*t4*	*t5*
Gender						
- male	-0.037***	-0.041***	-0.051***	-0.054***	-0.046***	-0.030***
Income						
- 1st quartile	0.038***	0.042***	0.049***	0.050***	0.048***	0.043***
- 2nd quartile	0.043***	0.046***	0.050***	0.049***	0.044***	0.035***
- 3rd quartile	0.028***	0.030***	0.032***	0.030***	0.026***	0.023***
Education						
- primary	0.032***	0.034***	0.034***	0.036***	0.036***	0.031***
- further	-0.056***	-0.058***	-0.058***	-0.055***	-0.050***	-0.037***
Age						
- 16-29	-0.007*	-0.006	0.004	0.008**	0.014***	0.011***
- 50-64	0.020***	0.018***	0.009***	0.003	0.006**	0.006***
- 65+	0.040***	0.036***	0.021***	0.012***	0.013***	0.015***
N	113 161	113 161	113 161	113 161	113 161	113 161
Tests for parameters significance						
Gender	176.17***	223.41***	390.23***	476.14***	435.54***	235.48***
Income	123.41***	144.58***	196.31***	208.90***	219.26***	195.24***
Education	536.51***	586.81***	650.49***	696.79***	747.63***	570.01***
Age	128.69***	107.16***	26.97***	10.51***	22.71***	24.82***

(b) Poland

	t0	*t1*	*t2*	*t3*	*t4*	*t5*
Gender						
- male	0.006**	0.005*	0.004	0.004	0.004	0.006***
Income						
- 1st quartile	0.035***	0.034***	0.034***	0.034***	0.029***	0.030***
- 2nd quartile	0.027***	0.026***	0.025***	0.025***	0.021***	0.021***
- 3rd quartile	0.020***	0.020***	0.020***	0.019***	0.013***	0.015***
Education						
- primary	0.005	0.006	0.009**	0.010***	0.009***	0.007**
- further	-0.008*	-0.008*	-0.008**	-0.010**	-0.008**	-0.007**
Age						
- 16-29	-0.003	-0.003	0.003	0.005	0.007**	0.006*
- 50-64	-0.002	-0.003	-0.001	-0.003	0.001	0.001
- 65+	-0.003	-0.002	0.001	0.001	0.000	0.001
N	92 592	92 592	92 592	92 592	92 592	92 592
Test for parameters significance						
Gender	4.34**	2.96*	1.68	1.82	2.17	7.05***
Income	68.29***	67.07***	71.22***	77.36***	67.42***	87.9***
Education	5.25*	6.68**	11.08***	16.45***	14.86***	11.2***
Age	0.71	0.74	1.39	4.65	4.89	3.7

Notes: Based on estimation results of probit model with ordinary standard errors. *, ** and *** represent statistical significance at the 10%, 5% and 1% levels, respectively. Only responses for which we are able to assess consistency are taken under consideration, i.e. [E1]-[E3] and [P1]-[P3].

Table 7: Regression results

	baseline		*t0*		*t1*		*t2*		*t3*		*t4*		*t5*	
						Finland								
perceived infl.	0.72***	0.73***	0.80***	0.81***	0.80***	0.81***	0.80***	0.82***	0.80***	0.82***	0.78***	0.79***	0.76***	0.76***
perceived infl. × *I*			-0.19***	-0.19***	-0.20***	-0.20***	-0.23***	-0.23***	-0.24***	-0.25***	-0.24***	-0.25***	-0.20***	-0.20***
expert forecast	0.07***	0.08***	0.11***	0.13***	0.11***	0.13***	0.10***	0.12***	0.10***	0.12***	0.09***	0.11***	0.09***	0.10***
expert forecast × *I*			-0.08***	-0.09***	-0.09***	-0.10***	-0.09***	-0.10***	-0.10***	-0.12***	-0.90***	-0.11***	-0.10***	-0.12***
						Poland								
perceived infl.	0.77***	0.78***	0.85***	0.86***	0.85***	0.86***	0.85***	0.85***	0.85***	0.85***	0.83***	0.83***	0.81***	0.81***
perceived infl. × *I*			-0.22***	-0.22***	-0.23***	-0.23***	-0.26***	-0.26***	-0.27***	-0.27***	-0.25***	-0.25***	-0.21***	-0.21***
expert forecast	0.90***	0.80***	1.00***	0.91***	1.00***	0.90***	0.96***	0.87***	0.93***	0.85***	0.91***	0.83***	0.92***	0.83***
expert forecast × *I*			-0.39***	-0.40***	-0.37***	-0.38***	-0.26***	-0.27***	-0.17	-0.18*	-0.11	-0.13	-0.22	-0.24*
						Specification summary:								
demographic charact.	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
perception ×demo	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
expert forecast × demo	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
perc × *I*			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
exp × *I*			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
demo × *I*			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

