How to define the Consumer Perceived Price Index? The case of Poland

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[Preliminary version, please do not quote]

Abstract

Inflation perceived by consumers may differ from official statistics particularly due to different baskets of goods and services both variables refer to and by consumer loss aversion to price increases. Those effects, suggested by the Prospect Theory, are confirmed in many empirical studies, showing that consumers are substantially influenced by prices of frequent purchases and price increases are perceived more strongly than price decreases. Following those observations, particularly useful in interpreting a jump of inflation perception in some of the EMU economies after the euro introduction, an alternative price index, i.e. the Index of Perceived Inflation, was proposed in Brachinger (2006) and Brachinger (2008).

The role of price changes of frequently bought goods and services in determining consumer opinions on price changes was also significant in Poland, especially after its accession to the EU. To assess whether this effect is of a systematic nature, in this paper we develop different indices of price changes of frequently bought goods and services in Poland, including the Index of Perceived Inflation. Then we evaluate those indices vs. CPI inflation in terms of their impact on consumer inflation perception, as proxied with survey data. The results suggest that Polish consumers observe a relatively wide range of goods and services and that both factors suggested by the Prospect Theory seem to influence their opinions on evolution of prices in the past.

Having the measure of perceived inflation – i.e. the Consumer Perceived Price Index (CPPI) – that seems more adequate than current CPI inflation on the one hand and survey-based measures of perceived inflation scaled with respect to the trend of CPI inflation on the other hand, we use it as a scaling factor to derive a probability measure of consumer inflation expectations in Poland. Then we compare forecasting accuracy of this measure with respective results based on the measure of consumer inflation expectations quantified in a standard manner.

JEL: D12, D84, E31.

Keywords: Inflation, inflation perceptions, inflation expectations, survey.

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1 Introduction

Inflation expectations play a crucial role in macroeconomics, therefore economist attempt to measure them directly. Consumer inflation expectations are usually quantified on the basis of qualitative survey data. To obtain reliable survey-based measures of inflation expectations with the use of quantification methods – including the most popular probability and regression ones [see e.g. Pesaran (1989), Pesaran and Weale (2006) for a description] – it is important to know what particular measure of current price dynamics consumers have on mind expressing survey opinions on expected price developments. The need to understand how consumers assess current price developments results also from the fact that persistent divergences between economic agents' subjective opinions concerning current price developments and statistical inflation indicators may lower the credibility of official statistics and monetary policy that uses official inflation measures to express its targets and/or communicate policy decisions. Moreover, changes in subjectively perceived inflation can influence expectations about future price changes and distort decisions on prices and wages.

Empirical literature focused on determinants of price changes perceived by consumers has been developed significantly since the launch of the euro in the Economic and Monetary Union (January 2002). Survey data suggest that there was a significant worsening of survey opinions on past price changes after the launch of the euro, even if statistical inflation measures were relatively stable.[1] There are different explanations in the literature concerning the driving forces of the inflation perception gap in the euro area, however there are two principal factors mentioned in this context: firstly, the increase in prices of frequently bought goods and services [e.g. Del Giovane and Sabbatini (2005), Del Giovane and Sabbatini (2006), Fluch and Stix (2005)]; secondly, paying by consumers (especially by those having in advance beliefs of the euro-induced increase in prices) more attention to price increases than to price decreases [Kurri (2006)].[2]

Structural features of the Polish economy make it probably less prone to inflation perception bias resulting from the effect of price changes of frequent purchases. It is due to the fact that frequent purchases – especially foodstuffs and energy (see Table 1) – account for a relatively large part of households expenditures in Poland, so changes in prices of those items affect the CPI inflation to higher extent than in developed economies. However, there is empirical evidence showing that inflation perceptions of Polish consumers are driven by prices of frequent purchases, especially in the periods, when their dynamics exceeds the CPI inflation significantly [Łyziak (2009)].

	food and non-alcoholic beverages	energy	fuels
Poland	21.8%	13.6%	4.2%
European Union (27 countries)	15.7%	10.4%	4.4%
Euro area (17 countries)	15.5%	10.1%	4.5%

Table 1: Average shares of selected goods in the HICP basket, 2008-2012

As far as the impact of price changes of frequently bought goods and services on consumer opinions about price changes in Poland has been already tested, differences in perceiving price changes of different signs or magnitudes by consumers has not. Therefore in the present study we attempt to take both those factors into consideration. Moreover, we analyse a large number of price indices that assume a special role of those factors in affecting consumer inflation perception – larger than in any previous studies.

[1] On the other hand however we should underline that after the launch of the euro consumers in many of the euro area economies became more optimistic about future price changes.

[2] There were also other factors affecting consumer opinions on observed price changes, such as recalculation of prices to former domestic currencies and rounding effects or the tendency to confirm previous strong expectations of price increases after the euro introduction [Stix (2005)].

The aim of this paper is to propose the method for selecting the Consumer Perception Price Index (CPPI) – a measure of inflation that systematically and to the highest extent corresponds to consumer perceptions of recent price changes. We present the results of adopting this method in Poland and then use the obtained estimates of CPPI as a scaling factor in quantifying consumer inflation expectations. Both in selecting the CPPI and in deriving survey-based measures inflation expectations we use the probability quantification method proposed by Carlson and Parkin (1975) and then developed by Batchelor and Orr (1988).

The paper is organized in the following way. Section 2 presents data applied in the paper – i.e. price indices that can affect consumer inflation perception and survey data on price changes perceived by consumers – as well as describes the method used to select the CPPI. Section 3 describes the results of applying this method using Polish data covering the years 2004-2011. Section 4 quantifies inflation expectations using current CPI inflation and CPPI as scaling factors and analyses some features of both measures of inflation expectations. The last section concludes.

2 Data and method applied

2.1 Data

In the study we use two sources of information on price changes perceived by consumers, i.e. price indices that in the light of the literature could be treated as a good approximation of price changes perceived by consumers as well as data from consumer surveys. Due to survey data availability the sample period used in our analysis comprises the years 2004-2011, however price indices are available for the longer period, i.e. 2000-2011.

2.1.1 Price indices used in the study

Based on theoretical considerations suggesting that in forming views on past price changes by consumers the weight of price changes of frequently purchased goods and services may exceed the share of those goods in consumer expenditures as well as that price increases can be perceived more strongly than price decreases, we propose different price indices that reflect such effects. Then we select the optimal one – called the Consumer Perception Price Index (CPPI) – taking into account survey data and analysing to what extent price indices applied are consistent with survey data.

In our study, calculating different types of consumer price indices we use highly disaggregated CPI data, including up to 326 elementary groups. Those elementary group indices are used (with adequate weights) to calculate price indices at a higher level of aggregation, up to the total Consumer Price Index (CPI). Weights used to calculate CPI are based on household budget survey which are conducted every year and hence the weights used to calculate CPI change every year.

As the potential measures of price changes perceived by consumers, denoted as π_t^{Fn}, we consider three groups of price indices:

- The first group comprises 52 price indices of price dynamics of the n most frequently bought goods and services, i.e. those bought every month by at least 50% of households (the list of those goods and services is presented in Annex 1), and we do not differentiate between goods that are or are not seasonally purchased. After ordering all the CPI items by the share of households buying them every month, we start from calculating the index of annual price changes of the category purchased most often in 2000-2011, namely *mixed bread and other bakery products* (π_t^{F1}) and then we gradually supplement it with subsequent items to the 51th one, i.e. *other cereal products* (π_t^{F51}). The formula

used to calculate those indices is the following:

$$\bigwedge_{n=1,\ldots,51} \pi_t^{Fn} = \frac{\sum_{i=1}^{n} q_{t-12}(i) p_t(i)}{\sum_{i=1}^{n} q_{t-12}(i) p_{t-12}(i)} \tag{1}$$

where $p_t(i)$ denotes the price of the i-th good in the period t, while $q_t(i)$ denotes the weight of the i-th good in the period t. The final measure in this group of indices (π_t^{F52}) is based on the items purchased by at least 50% of households in each year under consideration, so its content may change every year.

