

Mehrhoff, Jens; Breuer, Claus Christian

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## Is Inflation Heterogeneously Distributed Among Income Groups?

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# Is Inflation Heterogeneously Distributed Among Income Groups?\*

Jens Mehrhoff<sup>†</sup>, Claus Christian Breuer<sup>‡</sup>

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## Abstract

Inflation rates of more than 3% in Germany during some months in the spring and summer of 2008 have been giving rise to claims from both politicians and the unions for social measures for welfare recipients. It is argued that the burden of inflation is heterogeneously distributed among different income groups. The reasoning behind this perception is that prices for food and energy increased disproportionately at that time and that low income households spend more on these goods in relative terms. We analyse data at the lowest level of aggregation publicly available (four-digit COICOP positions) taken from the most recent German sample survey of household income and expenditure in order to calculate income group specific price indices. Households' net income is divided into 13 groups ranging from less than €1,000 to more than €7,000. Numerous studies have found widely different inflation rates for different socio-economic groups. Although we find some variation, for the price indices as well as for the weighting schemes, the general inflation trend is almost the same, irrespective of the household's net income.

**Keywords:** Consumer Price Index, Household Income and Expenditure Survey, Price Indices by Income Groups.

**JEL:** C43, D12, E31.

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\*This paper represents the authors' personal opinions and does not necessarily reflect the views of the Deutsche Bundesbank or its staff. Detailed results and descriptions of methodology are available on request from the authors.

<sup>†</sup>Corresponding author: Jens Mehrhoff, Statistics Department and Research Centre, Deutsche Bundesbank, Wilhelm-Epstein-Strasse 14, 60431 Frankfurt am Main, Germany, Tel: +49 69 9566-3417, Fax: +49 69 9566-2941, E-mail: jens.mehrhoff@bundesbank.de.

<sup>‡</sup>Claus Christian Breuer, Department of Economics, University of Duisburg-Essen, Essen Campus, Universitaetsstrasse 12, 45117 Essen, Germany, Tel: +49 201 183-2302, Fax: +49 201 183-4209, E-mail: claus.breuer@uni-due.de.

# 1 Introduction

In political discussions, it is sometimes argued that the burden of inflation is unequally distributed among the population. A possible explanation for this perception is that prices for some products which make up a large percentage of expenditure, such as food and energy, have risen relatively sharply. It is important to note that this perception is not specific to Germany as similar observations were made in many European countries after the introduction of the euro as means of payment.<sup>1</sup> However, contrary to some other European countries (e.g. Belgium), German social security and pension payments are not automatically adjusted to the growth rate of the Consumer Price Index (CPI), although they are adjusted in line with the development of net incomes. For this reason, high inflation rates have been giving rise to claims from both politicians and the unions for social measures for welfare recipients and low income households in general. In their opinion, monthly extra money for necessities, in particular dairy products, or food vouchers may help poor families to cope with higher inflation. Opponents of such supporting measures, on the other hand, fear misuse, with extra money mainly being spent on alcohol and tobacco.

In the case of Germany, the question of whether or not this perception of different inflation burdens is legitimate, is not easy to answer mainly because of a lack of official statistics. While formerly, up to the end of December 2002, the German Federal Statistical Office (GFSO) calculated price indices for three household types (four-person households with higher income, four-person households with middle income, and two-person pensioner households with low income), now only a single overall CPI is computed.<sup>2</sup>

The aim of our paper is to quantify the differences in the distribution of the inflation burden among income grouped household types. For this purpose we use household level micro data from the German sample survey of household income and expenditure (abbreviated by its German initials EVS, which stands for *Einkommens- und Verbrauchsstichprobe*) to calculate income group specific weighting schemes necessary for the calculation of individual price indices.

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<sup>1</sup>See Jungermann et al. (2007) for a detailed analysis of the influence of the euro cash changeover on perceived inflation.

<sup>2</sup>For a more detailed discussion of this topic, see Egner (2003).

The paper is organised as follows. Section 2 illustrates our motivation, the existing literature and the methodology applied. Section 3 gives a description and general considerations concerning the sample survey of household income and expenditure. Section 4 describes the data used in our study. Section 5 presents and discusses the results of our analysis. The final section concludes the paper and gives an outlook on possible future research in this field.

