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Abstract

Inflation rates have traditionally been measured by the percentage change in the price level of a market basket of consumer goods and services purchased by households. The market basket represents the spending patterns of average household. However, households differ in their spending patterns and there are differences in the price changes of various goods and services. Therefore, different households experience different inflation rates. This paper finds that these differences have been significant in the Czech Republic during the period 1995–2010. Only around 60% of households actually experienced an inflation rate that was similar to the national average. Furthermore, the higher the average inflation rate over time, the lower the percentage of households whose inflation rate was similar to that average. The main determiners of inflation were expenditures for housing and energy, food and non-alcoholic drinks. In most years, pensioners and low-income households faced significantly higher inflation rates than the average rate for the whole population.

Keywords: households, inflation, inflation differentials, relative prices
JEL Classification: D12, H22, I31

1.   Introduction

The inflation rate was relatively high in the Czech Republic over the last two decades, with yearly rates of around 10% in the mid-1990s and a 6% rate in 2008. From a macroeconomic point of view, these magnitudes of price increases contributed to the introduction of inflation targeting in 1998, while from a microeconomic point of view, they contributed to a debate about the costs of inflation. An important consideration that has largely been missing from this debate so far is the different impact that inflation might have on various households, and we aim to fill this gap.

The relatively important role of the official inflation rate is arguably driven to a large extent by the underlying assumption that it is the inflation rate faced by, if not all, then at

least a majority of households. Yet this assumption might not reflect reality. Indeed, since specific groups of households have different spending patterns, and pay different prices for the same goods and services by shopping in different places, they may experience significantly different inflation rates. These potential differences could be reflected in the relevant policies.

There are prior studies that evaluate inflation rates for different demographic groups. While Prais (1959) laid the theoretical foundations, Snyder (1961) was most likely a pioneer in computing subgroup inflation rates, using US data from 1936 to 1955 to compute the inflation rates for low and high-income groups. More recent examples of these types of analyses include Ruiz-Castillo *et al.* (1999) for Spain, Crawford, Smith (2002) for the United Kingdom, Oosthuizen (2007) for South Africa, Sugema *et al.* (2010) for Indonesia. These studies often differ in their specific conclusions, but they generally concur that there is significant dispersion among the inflation rates experienced by different households at any given point in time. However, there has essentially been no previous research in this area for the Czech Republic or, to the best of our knowledge, for any other Central or Eastern European or former transition country.

Therefore in this paper we aim to analyse inflation rates for individual households in the Czech Republic between 1995 and 2010 and to describe the representativeness of the inflation rate and differences between the inflation rates for low-income households, pensioner households and the whole population. We estimate the share of the population for which the average inflation rate can be considered representative and examine the relationship between the average inflation rate and its representativeness. Furthermore, we analyse inflation differentials for the subgroups of low-income and pensioner households and identify the main determiners of higher inflation. We want to underline here that the aim of the paper is not the replication of the official inflation rate as published by the Czech Statistical Office.

The layout of the paper is as follows: the methodology is explained in Section 2; the main datasets used for the analysis are described in Section 3; the representativeness of the official Czech inflation rate is measured in Section 4; Section 5 analyses the magnitudes and drivers of subgroup inflation rates for pensioners and low-income households; and the conclusion is found in Section 6.

2. Methodology

This section discusses inflation rate measurement and introduces terminology that will be used throughout the paper. The official inflation rate is the inflation rate published by the Czech Statistical Office (CZSO). The specific inflation rate is the inflation rate to which a given household is exposed. The subgroup inflation rate is the inflation rate which impacts a given subgroup of households. When the subgroup is a whole population of households, the subgroup inflation rate is the aggregate inflation rate. Where possible, we followed the standard Czech notation used in Jílek, Moravcová (2007).

When estimating inflation rate in order to measure real changes in the cost of living, we have to deal with the problem that, as noted by Hobijn, Lagakos (2005, p. 582), it is well known from price index theory that calculating an exact index of the cost of living is not feasible. Instead, the measure of the average change in the cost of living in a period *t* is usually approximated by a change in the Consumer Price Index (CPI), which is calculated by the Laspeyres index:

$$CPI\Delta_t = \frac{\sum_{i=1}^{n} p_{t,i} q_{t-1,i,}}{\sum_{i=1}^{n} p_{t-1,i} q_{t-1,i}} - 1 \qquad (1)$$

where $CPI\Delta_t$ is the change in the CPI in period t, $q_{t,i}$ is the quantity of good or service i consumed in period t in a whole economy, $p_{t,i}$ price of good or service a in period i, n is the number of different goods or services.