Note: *, ** and *** represent statistical significance at the 10%, 5% and 1% levels, respectively. Estimated with robust standard errors. Only responses for which we are able to assess consistency are taken under consideration, i.e. [E1]-[E3] and [P1]-[P3].

Table 8: Differences in monthly aggregate statistics between original and adjusted data

	Finland			Poland		
	MD	RMSD	MAPD[1]	MD	RMSD	MAPD[1]
balance statistics, perception	4.31	4.51	-	3.92	4.18	-
balance statistics, expectations	5.85	6.13	-	4.83	5.18	-
mean, perception (*t0*)	0.31	0.33	17.19	0.85	0.94	8.15
mean, perception (*t5*)	0.11	0.12	6.67	-0.16	0.46	2.95
mean, expectations (*t0*)	0.20	0.22	9.58	0.63	0.70	7.33
mean, expectations (*t5*)	0.09	0.10	4.13	-0.20	0.55	3.83
standard deviation, perception	0.13	0.23	4.44	0.52	0.75	5.27
standard deviation, expectations	0.05	0.11	2.70	0.17	0.30	2.45

Notes: Mean difference defined as $MD = \sum_{t=1}^{T} (X_t - X_t^*)/T$, where X_t denotes monthly statistics based on all responses, while X_t^* the same statistics based on only consistent responses. [1] – MAPD for balance statistics is not shown due to problems related to dividing by values very close to zero.

Table 9: Formation of consumer inflation expectations – equation (6)

	Finland				Poland			
	γ	λ	adj.R^2	F-prob, λ	γ	λ	adj.R^2	F-prob., λ
all expectations	0.134***	0.168***	0.92	-	0.684***	0.086***	0.88	-
consistent expectations								
t0	0.081**	0.137***	0.91	0.66	0.701***	0.094***	0.87	0.85
t1	0.083**	0.138***	0.91	0.67	0.746***	0.093***	0.87	0.86
t2	0.090**	0.141***	0.91	0.70	0.731***	0.090***	0.87	0.92
t3	0.093**	0.141***	0.91	0.70	0.725***	0.088***	0.88	0.95
t4	0.100***	0.146***	0.91	0.76	0.720***	0.087***	0.88	0.98
t5	0.108***	0.153***	0.91	0.83	0.703***	0.084***	0.88	0.97

Notes: *, ** and *** represent statistical significance at the 10%, 5% and 1% levels, respectively. F-prob shows the results of the Wald test, in which we check if the estimated coefficients λ based on internally consistent survey responses are equal to the analogous coefficient estimated using the whole dataset.

Table 10: Formation of consumer inflation expectations – equation (7)

	Finland				Poland			
	γ	λ	adj.R^2	F-prob, λ	γ	λ	adj.R^2	F-prob., λ
all expectations	-0.024	0.076**	0.90	-	-0.274***	0.164***	0.78	-
consistent expectations								
t0	-0.016	0.070**	0.90	0.89	-0.194**	0.148***	0.80	0.78
t1	-0.016	0.070**	0.90	0.89	-0.175**	0.139***	0.81	0.65
t2	-0.016	0.070**	0.90	0.89	-0.175**	0.137***	0.81	0.63
t3	-0.017	0.070**	0.90	0.89	-0.177**	0.136***	0.81	0.62
t4	-0.020	0.071**	0.90	0.91	-0.190**	0.134***	0.81	0.59
t5	-0.024	0.072**	0.90	0.93	-0.203**	0.134***	0.81	0.59

