Euro or "Teuro"?:
The Euro-induced Perceived Inflation in Germany

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Abstract

After the introduction of the euro notes and coins in January 2002, throughout the Economic and Monetary Union member countries there was a widespread feeling that the euro had brought about a significant hike in consumer prices. A substantial discrepancy was evident between inflation as measured by the official consumer price indices (*CPI*) and the one perceived by the general public. In this paper the German case is treated. First, a short overview is given on the public discussions and the many studies published by the German Federal Statistical Office. Then a newly developed theory of inflation perception is outlined and a corresponding index of perceived inflation (*IPI*) is developed. This index has been calculated for Germany. In the main part of the paper, the results are presented. The *IPI* time series for Germany from 1996 through 2006 clearly show a special inflation around the introduction of the Euro notes and coins. During that period, the average perceived inflation was approximately 4 times higher than the official inflation rate.

Key words: perceived inflation, price index, prospect theory, euro cash changeover.

JEL classification: C43, E31, D81.

1 Introduction

After the introduction of the euro in January 2002, a substantial discrepancy was evident throughout the Economic and Monetary Union member countries between inflation as measured by the official consumer price indices (CPI) and the one perceived by the general public. This was also true for Germany: there was a widespread feeling that the introduction of the euro as legal tender had brought about a significant hike in consumer prices. Amidst the general uproar, Consumer Protection Minister Künast even organised an "Anti-Teuro Summit" ("teuro" is a play on words linking the word "euro" with the word "teuer",

meaning expensive). The German Chancellor also shared the consumers' concern. In 2002, *"teuro"* was voted word of the year.

No, the euro was no *teuro*, retorted the official statistics and the leading economics research institutes. It was pointed out that the consumer price index in May 2002 had risen by only 1.1% over the previous twelve months and that it was at its lowest level since November 1999 (1.0%). The European inflation rate, at 2.0%, exhibited the same level in the twelve months to May as had been recorded right before the introduction of the euro notes and coins. One could truly not speak of a price hike.

The Ifo Institute emphasised that the introduction of the euro had been a "non-event" in terms of inflation and ascribed the debate over the *teuro* to the "imaginary realm of the psyche and subjective perceptions" (SINN, 2002). Other influential economic and political opinion leaders dismissed the phenomenon as well. In May 2005, the FRANKFURTER ALLGEMEINE ZEITUNG (2005), a major German daily, summarized that the *teuro* had simply been a mere illusion for many. The oh-so-naïve consumer had just been affected by a "distorted price feeling". What wasn't there could just not be.

It was admitted, however, that at the moment the euro was introduced as legal tender, a minor price hike had taken place in some local services. As regarded foodstuffs, which were 6.7% more expensive in January 2002 than in the same month a year before, the effect of a harsh winter in the southern European fruit- and vegetable-producing areas had been accountable for the higher prices. Conversely, the prices of many industrial products, in particular those related to entertainment electronics, had been fallen significantly. Thus, computers indeed cost 23% less in May 2002 than in the same month the year before. The net effect of all these price movements had been negligible.

In July 2004, Germany's Federal Statistical Office released a definitive study on the issue of whether the euro was indeed a *teuro* (STATISTISCHES BUNDESAMT, 2004). According to it, in the last two-and-a-half years of the Deutschmark (DM) inflation in Germany had clocked 4.3%, while in the first two-and-a-half years of the euro it had reached only 3.3%. Thus, it was hoped, the matter could be laid to rest once for all. The *Süddeutsche Zeitung* regarded the "*teuro* feeling" as unquestionably disproved (EINECKE, 2004). The prestigious *Neue Zürcher Zeitung* subsequently consigned the euro-as-*teuro* notion to the realm of legends (RASONYI, 2004). And yet: the *teuro* feeling stubbornly remained.

The gap between perceived and measured inflation is an important phenomenon in various respects (see DEL GIOVANE AND SABBATINI, 2005). It can lead to erosion of the euro's public acceptance and its institutional framework, signs of which became already evident in Italy in 2005. Furthermore, this gap may influence inflation expectations and thus lead to distorted prices and wages. It can also lead to questioning the credibility of monetary policy, based as it is upon a price index that is not publicly accepted. Lastly, this gap possibly diminishes the capacity of producers and consumers to assess prices correctly, reducing thereby the price system's allocative efficiency.

This makes evident that measuring perceived inflation is a useful undertaking. However, until late 2004 no method to directly quantify perceived inflation was known. The sole empirical data set for inflation perception has been, for many years, the consumer survey carried out on a monthly basis by the European Commission within the framework of the Joint Harmonised EU Programme of Business and Consumer Survey (EUROPEAN COMMISSION, 2003) on a Europe-wide random sample of consumers.

The survey asks respondents how in their opinion consumer prices have evolved in the past 12 months. Various methods have been put forth in the literature in the past few years for deducing from these survey data an estimation of the yearly rate of perceived inflation. These methods are based on empirically unsubstantiated assumptions, for instance that the perceived inflation rate has a Gaussian distribution. In addition, research such as that conducted by DEL GIOVANE AND SABBATINI (2005) shows that the perceived inflation rate deduced varies markedly from one method to another. These methods are therefore highly unreliable.

Following the publication of the "definitive" study by the Federal Statistical Office mentioned above, which stated that the average inflation of the first two-and-a-half years of the euro had been lower than the average one for the last two-and-a-half years of the DM, this author proposed a concept for a perceived inflation index ("IPI") in the *Neue Zürcher Zeitung* (BRACHINGER, 2004b). This concept was subsequently refined and presented at international congresses (BRACHINGER, 2004a, 2005b,c). The purpose of this index is a direct measurement of the yearly perceived inflation rate that is not based on survey data, but on directly or indirectly available official data.

The IPI made it possible for the first time to examine the gap between official and perceived inflation in a scientifically more accurate manner. In a joint project between the Seminar of Statistics at the University of Fribourg in Switzerland and Destatis this index was calculated for Germany. This article presents the principal findings of that project.

The following section will briefly refer once again to the analyses carried out by the Federal Statistical Office. It will also be shown, on the basis of the Consumer Surveys conducted by the EU, that contrary to what could be read in the newspapers in springtime 2005 it cannot be asserted that, in 2005 at the latest, there was no significant difference anymore between perceived inflation and consumer price index.

The third section of this paper addresses the inflation perception problem and examines the issue of measuring perceived inflation. First, it introduces briefly the theory of inflation perception developed by Brachinger. Then, on the basis of it, a perceived inflation index (IPI) will be developed. This will be followed by the basic findings of the project conducted jointly with Destatis. It becomes evident that the perceived inflation index indeed captures the inflation perceived by the German general public. At the time of introduction of euro notes and coins, this index was several times higher than the official Consumer Price Index (CPI).