In contrast to a true costs-of-living index, the CPI measures the average change in prices with reference to a fixed list of demands rather than a fixed standard of living, as discussed by Crawford, Smith (2002, p. 3). Since the CPI assumes there is no substitution when relative prices change, it corresponds to the upper limit of the true growth of the cost-of-living index. In reality, if there is significant growth in prices of particular goods, people can substitute these goods for the ones whose price did not grow, and then the value of the change in the Consumer Price Index might not represent the change of overall living costs. On the other hand, when there are no significant changes in prices, it can be assumed that the bias is low, since households are not motivated to substantially change their expenditure patterns. The problem of substitution is not the focus of our paper, however, it has been studied in more detail recently for example by Dybczak *et al.* (2010) and Janský (2014).

Unfortunately, the data on quantities consumed that are necessary for the evaluation of formula (1) are not usually available, only data on expenditure for a given good or service. Also, data on prices are usually less costly to obtain than data on expenditures, and therefore price data are more readily available than expenditure data. With these limitations, the CPI change is computed as:

$$CPI\Delta_t = \frac{\sum_{i=1}^{n} E_{b,i} \dfrac{p_{t,i}}{p_{b,i}}}{\sum_{i=1}^{n} E_{b,i} \dfrac{p_{t-1,i}}{p_{b,i}}} - 1 \qquad (2)$$

where $E_{t,i} = p_{t,i} q_{t,i}$ is the expenditure on a good or service a in at time t in a whole economy, $t = b$ is the base time period.

Regarding the official inflation rate, the CZSO does not change the base period every year (CZSO, 2014). In the US in the recent history, according to Greenlees & Mason (1996, p. 3), argues that *"an updating of the index is undertaken approximately every 10 years."* As underlined by Hobijn & Lagakos (2005, p. 583), infrequent updating of the base period can be a major source of substitution bias, as *"it implies that the CPI does not properly account for people substituting goods that become relatively cheaper for more expensive goods"*. In this paper, the expenditures are updated in every period when the inflation rate is computed (so $b = t -$ is set). This has two advantages, as in Hobijn & Lagakos (2005): the analysis is not limited by dependence on the selection of a particular base period, and the substitution bias is reduced. For our computations the aggregate inflation rate at time t is defined as:

$$\pi_t = \frac{\sum_{i=1}^{n} E_{t-1,i} \dfrac{p_{t,i}}{p_{t-1,i}}}{\sum_{i=1}^{n} E_{t-1,i}} - 1 \qquad (3)$$

Defining the relative price change of specific goods or service *a* at the time *t* as:

$$r_{t;i} = \frac{p_{t,i}}{p_{t-1,i}} - 1 \tag{4}$$

The definition of an aggregate inflation rate can be rewritten as:

$$= \frac{\sum_{1,i} \dfrac{t\,i}{1,i}}{\sum_{i=1}^{n} E_{t-1;i}} = \frac{\sum E_{t\ 1;i}\left(r_{t,i}\right)}{\sum_{i=1}^{n} E_{t-1,i}} - = \frac{\sum E_{t\ 1,i} r_{t,i}}{\sum_{i=1}^{n} E_{t-1,i}} \tag{5}$$

Following (5), the specific inflation rate of a household *h* at time *t* can be defined as:

$$\pi_{h,t} = \frac{\sum_{i=1}^{n} E_{h,i,t-1} r_{t;i}}{\sum_{i=1}^{n} E_{h,i,t-1}} \tag{6}$$

where $E_{h,i,t}$ is the expenditure of a household *h* for a good or service *i* at time *t*. There are two possible approaches to calculating the aggregate or subgroup inflation rates: democratic and plutocratic averages. One of the first authors to extensively discuss the problem of multiple possibilities when computing the aggregate or subgroup inflation rate was Prais (1959), while the differences between democratic and plutocratic averages were more recently discussed by Artsev *et al.* (2006) and by Crawford & Smith (2002). Formally, the democratic average for a subgroup *x* at time *t* is the arithmetic average of specific inflation rates at time *t* of all households from *x*:

$$D_{x,t} = \frac{\sum_{t=1}^{m} \pi_{h,t}}{m} \tag{7}$$

where $\pi_{h,t}$ is the specific inflation rate of household *h* (in this case, belonging to subgroup *x*) at time *t*, *m* is the number of households in subgroup *x*.
The plutocratic average for subgroup *x* at time *t* is defined as:

$$\pi_{x,t} = \frac{\sum_{a=1}^{n} E_{x,a,t-1} r_{a,t}}{\sum_{a=1}^{n} E_{x,a,t-1}} \tag{8}$$