- The second group of 21 indices is based on all the items in the CPI basket. It comprises so-called Indices of Perceived Inflation (IPI) calculated in line with the original method proposed by Brachinger (2006) and Brachinger (2008):

$$\bigwedge_{n=52,\ldots,73} \pi_t^{Fn} = \sum_{i:\, p_t(i) > p_{t-12}(i)} c_n \frac{\sum_{i=1}^{n} f_{t-12}(i) p_t(i)}{\sum_{i=1}^{n} f_{t-12}(i) p_{t-12}(i)} + \sum_{i:\, p_t(i) \leq p_{t-12}(i)} \frac{\sum_{i=1}^{n} f_{t-12}(i) p_t(i)}{\sum_{i=1}^{n} f_{t-12}(i) p_{t-12}(i)} \tag{2}$$

where $p_t(i)$ denotes the price of the i-th good in the period t, $f_t(i)$ – frequency of its purchases, while $c_n > 1$ is the loss aversion coefficient. The logic behind the above mentioned formula is intuitive. In line with the Prospect Theory [Kahneman and Tversky (1979)], price increases are evaluated higher than price reductions.[3] Moreover, it assumes that the weights of single products and services included in the index (all the CPI basket items are considered) depend rather on relative purchasing frequency of those goods than on their expenditure shares. In line with empirical studies applying the concept of IPI we form 20 different assumptions concerning the coefficient of loss aversion that oscillates between 1.5 and 2.5, i.e.:

$$\bigwedge_{n=53,\ldots,73} c_n = 1.5 + 0.05 \cdot (n - 53) \tag{3}$$

- Two indices in the third group were constructed on the basis of ad hoc selection of the broader groups of the CPI basket, whose items seem to be frequently bought. They are similar to the "frequently out-of-pocket purchases" price index computed by the ECB for the euro area [ECB (2003)], although their content is slightly different. In the Polish case price changes of the following groups of goods and services are taken into consideration: food and non-alcoholic beverages, tobacco, housing and energy carriers, medical products, fuels, communication services, newspapers and articles and products for personal care. Except the main out-of-pocket price index (π_t^{F74}), we calculate also another one, called the positive out-of-pocket price index (π_t^{F75}), in which we disregard all the negative price changes of its components.

- The current CPI inflation (π_t^{F76}) constitutes the final price index taken into consideration as a potential proxy for consumer inflation perception.

The average annual growth rate of all newly created indices is higher than the average CPI, except five indices from the first group, i.e. price changes of the most frequently bought items (π_t^{F46} to π_t^{F50}). The difference between the CPI and other indices is particularly visible during years 2007-2008. Looking closer at this period, we can see, that it was the time when prices of food and energy goods were rising at the

[3] Alternatively we modified this method by introducing three intervals of price changes applying different values of the parameter c for each of them. In this way we consider separately non-positive or negligible inflation, moderate inflation and high inflation. The bounds of those intervals – 1.5% and 3.5% – are based on the limits of the interval of tolerated deviations from the NBP inflation target.

most; and food and energy goods are those items that are most often bought. So when calculating Indices of Perceived Inflation according to the Brachinger method, where we place more weight on the items which are most frequently bought, we amplify the effect of raising prices of food and energy. Also in the case of price indices of the most frequently bought items and both measures of out-of-pocket price changes, we select categories of goods with relatively high price dynamics.

Let us analyse more closely into each group of created indices. The first group comprises 51 price indices of price dynamics of the n most frequently bought goods and services. On average, they have higher dynamics then the CPI (except π_t^{F46} to π_t^{F50} indices), but also higher volatility (again except π_t^{F46} to π_t^{F50} indices). But as we move from the first index (which covers only one item), to the last one (which covers 51 items) it appears that volatility of the indices decreases. It is due to the fact that we receive smoother and less changeable index when increasing number of items is included in the index. When looking closer into the behavior of calculated indices, we observe two sub-groups. The first one is made up of the first twenty indices in which we can distinguish some periods when they are visibly higher (years 2007-2008 and 2010-2011) or lower (years 2001-2002 and 2006) then the CPI. It is not surprising, as those indices consist mostly of food components, and during aforementioned periods food inflation was lower or higher than the CPI, respectively. The second sub-group (the rest of the indices) have similar dynamics to the CPI. This can be attributed to the fact, that in the second sub-group of indices not only food is included, but also other goods and services, which have different price dynamics' behaviour than food (see Figure 1).

The second group of indices, i.e. Indices of Perceived Inflation, are on average higher than CPI inflation (they are between 4.3% and 5.1% vs. 3.5% for the CPI), but their volatility is lower than in the case of the CPI index (standard deviation ca. 2.4 pp. vs. 2.5 pp. for the CPI). This outcome, that may seem surprising, is quite easy to explain. Calculating IPI indices we multiply the weight of an item with higher price's dynamics by a constant c, which is bigger than 1. It means that we assign relatively higher weights to the groups with price increases, and thence we assign relatively higher weights to those price dynamics which are in a way closer to the mean (as the mean is 3.5%). At the same time, we give relatively lower weight to price dynamics significantly different from average. By doing so, we lower the variability of the whole index. When looking at the IPIs and the CPI over the analyzed period, we can observe that up to 2005 those indices were evolving around each other, but from 2005 till now on (with the exception of second half of 2011) the IPI indices have been higher than CPI inflation (see Figure 2).

The last group consist of two indices – frequently out-of-pocket purchases (OOP) and positive frequently out-of-pocket purchases (POOP). Both measures, similarly as indices in the first two groups, are on average higher than CPI inflation (4.6% and 5.6%, respectively vs. 3.5% for the CPI) (see Figure 3). Also, both indices have higher volatility (2.8 pp. and 2.6 pp., respectively vs. 2.5 pp. for the CPI). Moreover, both indices during the analyzed period were above the CPI inflation (in the case of the OOP – with the exception in 2002). The explanation of this behaviour of both indices, is that frequently out-of-pocket index consist mostly of food products (nearly 40% of the OOP basket), which on average have higher price dynamics than the CPI. The only period when food inflation was very low was in 2002, and that is the period when OOP index was lower than CPI inflation. In the case of the second index the explanation is even more obvious. We disregard all price drops, instead we assume that the prices did not change.

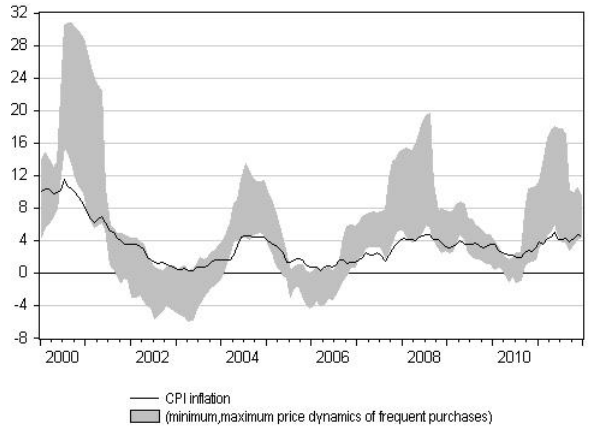

Figure 1: CPI vs index of most frequently bought goods and services

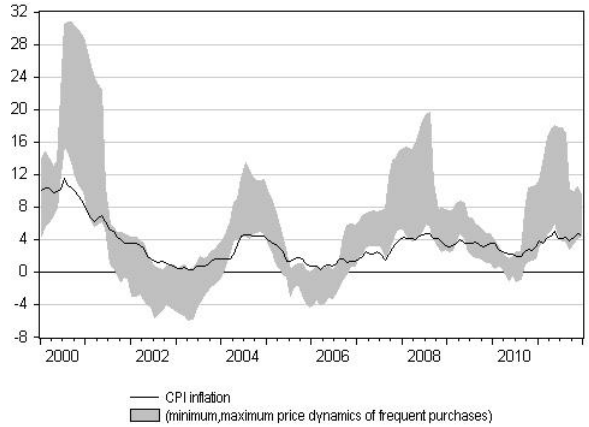

Figure 2: CPI vs IPI indices

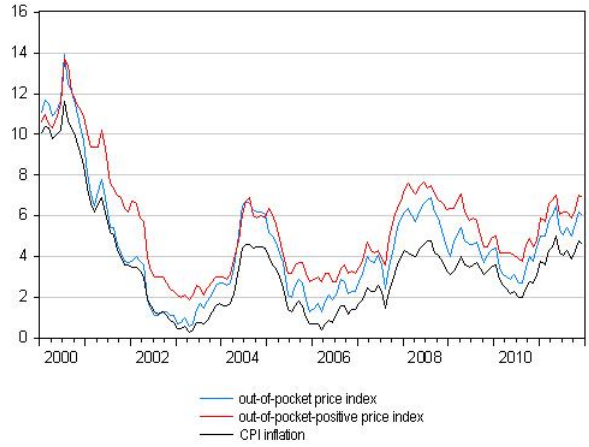

Figure 3: CPI vs frequently out-of -pocket purchases

2.1.2 Survey data used in the study

In the paper we use survey responses to polychotomous survey questions on perceived and expected price changes. Those questions have the following form:

> "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".
>
> "By comparison with the past 12 months, how do you expect that consumer prices will develop in 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".