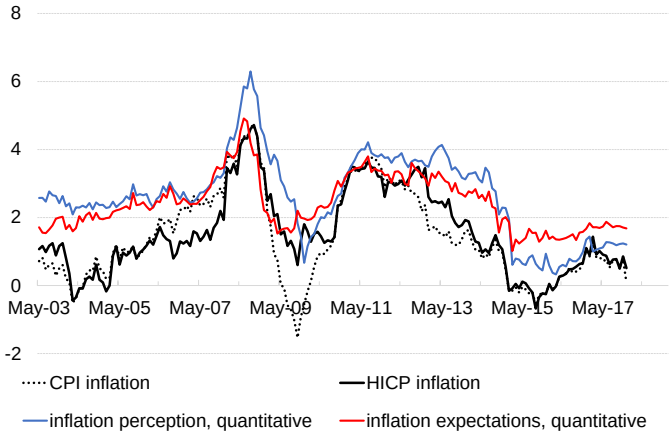
Notes: *, ** and *** represent statistical significance at the 10%, 5% and 1% levels, respectively. F-prob shows the results of the Wald test, in which we check if the estimated coefficients λ based on internally consistent survey responses are equal to the analogous coefficient estimated using the whole dataset.

Table 11: Formation of consumer inflation expectations – equation (8)

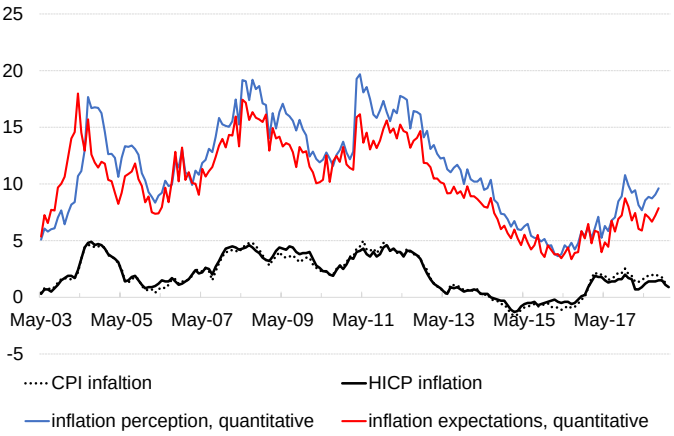
	Finland				Poland			
	γ	λ	adj.R^2	F-prob, λ	γ	λ	adj.R^2	F-prob., λ
all expectations	-0.032*	0.091***	0.90	-	-0.323***	0.192***	0.75	-
consistent expectations								
t0	-0.028	0.095***	0.90	0.86	-0.236***	0.178***	0.72	0.79
t1	-0.027	0.095***	0.90	0.87	-0.212**	0.170***	0.74	0.68
t2	-0.027	0.094***	0.90	0.91	-0.213**	0.169***	0.74	0.65
t3	-0.028	0.093***	0.90	0.92	-0.216***	0.168***	0.75	0.64
t4	-0.031*	0.093***	0.90	0.94	-0.234***	0.168***	0.76	0.64
t5	-0.035*	0.093***	0.90	0.93	-0.254***	0.170***	0.76	0.67

Notes: *, ** and *** represent statistical significance at the 10%, 5% and 1% levels, respectively. F-prob shows the results of the Wald test, in which we check if the estimated coefficients λ based on internally consistent survey responses are equal to the analogous coefficient estimated using the whole dataset.

Figure 1: CPI and HICP inflation rates, inflation perceptions and inflation expectations



(a) Finland



(b) Poland

Figure 2: Inflation perception gap (in pp.)