2 Analysis by the Federal Statistical Office and Persistence of the Phenomenon

The German Federal Statistical Office has recognised quite early on the gap between the official rates and the perceived inflation and had presented several studies that addressed this matter (see for instance BUCHWALD *et al.*, 2002b; CHLUMSKY AND ENGELHARDT, 2002). As from mid-2001, a total of 18,000 price series of selected daily products from 35 product groups were examined together with the Deutsche Bundesbank (German Central Bank). The findings of this effort delivered always the same message: the introduction of the euro as legal tender exerted no significant influence upon the general German consumer price index. The yearly index, purged of special effects such as tax increases and price hikes

of fruits and vegetables caused by weather was already in January 1.6%, thus within the trend of the previous months. From mid-year on, the inflation rate levelled off even more, with inflation on a basis of 2000=100 attaining 1.3% in October 2002 and 1.2% in November 2002.

It was possible, however, to identify a series of "special developments" (STATISTISCHES BUNDESAMT, 2002, see) which, according to the Statistical Office, could have contributed to the consumer's perceived inflation, such as the fact that at the moment of introducing the euro notes and coins the number of price changes had increased markedly. In the opinion of the Statistical Office, this was caused by the many "euro-induced" price changes, i.e. those due to the migration from an attractive price in DM to an attractive price in euros. Furthermore, significant price hikes were observed in certain services (such as coiffeur services and dry cleaning) that were not reversed later on. In addition, at the beginning of the year a significant price increase was observed in foodstuffs.

However, the price increases observed for foodstuffs, which coincided with the introduction of the euro notes and coins and that affected principally fruits and vegetables, had basically been attributable to weather conditions. In November 2002 the price level of foodstuffs, upon a year 2000 = 100 basis, was already 0.9% lower year-on-year, while fruits and vegetables were 2.2% and 5.3% cheaper, respectively. On top of this, the number of price changes throughout the year 2002 had decreased continuously and by December 2002 had again reached its usual long-term level. Lastly, most services had shown below-average price increases in 2002 in comparison with the year before.

Thus, the Statistical Office estimated the influence of all euro-induced price changes ascertained from October 2001 to October 2002 upon the yearly rate of inflation for the product groups examined to lie between -1.6 and $+2.7$ percentage points (see STATISTISCHES BUNDESAMT, 2002). A minimal influence, if one considers that the product groups examined account for only a small portion of the general consumer price index.

In short: No satisfying explanation could be presented for the enormous gap between the consumer price index and the perceived inflation in the years 2002 through 2004. Lacking an appropriate concept for the measuring of perceived inflation, Destatis – just as every other European statistical office – stood rather helpless before this phenomenon and stresses repeatedly since then that inflation in the period after the introduction of the euro was in no way higher than that prior to its introduction.

In fact, the public uproar regarding the euro as *teuro* has lessened in the meantime and it could almost appear that the consumers have realised that their high perceived inflation actually was a distorted perception. *"The days of high-inflation perception are over"*, gushed the FAZ (see FRANKFURTER ALLGEMEINE ZEITUNG, 2005) and asserted that *"the gap between perceived and actual inflation"* had disappeared. Figure 1 was used as proof of that assertion.

The data upon which the perceived inflation time series, red in Figure 1, was based came from the already mentioned Consumer Survey that the European Commission conducts monthly within the framework of the Joint Harmonised EU Programme of Business and Consumer Survey on a Europe-wide sample of 21,000 consumers. This survey asks respondents how, in their opinion, the consumer prices have developed over the last 12 months. Basing on the distribution of the replies over different response categories an "aggregate balance" is calculated as the difference between the positive answers ("risen a lot" and "risen
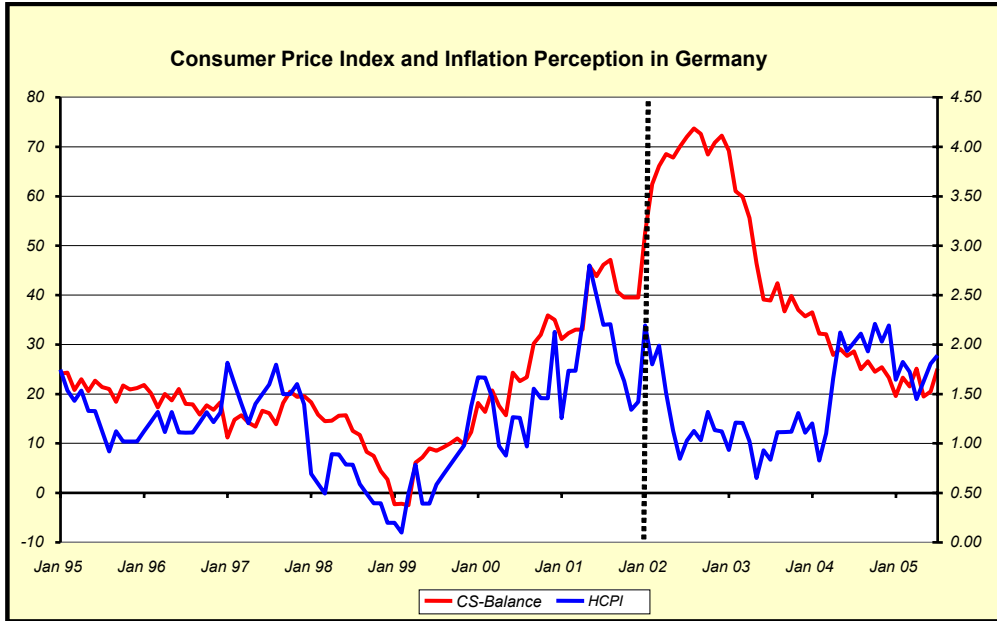
Figure 1: Harmonised Consumer Price Index ("*HCPI*"; rescaled right-hand scale) and perceived inflation ("*CS-Balance*"; left scale) in Germany from 1/97 to 6/05

moderately") and the negative ones ("stayed about the same" and "fallen"), in percentage points of total answers.

Obviously, the value of this balance oscillates between a minimum value of -100 and a maximum one of $+100$. The development of this balance for Germany since 1995 is shown in red in Figure 1 (left scale). To provide a comparison, the harmonised consumer price index for Germany is shown next to the above balance. It can be readily seen that the Consumer Survey time series peaks markedly around the time of euro introduction and that for 2005 it shows, in comparison to 2002, a clear decrease in the "perceived" inflation. This is, however, in no way a correct interpretation of the Consumer Survey.