Definition (8) is very similar to the definition of the specific inflation rate (6), but instead of the expenditures of household *h* for good or service *a* at time *t* ($E_{h,a,t}$), the expenditures of subgroup *x* for good or service *a* at time *t* is used ($E_{x,a,t}$). Households are weighted equally in the case of (7), the democratic average, whereas in the case of (8), the plutocratic average, households with higher expenditures have higher weights and *vice versa*. The CPI change is constructed as a plutocratic average.

3.   Data

To compute the variables of interest using the formulas defined in the previous section, we need data on household characteristics and expenditures on various goods and services, as well as data on relative price developments for various goods and services. These data sets come from the CZSO in the form of the Household Budget Survey (HBS) and in price data gathered for the purpose of the Consumer Price Index (CPI). We used the HBS annual data for 1994 to 2009, and the CPI nationwide price indices from 1994 to 2010.

The HBS contains very detailed data on the income, expenditures, and other characteristics of a sample of Czech households, and has been previously used in recent microeconomic analyses, such as Dušek & Janský (2012). Specifically, the data provides information for around 250 expenditure groups (goods and services), approximately 60 demographic identifiers, and around 30 income items, for a representative sample of approximately 3,000 households in the Czech Republic. It is the most detailed dataset of its kind for the Czech Republic. The composition of the sample is amended, usually annually, to maintain a high level of representativeness. The size of the survey and the number of observed attributes changes slightly year to year. There are some potential confounders of the representativeness of HBS, but we do not consider them particularly influential, especially in the data collected since 2006, not least on the basis of analysis in Dybczak *et al*. (2010)[1]. Let us also note that the sample for the household budget survey was selected by purposive quota sampling. The designers of the survey have made efforts to make it as similar to a random sample as possible, but nevertheless its characteristics are not the same as those of a random sample, in general. One implication of this suboptimal sampling is that the results of hypothesis testing on the data might be biased or misleading. However, we believe that our use of the data is consistent and in line with the efforts of the CZSO to make the sample resemble a random sample as closely as possible, as well as with previous uses of the data such as Dybczak *et al*. (2010).

This paper uses some HBS variables for sorting households into subgroups. Data about financial expenditure are fully utilised. In-kind income and expenditure are not used in the computation of various inflation rates. For most of the goods and services, the survey does not contain the number of units bought, but only expenditure on these goods and services. Therefore, a dataset of prices is needed in order to be able to evaluate the inflation rates.

The CZSO collects price data on a monthly basis for all units in the consumer basket, which has around 700 units. These detailed data are, however, only for the internal purposes of CZSO including the computation of the Harmonised Index of Consumer Prices (introduced by Eurostat and employed by the European Central Bank for the purposes of monetary policy in Eurozone). For this research, it was only possible to obtain the monthly price indices of 145 groups of goods and services, from 1991 to 2010, aggregated for the whole Czech Republic. These are the most detailed time-series datasets of Czech prices that are available to researchers. The number of price indices allocated to every first-level Classification of Individual Consumption by Purpose (COICOP) expenditure category varies.