## **2 Motivation, Literature and Methodology**

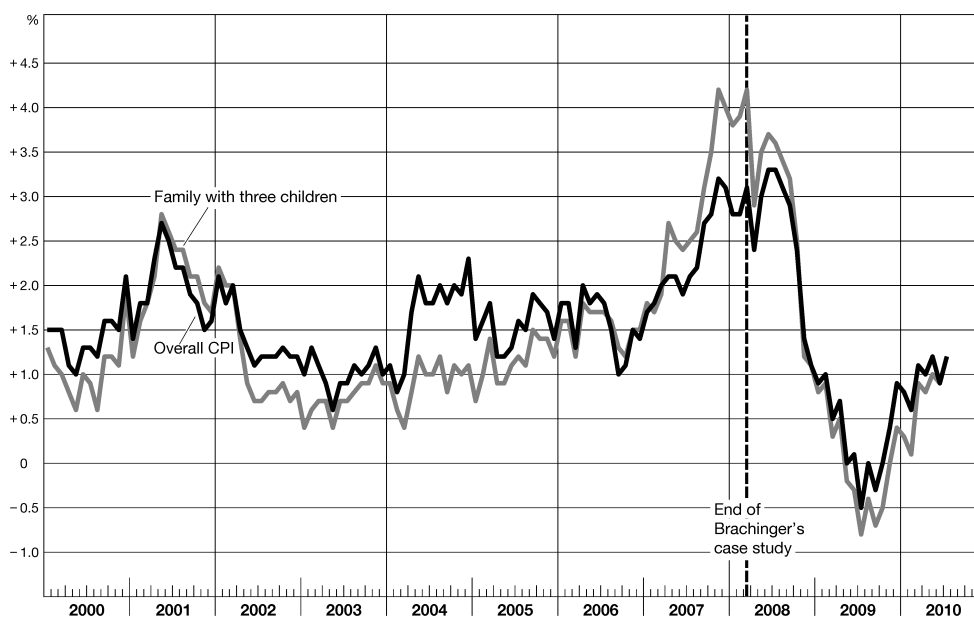
After a long period of low inflation rates of around 2% in most western European countries, consumer prices rose in the spring and summer of 2008. In Germany, the annual inflation rate, measuring the price change between the current month and the same month of the previous year, reached a 15-year high of 3.3% in June and July 2008. This rise of the German CPI was the result, in particular, of a sharp increase in energy and food prices due to a booming world economy and the high demand for oil and other raw materials. In the oil market, the upward pressure on demand pushed the price of crude oil to an all time high of US\$147 a barrel. Unsurprisingly, this high oil price directly affected the price of fuel related products such as gasoline. Moreover, high oil prices had an indirect impact on the price of many other products through an increase in production costs. With the beginning of the financial crisis and the abrupt ending of the economic boom in 2008, this period of continuous price growth came to a halt and inflation rates returned to their former levels of around 2%. Nevertheless, the current financial market situation, with historically low interest rates and quantitative easing policies on the part of some of the most important central banks around the world, lead some economists to predict risks of rising inflation rates in the near future.

In an environment of rising prices, the perception of different inflation burdens increased. Not only politicians but also researchers became more and more interested in this topic. Recent studies on inflation rates for different socio-economic groups demonstrated that different household types might be facing different inflation burdens. Most of these studies use expenditure data from the German EVS

to calculate weighting schemes for group specific Laspeyres price indices.<sup>3</sup> For instance, Brachinger (2008) focused on the very special case of a family with three children and a net monthly income between €2,600 and €3,600 which does not consume tobacco products and spends only a small amount on alcohol products. The EVS 2003 contains only 371 household datasets of this very specific household type out of 232,000 households (0.16%), which is nevertheless still regarded as being representative of all households of this type in Germany.<sup>4</sup> Brachinger found that for the period from January 2000 to December 2006, the inflation rate of this specific household type was almost exactly correlated with, and for a long time, was even lower than the overall CPI. Only during the year 2007 and the beginning of 2008, this household type specific price index always exceeded the official CPI. If one extends his price index with the most recent data, it is again lower than the overall CPI as can be seen from Figure 1. The vertical line indicates March 2008, the end of Brachinger's case study.

**Brachinger's case study of household type specific inflation rates**

Figure 1



<sup>3</sup>A very detailed discussion on the choice of the index formula for CPI calculation can be found in von der Lippe (2007).

<sup>4</sup>The population consists of 38,110,000 households, thus Brachinger's household type covers just 0.61% of the population's households.

Similar to Brachinger, Tober (2008) found somewhat less pronounced, yet significant differences between household specific inflation rates.