If the balance S of the response categories is high, it suggests that the proportion of those in the target population who perceived prices as having increased clearly surpasses that of the respondents who perceived the opposite. The higher this balance, the larger this proportion. In this respect, this indicator shows something about the extension of a higher perceived inflation. But this indicator says nothing regarding the level of perceived inflation itself. One cannot therefore assert that the gap between perceived and actual inflation is closing.

It is most problematic, however, when – as the FAZ did – the EU balance of perceived inflation is placed directly against the consumer price index. Both values are measured according to very different scales and, depending on how both curves are scaled in a graph, a different fit can be portrayed. That means that the scale of the balance curve is generally trimmed in such a way as to obtain the desired picture.

A correct analysis of the development of the Consumer Survey balance shows that there are indeed indications that the proportion of those who perceive prices to be increasing is diminishing. But it cannot be stated that the gap is actually closing. The findings of the EU

5

consumer survey show rather that the proportion of those who perceive a higher inflation clearly surpasses that of the respondents who perceive a lower inflation, even in the year 2005. The *teuro* feeling remains in fact to this day! How can then the level of perceived inflation be measured?

3 Perception and Measurement of Perceived Inflation

3.1 A Theory of Inflation Perception

Starting from fundamental psychological insights over human perception, BRACHINGER (2005a,b) developed a theory of inflation perception. A basic underpinning of this theory is the Prospect Theory, developed by Kahneman and Tversky (see KAHNEMAN AND TVERSKY, 1979; TVERSKY AND KAHNEMAN, 1991) as a descriptive model for individual decision-making under risk. Both researchers were awarded the Nobel Prize in Economics in 2002 (Tversky posthumously) for this theory.

This theory of inflation perception is characterised by the following three hypotheses: It is assumed (1) that in a first phase of perception the prices of the goods the consumer is confronted with are coded as *gains* or *losses* with respect to reference prices specific to that goods. For instance, a 60-euro menu does not cost just 60 euros, but will be perceived as relatively expensive or relatively cheap depending on the reference point. If a patron at a restaurant expects a menu price of 60 euros (that would be a reference point) and is charged only 45 euros, he will consider it as a "gain". If he, however, had expected a 30-euro menu and is confronted with a 45 euro check, he will rate this as a considerable "loss".

In this theory of inflation perception it is then assumed (2) that these gains or losses are evaluated according to a value function V, whereby losses are evaluated higher than gains. This means that the consumer reacts much more sensitively to price increases that to price reductions. This asymmetric evaluation, labelled *loss aversion* in the decision-theory literature, is performed individually for every price change the consumer is confronted with.

Finally, it is assumed (3) that inflation perception is furthermore influenced by the fact that inflation will be deemed to be higher, the more often the consumer experiences price increases, thereby making it easier for him to recall examples of noticeable price increases. Accordingly, price reductions of goods purchased seldomly or of those goods lacking an explicit purchasing action whose prices are charged once a month such as rent on an apartment, have barely any effect at all on inflation perception.

On the basis of this theory, to measure perceived inflation, BRACHINGER (2004a, 2005b,c) proposed a perceived inflation index ("IPI"). This index starts from actual price data and integrates these data in such a way that the three hypotheses on inflation perception are taken account of. The purpose of this index is to quantify the extent to which the individual consumer is affected by inflation according to her own subjective perception through her daily shopping.

3.2 Indices of the general Laspeyres type

The development of a price index to measure perceived inflation presupposes an understanding in the sense of a conceptual preconception of what is understood as perceived inflation.

The understanding that traditionally underlies the official measuring of inflation in practically all countries of the European Economic and Monetary Union is based upon the idea that, for the purpose of measuring inflation, only the prices of those goods offered in an economy are to be considered as variables. The purpose is to capture the pure price evolution in an economy. This approach appears to be appropriate also for measuring perceived inflation.

The individual consumer is concerned most of all with the extent to which, according to her subjective perception, she is affected by inflation in her daily shopping. The focus of inflation perception lies exclusively with price changes. The changes in perception that could be induced by changes in the quantities consumed are disregarded.

Last but not least, for the sake of the desirable comparability with the consumer price index, the IPI is based, like practically all consumer price indices the world over, upon the Laspeyres construction principle which is characterised by its ease of interpretation. It is based on a basket of n goods that represents the consumption habits of an average household. Laspeyres-type price indices can be generally represented by the so-called mean-value formula

$$P_L^{0,t} = \sum_{i=1}^n \frac{p_t(i)}{p_0(i)} \times \frac{p_0(i)q_0(i)}{\sum_{i=1}^n p_0(i)q_0(i)} \tag{1}$$

where $p_t(i)$ and $p_0(i)$ denote the prices of the ith good for the reporting period t or for the base period 0 and $q_0(i)$ the quantities consumed by the average household of the good i in the base period. In this formula, the price relatives of all the goods in the basket are weighted by the corresponding expenditure shares for the base period. A Laspeyres price index shows the factor by which the basket of goods has become more expensive over the reporting period in comparison with the base period when the price relatives $p_t(i)/p_0(i)$ of each individual good are weighted by the corresponding expenditure shares.

From this formula a generalised Laspeyres index formula can be obtained by, on the one hand, allowing for a transformation of the price relatives and, on the other, for discretionary weighting factors. In order for the index to be of the Laspeyres type, these weighting factors must characterise the conditions in the base period. This leads to a *generalised Laspeyres index* of the form

$$P_{\text{gL}}^{0,t} = \sum_{i=1}^n G_i \left(\frac{p_t(i)}{p_0(i)} \right) \times g_i \tag{2}$$

where G_i is any non-negative real-valued transformation of the price relative of the ith good and the g_i denote discretionary base period weights with which the individual price relatives are weighted. These weights are positive and normalised to one, $g_i \geq 0$, $\sum_{i=1}^n g_i = 1$.

Now, the idea of the perceived inflation index consists of selecting the transformation function and the weights in the generalised Laspeyres index formula in such a way that they take account of the theory of perceived inflation as outlined above. The IPI is then conceived as a special case of a price index of the general Laspeyres type.

3.3 Perceived Inflation Index ("IPI")

In the first hypothesis of the theory of perceived inflation outlined above the assumption is made that in a first phase of perception the prices of the goods with which the consumer is confronted are encoded as gains or losses with respect to good-specific reference prices.

A second hypothesis assumes that the gains or losses are evaluated according to a value function were losses are given more weight than gains.

Encoding and evaluation of a price change depend in general on the good in question, i.e. on the type of good and its observed price level. This means that each individual price is encoded in general with respect to a good-specific point of reference and that the value function applied for evaluating probably varies from good to good. This latter point implies that, for measuring perceived inflation with an index of the type $P_{\mathrm{gL}}^{0,t}$, one has to proceed from the idea that each of the transformation functions G_i must be chosen according to the specific good.