Since the data provided from the HBS are annual, no use is made of the fact that the price index data are available on a monthly basis; only the annual averages are used in the inflation computations. There is a wide dispersion among the development of relative

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1   A short discussion of potential confounders of HBS resulting in its potential non-representativeness, most relevant to the pre-2006 data, follows. First, institutional households and homeless people are not included in the survey by the European Communities (2004). Also, the sample might be too small because the ratio of the number of households surveyed to the number of households in the actual population was the second lowest among 13 European countries according to the European Communities (2004). Furthermore, as Crawford & Smith (2002) discuss, systematic over- or under- reporting of expenditures can occur in this type of data collection, due to forgetfulness (*e.g.* consumption outside the home), active concealment (*e.g.* receipt from a beauty studio), and guilt (*e.g.* cigarettes). And, since some expenditures are recorded monthly, large and infrequent purchases may be underestimated. The treatment of these confounders is beyond the scope of this analysis, and it is assumed in line with Dybczak *et al*. (2010) and other similar studies that they are not very significant.

prices even if we examine only the highly aggregated cumulative price indices for 12 groups of goods and services according to the first level of the COICOP from 1994 to 2010. Using 1994 as a base equal to 100%, housing and fuel costs and health costs grew by more than 200%. In contrast, the average nominal prices of clothing and footwear were the same in 1994 as in 2010, and furnishing and household equipment and maintenance grew by just 16% over the period.

The structure of the expenditure breakdown in the HBS is different from the price indices breakdown provided by the CZSO. Therefore we constructed a conversion table linking variables from the financial expenditures of HBS to the specific price index from the set of 145 price indices in order to compute inflation rates as defined in the previous section. The conversion was quite clear for many variables, since the name of the variable in the expenditures list and the price index are the same or very similar. As the number and structure of observed variables within the financial expenditures in HBS varies somewhat from year to year, conversion tables for different years sometimes vary slightly.

4. Average Inflation Rate Representativeness

This section analyses the representativeness of the average inflation rate. By definition, the average is relevant only for some people at or around the average values. For the purposes of this paper, the aggregate democratic inflation rate is considered representative for a given household if the specific inflation rate of that household is "very close" to it. Leicester *et al*. (2008) proposed two measures of "closeness" and applied them to the UK data. The second measure is also used on UK data by Crawford & Smith (2002) and on Israeli data by Artsev *et al*. (2006). Both of these measures are applied in this paper and so our results can be compared with those for the UK, and partially with those for Israel.

Leicester *et al*. (2008) define the first measure (Measure 1) as the answer to the question of how many households have an inflation rate that is more than 25 per cent away from the mean inflation rate in each year. The second measure (Measure 2) is then the answer to the question of how many households experience inflation that is more than 1 percentage point away from the mean. The two measures therefore produce different results as noted by Leicester *et al*. (2008). The first measure tends to suggest that many households are far from the mean when inflation is very low, whereas the second measure suggests that many households are far from the mean when inflation is very high.

Formally, we define the two measures in the following way.

Measure 1:   if $i \geq 0$: $i_h \in \langle 0.75i; 1.25i \rangle \Longleftrightarrow i_h \in C$

Measure 2:   if $i < 0$: $i_h \in \langle 1.25i; 0.75i \rangle \Longleftrightarrow i_h \in C$

$i_h \in (i - 1\%; i + 1\%) \Longleftrightarrow i_h \in C$

where C is the subset of specific inflation rates which are "close" to the democratic inflation rate, i is the democratic inflation rate, i_h is the specific inflation rate for a household h.

Table 1 shows the estimated ratios of representativeness and the democratic average inflation rate for 1995–2010. The average proportions of households fulfilling measures 1 and 2 for closeness over the whole period are 53% and 64%, respectively. In the UK, based on Leicester *et al*. (2008), in 1995–2008, the ratios were 46% and 52% respectively.[2] In Israel, in 1999–2005, the average measure 2 ratio was 58% (Artsev *et al*., 2006).

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2   Leicester *et al*. (2008) provided a chart on page 22, but no exact numbers, so we have estimated this average from their chart.

Table 1 | Estimated Ratios of Representativeness of Democratic Inflation Rate over Time (%)

	1995	1996	1997	1998	1999	2000	2001	2002	
Democratic inflation rate	9.2	9.3	8.8	11.1	1.9	3.1	5.0	1.2	
Measure 1	97.4	93.4	87.7	74.1	47.6	41.5	66.3	26.3	
Measure 2	73.2	65.9	56.2	31.5	77.8	54.2	55.7	72.3	
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**Avg.**
Democratic inflation rate	−0.3	2.7	1.6	2.5	2.6	6.7	1.5	1.3	4.3
Measure 1	10.3	62.4	36.6	45.8	44.4	65.0	29.1	27.6	53.5
Measure 2	87.0	79.5	73.8	64.1	64.1	42.0	64.9	67.3	64.3

Source: Authors' computations on the basis of the data from the Czech Statistical Office.