There are three consumer surveys providing opinions on current and expected price changes, i.e. surveys by the Central Statistical Office in Poland (GUS), and two private firms: GfK Polonia (a part of the harmonised European Commission Consumer Survey[4]) and Ipsos. Survey data start in May 2001 in the case of the GfK Polonia survey, January 2004 in the case of the GUS surveys and in January 2008 in the case of Ipsos. Due to the length of the survey data and their international comparability, it would be reasonable to use GfK Polonia survey. However, the GfK Polonia survey question on perceived price changes is not the exact translation of the harmonised EC question and differences in this respect introduce bias to survey data [see: Łyziak (2012)], therefore we consider data from the survey conducted every month by the Central Statistical Office (GUS). In this case the survey question is fully consistent with the harmonised question included in the EC consumer survey and – what is even more important – suits probability methods used to quantify perceived inflation on the basis of qualitative survey data.

To summarize the survey responses concerning observed changes in prices we use the balance statistic consistent with the probability method of quantification assuming normal distribution of perceived rate of inflation in the population, as proposed originally by Carlson and Parkin (1975) and developed by Batchelor and Orr (1988):

$$BS_{1t}^{p} = \frac{Nz^{-1}\left(1 - \sum_{k=1}^{3} a_{kt}^{p}\right) + Nz^{-1}\left(c_{t}^{p}\right)}{Nz^{-1}\left(1 - \sum_{k=1}^{3} a_{kt}^{p}\right) - Nz^{-1}\left(c_{t}^{p}\right)} \tag{4}$$

where a_{1t}^{p} denotes the percentage of respondents noticing that price level is much higher than 12 months ago, a_{2t}^{p} – the percentage of respondents noticing that price level is moderately higher, a_{3t}^{p} – the percentage of respondents noticing that price level is slightly higher and c_{1t}^{p} – the percentage of respondents claiming that prices are lower than 12 months ago. As a cross-check we use a simpler balance statistics, attaching a system of constant weights $\{3, 2, 1, 0, -1\}$to subsequent fractions of respondents, i.e.:

$$BS_{2t}^{p} = 3a_{1t}^{p} + 2a_{2t}^{p} + a_{3t}^{p} - c_{t}^{p} \tag{5}$$

GUS survey data on perceived inflation suggest that on average almost a half of respondents observes that prices have increased a lot, 37% of consumers claims that price have increased moderately, 10% of respondents declares a slight price increase and ca. 5% notices stabilisation of the price level. The remaining fractions of respondents are relatively small. In the case of the survey question on inflation expectations the

[4] A detailed description of the European Commission Consumer Survey is provided in EC (2006) and EC (2007).

distribution of survey responses the fraction of the most pessimistic respondents equals approximately 20%, the fraction of respondents declaring that prices will increase at the same rate reaches 50% on average and percentages of consumers declaring a smaller price increase or price stabilisation equal 12% each. Analysis of survey responses (Figure 4) and balance statistics of perceived and expected inflation (Figure 5) suggests that consumers are more optimistic in expressing their views concerning future price developments than in assessing current price changes.

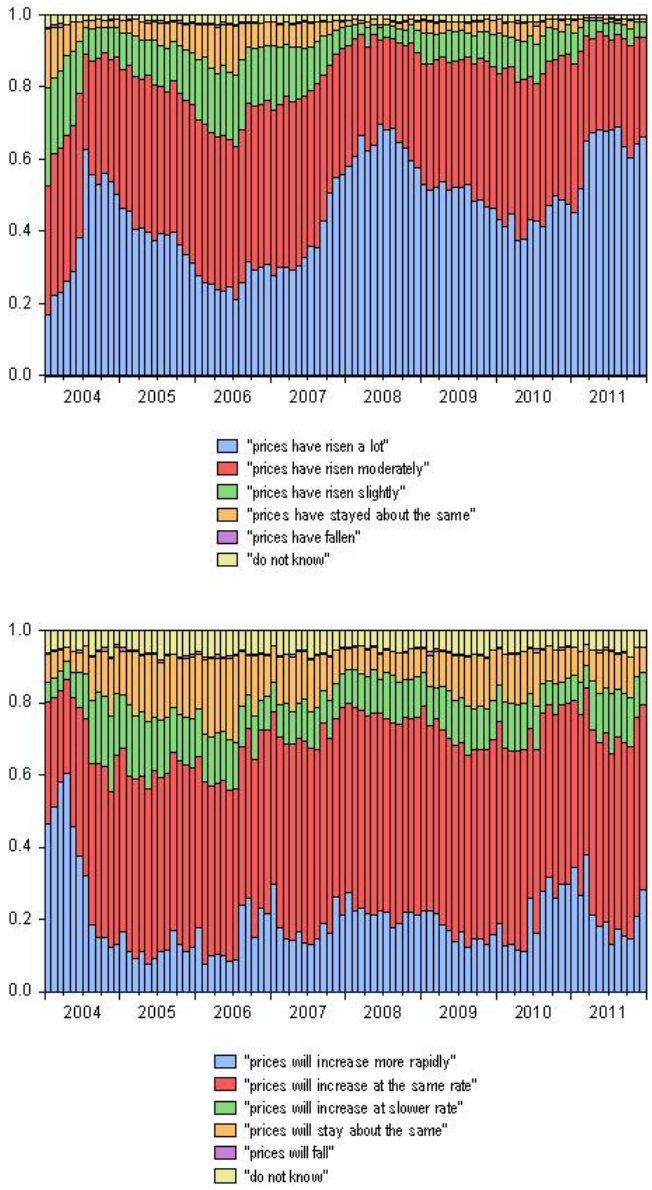

Figure 4: GUS survey data on perceived (upper panel) and expected (lower panel) price changes

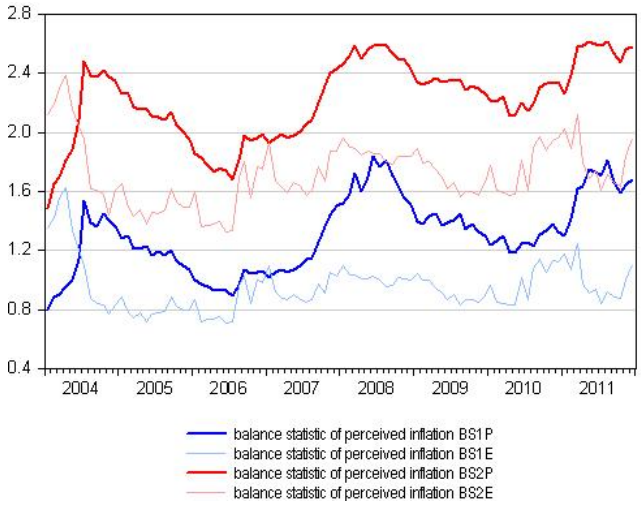

Figure 5: Balance statistics of perceived and expected price changes

2.1.3 Quantification of perceived and expected inflation on the basis of survey data

In the empirical part of the paper, except using balance statistics of perceived inflation, we also refer to quantified measures of inflation perceptions and expectations. Probability quantification method that is applied was originally proposed by Carlson and Parkin (1975) for tendency survey questions with three response categories ("go up", "stay the same", "go down") and then developed by Batchelor and Orr (1988) to work with polychotomous survey questions. It can be used to quantify both inflation perception and inflation expectations.

There are two main assumptions to be made. The first one refers to the type of distribution of the perceived or expected inflation in the population. Usually the normal distribution is applied in this context, which has some theoretical justifications.[5] The results of empirical applications of non-normal distributions in probability methods are not much different from those based on the assumption that inflation expectations are normally distributed [Berk (2000), Nielsen (2003)].

The second assumption concerns a scaling variable. In the case of the survey question on expected future price developments, the scaling factor (f_t^e) is given by perceived inflation, to which respondents compare their predictions in line with the survey question. In the case of survey question on perceived price changes it is assumed that respondents indicating an increase in the price level in order to select the exact response compare their perceived price dynamics with the 'natural' rate of inflation or a 'moderate' rate of inflation [Batchelor and Orr (1988)]. It reflects the permanent or trend rate of price changes and can be approximated by smoothing the actual inflation (with HP filter, moving averages etc.). Such measure is treated as a scaling factor in the quantification of perceived inflation (f_t^p).

Another feature of the probability approach is thinking in terms of 'sensitivity intervals' or 'indifference intervals'. In the case of polychotomous survey questions there are two sensitivity intervals, whose bounds can be different in the case of perceived ($\bullet = p$) or expected ($\bullet = e$) inflation. The first sensitivity interval –

[5] In the seminal article Carlson and Parkin (1975) argue that survey respondents have similar information set, that contains publicly available professional forecasts, so a unimodal distribution of their expectations around the consensus can be expected. The authors claim that if individual distributions are independent across respondents, have a common form and finite first and second moments, the survey results can be interpreted as a sampling from some aggregate distribution, which under the Central Limit Theorem is normally distributed.