Setting a good-specific reference point does not pose a big problem. For each good a past price of that good can be chosen as reference. This can be for instance the current base price from the consumer price index or any previous price of the good in question or even an appropriate average of such previous prices. For the analysis of whether the euro is a *teuro*, a particularly relevant reference price is a price of the good in question in the former national currency, that is, e.g., an average price in DM for the year 2001.

However, in practice it is nearly impossible to fulfil the requirement that, for each good, a specific value function and therefore a specific loss aversion should be applied in order to measure perceived inflation with a general Laspeyres-type index. At present there is no published research dealing with the issue of what individual value functions for the evaluation of price changes look like, how they relate to the degree of loss aversion, and how far these value functions depend on price level and/or on the type of good in question. The sole viable way for the practical measurement of perceived inflation is to work with *constant loss aversion*, independent of good or price level.

The concept of constant loss aversion was developed by Tversky and Kahneman within the framework of multi-criteria decision-making (see TVERSKY AND KAHNEMAN, 1991). Taken in the context of inflation perception, this idea means that the value function V, used to evaluate the price changes encoded as a gain or loss, is independent both from the good in question and the price level of this good. A further simplification is to work with a value function that is linear.

In this sense, the IPI is based upon the assumption of a *linear constant* loss aversion. Furthermore, it is assumed that the perception of the price of an individual good uses a *past price* of this good as reference point. This means that with the perceived inflation index the current price $p_t(i)$ of a given good i, first, will be encoded as a gain or a loss through the additive comparison with a past price $p_v(i)$. Then, the price is evaluated in accordance with the value function

$$V(p_t(i)) = \begin{cases} p_t(i) - p_v(i) & \text{for } p_t(i) \leq p_v(i) \\ c\,(p_t(i) - p_v(i)) & \text{for } p_t(i) > p_v(i). \end{cases} \qquad (3)$$

Here, price increases ("losses") are evaluated higher than price reductions ("gains") according to the *loss aversion coefficient* $c > 1$. The IPI value function for the coefficient $c = 2$ is shown in Figure 2.

In the generalised Laspeyres index formula (2), a particular weighting function G for the price relatives corresponds with value function (3). For price relatives, namely, the following holds:

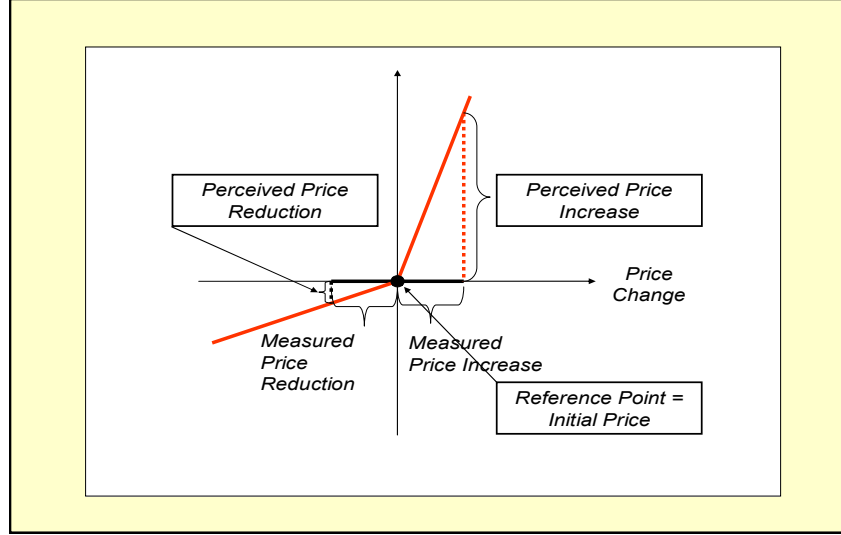$$\frac{p_t(i)}{p_v(i)} = \frac{p_t(i) - p_v(i)}{p_v(i)} + 1 \qquad (i = 1, \ldots, n)$$

Figure 2: *IPI* value function with loss aversion coefficient $c = 2$

i.e. price relatives can be represented as a function of price differences. These price differences can be transformed using value function (3). For a price increase, independent of the price level, transformation of the price relative yields

$$G\left(\frac{p_t(i)}{p_v(i)}\right) = G\left(\frac{p_t(i) - p_v(i)}{p_v(i)} + 1\right) := \frac{c\left(p_t(i) - p_v(i)\right)}{p_v(i)} + 1 = c\left(\frac{p_t(i)}{p_v(i)} - 1\right) + 1$$

For a price decrease, G can be set equal to the identity function. This way, the transformation function G that will be selected for the *IPI* in formula (2) of a generalised Laspeyres-type index is specified.

In order to fully specify the general Laspeyres-type index formula (2), suitable weights g_i must be selected. The third hypothesis of the theory of perceived inflation outlined above assumes that the perception of inflation is influenced also by the fact that the consumer assesses inflation to be higher the more often he experiences price increases, thereby making it easier for him to think of examples of noticeable price increases. This means that it is appropriate, in order to measure perceived inflation, to take as weight g_i in index formula (2) the relative purchasing frequency of good i with which this good is purchased by the average consumer during the base period.

Now, the perceived inflation index $IPI_{\mathrm{L}}^{v,t}$ results from taking, in the generalised Laspeyres-type index formula (2), for every good i the transformation function G derived above and, as weight g_i of good i, the relative frequency f_i^0 with which this good is purchased in the base period. The perceived inflation index is then defined by

$$IPI_{\mathrm{L}}^{v,t} = \sum_{i:p_t(i)>p_v(i)} \left[c\,\frac{p_t(i)}{p_v(i)} - (c-1)\right] f_i^0 + \sum_{i:p_t(i)\leq p_v(i)} \frac{p_t(i)}{p_v(i)}\, f_i^0 \tag{4}$$

The *IPI* is an inflation indicator that, contrary to the consumer price index, satisfies an individual information problem of the average household. It quantifies the degree to which,

9

in its own subjective perception, the individual household is affected by inflation in its daily shopping.

4 Measuring Perceived Inflation in Germany

4.1 Data Base

A joint project with Destatis calculated the perceived inflation index (4) in order to measure the perceived inflation in Germany. In order to ensure comparability with the German consumer price index (CPI), it was considered appropriate for this calculation to choose the same basket of goods that underlies the official consumer price index. The CPI basket with basis 2000 comprises 740 so-called *index positions* representing various categories of goods that consumers buy. These index positions are the lowest subcategory of the German CPI for which expenditure weights are available.