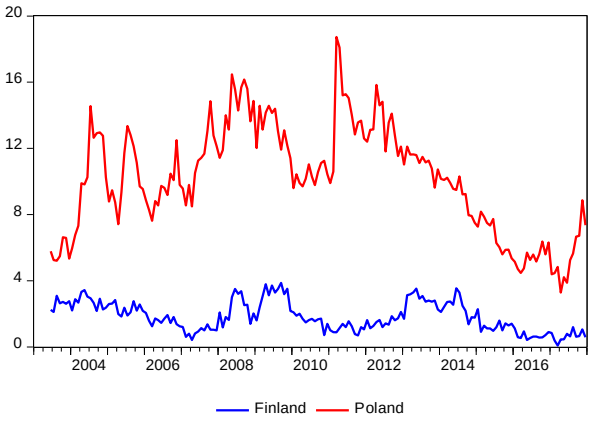
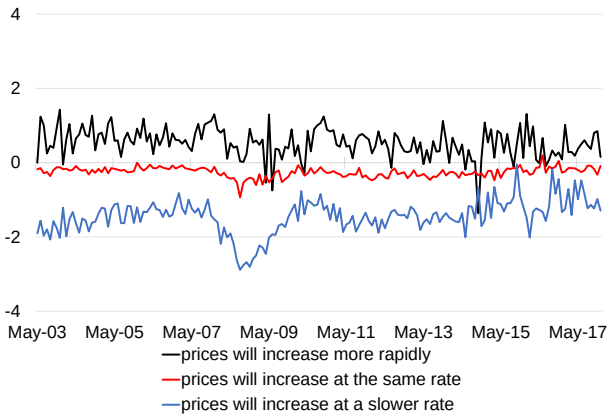
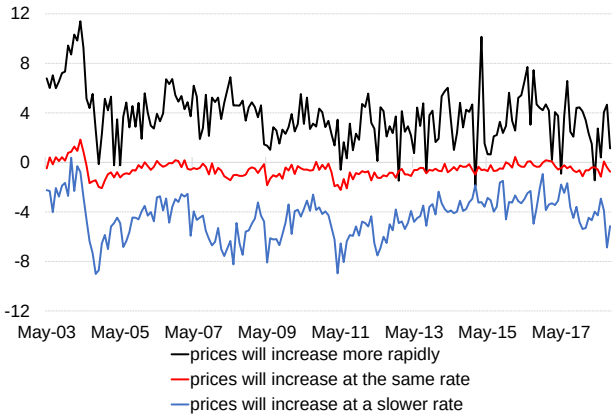


Figure 3: Mean expected change in inflation ($\Delta\pi^e = \pi^e - \pi^p$) for different qualitative categories



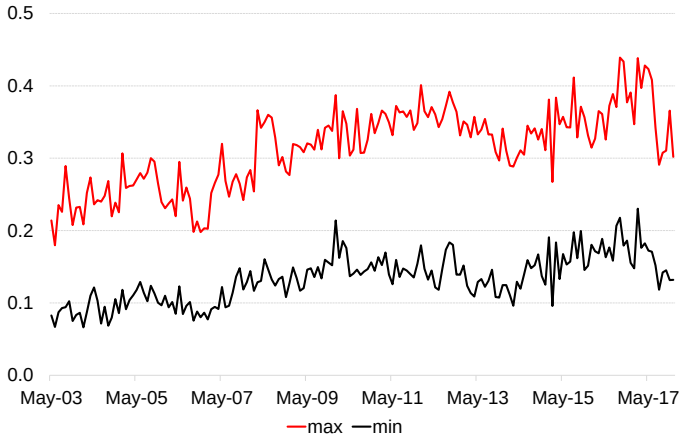
(a) Finland



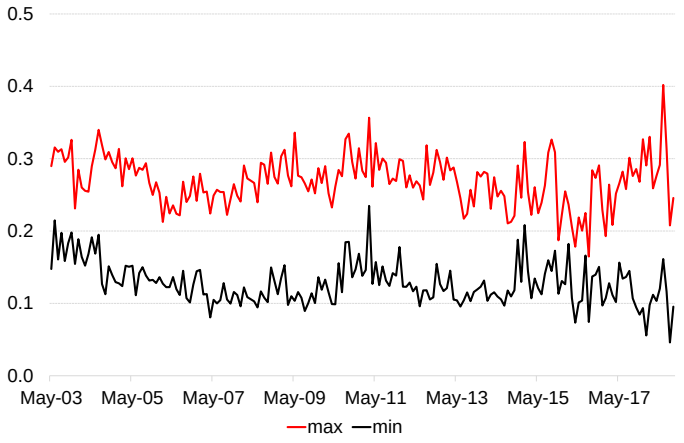
(b) Poland

Note: Only responses in categories [P1]-[P3] and [E1]-[E3].

Figure 4: Share of inconsistent individual responses in categories [E1]-[E3]



(a) Finland



(b) Poland

Notes: Maximum value concerns case with no tolerance interval in category (2) (*prices will increase at the same rate*), while minimum value concerns the case with the widest tolerance interval in this category. Share of responses in relation to the number of responses in categories [P1]-[P3] and [E1]-[E3].