Table 1 also confirms our expectations that the two measures will vary, and in what ways. For example when the inflation was relatively low around 2003, Measure 1 does suggest that many households are far from the mean, whereas when inflation was relatively very high in 2008, Measure 2 suggests that many households are far from the mean.

Crawford & Smith (2002) further analysed whether the magnitude of an aggregate democratic inflation rate was significantly associated with lower representativeness, using UK data from the period 1975–1999, by using the ordinary least squares to regress the Measure 2 ratio on the aggregate democratic inflation rate. The value of the estimated coefficient of aggregate democratic inflation rate was –1.7 with standard error 0.5. Artsev *et al*. (2006) performed the same test on the Israeli 1999–2005 data, and the value of the estimate was –0.7.[3] The result of this regression estimated on the Czech data is –2.5.

The estimated coefficient is statistically significant at the 99% confidence level (p-value 0.009), and is lower than that for the UK and Israeli data. The regression is based only on a very small number of observations (16) and the data analysis also indicated possible heteroskedasticity. The p-value of the Breusch-Pagan test is 0.055. Running the regression with robust standard errors, the estimate is still significant at the 95% confidence level (p-value 0.028).

Overall, the average inflation rate was representative for only around 60% of the Czech households, with significant changes over time and depending on the measure used. We find a statistically significant negative association between the average inflation rate and the representativeness, approximated by Measure 2 ratio, which is in line with the previous results on the UK and Israeli data.

5. Pensioner Household and Low-Income Household Subgroups

In this section we analyse subgroup inflation rates for pensioner households and low--income households as well as the main influences on these rates. Of course there are many other population subgroups that could be analysed. We define a pensioner household

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3   Variance was not provided by Artsev *et al*. (2006) and so the statistical significance cannot be judged.

in line with the CZSO as a household in which there are no economically active members and whose head is a pensioner. Low-income households were defined in various ways in previous studies, and we present these in Table 2.

Table 2 | Various Definitions of Low-Income Households

Study	Definition
Sugema *et al.* (2010)	*Per capita* income of a household below specified absolute threshold
Artsev *et al.* (2006)	*Per capita* net income in lowest 10% of the distribution
Garvey, Murphy (2004)	Lowest 10% of the households income distribution
Crawford, Smith (2002)	Lowest 10% of the households income distribution
Garner *et al.* (1996)	1. Income below given absolute poverty threshold
	2. Expenditures below given absolute poverty threshold
	3. Participation in selected welfare programs
Blank, Blinder (1985)	Lowest 20% of the households income distribution
Hagemann (1982)	Income of a household below absolute specified threshold

We consider the status of low-income as having a relative rather than absolute meaning: a low-income household is defined as one with an income in the lowest 10% of the income distribution in a given year. Once again, we ensure representativeness. Table 3 compares democratic inflation rates for three groups: the so called aggregate covers the whole population, whereas the other two democratic inflation rates focus on pensioners and low-income households. To enrich the analysis, it also contains the plutocratic rate for pensioners as reported by CZSO.

Table 3 | Democratic Inflation Rates – Aggregate, Low-Income Households, Pensioners

	1995	1996	1997	1998	1999	2000	2001	2002	
Aggregate	9.2	9.3	8.8	11.1	1.9	3.1	5.0	1.2	
Pensioner households	10.0	9.8	9.8	12.0	1.9	3.4	6.1	1.6	
Low-income households	9.3	9.8	9.2	12.9	2.2	3.6	6.5	2.1	
CZSO Pensioner households (Plutocratic rate)	10.4	9.4	9.9	13.5	2.4	4.7	6.1	2.4	
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**Avg.**
Aggregate	−0.3	2.7	1.6	2.5	2.6	6.7	1.5	1.3	4.3
Pensioner households	−0.1	3.0	2.1	3.3	2.5	8.1	1.6	1.4	4.8
Low-income households	−0.2	3.1	2.3	3.7	2.6	8.5	1.4	1.5	4.9
CZSO Pensioner households (Plutocratic rate)	0.4	3.2	2.4	3.6	3.7	8.2	1.5	2.1	5.2

Source: Authors' computations on the basis of the data from the Czech Statistical Office

The average of the aggregate democratic inflation rate for the whole sample for the sample period is, as mentioned earlier, 4.3%, while it is 4.8% for low-income households, and 4.9% for pensioner households. Both subgroup inflation rates are higher than the aggregate rate in most years.[4] Using the same data as in Table 3, and considering 1994 as a base year with a price level equal to 100% for all groups of households, the cumulative inflation in 2010 would be 193% for the whole sample, 209% for pensioner households, and 213% for low-income households. These differences seem substantial to us, and in our opinion deserve the attention of policy makers, for example, when planning the indexation of pensions or social benefits.