The prices used were the prices employed by the official statistics for calculating the consumer price index. These prices are generally weighted averages of average prices polled in the federal states. In order to calculate the IPI, the price relatives of all goods whose prices had decreased went directly into the IPI. The price relatives of all goods whose prices had increased had to be evaluated using the transformation function G.

The evaluation of price increases with the transformation function G requires knowing coefficient c, which, under the assumption of a linear constant loss aversion, captures the degree of loss aversion of the average household. This coefficient cannot be observed empirically just like that. We are aware of no published research on the value of this coefficient in the context of price change perception. An experimental research study dealing with this issue is being conducted at the moment under the direction of Professor Jungermann (Technical University Berlin) with the support of the Berlin State Statistical Office.

The decision-making theory literature contains some indications of how high to set the loss aversion of decision-makers in general. Tversky and Kahneman allude to a loss aversion coefficient "slightly greater than two" resulting from an experiment on individuals' willingness to pay (TVERSKY AND KAHNEMAN, 1991, p. 1053). They stress that from a series of experimental findings on individual decision-making under risk a loss aversion coefficient of about 2 can be derived. In a lottery experiment with real payments a loss aversion coefficient of 2.5 was found. In an earlier article, Kahnemann points out once again that "estimates of the coefficient of loss aversion . . . converge on a value of about 2" (KAHNEMAN, 2003, p. 164). HARDIE *et al.* (1993) attempted to measure the loss aversion coefficient within the framework of an experimental study dealing with brand selection. They arrived at the conclusion that this coefficient, depending on the variable observed, lies in an interval between 1.5 and 2.5.

On the basis of these indications, alternative calculations were performed for the computation of the IPI using loss aversion coefficients of 1.5, 2 and 2.5. It is assumed that the *IPI(2.0)* represents a reasonable approximation of the "true" index of perceived inflation. The band between the *IPI(2.5)* and *IPI(1.5)* time series is interpreted in the sense of a "confidence band", with the "true" IPI lying with high probability within this band.

The main problem with ascertaining the IPI for Germany resided in determining the purchasing frequencies for the 740 index positions. Given that the German CPI takes 2000 as the base year, in order to safeguard both the Laspeyres principle and the comparability

between the *IPI* and the *CPI*, the purchasing frequencies should be those for the 2000 base period.

The purchasing frequencies turn up as a by-product of the data collection carried out periodically on a random sample of households to determine the expenditure weights for the consumer price index. In Germany these frequencies could be obtained from the Income and Consumption Survey (EVS). They could be taken from the so-called Sampling Notebooks given to the sampled households to help them keep their records but which do not form part of the actual data collection documentation. However, the labour intensive nature of analysing these notebooks made it impractical to use them.

Instead, approximate relative purchasing frequencies were determined from the actual expenditure weights $AG_0(i)$ employed with the *CPI*. When the consumer price index mean-value form is considered

$$P_{\mathrm{L}}^{0,t} = \sum_{i=1}^{n} \frac{p_t(i)}{p_0(i)} \times \frac{p_0(i)q_0(i)}{\sum_{j=1}^{n} p_0(j)q_0(j)} = \sum_{i=1}^{n} \frac{p_t(i)}{p_0(i)} \times AG_0(i)$$

it can be seen that the quantity $q_0(i)$ of good i consumed by the index household during the base period can be determined from the expenditure weight $AG_0(i)$ of that good, by multiplying the weight with the total expenditure of the index household and dividing by the average base period price of that good, i.e.

$$q_0(i) = AG_i(i) \times \frac{\sum p_0(j)q_o(j)}{p_0(i)} \, .$$

When interpreting the quantity $q_0(i)$, it must be borne in mind that, underlying these quantities, is precisely the quantity unit that is being priced. This implies that in certain cases the quantities $q_0(i)$ represent very good approximations of the purchasing frequencies. In other cases these quantities overestimate or underestimate the actual purchasing frequencies. In some cases, secondary statistical material had to be used. For details regarding determination of purchasing frequencies refer to BECHTOLD *et al.* (2005).

4.2 Comparison of *CPI* and *IPI*

Given the fact that in the *IPI* price increases are weighted higher than in the *CPI*, the *IPI* can be expected to take on values that lie always above those of the *CPI*. In fact, however, the *IPI* values depend most of all also on the frequency weights of the individual index positions. A comparison of the expenditure weights with the frequency weights shows that they are hardly correlated. The Bravais-Pearson correlation coefficient is barely 0.0971.

Both the distributions of the expenditure and the frequency weights show the same mean value, on account of their normalisation to unity. However, the distribution of the frequency weights is less steep on the left than the distribution of the expenditure weights and shows a variance only half as large as that of the expenditure weight distribution. Furthermore, the distribution of the frequency weights is less strongly peaked, over a shorter range.

The scatter plot of both weight distributions in Figure 3 shows that nearly all weights move within the 10 tenth-of-one-percent range, with only a few of them standing out from the mass. The four goods with the highest purchasing frequency are "daily newspapers, retail", "cigarettes", "beer in liquor store", and "bread". These goods are set apart significantly
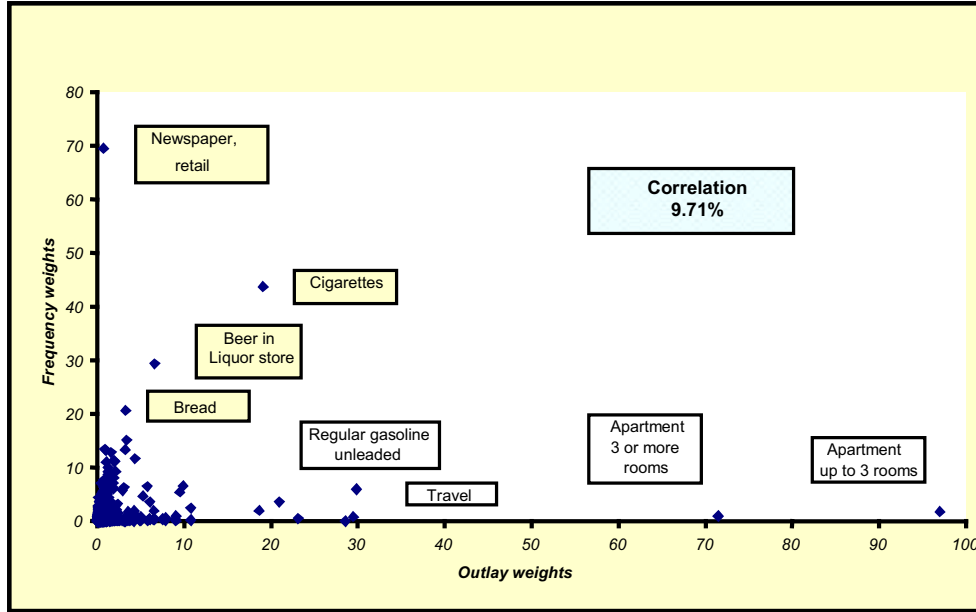
11

Figure 3: Scatter plot of expenditure and frequency weights

from the rest of the goods on account of their purchasing frequency. It stands out that three of these goods have only a very low expenditure weight. The good "cigarettes" is the only good that shows a significantly high weight in both weightings. The four goods with the highest expenditure weights are "apartment up to three rooms", "apartments with three or more rooms", "regular gasoline, unleaded" and "travel". It is generally noticed that these goods show a very low purchasing frequency.