$(-l_t^\bullet; l_t^\bullet)$ – is centred on zero, i.e. implied price dynamics that reflects the response indicating no change in the price level. It is assumed that among respondents declaring that "prices have stayed about the same" there are not only individuals claiming that current price dynamics is exactly zero, but also agents, whose perceptions are insignificantly different from zero. Similarly it is assumed that among respondents expecting that "prices will stay about the same" there are not only individuals who believe that future inflation will be exactly zero, but also those, whose predictions are close to zero. The second sensitivity interval surrounds the scaling factor - it is that respondents, whose assessment of the price dynamics is in the interval$(f_t^\bullet - s_t^\bullet; f_t^\bullet + s_t^\bullet)$select the response category "prices have increased moderately" or "prices will increase at the same rate". As a result, respondents are supposed to declare that "prices have risen a lot" ["prices will increase more rapidly"] if their perceptions [expectations] exceed the upper bound of the sensitivity interval centered on the scaling factor. The response: "prices have risen slightly" ["prices will increase at slower rate"] is chosen by respondents whose perceptions [expectations] are between the upper bound of the sensitivity interval surrounding zero and the lower bound of the sensitivity interval centered on the scaling factor, while the response that "prices have fallen" ["prices will fall"] – by individuals whose expectations are below the lower bound of the sensitivity interval centered on zero.

Assuming normal distribution of perceived or expected inflation, the probability quantification method can be summarized in the set of the following equations, using density $(f_t^\bullet)$ and cumulative standard normal distributions $(F_t^\bullet)$:

$$a_{2t}^\bullet = F_t^\bullet\left(\frac{f_t^\bullet + s_t^\bullet - \overline{\pi_t^\bullet}}{\sigma_t^\bullet}\right) - F_t^\bullet\left(\frac{f_t^\bullet - s_t^\bullet - \overline{\pi_t^\bullet}}{\sigma_t^\bullet}\right) \quad , \bullet = e, p \tag{6}$$

$$a_{3t}^\bullet = F_t^\bullet\left(\frac{f_t^\bullet + s_t^\bullet - \overline{\pi_t^\bullet}}{\sigma_t^\bullet}\right) - F_t^\bullet\left(\frac{l - \overline{\pi_t^\bullet}}{\sigma_t^\bullet}\right) \quad , \bullet = e, p \tag{7}$$

$$b_t^\bullet = F_t^\bullet\left(\frac{l - \overline{\pi_t^\bullet}}{\sigma_t^\bullet}\right) - F_t^\bullet\left(\frac{-l - \overline{\pi_t^\bullet}}{\sigma_t^\bullet}\right) \quad , \bullet = e, p \tag{8}$$

$$c_t^\bullet = F_t^\bullet\left(\frac{-l - \overline{\pi_t^\bullet}}{\sigma_t^\bullet}\right) \quad , \bullet = e, p \tag{9}$$

Solving the equations (6)-(9) we get the following expressions defining the mean of the distribution $(\overline{\pi_t^\bullet})$, its standard deviation $(\sigma_t^\bullet)$ and both sensitivity intervals:

$$\overline{\pi_t^\bullet} = f_t^\bullet \cdot \frac{G_t^\bullet + H_t^\bullet}{G_t^\bullet + H_t^\bullet - (E_t^\bullet + D_t^\bullet)} \tag{10}$$

$$\sigma_t^\bullet = f_t^\bullet \cdot \frac{-2}{G_t^\bullet + H_t^\bullet - (E_t^\bullet + D_t^\bullet)} \tag{11}$$

$$s_t^\bullet = f_t^\bullet \cdot \frac{D_t^\bullet - E_t^\bullet}{G_t^\bullet + H_t^\bullet - (E_t^\bullet + D_t^\bullet)} \tag{12}$$

$$l_t^\bullet = f_t^\bullet \cdot \frac{H_t^\bullet - G_t^\bullet}{G_t^\bullet + H_t^\bullet - (E_t^\bullet + D_t^\bullet)} \tag{13}$$

where $E_t^\bullet = {F_t^\bullet}^{-1}(1 - a_{1t}^\bullet)$, $D_t^\bullet = {F_t^\bullet}^{-1}(1 - a_{1t}^\bullet - a_{2t}^\bullet)$, $G_t^\bullet = {F_t^\bullet}^{-1}(1 - a_{1t}^\bullet - a_{2t}^\bullet - a_{3t}^\bullet)$, $H_t^\bullet = {F_t^\bullet}^{-1}(c_t^\bullet)$.

2.2 Method

In order to select the Consumer Perceived Price Index (CPPI), we confront price indices we developed with survey data on perceived price changes. The main indicator we take into consideration is the Spearman rank correlation coefficient between a given price index and the balance statistic of perceived inflation. If a given price index described well consumer perceptions about price changes during previous 12 months, it should be highly correlated with survey opinions on recent price developments. However, as a cross-check, we take into consideration an additional indicator based on the measures of perceived inflation quantified with the probability method [Batchelor and Orr (1988)]. Those measures use different price indices to determine the measure of moderate inflation that scales the survey responses. We express the moderate inflation, i.e. the scaling factor in the quantification method, in two ways – either as moving averages of those price indices (2 to 24 lags are taken into account):

$$\bigwedge_{n=1,\ldots,97} \bigwedge_{j=2,\ldots,24} f_t^{p(N,J)} = \frac{1}{J}\sum_{j=1}^{J} \pi_{t-1-j}^{FN} \tag{14}$$

or as the mean of a given price index during the whole period under consideration (2004-2011), $f_t^{p(N,25)}$. As a result of different price indices and different measures of moderate inflation applied, we derive a large number of measures of inflation perception (approx. 1800).[6] We assume that if a given price index was a benchmark for consumers in expressing their opinions on price changes in the past, then defining moderate inflation in its terms while quantifying survey-based measure of perceived inflation should make it close to the benchmark price index. Therefore in our assessment which of the price indices under consideration can be treated as appropriate proxy for consumer inflation perception, we analyse errors of the estimates of perceived inflation. More specifically, we focus on the mean absolute percentage error (MAPE) to account for differences in the price dynamics across indices under consideration.

3 Selection of the Consumer Perceived Price Index

Analysis of the Spearman rank correlation between price indices treated as potential determinants of consumer inflation perception in Poland and the balance statistic of perceived inflation BS_1^p indicates that the out-of-pocket price index that disregards negative price changes of its components (π_t^{F75}) displays the highest correlation with survey data (Figure 6).[7] It should be noted that it is the only price index that overcomes the CPI inflation in this respect. The MAPE indices based on quantified measures of perceived inflation (Figure 7) confirm that the positive out-of-pocket price index is the best proxy for the Consumer Perceived Price Index in Poland. Other indices performing well comprise the standard out-of-pocket price index and CPI inflation.

The results summarized above suggest that Polish consumers do not constrain their attention to single items of the consumer basket being purchased most frequently, but base their opinions on price changes of a relatively broad set of goods and services.

[6] There is one important obstacle in using the probability method relevant for some of the measures we quantify in the paper, that appears, when the scaling factor of the quantification method becomes non-positive. The use of a formal algorithm for adjusting the probability method when the scaling factor becomes non-positive [Łyziak (2013)] would be time-consuming given the number of measures of perceived inflation we quantify, therefore we apply a simpler method. If in a given period the moderate inflation becomes non-positive, we replace it with its minimum positive value observed in the sample period.

[7] The results are similar while using balance statistic BS_2^p, therefore we do not report separately results based on this statistic.

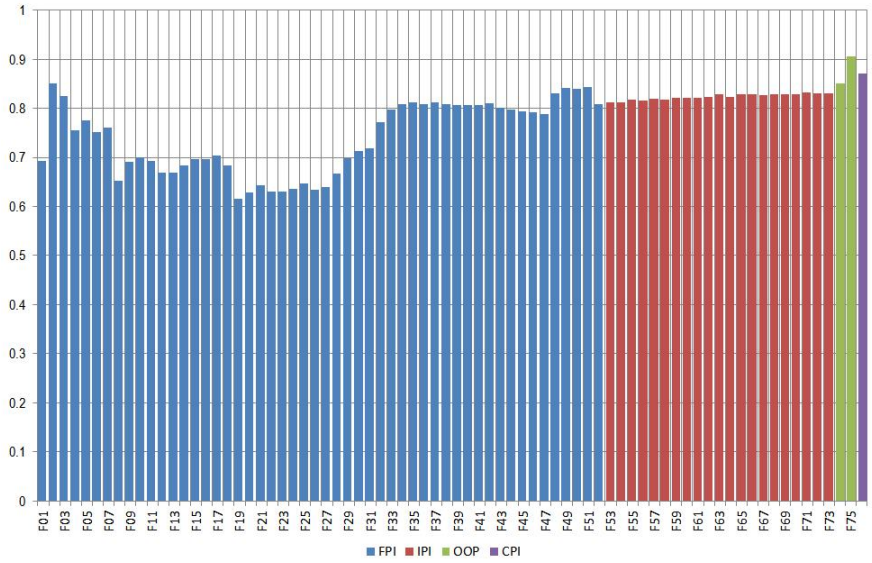

Figure 6: Correlation between price indices and balance statistic of perceived price changes BS_1^p