To finish the analysis of figures from Table 3, comparing democratic pensioners figures with plutocratic ones published by the CZSO, the average of the latter is by half percentage point higher. So the conclusion could be that the richer pensioner households (in comparison to poorer ones) have spent relatively more on goods and services whose prices grow relatively faster. We have to be aware that the CZSO uses different methodology than we do since it uses the national accounts as a source of household consumption expenditures, whereas we use the HBS.

Let us compare our results with the existing literature for other countries. Looking only at papers that analyse periods of at least 5 years, many have concluded that low-income households faced a higher than average inflation rate (for example, Stewart, 2008 on US data, Garvey, Murphy, 2004 on Irish data, and Sugema *et al.*, 2010 on Indonesian data), some concluded that they faced overall the same inflation rate as the average (Artsev *et al.*, 2006 on Israeli data), and some concluded that they faced lower inflation (Crawford, Smith, 2002 on UK data). Blank, Blinder (1985) examined a very long period from 1947 to 1982 using US data, and concluded that on average there is no difference. Generally, poor households are less able to substitute when the price of the goods and services they buy increases. Therefore, the bias of the CPI as an estimator of true inflation rates (caused by the assumption of constant expenditure patterns as price changes) is lower for them than for richer households. Furthermore, the aggregate inflation rate is biased upward more than the low-income households' inflation rate. Therefore, our estimated difference between results for the subgroups and for the whole sample might be even greater in reality. The same argument holds for pensioners, if only because, on average, they also belong to poorer households.

The results for pensioners are similarly varied. For example, Hobijn, Lagakos (2005) concluded based on US data that pensioners faced on average a higher inflation rate, while Crawford, Smith (2002) arrived at the opposite conclusion based on UK data, and Lieu *et al.* (2004) found on average no difference between the two rates, based on data from Taiwan. While summarising various studies on subgroup price indices, Oosthuizen (2007) concluded that no single group experiences consistently higher or lower rates of inflation in the long run, relative to other groups. Assuming that price indices develop differently, and that subgroups have different spending patterns among countries, there is no reason that there should be worldwide similar trends among subgroup inflation rates in comparison to the national aggregate inflation rates.

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4   Using Welch's one-tailed t-test, the pensioner rate is significantly greater than the aggregate rate at a 95% confidence level in every year except 1999, 2007, 2009 and 2010. Almost the same holds for low-income households, whose inflation rate is significantly greater except in 2007, 2009, and 2010. Also, it can be hypothesised that low-income households face the same inflation rate as pensioner households. However, using Welch's two-tailed t-test, the rates are, at the 95% confidence level, not significantly different only in 6 of the years studied: 1996, 2000, 2003, 2007, 2009 and 2010.

To determine the biggest contributors to the inflation rate to which a subgroup is exposed, the relative contribution of expenditure on a specific good or service i to the plutocratic inflation rate at the period t for sub-population x can be calculated as:

$$R_{x,t,i} = \frac{E_{x,i,t-1}r_{i,t}}{\left|\sum_{i=1}^{n}E_{x,i,t-1}r_{t;i}\right|} \tag{9}$$