Considering these quite large differences between the expenditure weights of the *CPI* and the frequency weights it is not surprising that the *CPI* and the *IPI* move quite independently of each other. Figure 4 shows the evolution of the *CPI* and the *IPI* with a loss aversion coefficient $c = 2$ since 1996.

Three periods are evident immediately from that chart: a first period prior to introduction of the euro notes and coins, which lasts until the beginning of the year 2001, a euro-introduction period from January 2001 until June 2002, and a post-euro-introduction period that starts in July 2002. In the pre-euro-introduction period, two sub-periods can be made out: a first one lasting until May 1999 in which perceived inflation lies above the *CPI*, and a second one that stretches from May 1999 through December 2000. In the second sub-period perceived inflation lies below the *CPI*. This is all the more remarkable considering that in *IPI(2.0)* price increases are entered with a double weight compared to *CPI*!

This figure shows clearly that a special inflation can be diagnosed around the point of introduction of the euro notes and coins. At year-end 2000 *CPI* and *IPI* still coincided. Afterwards the *IPI* shot up, reaching in June/July 2001 a maximum value of 8.8%, and remained above 7% throughout the year. The *CPI*, in contrast, moved around the 2% mark. In January 2002, at the time of adoption of the euronotes and coins, the *IPI* jumped to 10.6%. The *CPI* rose as well then, but it increased from 1.6 in December 2001 to a publicly derided 2.1%. In June 2002 the *CPI* settled down again at 1.0% and remained for the rest
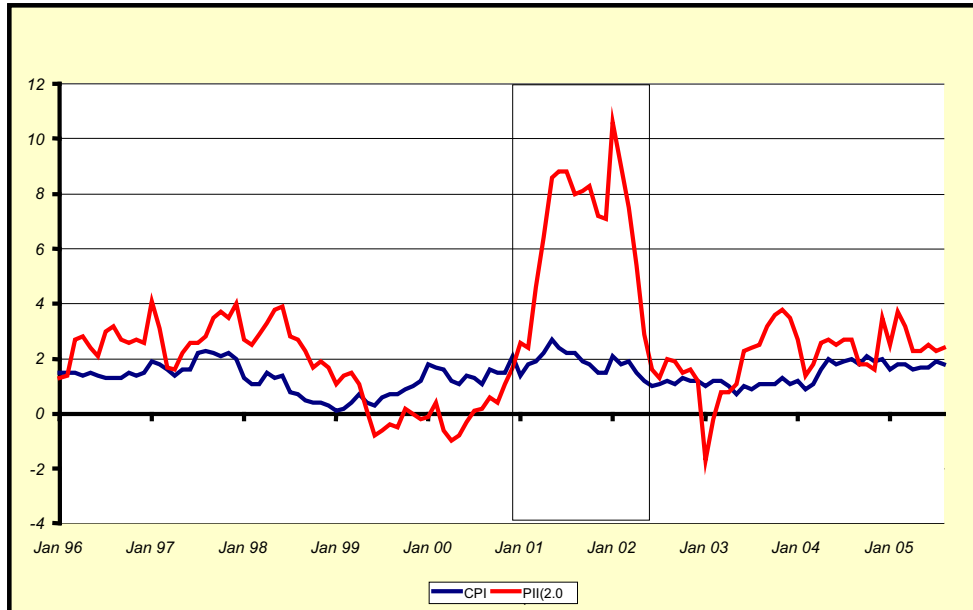
Figure 4: Comparison of the *IPI(2.0)* and *CPI* evolutions

of the year around one percent. The *IPI* also fell as the year wore on and in July it lay at the level of the *CPI*. The "gap" between perceived and official inflation had closed again.

During the period from January 2001 to June 2002, the average perceived inflation, at 6.6%, hovered well above the average rate of the *CPI*, with 1.8%. The average perceived inflation was then 3.7 times higher than the official inflation rate.

Starting in July 2002, the *IPI* moved closer to the *CPI* level. Both peaks in January and November 2003 could be explained by baseperiod effects. The relationship between perceived inflation and *CPI* "normalised" itself: the average perceived inflation up to August 2005, with 2.1%, lies above the average *CPI* rate of 1.4%. The former, then, is 1.5 times higher than the official inflation rate. During the period before introduction of the euro notes and coins, from January 1996, this ratio was 1.3.

What does this show? At the time of the introduction of the euro notes and coins the perceived inflation, as measured according to the *IPI* standard, was in fact dramatically higher than the *CPI*. This period of the "euro-induced" special inflation does not start, however, with the introduction of the euro notes and coins, but during the previous year. In 2001, Destatis had already observed a whopping 5.1% increase in food prices. The Institute for Applied Consumer Research in Cologne[1] observed the evolution of prices for a vast sample of 700 everyday commercial goods between June 2001 and January 2002. A careful analysis of these price data shows that for 80% of the goods whose price had increased between June 2001 and January 2002, the prices had already been set in 2001. The same holds, albeit to a smaller extent, for the service sector and retail banking. In each of these two sectors, around 50% of the prices raised till January 2002 had been set during 2001.

The retail sector had evidently increased prices markedly before introduction of the euro notes and coins. Only a small proportion of the especially relevant prices was increased

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[1]The author thanks Mr Rainer Wezel of IfaV for making the base data available

13

further in January 2002. The additional price increase in January 2002 (base 1995=100) was induced mostly by the significant price hikes of tobacco goods (+7.4%) and groceries (+6.7%). The increase in the tobacco tax, however, meant that a decision of the legislator was the decisive factor for the price increase of tobacco products, while for foodstuffs the weather-induced fall in harvest was responsible, and not the currency change.

4.3 Extent of the "euro-induced" special perceived inflation

How high is the extent of the euro-induced special perceived inflation diagnosed above? Let us assume that the period before introduction of the euro notes and coins together with the period after its introduction constitute a period during which there was a "normal" relationship between perceived and official inflation. That this assumption is reasonable is shown by the above analyses. Furthermore, let us assume that both the *IPI* values and the *CPI* values during this period can be considered as outcomes of corresponding stochastic processes. Thus, the average of the *IPI* values and the average of the *CPI* values can be considered estimations of the corresponding inflation levels, and the difference between them as an estimation for the "normal" long-term difference between perceived inflation and *CPI*.