Our paper supplements these recent computations by using less aggregated, and hence more detailed, data. The EVS data for different household types is publicly available from the GFSO only for eleven broad consumption goods categories, corresponding approximately to the twelve two-digit COICOP (United Nations Classification of Individual Consumption by Purpose) divisions. The aforementioned studies used this data on an aggregated macro level in order to calculate commodity specific sub-indices.<sup>5</sup> As we have access to EVS household level micro data, we can calculate income group specific price indices at a lower level of aggregation, the four-digit COICOP class level. This enables us to gain a clearer insight into the consumption habits specific to each income group and allows us to more precisely determine their burden of inflation. A drawback of using household level micro data at a lower level of commodity aggregation is the lack of information on the representativeness of the sample results for the whole population. The GFSO publishes information on the representativeness of the results only on an aggregated macro level. So we have to take extra care with the number of observations in our income groups. A further diversification of household types by other socio-demographic characteristics, such as household size, number of children, age or employment status, would reduce our sample sizes per household type and the representativeness of the results could not be guaranteed anymore. In short, the price we have to pay for a lower level of commodity aggregation is a higher level of household aggregation.

### 3 Household Income and Expenditure Survey

The weights and selected items of the German CPI are derived from several sources inside and outside the German system of official statistics. By far the most important source is the EVS, the sample survey of household income and expenditure. The EVS is part of the German system of household budget surveys, which consists, in addition to the EVS, of the current household budget survey (*Laufende*

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<sup>5</sup>The COICIOP divisions 01, food and non-alcoholic beverages, and 02, alcoholic beverages, tobacco and narcotics, are jointly stated in the expenditure data.

*Wirtschaftsrechnungen*, abbreviated LWR), which is conducted once a year.<sup>6</sup> Besides the use of the results of the EVS to calculate the weighting scheme of the German CPI, this is the main database for the German federal Government's reports on poverty and wealth.

The EVS is a cross-section household survey, conducted every five years, which started in 1962/63 in West Germany and was extended in 1993 to East Germany. A household is defined as a statistical unit with the provision that it is a group of persons whose command over income is shared, independently of their kin relationship. With a net sample, i.e. fully completed questionnaires, of 53,432 voluntarily participating households in 2003, the EVS is the largest survey of its kind in the European Union. Nevertheless, not the entire German population is covered by the EVS. Homeless people, people living in institutional accommodation, such as jails, hostels for students or nurses, barracks for armed forces or care homes for elderly or disabled people, and households with a net monthly income above €18,000 are excluded from the survey. Due to this restriction and the underrepresentation of foreigners, who are more difficult to recruit because of language barriers, the sample of the EVS is not fully representative.<sup>7</sup> The EVS is a quota rather than a stratified random sample. The annual current population survey of Germany, the Microcensus, serves as a benchmark for recruiting the participants, who earn a small honorarium. Some of the quotas cannot be achieved completely, so that a final weighting has to be conducted. To publish results at federal state level, the EVS is weighted according to the criteria "type of household", "social position of the household's reference person" and "income bracket" for each federal state using the current Microcensus results.

The EVS is divided into four parts:

1. Initial household interview, in which the socio-demographic information about every household member, the overall housing situation and the endowment with durable consumer goods is established.
2. An appendix to the initial household interview evaluating the financial assets and debts of the household.

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<sup>6</sup>The results of the LWR are used to fine-tune the CPI weighting scheme on the lowest level of commodity aggregation, the ten-digit COICOP level.

<sup>7</sup>For a more detailed discussion, see Becker et al. (2002).

3. A household book, containing all kinds of income – including public and in-kind transfers – and expenditures on all categories of private consumption, has to be kept for three months.
4. A sub-sample of 20% of the participating households has to keep another household book (detailed log book) for one month, in which all expenditures on and purchased quantities of food, alcoholic and non-alcoholic beverages, and tobacco products have to be noted in very great detail.

To ensure that the household books provide equal coverage of all months of the year, the total household sample is split equally across all four quarters of the survey year. Annual results from the household books are, in general, available around one and half years after the end of the survey year, whereas results from the initial household interviews are already published during the autumn of the survey year. According to the GFSO, a wide range of plausibility checks are conducted so that the published results can be regarded as highly accurate and reliable.