Appendix

Table A.1: Aggregated quantitative perceptions and expectations for different qualitative categories

Qualitative category (perception):	Quantitative inflation perception (perc. point)	
	Finland	Poland
prices have risen a lot	6.8	21.3
prices have risen moderately	6.0	14.6
prices have risen slightly	3.7	9.9
Qualitative category (expectations):	Quantitative inflation expectations (perc. point)	
	Finland	Poland
prices will increase more rapidly	4.4	19.1
prices will increase at the same rate	3.6	13.0
prices will increase at a slower rate	2.8	8.6
Qualitative category (expectations):	Expected change in inflation (perc. point)[1]	
	Finland	Poland
prices will increase more rapidly	0.5	3.8
prices will increase at the same rate	-0.3	-0.6
prices will increase at a slower rate	-1.5	-4.4

Notes: [1]– only responses in [E1]-[E3] and [P1]-[P3].

Table A.2: Qualitative inflation expectations and inflation perceptions – two-way relative frequency table (in %)

(a) Finland

		qualitative inflation expectations category					
		E1	E2	E3	E4	E5	**Total**
qualitative inflation perception category	P1	0.8	1.9	0.7	0.5	0.1	**3.9**
	P2	1.8	6.1	2.0	1.3	0.2	**11.2**
	P3	6.2	30.6	8.2	8.3	0.8	**54.1**
	P4	2.5	6.7	3.3	12.9	1.1	**26.5**
	P5	0.4	0.4	0.5	2.2	0.7	**4.2**
	Total	**11.7**	**45.6**	**14.7**	**25.1**	**2.8**	**100.0**

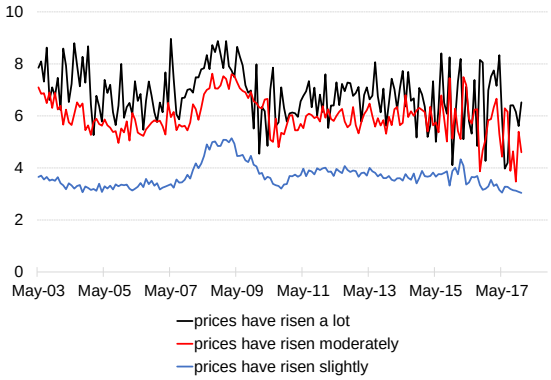
(b) Poland

		qualitative inflation expectations category					
		E1	E2	E3	E4	E5	**Total**
qualitative inflation perception category	P1	3.3	6.3	1.6	0.5	0.0	**11.7**
	P2	4.8	27.4	6.8	2.4	0.1	**41.5**
	P3	2.1	14.5	7.4	4.5	0.1	**28.5**
	P4	0.8	1.6	1.7	13.6	0.1	**17.9**
	P5	0.0	0.1	0.1	0.2	0.1	**0.4**
	Total	**11.0**	**50.0**	**17.5**	**21.2**	**0.4**	**100.0**

Notes: Sample from May 2003 to December 2017 (Finland) / September 2018 (Poland). Inflation perception categories: [P1] prices have risen a lot, [P2] prices have risen moderately, [P3] prices have risen slightly, [P4] prices have stayed about the same, [P5] prices have fallen. Qualitative inflation expectations categories: [E1] prices will increase more rapidly, [E2] prices will increase at the same rate, [E3] prices will increase at a slower rate, [E4] prices will stay about the same, [E5] prices will fall.

Figure A.1: Quantitative mean perceptions for different qualitative categories

(a) Finland



(b) Poland

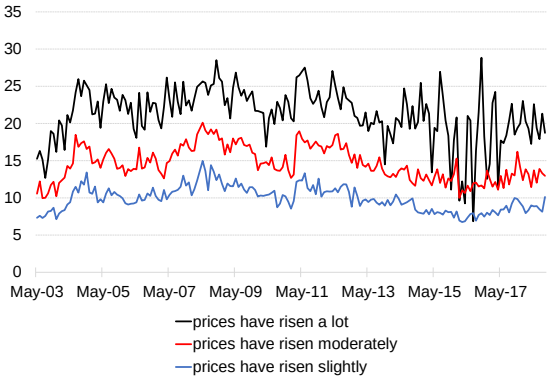
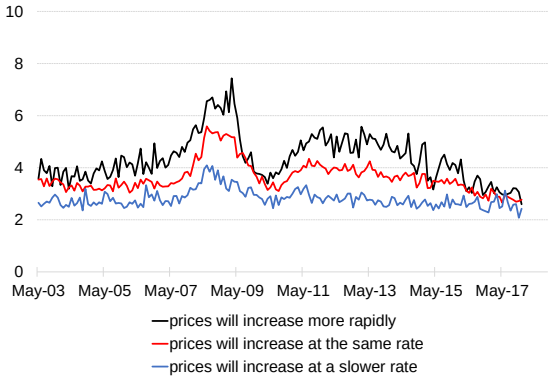