Correspondingly, let us assume that in the period from January 2001 through June 2002 a special relationship prevailed between perceived inflation and *CPI* that was determined by the introduction of the euro notes and coins. The above analyses show that this assumption is also reasonable. Then, the average of the *IPI* values and the average of the *CPI* values during this period can be again considered as estimations of the corresponding inflation levels, while the difference between both averages serves as an estimation of the difference between both inflation levels at the time of introduction of the euro notes and coins. An estimation of the "euro-induced" special perceived inflation can be obtained by correcting this difference by deducting the "normal" difference between *IPI* and *CPI*.

The average *IPI* rates over the sub-periods prior to and after introduction of the euro notes and coins was 1.9 percent, while that for the *CPI* rates was 1.3 percent, which yields an estimated "normal" difference between perceived inflation and *CPI* of 0.6 percent. The difference between the averages of the *IPI* rates and the *CPI* rates over the euro-introduction period was 4.8 percent. Subtracting the "normal" difference from this rate yields an estimation of the euro-induced special perceived inflation of 4.2%.

This estimation depends naturally on the degree of loss aversion assumed for the *IPI*. The 4.2% value is based on a loss aversion of $c = 2$. A "confidence interval" for this value is obtained by performing the same computation for *IPI*'s using loss aversion coefficients of $c = 1.5$ and $c = 2.5$. The extent of the "euro-induced" special inflation as perceived by the consumer is 2.6% for $c = 1.5$, and 5.7% for $c = 2.5$.

Figure 5 shows the time series of the *CPI*-rates together with the time series of the *IPI*-rates for all three loss aversion coefficients $c = 1.5$, $c = 2.0$ and $c = 2.5$. It can be seen that the index series evolve differently depending on the degree of loss aversion. It is clear that the evolution paths followed by the *CPI* and *IPI* in the period before introduction of the euro notes and coins lie quite close to each other. During the euro introduction period both paths suddenly diverge markedly. During the post-euro-introduction period, they appear to evolve parallel to each other again.
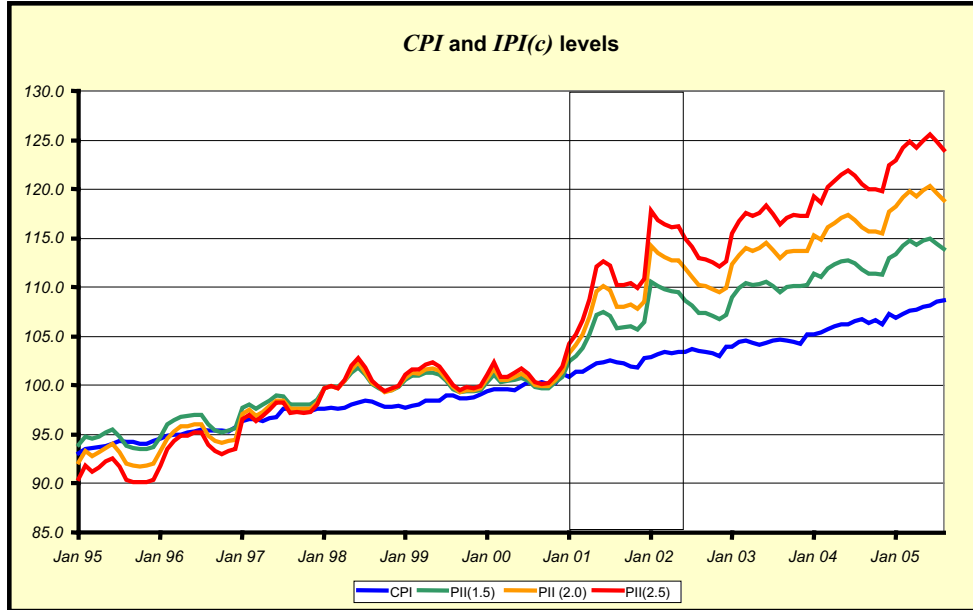
14

Figure 5: Comparison of perceived inflation and *CPI* evolution

An analysis of the *CPI* and *PII* levels during the post-euro-introduction period makes it possible to estimate the extent to which the general price level, according to public perception induced by the euro introduction, was at the time above the official price level.

To that, the evolution of the *CPI* and *IPI(2.0)* indices will be considered, starting from the beginning of the period defined as "after euro introduction", i.e. from July 2002 to the end of the curve in August 2005. The average value of the *CPI* over this period is 105.6, while the average value of the *IPI(2.0)* is 114.3, i.e. around 8.2% higher (see Figure 6). It is assumed then, as was the case above, that the "normal" difference between *CPI* and *PII* levels can be estimated reasonably by the difference of the average *CPI* and *IPI* levels during the period before the introduction of the euro notes and coins. These average levels, however, are identical for the *IPI(2.0)*, so that the difference between both average levels in the period after introduction of the euro notes and coins does not need to be corrected. This means that after the introduction of the euro notes and coins, according to public perception, the price level in fact lies around 8.2% higher than shown by the *CPI*.

For assessing the margin of error induced by the uncertainty regarding the loss aversion coefficient, this figure, again, can be embedded in a "confidence interval". During the period before introduction of the euro notes and coins the average level of the *IPI(2.5)* was 0.7 percentage points below the average level of the *CPI*. Correcting by this value the difference between the average *CPI* level and the average *IPI(2.5)* level during the post-euro-introduction period yields a difference of 12.9 percentage points. Correspondingly, for the *IPI(1.5)* results a corrected difference of 4.3 percentage points. According to public inflation perception, the price level through euro introduction is only 4.1% higher for the *IPI(1.5)* but 12.2% higher for the *IPI(2.5)* than shown by the CPI.