## 4 EVS 2003 Data

### 4.1 Data Description

For our purposes, the household level expenditure figures in conjunction with households' net income are of great value. The predefined expenditure categories of the household books closely follow COICOP at the four-digit level. Results from detailed log books are even available at the lowest, ten-digit, level. By dividing the expenditures for each consumption goods category by total expenditures, the weight of each category in the basket of goods of the CPI can be obtained. For research purposes, the Research Data Centre of the GFSO provides so-called Scientific-Use-Files containing household level micro data from the EVS.<sup>8</sup> The micro data is anonymised by making only an 80% random sample of all household datasets available and by limiting the number of variables for which data are provided.<sup>9</sup>

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<sup>8</sup>An overview of the practice of the Research Data Centre of the GFSO concerning micro data and its anonymisation is given by Zühlke et al. (2003).

<sup>9</sup>We are very grateful to the GFSO for providing the Scientific-Use-Files of the EVS and much useful advice concerning the dataset.



Using the latest available Scientific-Use-Files of the EVS 2003, containing data from 42,744 household books and 11,831 detailed log books, we are able to calculate weighting schemes for 13 different income groups according to the households' monthly net income. We use the EVS net income concept, which not only includes market income but also social assistance benefits of the household members. The lowest income group contains households with monthly net incomes below €1,000, the next higher group those with monthly net incomes from €1,000 to less than €1,500. This classification with steps of €500 is continued until €6,000. The second highest group ranges from €6,000 to €7,000 and the highest group contains all households with monthly net incomes of €7,000 or more.

Micro data from detailed log books are used to calculate commodity weights for each of these income groups at the COICOP four-digit level for the expenditure divisions 01 and 02, and micro data from household books are used for the expenditure divisions 03 to 12. This approach corresponds approximately to the way in which the GFSO recalculates the overall weighting scheme every five years, with the slight difference that the GFSO can check the plausibility of EVS data by using other sources inside and outside the German system of official statistics. But to our knowledge, only the two consumption goods categories of alcohol and tobacco products are cause for concern regarding systematically biased results. Comparing figures from tax statistics and national accounts with reported alcohol and tobacco consumption in the EVS, it becomes obvious that households understate expenditures for these product categories. The reason may be a certain sense of shame for high alcohol or tobacco consumption.<sup>10</sup> Since we have no access to the data sources the GFSO uses for fine-tuning and plausibility checks, we use CPI weights for tobacco and alcoholic beverages to adjust understated expenditures for these commodity groups proportionally to expenditures for food and non-alcoholic beverages. While the GFSO uses a number of data source to calculate the official CPI weighting scheme, our income group specific weighting schemes are based on the EVS 2003 alone. Furthermore, expenditures are estimated according to the overall CPI weights when no data from the EVS are available. Note that the number of households in our study is not adjusted for quota sampling.

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<sup>10</sup>The problem of and possible reasons for under-reporting of alcohol consumption were discussed in Stockwell et al. (2004).

Besides expenditure data, which are necessary for the calculation of the weighting schemes, we also need time series of sub-indices at a low level of aggregation for all relevant commodity groups. The GFSO provides monthly sub-indices of the CPI at the COICOP four-digit level free of charge. We use this monthly price data, which range from January 2005 to July 2010. Income group specific weighting schemes and price data enable us to calculate specific monthly Laspeyres price indices (PIs) and their year-on-year inflation rates with base year 2005 = 100 for each of the 13 income groups.

## 4.2 Summary Statistics

We first present an overview of the data in the form of some summary statistics. In particular, we take a closer look at income and expenditures by income groups rather than in total.

Table 1: Summary statistics

Income group in €	Number of households	EVS share in %	CPI weight in %	$I^*$ in €	$C^*$ in €	$C/I^*$ in %
<1,000	2,271	5	2	749	945	126
1,000-1,500	3,901	9	5	1,267	1,324	104
1,500-2,000	4,693	11	7	1,754	1,685	96
2,000-2,500	4,953	12	9	2,250	2,085	93
2,500-3,000	4,779	11	10	2,746	2,405	88
3,000-3,500	4,516	11	11	3,245	2,704	83
3,500-4,000	3,806	9	10	3,744	2,953	79
4,000-4,500	3,160	7	9	4,243	3,221	76
4,500-5,000	2,628	6	8	4,737	3,389	72
5,000-5,500	2,069	5	7	5,243	3,622	69
5,500-6,000	1,522	4	5	5,738	3,897	68
6,000-7,000	1,955	5	7	6,454	4,177	65
≥7,000	2,491	6	11	8,994	5,050	56
Total	42,744	100	100	3,474	2,661	77

\*  $I$ : Income,  $C$ : Expenditures,  $C/I$ : Consumption ratio

The second and third column of Table 1 show the number of households participating in the EVS 2003 by income group and their relative share in per cent, respectively. In the fourth column, the shares of these households in the CPI weighting scheme, i.e. expenditures of that income group over total expenditures, are stated. The average monthly net income of each income group is to be found in column five, followed in column six by average expenditures. Lastly, the consumption ratio is shown in the seventh column.