Figure A.2: Quantitative mean expectations for different qualitative categories

(a) Finland



(b) Poland

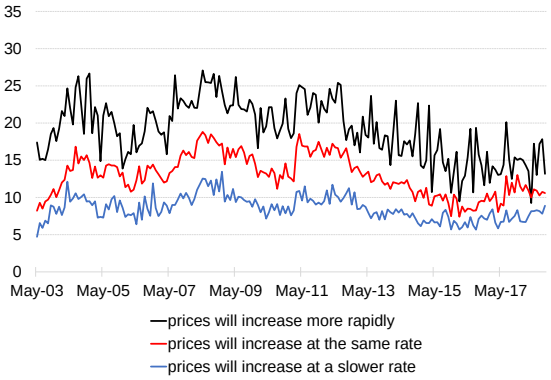
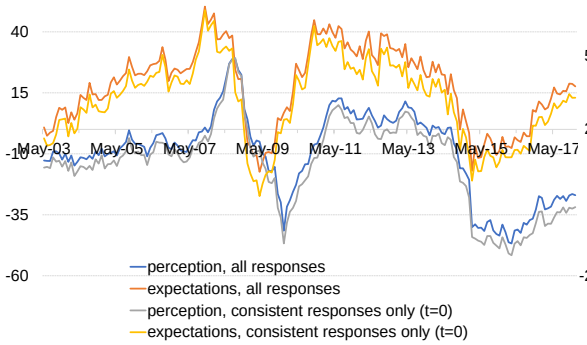


Figure A.3: Balance statistics - based on original and adjusted dataset

(a) Finland



(b) Poland

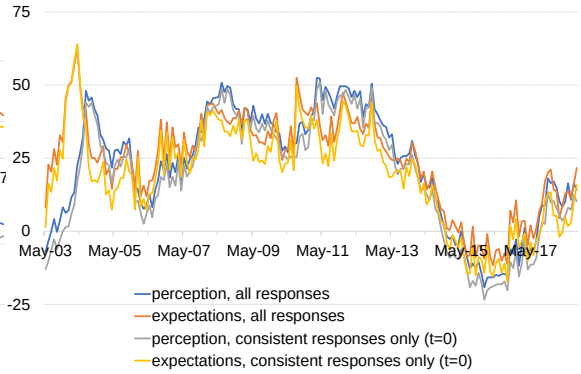
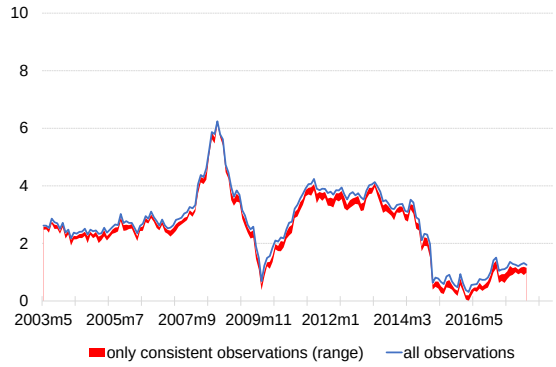


Figure A.4: Mean inflation perception - based on original and adjusted dataset

(a) Finland



(b) Poland

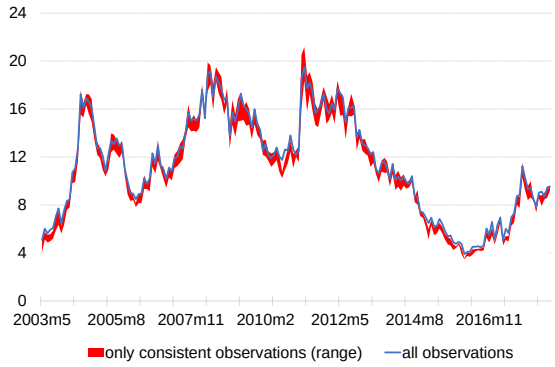
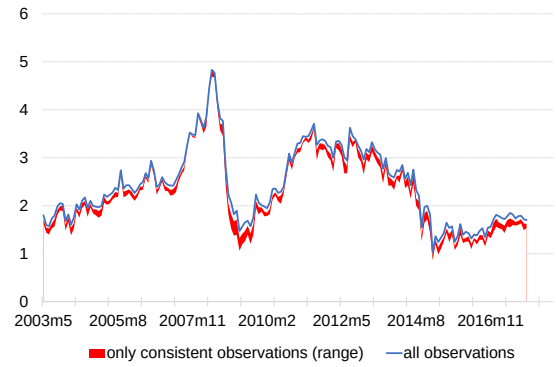