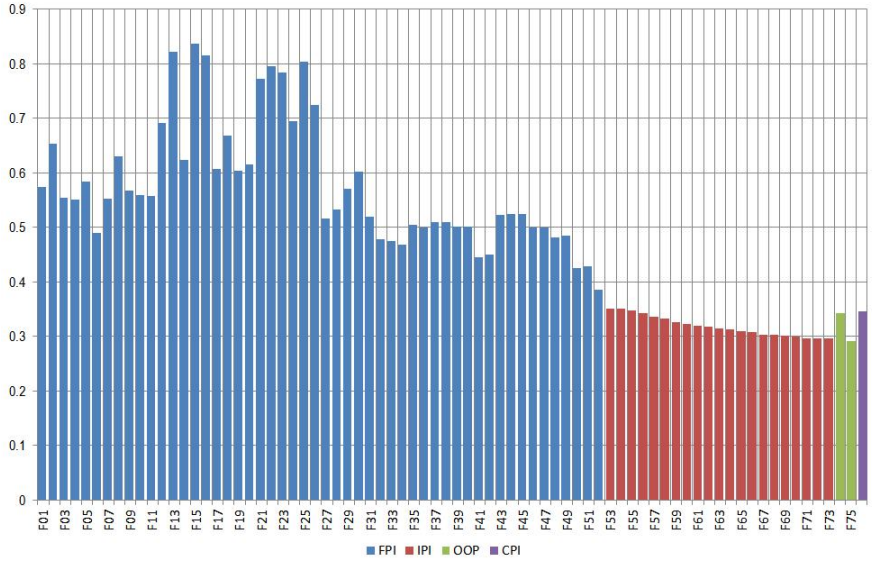

Figure 7: MAPE of the quantified measures of inflation perception scaled with price indices under consideration

Methods for selecting the CPPI measure allow better understanding how consumers respond to the survey question on perceived price changes. For each of the price indices under consideration, there are 24 quantified measures of perceived inflation that assume different proxies for the trend inflation. The latter variable is used by consumers to assess, whether prices in the previous 12 months increased a lot, increased moderately or increased slightly. In the case of the positive out-of-pocket price index it appears that the best performance in terms of MAPE (Table 2) corresponds to the moderate inflation defined as the average value of this price index during the whole sample period under consideration. Therefore assessing current price changes, Polish consumers seem to compare the observed positive out-of-pocket price index with its long-run value rather

than with moving averages of the recent observations. This conclusion applies also to other price indices under consideration that display the best fit to survey data, when we apply the mean of a given price index during the whole period under consideration as a proxy for the moderate inflation.

Measure of moderate inflation used to quantify perceived inflation on the basis of subsequent price indices

Price index	MOVAVG, j=2	MOVAVG, j=3	MOVAVG, j=4	MOVAVG, j=5	MOVAVG, j=6	MOVAVG, j=7	MOVAVG, j=8	MOVAVG, j=9	MOVAVG, j=10	MOVAVG, j=11	MOVAVG, j=12
F01	0.57	0.66	0.76	0.99	1.00	1.11	1.20	1.30	1.38	1.48	1.59
F02	0.67	0.65	0.72	0.86	0.98	1.15	1.19	1.30	1.34	1.40	1.51
F03	0.55	0.62	0.72	0.83	0.96	1.08	1.20	1.30	1.41	1.52	1.60
F04	0.55	0.60	0.78	0.85	0.94	1.08	1.17	1.25	1.34	1.44	1.52
F05	0.58	0.66	0.81	0.86	0.97	1.15	1.28	1.41	1.57	1.67	1.80
F06	0.49	0.54	0.60	0.68	0.80	0.86	0.93	1.01	1.07	1.12	1.17
F07	0.55	0.65	0.68	0.78	0.86	0.95	1.06	1.14	1.21	1.29	1.37
F08	0.63	0.76	0.94	1.18	1.44	1.66	1.91	2.14	2.33	2.48	2.63
F09	0.57	0.67	0.80	0.94	1.08	1.23	1.37	1.49	1.61	1.72	1.81
F10	0.56	0.64	0.74	0.87	0.99	1.12	1.24	1.37	1.49	1.60	1.69
F11	0.56	0.64	0.69	0.80	0.87	0.97	1.07	1.18	1.32	1.34	1.38
F12	0.69	0.76	0.92	1.06	1.19	1.34	1.48	1.61	1.73	1.83	1.90
F13	0.82	0.95	1.20	1.42	1.61	1.80	1.97	2.11	2.25	2.36	2.47
F14	0.62	0.65	0.73	0.84	0.92	1.03	1.13	1.22	1.33	1.40	1.47
F15	0.84	0.98	1.21	1.46	1.69	1.90	2.09	2.26	2.40	2.54	2.69
F16	0.82	0.87	1.08	1.33	1.52	1.71	1.89	2.03	2.17	2.30	2.41
F17	0.61	0.72	0.82	0.92	1.02	1.16	1.29	1.41	1.52	1.61	1.71
F18	0.67	0.81	0.98	1.17	1.39	1.64	1.84	2.04	2.22	2.39	2.55
F19	0.60	0.70	0.82	0.95	1.10	1.27	1.40	1.53	1.64	1.76	1.85
F20	0.62	0.74	0.87	0.97	1.14	1.27	1.40	1.52	1.64	1.75	1.85
F21	0.77	0.99	1.14	1.30	1.50	1.69	1.85	2.00	2.14	2.27	2.40
F22	0.80	0.93	1.09	1.25	1.50	1.70	1.91	2.12	2.28	2.45	2.61
F23	0.78	0.92	1.09	1.29	1.54	1.77	2.00	2.20	2.38	2.58	2.73
F24	0.69	0.83	0.97	1.18	1.33	1.48	1.62	1.79	1.91	2.04	2.18
F25	0.80	0.98	1.15	1.38	1.53	1.73	1.86	2.03	2.18	2.30	2.43
F26	0.73	0.82	0.97	1.12	1.30	1.46	1.62	1.76	1.88	2.01	2.13
F27	0.52	0.58	0.65	0.71	0.81	0.89	0.97	1.08	1.15	1.23	1.31
F28	0.53	0.59	0.66	0.72	0.82	0.90	1.00	1.09	1.17	1.26	1.34
F29	0.57	0.72	0.84	0.93	1.07	1.22	1.32	1.42	1.55	1.63	1.73
F30	0.60	0.71	0.87	0.92	1.06	1.24	1.32	1.42	1.57	1.63	1.75
F31	0.52	0.66	0.72	0.85	1.03	1.25	1.38	1.56	1.73	1.89	2.04
F32	0.48	0.54	0.58	0.63	0.69	0.75	0.83	0.86	0.92	0.97	1.03
F33	0.47	0.53	0.56	0.61	0.66	0.72	0.79	0.82	0.88	0.93	0.99
F34	0.47	0.52	0.56	0.60	0.66	0.76	0.80	0.81	0.86	0.93	0.97
F35	0.50	0.65	0.73	0.83	0.95	1.08	1.20	1.31	1.42	1.54	1.67
F36	0.50	0.64	0.73	0.82	0.95	1.07	1.18	1.28	1.38	1.47	1.58
F37	0.51	0.66	0.74	0.84	0.96	1.08	1.19	1.28	1.39	1.52	1.67
F38	0.51	0.65	0.74	0.83	0.95	1.06	1.18	1.27	1.38	1.50	1.65
F39	0.50	0.64	0.72	0.81	0.92	1.04	1.14	1.23	1.32	1.41	1.52
F40	0.50	0.64	0.72	0.81	0.91	1.03	1.13	1.23	1.32	1.42	1.53
F41	0.44	0.48	0.52	0.56	0.62	0.71	0.79	0.86	0.94	1.02	1.12
F42	0.45	0.47	0.52	0.56	0.61	0.69	0.77	0.85	0.93	1.03	1.13
F43	0.52	0.66	0.74	0.83	0.94	1.05	1.16	1.26	1.38	1.51	1.65
F44	0.52	0.67	0.74	0.83	0.94	1.05	1.16	1.26	1.38	1.52	1.65
F45	0.53	0.67	0.74	0.82	0.93	1.05	1.16	1.26	1.38	1.52	1.67
F46	0.50	0.62	0.69	0.80	0.87	0.94	1.02	1.09	1.18	1.29	1.39
F47	0.50	0.61	0.68	0.79	0.86	0.93	1.02	1.08	1.17	1.28	1.38
F48	0.48	0.60	0.67	0.78	0.85	0.92	1.00	1.08	1.16	1.26	1.36
F49	0.49	0.60	0.67	0.78	0.85	0.91	1.00	1.08	1.16	1.26	1.36
F50	0.42	0.49	0.55	0.62	0.66	0.71	0.76	0.80	0.85	0.91	0.96
F51	0.43	0.49	0.55	0.61	0.65	0.70	0.75	0.79	0.83	0.89	0.94
F52	0.39	0.43	0.46	0.50	0.54	0.58	0.62	0.66	0.70	0.74	0.79
F53	0.35	0.38	0.39	0.41	0.42	0.42	0.43	0.43	0.44	0.45	0.46
F54	0.35	0.38	0.39	0.41	0.42	0.42	0.42	0.43	0.43	0.44	0.45
F55	0.35	0.37	0.39	0.40	0.41	0.42	0.42	0.42	0.43	0.44	0.44
F56	0.35	0.37	0.39	0.40	0.41	0.41	0.41	0.42	0.42	0.43	0.44
F57	0.35	0.37	0.38	0.40	0.41	0.41	0.41	0.42	0.42	0.43	0.43
F58	0.35	0.37	0.38	0.39	0.40	0.41	0.41	0.41	0.41	0.42	0.43
F59	0.35	0.37	0.38	0.39	0.40	0.40	0.41	0.41	0.41	0.42	0.42
F60	0.34	0.36	0.38	0.39	0.40	0.40	0.40	0.41	0.41	0.41	0.42
F61	0.34	0.36	0.38	0.39	0.40	0.40	0.40	0.40	0.41	0.41	0.42
F62	0.34	0.36	0.38	0.39	0.39	0.40	0.40	0.40	0.40	0.41	0.41
F63	0.34	0.36	0.38	0.39	0.39	0.40	0.40	0.40	0.40	0.41	0.41
F64	0.34	0.36	0.37	0.38	0.39	0.40	0.40	0.40	0.40	0.41	0.41
F65	0.34	0.36	0.37	0.38	0.39	0.39	0.39	0.40	0.40	0.40	0.40
F66	0.34	0.36	0.37	0.38	0.39	0.39	0.39	0.39	0.40	0.40	0.40
F67	0.34	0.36	0.37	0.38	0.39	0.39	0.39	0.39	0.39	0.40	0.40
F68	0.34	0.36	0.37	0.38	0.39	0.39	0.39	0.39	0.39	0.40	0.40
F69	0.34	0.36	0.37	0.38	0.38	0.39	0.39	0.39	0.39	0.39	0.40
F70	0.34	0.36	0.37	0.38	0.38	0.39	0.39	0.39	0.39	0.39	0.40
F71	0.34	0.36	0.37	0.37	0.38	0.38	0.38	0.39	0.39	0.39	0.39
F72	0.34	0.36	0.37	0.37	0.38	0.38	0.38	0.39	0.39	0.39	0.39
F73	0.34	0.36	0.37	0.37	0.38	0.38	0.38	0.39	0.39	0.39	0.39
F74	0.34	0.36	0.37	0.38	0.39	0.40	0.41	0.41	0.42	0.43	0.44
F75	0.33	0.33	0.33	0.33	0.34	0.34	0.34	0.34	0.34	0.34	0.34
F76	0.35	0.36	0.38	0.39	0.41	0.43	0.44	0.46	0.47	0.49	0.50