From the last three columns of Table 1 it follows that though expenditures increase with income, the consumption ratio decreases with income. This is due to the fact that expenditures display below-average growth, implying a higher rate of savings in households with higher income. Still the lowest income households have consumption ratios of more than 100% (cf. Brachinger, 2008, who finds similar results). This is reasonable given that e.g. rents for welfare recipients are paid directly by the state, thus they are not part of the household's income but do feature as expenditures.

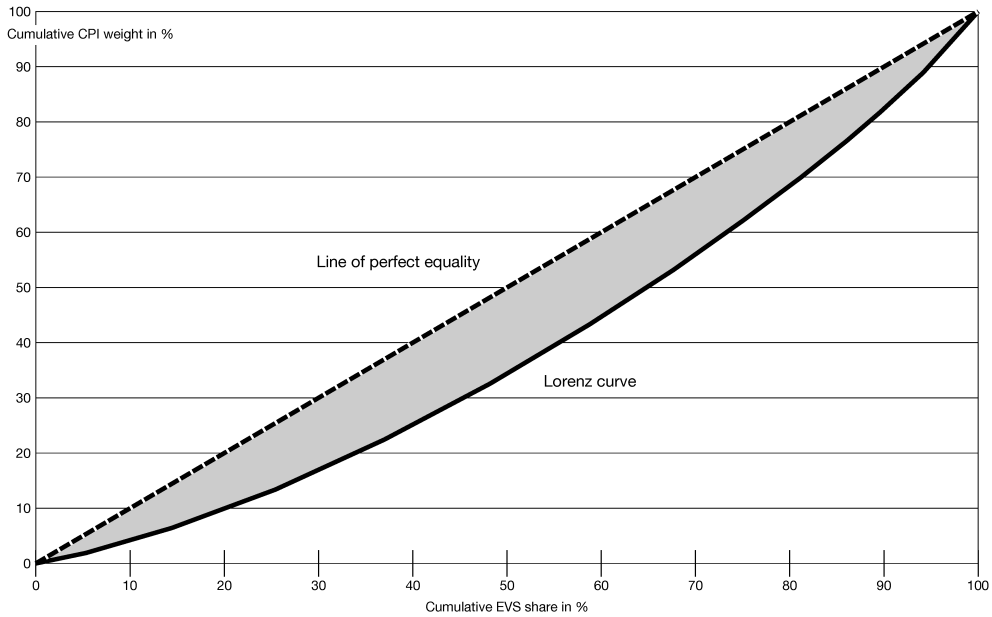
## **5 Heterogeneity Between Income Groups**

### **5.1 Heterogeneity in the CPI Weights**

We also see from Table 1 that the EVS is dominated by low and middle-income households. However, the major share of the CPI weight is assigned to middle and high-income households. This fact can be graphically represented by the Lorenz curve, which plots the cumulative CPI weight against the cumulative household share in the EVS. Figure 2 shows the Lorenz curve according to EVS data.