For a better aggregated illustration, we divide all goods and services monitored by HBS into 12 groups according to the first level of COICOP. The relative contribution of expenditure on a specific group of goods and services k ($k \in \{1, 2, ..., 12\}$) to the subgroup plutocratic inflation rate at a period t for sub-group x is calculated as:

$$R_{x,t,k} = \frac{\sum_{i=1}^{m}E_{x,i,t-1}r_{t;i}}{\left|\sum_{a=1}^{n}E_{x,a,t-1}r_{t;i}\right|} \tag{10}$$

where m is the total number of specific goods/services in the group k. The absolute contribution of expenditure on a specific group of goods and services k ($k \in \{1, 2, ..., 12\}$) to the subgroup plutocratic inflation rate at a period t for subgroup x can be defined as:

$$A_{x,t,k} = \left(\frac{\sum_{i=1}^{m}E_{x,i,t-1}r_{t,i}}{\sum_{i=1}^{n}E_{x,a,t-1}r_{t,i}}\right)\pi_{x,t} = \left(\frac{\sum_{i=1}^{m}E_{x,i,t-1}r_{t,i}}{\sum_{a=1}^{n}E_{x,a,t-1}r_{t,i}}\right)\left(\frac{\sum_{a=1}^{n}E_{x,a,t-1}r_{t,i}}{\sum_{a=1}^{n}E_{x,a,t-1}}\right) = \frac{\sum_{i=1}^{m}E_{x,i,t-1}r_{t,i}}{\sum_{i=1}^{n}E_{x,i,t-1}} \tag{11}$$

Table 4 shows the absolute contribution of various expenditures of the whole sample towards their inflation rates. The biggest "increasers" (expenditure on a given subgroup of goods and services causing an absolute growth in inflation rate greater than 1%) are depicted in bold, the biggest "reducer" (expenditure on a given subgroup of goods and services causing an absolute fall in the inflation rate by more than 1%) in bold italic. Columns 1–12 refer to the first level of COICOP categories and are listed below the tables in the notes.

For the whole sample, the most common "increaser" of the inflation rate was expenditure on housing and energy, because its price index rose very fast, and expenditure on food and non-alcoholic drinks, because this was the biggest expenditure group. We carried out a similar analysis for the two subgroups (low-income and pensioners) and the same holds for both (the detailed results are not shown because of space constraints). These two groups of expenditure increased the subgroup inflation rate by more than 1 percentage point in twelve years and in eight years, respectively. Comparing the magnitudes, both these expenditure groups had a greater absolute impact on the two subgroups' inflation rates than on the aggregate one. This can be explained by the fact that both subgroups spend relatively more on these expenditure groups. Expenditure on transport was an "increaser" three times for the whole sample in the period 1995–2000, but only in 1996 for both the subgroups, because the subgroups spent relatively little on transport. Comparing the results for pensioner and low-income samples, the structure of "increasers" for both subgroups seems very similar with one minor exception – in 2008, pensioner expenditure for health caused the pensioner inflation rate to grow by 1.02%, whereas for low-income households it was 0.96%. We observe that there are no "reducers" with the one exception of food and non-alcoholic drinks expenditure for both subgroups in 1999.

Table 4 | Contributors to Inflation Rate in Absolute Terms, How Much Each of the Groups Contributed to Inflation Rate

	1	2	3	4	5	6	7	8	9	10	11	12
1995	**1.92%**	0.32%	**1.03%**	**1.66%**	0.51%	0.20%	0.72%	0.20%	0.82%	0.36%	0.58%	0.63%
1996	**1.59%**	0.40%	0.93%	**1.84%**	0.31%	0.21%	**1.67%**	0.19%	0.61%	0.25%	0.40%	0.55%
1997	0.77%	0.27%	0.79%	**2.80%**	0.40%	0.31%	**1.05%**	0.21%	0.66%	0.21%	0.39%	0.54%
1998	**1.00%**	0.37%	0.54%	**4.81%**	0.39%	0.22%	0.58%	0.21%	0.67%	0.29%	0.52%	0.53%
1999	−0.64%	0.12%	0.05%	**1.20%**	0.09%	0.05%	0.32%	0.27%	0.05%	0.13%	0.11%	0.13%
2000	0.13%	0.12%	−0.15%	**1.68%**	0.00%	0.04%	**1.17%**	0.15%	0.23%	0.03%	0.13%	0.24%
2001	0.84%	0.11%	−0.15%	**2.54%**	0.00%	0.06%	−0.04%	0.21%	0.46%	0.02%	0.19%	0.35%
2002	−0.44%	0.06%	−0.20%	**1.13%**	−0.01%	0.08%	−0.32%	0.05%	0.14%	0.03%	0.21%	0.23%
2003	−0.43%	0.04%	−0.51%	0.28%	−0.16%	0.10%	0.06%	−0.23%	−0.16%	0.03%	0.15%	0.42%
2004	0.52%	0.11%	−0.34%	0.63%	−0.17%	0.12%	0.38%	0.59%	−0.01%	0.02%	0.36%	0.29%
2005	−0.06%	0.04%	−0.35%	0.93%	−0.16%	0.16%	0.22%	0.24%	0.04%	0.02%	0.27%	−0.01%
2006	0.16%	0.03%	−0.39%	**1.66%**	−0.11%	0.10%	0.21%	0.23%	0.03%	0.03%	0.21%	0.04%
2007	0.69%	0.33%	−0.05%	**1.03%**	−0.03%	0.11%	0.02%	−0.04%	−0.04%	0.02%	0.19%	0.04%
2008	**1.18%**	0.30%	−0.08%	**2.89%**	0.03%	0.79%	0.31%	−0.15%	0.05%	0.02%	0.44%	0.29%
2009	0.18%	0.14%	−0.17%	0.43%	−0.05%	0.20%	0.48%	−0.12%	−0.20%	0.01%	0.15%	0.01%
2010	0.17%	0.14%	−0.16%	0.46%	−0.05%	0.19%	0.47%	−0.12%	−0.16%	0.01%	0.15%	0.01%