Price index	MOVAVG, j=13	MOVAVG, j=14	MOVAVG, j=15	MOVAVG, j=16	MOVAVG, j=17	MOVAVG, j=18	MOVAVG, j=19	MOVAVG, j=20	MOVAVG, j=21	MOVAVG, j=22	MOVAVG, j=23	MOVAVG, j=24	SAMPLE MEAN
F01	1.72	1.82	1.94	2.05	2.16	2.28	2.39	2.53	2.67	2.82	2.96	3.10	4.43
F02	1.55	1.64	1.68	1.73	1.81	1.82	1.88	1.93	1.98	2.04	2.08	2.15	2.20
F03	1.70	1.79	1.88	1.97	2.04	2.12	2.18	2.25	2.32	2.39	2.46	2.56	2.34
F04	1.59	1.68	1.75	1.82	1.88	1.93	2.00	2.06	2.13	2.19	2.28	2.35	2.01
F05	1.89	2.00	2.10	2.18	2.25	2.31	2.37	2.43	2.47	2.53	2.59	2.64	2.31
F06	1.24	1.28	1.33	1.37	1.42	1.46	1.51	1.55	1.60	1.64	1.68	1.72	1.38
F07	1.44	1.50	1.54	1.59	1.65	1.68	1.72	1.78	1.85	1.92	1.98	2.04	2.07
F08	2.77	2.90	3.00	3.06	3.11	3.15	3.18	3.22	3.28	3.36	3.45	3.55	3.18
F09	1.90	1.98	2.05	2.09	2.12	2.14	2.15	2.16	2.18	2.21	2.24	2.29	1.87
F10	1.79	1.86	1.93	1.97	2.01	2.02	2.02	2.02	2.03	2.04	2.07	2.12	1.81
F11	1.43	1.49	1.56	1.58	1.63	1.63	1.64	1.66	1.67	1.70	1.77	1.84	1.75
F12	1.98	2.04	2.10	2.12	2.13	2.14	2.16	2.15	2.15	2.18	2.23	2.30	2.03
F13	2.57	2.65	2.67	2.68	2.68	2.67	2.65	2.64	2.63	2.63	2.68	2.74	2.31
F14	1.55	1.63	1.66	1.71	1.75	1.79	1.81	1.83	1.86	1.90	2.01	2.09	1.96
F15	2.80	2.87	2.92	2.95	2.94	2.95	2.93	2.94	2.95	2.98	3.03	3.08	2.39
F16	2.52	2.58	2.65	2.68	2.69	2.70	2.70	2.69	2.70	2.69	2.77	2.83	2.45
F17	1.80	1.89	1.95	2.02	2.08	2.12	2.14	2.21	2.27	2.32	2.41	2.49	2.06
F18	2.70	2.82	2.94	3.01	3.07	3.11	3.14	3.16	3.19	3.22	3.27	3.32	2.63
F19	1.96	2.05	2.14	2.21	2.25	2.28	2.31	2.32	2.34	2.35	2.37	2.38	1.75
F20	1.95	2.04	2.11	2.16	2.20	2.23	2.24	2.26	2.27	2.28	2.29	2.30	1.67
F21	2.53	2.61	2.66	2.69	2.70	2.69	2.69	2.69	2.68	2.68	2.66	2.64	1.89
F22	2.76	2.87	2.96	3.02	3.04	3.06	3.06	3.07	3.06	3.05	3.03	3.01	2.24
F23	2.90	3.02	3.13	3.21	3.24	3.27	3.28	3.28	3.28	3.28	3.27	3.26	2.46
F24	2.31	2.42	2.51	2.58	2.63	2.67	2.71	2.74	2.78	2.81	2.83	2.85	2.21
F25	2.55	2.63	2.69	2.72	2.74	2.76	2.77	2.79	2.80	2.81	2.80	2.79	2.13
F26	2.24	2.31	2.37	2.42	2.43	2.44	2.44	2.44	2.42	2.40	2.38	2.36	1.72
F27	1.38	1.45	1.51	1.57	1.62	1.67	1.70	1.73	1.75	1.77	1.78	1.79	1.34
F28	1.42	1.49	1.54	1.60	1.63	1.67	1.70	1.72	1.73	1.74	1.76	1.76	1.31
F29	1.82	1.91	1.96	2.00	2.03	2.08	2.12	2.15	2.18	2.22	2.25	2.28	1.93
F30	1.82	1.91	1.99	2.07	2.13	2.20	2.26	2.31	2.36	2.42	2.47	2.51	2.12
F31	2.17	2.31	2.45	2.56	2.66	2.72	2.78	2.81	2.83	2.84	2.85	2.85	2.31
F32	1.09	1.15	1.23	1.31	1.38	1.46	1.53	1.59	1.65	1.70	1.74	1.77	1.53
F33	1.06	1.12	1.20	1.28	1.36	1.45	1.52	1.59	1.64	1.70	1.75	1.78	1.61
F34	1.05	1.10	1.19	1.27	1.36	1.45	1.53	1.61	1.68	1.75	1.80	1.85	1.74
F35	1.78	1.90	1.98	2.06	2.12	2.17	2.21	2.24	2.26	2.26	2.26	2.25	1.97
F36	1.68	1.78	1.86	1.93	1.99	2.04	2.08	2.11	2.13	2.14	2.14	2.13	1.89
F37	1.80	1.94	2.05	2.17	2.26	2.34	2.41	2.47	2.52	2.56	2.58	2.58	2.39
F38	1.78	1.92	2.04	2.15	2.24	2.33	2.39	2.46	2.51	2.55	2.57	2.56	2.38
F39	1.61	1.70	1.77	1.84	1.90	1.95	1.98	2.01	2.03	2.04	2.04	2.04	1.81
F40	1.62	1.72	1.80	1.87	1.93	1.98	2.02	2.06	2.08	2.09	2.10	2.09	1.87
F41	1.20	1.30	1.38	1.47	1.54	1.62	1.67	1.72	1.75	1.77	1.79	1.80	1.61
F42	1.23	1.32	1.42	1.51	1.60	1.68	1.74	1.80	1.84	1.87	1.89	1.90	1.73
F43	1.78	1.92	2.03	2.14	2.24	2.33	2.40	2.46	2.51	2.55	2.57	2.58	2.45
F44	1.79	1.93	2.04	2.15	2.25	2.33	2.40	2.47	2.51	2.55	2.57	2.58	2.45
F45	1.81	1.96	2.08	2.20	2.32	2.41	2.49	2.56	2.62	2.67	2.70	2.71	2.61
F46	1.50	1.62	1.70	1.79	1.87	1.94	2.00	2.06	2.11	2.15	2.18	2.19	2.08
F47	1.49	1.60	1.69	1.78	1.85	1.92	1.99	2.05	2.10	2.14	2.17	2.18	2.09
F48	1.46	1.56	1.63	1.70	1.76	1.81	1.86	1.90	1.93	1.96	1.97	1.97	1.90
F49	1.46	1.56	1.63	1.70	1.76	1.81	1.86	1.90	1.93	1.95	1.96	1.96	1.89
F50	1.02	1.08	1.13	1.17	1.21	1.25	1.28	1.31	1.33	1.35	1.37	1.37	1.27
F51	1.00	1.06	1.10	1.14	1.18	1.22	1.25	1.27	1.30	1.32	1.33	1.33	1.25
F52	0.84	0.88	0.92	0.96	0.99	1.02	1.04	1.06	1.08	1.09	1.10	1.10	0.95
F53	0.47	0.47	0.48	0.48	0.48	0.49	0.49	0.49	0.49	0.49	0.48	0.48	0.36
F54	0.46	0.47	0.47	0.47	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.47	0.36
F55	0.45	0.46	0.46	0.46	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.46	0.35
F56	0.44	0.45	0.45	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.45	0.34
F57	0.44	0.45	0.45	0.45	0.45	0.45	0.46	0.46	0.46	0.45	0.45	0.45	0.34
F58	0.44	0.44	0.44	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.44	0.33
F59	0.43	0.43	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.43	0.33
F60	0.43	0.43	0.43	0.43	0.44	0.44	0.44	0.44	0.44	0.43	0.43	0.43	0.32
F61	0.42	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.42	0.32
F62	0.42	0.42	0.42	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.42	0.42	0.32
F63	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.31
F64	0.41	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.41	0.31
F65	0.41	0.41	0.41	0.41	0.41	0.41	0.42	0.42	0.42	0.41	0.41	0.41	0.31
F66	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.40	0.31
F67	0.40	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.40	0.40	0.30
F68	0.40	0.40	0.40	0.40	0.41	0.41	0.41	0.41	0.41	0.40	0.40	0.40	0.30
F69	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.30
F70	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.39	0.30
F71	0.39	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.39	0.39	0.39	0.30
F72	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.40	0.39	0.39	0.39	0.39	0.30
F73	0.39	0.39	0.39	0.39	0.39	0.39	0.40	0.40	0.39	0.39	0.39	0.39	0.30
F74	0.45	0.46	0.47	0.47	0.48	0.48	0.49	0.49	0.49	0.50	0.50	0.50	0.38
F75	0.34	0.34	0.34	0.34	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.29
F76	0.52	0.54	0.56	0.57	0.58	0.59	0.60	0.60	0.61	0.61	0.62	0.61	0.52