**Lorenz curve**

Figure 2



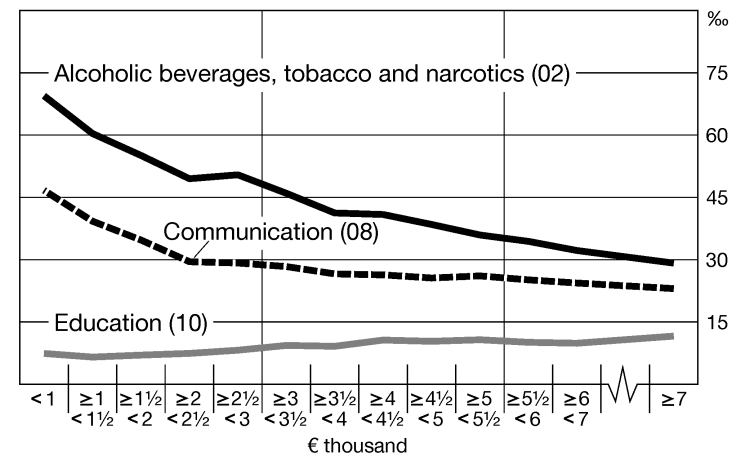
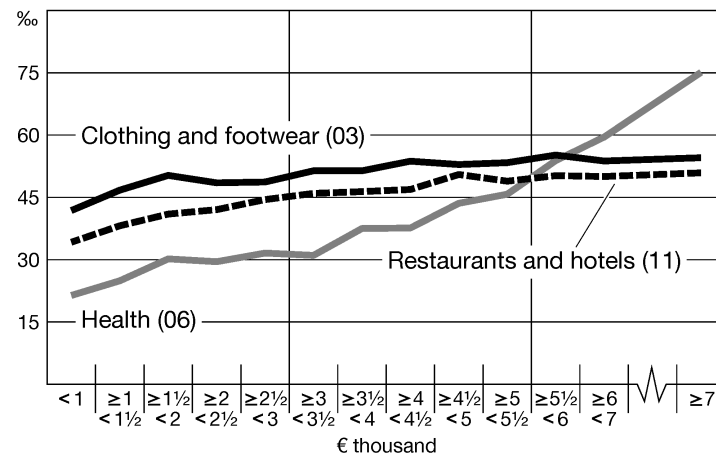
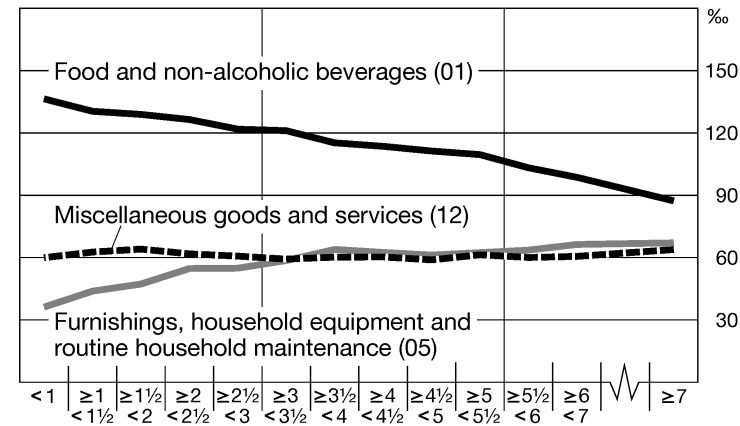
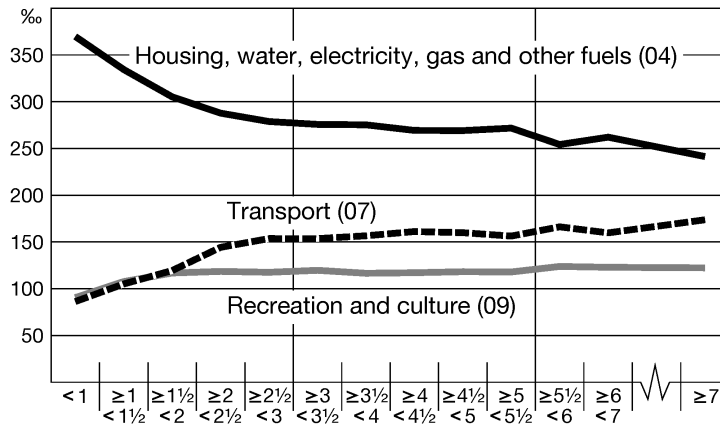
The proportion of the shaded area between the Lorenz curve and the line of perfect equality to the area under the line of perfect equality is the Gini coefficient, a measure of expenditure inequality. If the Gini coefficient is zero, the distribution is absolutely equal. In the opposite case of a Gini coefficient of one, the distribution is absolutely unequal. Here, the Gini coefficient is found to be 23.2%, which indicates moderate expenditure inequality.<sup>11</sup>

With the aforementioned data, income group specific expenditure shares are calculated at the four-digit COICOP level. For the purpose of exposition only, these weighting schemes for price indices by income group are aggregated to the two-digit COICOP level and are drawn in Figure 3. The income groups are plotted on the x-axis according to their monthly net income, the weights on the y-axis. The panels are arranged clockwise in descending order of the official 2005 weights.