Source: Authors' computations on the basis of the data from the Czech Statistical Office

The CZSO should consider constructing subgroup indices so as to be able to better distinguish the inflation rates faced by individual households. Some national statistical offices are already issuing subgroup indices (*i.e.* the US Bureau of Labor Statistics, as mentioned by Stewart (2008, p. 19), the Indian Ministry of Statistics and Programme Implementation and the Hong Kong Census and Statistics Department, as discussed by Ley (2005, pp. 634 and 641)). The question of exactly which and how many different price indices should be evaluated by the CZSO for the purposes of economic policy remains unanswered, and is beyond the scope of this paper. The introduction of more price indices should enable policy makers to design economic policies more precisely and therefore they contribute to better evidence-based policy making. However, since many Czech citizens do not even understand the meaning of the one, official, inflation rate, the cost of introducing this more detailed indexing might induce a higher level of public misunderstanding.

Areas for further research include the analysis of further subgroups and of the impact of price shocks on various inflation rates. Combining the data and methods used here with information on real wages and other indicators would be also very useful and would provide a more complex picture of developments in the living standards of various households.

Further research could make estimating the impact not only of inflation, but monetary policy more generally as well-established an exercise as that for fiscal policy, as demonstrated, for example, in Lustig *et al.* (2012) and Cormac, Preston (2012). A step in this direction is, for example, in Romer, Romer (1998). Further, estimates of distributional impact of other policies would benefit from further research, ranging from fiscal consolidation in Ball *et al.* (2013) to globalisation in Goldberg, Pavcnik (2007).

6. Conclusion

This article has analysed the heterogeneity of household-specific inflation rates in the Czech Republic between 1995 and 2010. For this analysis we have used the most detailed data available on households, and on the prices of various goods and services. By linking expenditure items with their respective price indices, we estimated the specific inflation rate for every household in the sample, which also enabled us to estimate subgroup inflation rates. We hope this analysis will attract increased attention to the often-neglected microeconomic implications of one of the most important macroeconomic variables.

We have found that around 60% of the Czech households studied experienced an inflation rate within 1 percentage point of the national average inflation rate, and have further found a negative association between the average inflation rate and representativeness: the higher the magnitude of the average inflation rate over time, the lower the percentage of households who experience an inflation rate similar to the average.

Since the results presented here are the first of their kind for the Czech Republic and the results from previously published studies vary quite significantly across countries, our results may not necessarily have predictive power for the forthcoming years. Therefore, the results warrant regular updating and policy-makers should be relatively cautious and should not rely solely on our estimates.

The cumulative inflation from 1994 to 2010 was estimated at 209% for pensioner households, and 213% for low-income households, in contrast to 193% for the whole sample. These differences could serve as a signal to Czech policy makers to begin applying knowledge of differences between subgroup inflation rates in their designs for evidence-based policies. Applying this approach to the indexation of pensions and social benefits would be a good starting point. For example, a new indexation of pensions that would be dependent on pensioner-specific inflation rates, rather than on aggregate rates, could be considered. Of course, this kind of indexation, similarly to other detailed adjustments, has implementation and operation costs that need to be weighed against the possible benefits.

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