Legend: - the lowest MAPE; - MAPE above 95th percentile; - MAPE between 90th and 9th percentile

Table 2: MAPE of the quantified measures of inflation perception scaled with price indices under consideration and different proxies for the moderate inflation

The selected measure of perceived inflation is significantly higher than the current CPI inflation – the average values of both indices in 2004-2011 are, respectively 5.1% and 3.0% (Figure 8). Moreover, the CPPI index usually stays above the survey-based measure of perceived inflation quantified with the standard probability method.

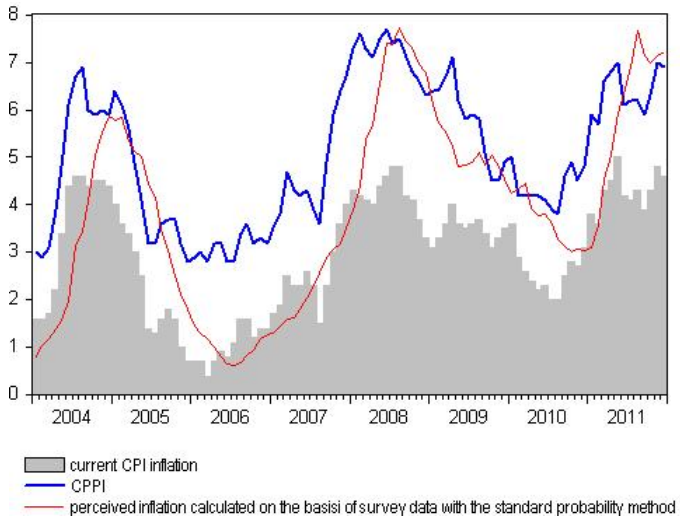

Figure 8: CPPI vs. CPI inflation and the probability measure of perceived inflation

There are a number of robustness checks we performed. Firstly, we experimented with different measures of the out-of-pocket price indices, eliminating different groups of goods (i.e. alcoholic beverages, tobacco products, medical products, Internet, television license fees, newspapers, services connected with dwelling, products for personal care). Secondly, we modified the way of calculating Indices of Perceived Inflation, introducing three instead of two intervals of price changes that are weighted with different risk aversion coefficients (see footnote 3). Thirdly, in analysing the Spearman rank correlation of price indices with survey data we applied deviations of the current values of a given price index from their moderate values instead of their levels. Finally, we used two different balance statistics of perceived price changes (BS_1^p and BS_2^p). In each of these cross-checks, the results remained qualitatively the same.

4 Quantification of inflation expectations

As explained above, the probability methods allowing quantification of expected inflation on the basis of survey data require an assumption concerning price dynamics that is perceived by respondents. It can be quantified on the basis of an additional survey question, however this question seems less precise than the one on expected price changes. Different assumptions concerning the scaling factor, i.e. the measure of moderate inflation, can significantly affect resulting measures of perceived inflation. Therefore having the Consumer Perceived Price Index selected on the basis of survey data, it is possible to use it in quantifying inflation expectations instead of the quantified measures of perceived inflation, characterized by high measurement uncertainty.

We calculate two measures of inflation expectations based on qualitative survey data. In the first case we use our measure of the CPPI as the scaling factor, while in the second case – we apply the standard approach, i.e. we use current CPI inflation as the scaling factor (Figure 9). Due to the gap between subjectively perceived inflation and current CPI inflation, expected inflation scaled with our preferable measure of the

CPPI is significantly above the measure based on the assumption that consumers perceive current price changes through the lenses of official statistics – sample averages of both measures of expectations are, respectively, 4.9% and 2.9%. However, both series are highly correlated with each other (correlation coefficient equals 0.95).

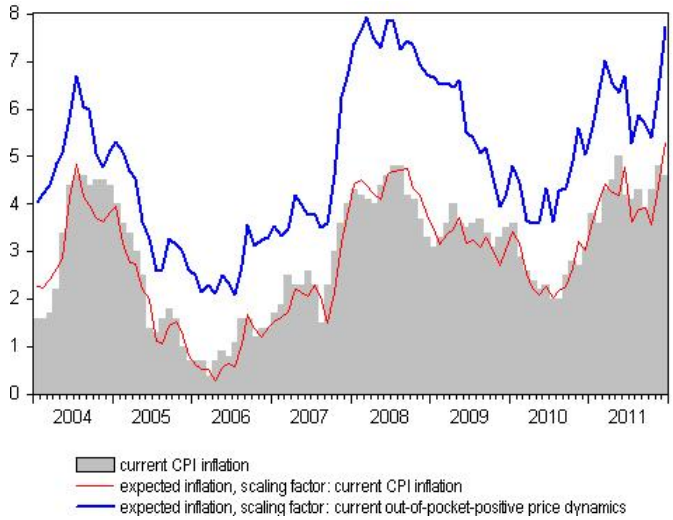

Figure 9: Quantified measures of inflation expectations vs. current CPI inflation

After quantifying both measures of consumer inflation expectations in Poland we assess their forecasting properties with different measures of expectational errors, i.e. mean error (ME), mean absolute error (MAE) and mean absolute percentage error (MAPE). In the case of the expected inflation that assumes that the positive out-of-pocket price index (POOP) is the appropriate proxy for Consumer Perception Price Index, we calculate expectational errors both with respect to future actual CPI and CPPI inflation.