<sup>11</sup>In its latest Human Development Report, the United Nations (2007) state, using World Bank data, that Germany has a Gini coefficient of 28.3% for income inequality, instead of expenditure inequality, as of the year 2000 – one of the lowest figures worldwide.

Figure 3

### Expenditure shares by COICOP division



On the one hand, the largest slope parameters are found for the two most important divisions, i.e. “housing, water, electricity, gas and other fuels”, and “transport”, but with opposite signs so that their changes balance out. On the other hand, the next largest slope parameters are found for some of the least important divisions. Furthermore, some important divisions, such as “recreation and culture” or “miscellaneous goods and services”, are virtually flat. All in all, this points to limited heterogeneity in the CPI weights.

## 5.2 Heterogeneity in the Inflation Rates

We continue by examining heterogeneity between income groups with respect to inflation rates. Therefore, income group specific price indices are calculated based on the weighting schemes which were analysed in the preceding subsection and disaggregated price data. In Figure 4, year-on-year inflation rates are drawn, comparing the overall CPI with the minimum and maximum inflation rates. Our recalculated CPI is very close to the official one except for a few months when prices rose sharply in 2007. The minimum and maximum might stem from any income group.



No single income group shows the minimum or maximum inflation rate throughout. Households with a monthly net income of less than €1,000 currently display the lowest inflation rates. However, minimum and maximum lie in a narrow band between income groups and hence, are very close to each other and thus to the overall CPI.

Figure 5 shows the dispersion of inflation rates, in particular the maximum absolute deviation (MAD) of any price index from the CPI and the root mean squared error (RMSE) of all price indices to the CPI. Table 2 depicts the most important summary statistics for these heterogeneity measures.

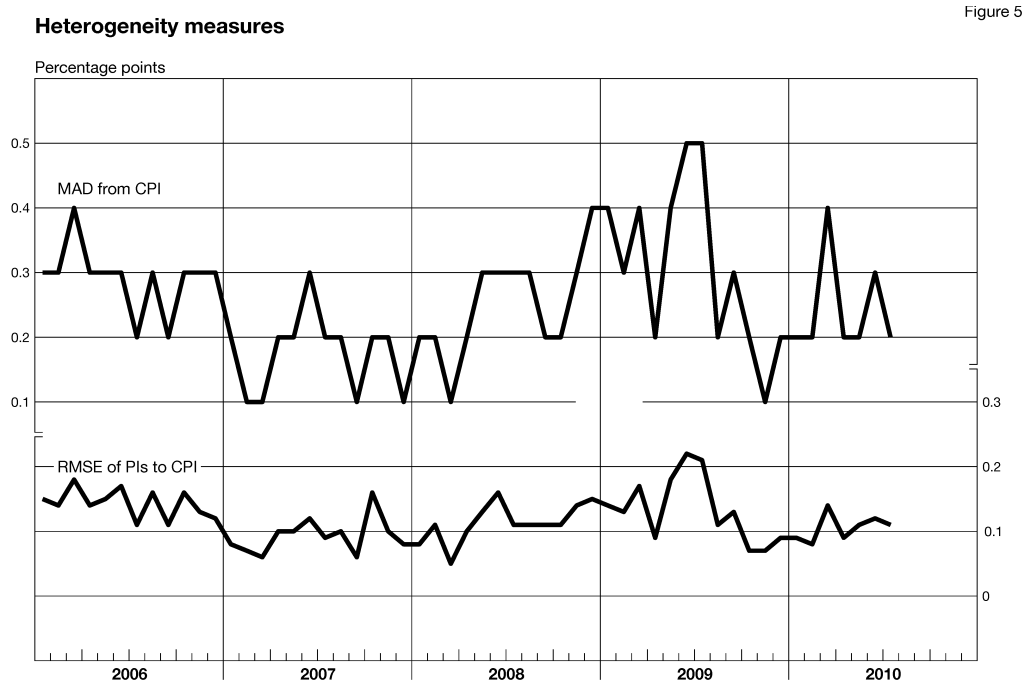
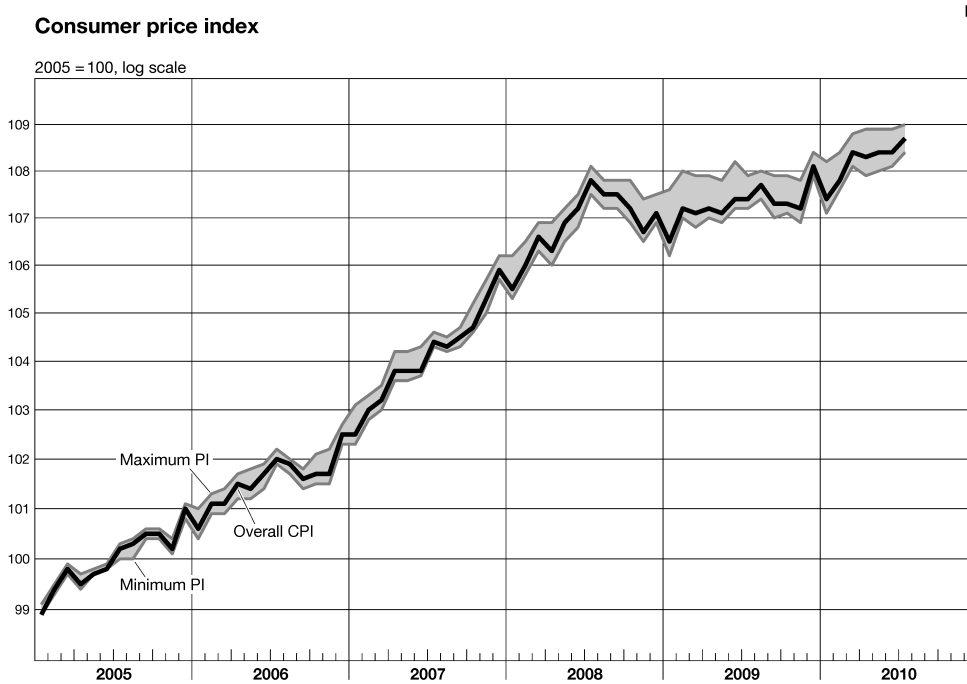