Figure A.5: Mean inflation expectation - based on original and adjusted dataset

(a) Finland



(b) Poland

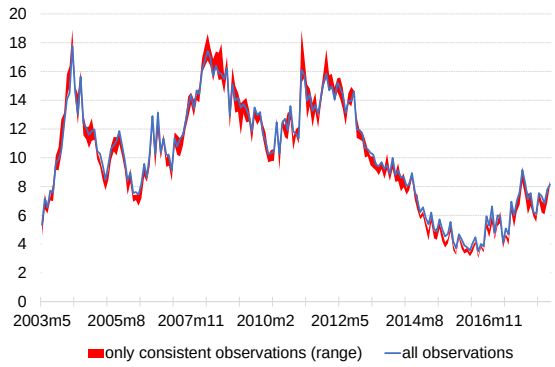
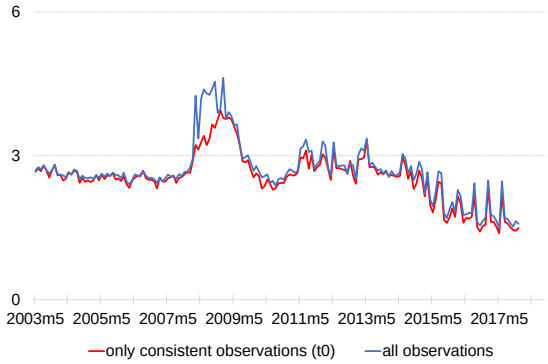


Figure A.6: Disagreement about current inflation - based on original and adjusted dataset

(a) Finland



(b) Poland

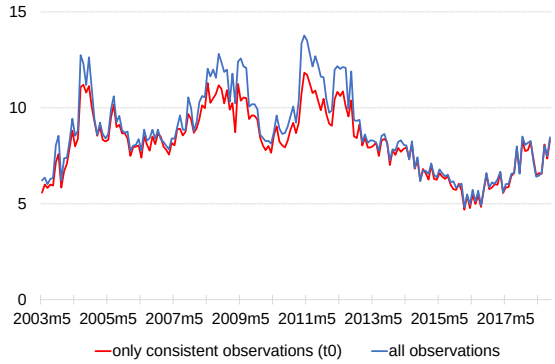
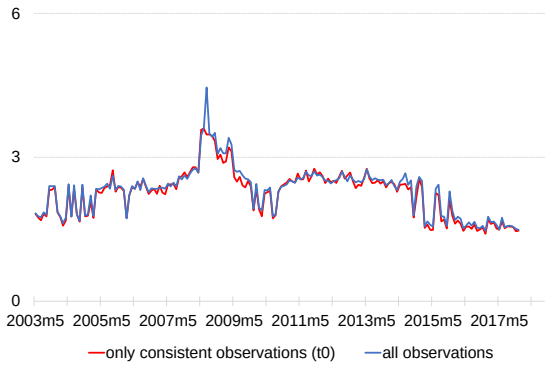
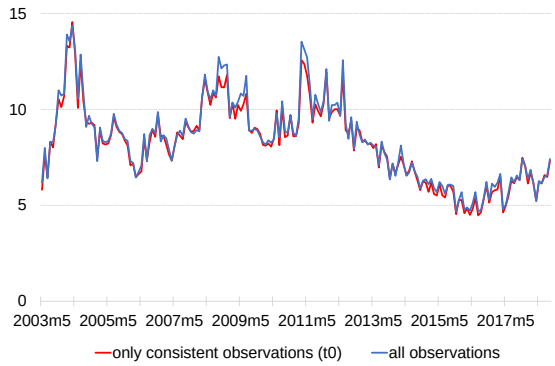


Figure A.7: Disagreement about future inflation - based on original and adjusted dataset

(a) Finland



(b) Poland



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