Analysis of expectational errors (Table 3) suggests that the forecasting properties of consumer inflation expectations are rather poor. The expected inflation scaled with the current CPI inflation forecast CPI inflation better than analogous measure scaled with current CPPI index, which seem obvious given the gap between both scaling factors. However, we can observe that the forecasting accuracy of the latter measure of inflation expectations with respect to future CPPI inflation is in relative terms (MAPE) significantly better than forecasting accuracy of both measures on inflation expectations calculated with respect to future CPI inflation. Therefore we can conclude that consumers, although not specialized in macroeconomic forecasting, seem better suited to forecast the measure of inflation consistent with their perception of price changes than the overall CPI inflation.

	expected inflation scaled with CPPI index	expected inflation scaled with CPI inflation
ME (CPI)	1.87	-0.19
MAE (CPI)	2.13	1.38
MAPE (CPI)	120.4	71.2
ME (CPPI)	-0.38	x
MAE (CPPI)	1.73	x
MAPE (CPPI)	34.5	x

Table 3: Inflation expectational errors with respect to actual future CPI inflation and CPPI indices

5 Conclusions

Perception of current price changes by Polish consumers is significantly affected by price changes of frequently bought products and services. Consumers take into consideration a relatively broad basket of goods and services, including food and non-alcoholic beverages, tobacco, housing and energy carriers, medical products, fuels, communication services, newspapers and articles and products for personal care. At the same time consumers seem to disregard negative price changes of the above mentioned items, therefore the Consumer Perceived Price Index is significantly and systematically higher than CPI inflation.

The results of quantification of consumer inflation expectations with the use of the current CPPI index as a scaling factor (instead of current CPI index), worsens forecasting accuracy of this measure with respect to future CPI inflation, but reduces the relative forecast errors (MAPE) with respect to future CPPI inflation.

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Annex 1

index	items	frequency	weight	mean	std
π^{F1}	mixed bread and other bakery products	97.0	1.4	6.7	8.4
π^{F2}	above item plus other cold-meat	92.8	1.3	5.3	6.3
π^{F3}	above items plus wheat bread	90.6	0.6	5.3	6.3
π^{F4}	above items plus high-quality cold meat	81.9	1.4	5.0	6.0
π^{F5}	above items plus cakes	85.5	1.0	4.5	5.9
π^{F6}	above items plus ripened cheese and processed cheese	87.0	0.7	4.3	5.6
π^{F7}	above items plus cottage cheese/curd	88.6	0.6	4.6	6.0
π^{F8}	above items plus chicken (fresh, chilled or frozen)	88.3	1.0	4.2	5.9
π^{F9}	above items plus eggs	88.3	0.4	4.1	5.8
π^{F10}	above items plus other appliances, articles and products for personal care	83.9	0.9	4.1	5.8
π^{F11}	above items plus sour cream and cream	84.3	0.3	4.0	5.7
π^{F12}	above items plus pork (fresh, chilled or frozen)	82.1	1.4	4.0	5.6
π^{F13}	above items plus homogenized baby food and dietary preparations	81.3	0.4	3.9	5.5
π^{F14}	above items plus telephone subscription	74.1	0.5	3.9	5.5
π^{F15}	above items plus other vegetable and mushroom products	79.5	0.3	3.7	5.2
π^{F16}	above items plus margarine and other vegetable fats	83.6	0.3	3.7	5.1
π^{F17}	above items plus articles for personal hygiene	81.7	0.6	3.7	5.0
π^{F18}	above items plus coffee	80.9	0.6	3.8	4.7
π^{F19}	above items plus sauces and seasonings	77.5	0.3	3.7	4.6
π^{F20}	above items plus potatoes	78.2	0.4	3.7	4.5
π^{F21}	above items plus tomatoes (fresh, chilled or frozen)	72.0	0.3	3.8	4.4
π^{F22}	above items plus sugar	80.6	0.5	3.8	4.3
π^{F23}	above items plus apples (fresh, chilled or frozen)	78.4	0.3	3.8	4.3
π^{F24}	above items plus pasta	77.0	0.2	3.7	4.2
π^{F25}	above items plus non-durable household articles for cleaning	72.5	0.4	3.6	4.2
π^{F26}	above items plus tea	76.1	0.3	3.8	4.5
π^{F27}	above items plus pharmaceutical products	71.6	3.0	3.7	4.4
π^{F28}	above items plus yoghurt	64.1	0.4	3.6	4.4
π^{F29}	above items plus refuse collection	70.7	0.8	3.7	4.2
π^{F30}	above items plus confectionery	71.0	0.5	3.8	4.1
π^{F31}	above items plus other non-alcoholic beverages	68.4	0.6	3.8	4.0
π^{F32}	above items plus electricity	68.2	4.4	3.9	4.0
π^{F33}	above items plus water supply	72.1	1.2	4.0	3.8
π^{F34}	above items plus butter	74.1	0.5	4.1	3.7
π^{F35}	above items plus citrus fruits (fresh, chilled or frozen)	67.5	0.3	4.2	3.5
π^{F36}	above items plus other non-durable household articles	63.4	0.3	4.2	3.5
π^{F37}	above items plus carrot	72.5	0.1	4.1	3.5
π^{F38}	above items plus mineral or spring waters	60.4	0.4	4.1	3.4
π^{F39}	above items plus onion (fresh, chilled or frozen)	68.6	0.1	4.1	3.4
π^{F40}	above items plus spices and culinary herbs	67.2	0.2	4.1	3.4
π^{F41}	above items plus cleaning and maintenance household products	72.5	0.7	4.1	3.3
π^{F42}	above items plus flour	73.0	0.2	4.1	3.5
π^{F43}	above items plus milk	60.4	0.4	4.1	3.5
π^{F44}	above items plus other root and tuber vegetables (fresh, chilled or frozen)	67.2	0.1	4.1	3.5
π^{F45}	above items plus vegetable fats	69.5	0.3	4.1	3.5
π^{F46}	above items plus sewerage collection	63.9	1.1	3.4	2.4
π^{F47}	above items plus cosmetics and perfumery	62.0	1.0	3.4	2.4
π^{F48}	above items plus newspapers and magazines designed for other purposes	65.8	0.3	3.5	2.3
π^{F49}	above items plus chocolate	58.0	0.2	3.5	2.3
π^{F50}	above items plus cucumbers (fresh, chilled or frozen)	54.2	0.1	3.4	2.3
π^{F51}	above items plus other cereal products	58.7	0.2	3.5	2.3

Table 4: Items included in the indices of most frequent bought items, mean frequency, mean weight in the CPI, mean value of the index and standard deviation (2000-2011)

	mean	std
π_t^{F76}(CPI)	3.5	2.5
π^{F53}; IPI (c=1.50)	4.3	2.4
π^{F54}; IPI (c=1.55)	4.4	2.4
π^{F55}; IPI (c=1.60)	4.4	2.4
π^{F56}; IPI (c=1.65)	4.5	2.4
π^{F57}; IPI (c=1.70)	4.6	2.4
π^{F58}; IPI (c=1.75)	4.6	2.4
π^{F59}; IPI (c=1.80)	4.6	2.4
π^{F60}; IPI (c=1.85)	4.7	2.4
π^{F61}; IPI (c=1.90)	4.7	2.4
π^{F62}; IPI (c=1.95)	4.8	2.4
π^{F63}; IPI (c=2,00)	4.8	2.4
π^{F64}; IPI (c=2.05)	4.8	2.4
π^{F65}; IPI (c=2.10)	4.9	2.4
π^{F66}; IPI (c=2.15)	4.9	2.4
π^{F67}; IPI (c=2.20)	5.0	2.4
π^{F68}; IPI (c=2.25)	5.0	2.4
π^{F69}; IPI (c=2.30)	5.0	2.4
π^{F670}; IPI (c=2.35)	5.0	2.4
π^{F71}; IPI (c=2.40)	5.1	2.4
π^{F72}; IPI (c=2.45)	5.1	2.4
π^{F73}; IPI (c=2.50)	5.1	2.3

Table 5: IPI indices and CPI inflation - mean and standard deviation, indices cover whole CPI basket (2000-2011)

	mean	std	CPI weight
π_t^{F75}(CPI)	3.5	2.4	100
π_t^{F73}(out of pocket)	4.6	2.7	64.9
π_t^{F74} (out of pocket, positive)	5.6	2.5	64.8

Table 6: Frequently out-of-pocket purchases indices - mean, standard deviation and CPI weight (2000-2011)