Table 2: Heterogeneity measures in percentage points

Statistic	MAD from CPI	RMSE of PIs to CPI
Mean	0.3	0.12
Standard deviation	0.1	0.04
Minimum	0.1	0.05
Median	0.2	0.11
Maximum	0.5	0.22

We find that heterogeneity of inflation rates is low. The maximum absolute deviation of any income group specific price index from the CPI is 0.3 percentage point on average and it never exceeds 0.5 percentage point. With an average of about one-tenth of a percentage point, the root mean squared error of the price indices to the CPI is equally low, remaining below one-quarter of a percentage point throughout. This is in contrast to the findings of Brachinger (2008), but more in line with those of Tober (2008).

We now turn to the levels of the overall CPI and the minimum and maximum price index in Figure 6. As for the inflation rates, the price indices lie in a narrow band and no income group shows a significantly different time path for the inflation burden.



## 6 Conclusion

Although we find some variation between income groups, for the price indices as well as for the weighting schemes, the general inflation trend is almost the same, irrespective of the household's net income. Our results invalidate the frequent assertion of higher inflation rates for poor households.



For further research, it may be interesting to build not only income grouped household types but also incorporate other socio-demographic characteristics, like household size, number of children, age and employment status, provided by the EVS. Whereas a further diversification of household types always incurs the risk of generating data samples that are too small to be representative of the population in question. An alternative to our household net income grouping procedure would be the use of income equivalence scales to classify the income groups. This would imply a weighting on the households' net income according to the number and age of the household members.

It also has to be taken into account that the EVS data we used to calculate the individual weighting schemes are from the year 2003, so that we have no information about potential adjustments in consumption undertaken after changes in the relative prices of goods. The current household budget survey could give a clue; however, its use would cause problems.<sup>12</sup> The comparison of group specific price indices with the official CPI, whose weighting scheme is mainly based on the EVS 2003, would become difficult.

In this paper, we calculate income group specific price indices by deriving individual weighting schemes from EVS data. However, if one wants to meet the demands of politicians and the unions that social welfare recipients and pensioners be compensated for their individually increased living costs, calculating such a specially weighted price index for poor people cannot be the solution. More than just the weighting scheme needs to be adjusted. Besides the weighting scheme itself, the basket of goods – more precisely for the case in hand, the goods themselves – and the stores where the goods are bought are probably not the same as for the average household (cf. Schultze and Mackie, 2002, who discuss this issue in great detail). Lastly, quality adjustment must be performed separately for the prices of the goods bought from each household type or income group. However, if price indices specific to this household type were calculated in this way, the results might change.

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<sup>12</sup>Additionally, access to household level micro data from the LWR is far more restricted than to the EVS data we used.

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