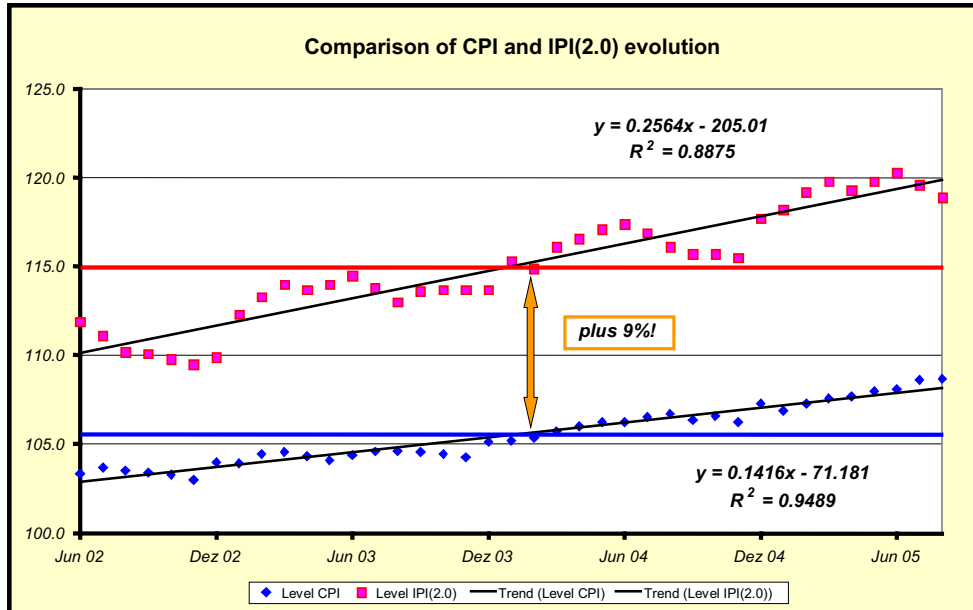Careful examination of Figure 6 shows that the evolutions of both price levels do not run

15

Figure 6: Comparison of perceived inflation and *CPI* evolution

parallel to each other. A simple trend analysis of both price level evolutions shows clearly that until August 2005 the *IPI* rises almost twice as fast on average as the *CPI*.

4.4 Inflation perception after introduction of the euro notes and coins

In a study conducted by the Cologne Institute for Applied Consumer Research (INSTITUT FÜR ANGEWANDTE VERBRAUCHERFORSCHUNG E.V., 2005), more than three fourths of the respondents stated that they still relied on the old currency to help them assess a new price in euros. Empirical studies carried out by the GfK (GESELLSCHAFT FÜR KONSUMFORSCHUNG, 2004) in Austria show that a significant proportion of the consumers in the euro zone even in 2004 still converted prices in euros into prices in the old national currency. The familiarity with the old currency has apparently led consumers to rely for price comparisons on certain base prices longer that otherwise would be the case. This *base price rigidity* is surely an effect that, while not distinctive of general inflation perception, must be regarded typical for inflation perception after the adoption of a new currency.

The computation of the evolution of the *IPI*-rate in Figure 4 followed the traditional tenets of index computation. The growth rates of the index are computed relative to the corresponding month year-on-year. This means that that when computing the *IPI* rates the practice of converting current euro prices into prices in the old currency and then estimate the price increase by comparing with the price in the old currency will not be considered. In this respect, the *IPI* index as shown in Figure 4 certainly underestimates the degree of inflation perceived by many people in Germany in the time after introduction of the euro notes and coins.

An adequate recording of the inflation perceived by consumers who still convert prices into the old currency requires that inflation perception be modelled by an index that utilises
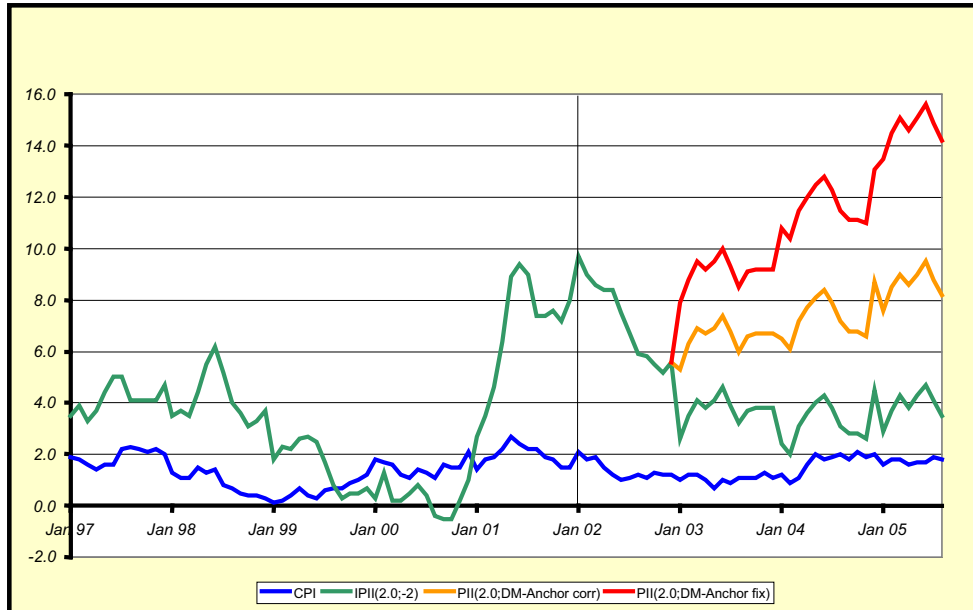
Figure 7: CPI and alternative inflation perceptions after euro introduction

other reference prices than those of the same month a year before. It has long been known that consumers assess current prices on the basis of personal experiences by comparing with prices asked in a recent past. The Adjustment Level Theory of HELSON (1964) provides a theoretical psychological foundation for such so-called *internal reference prices*. According to this theory, the reference value for the assessment of a new stimulus results from a weighted mean of past stimuli. According to this, it can be assumed that as reference price for the assessment of the current price of a good serves a weighted mean of earlier prices for this good.

On the basis of this theory, in order to model the rates of perceived inflation it appears appropriate to take as internal reference prices an average of earlier prices in DM. For the computation of the indices *IPI(2.0;−2)* shown in Figure 7, the reference prices used were the unweighted average prices of the two previous years. In a technically simplified form, this idea can approximately be realised by basing the current values of *IPI(2.0)* in each year upon the average of the *IPI(2.0)* values for both previous years. Figure 7 shows the evolution of this index since January 1997.

The *IPI(2.0;−2)* index, considering the practice mentioned above of converting current euro prices into prices in DM, stands out for the fact that in the year 2002, that is immediately after introduction of the euro notes and coins, it refers entirely to average prices in DM as reference prices. In 2003 the reference prices are a mixture of prices in euro and DM and, starting in 2004, only prices in euros are used as reference.

There are to date no specific studies aimed at elucidating the issue of how far back the periods stretch to which reference prices refer. It appears plausible, however, and some anecdotal evidence supports this, to use as reference prices the averages of the prices of the previous two years. If the assumption is made that in the normal case of inflation perception – that is in a price evolution that is not "distorted" by adoption of a new currency – the

17

average of the prices of the previous two years serves as internal reference price, then the (green) curve of the *IPI(2.0;−2)* describes the "normal" perceived inflation evolution in Germany since 1997. It can be observed that this index, as compared to the IPI index shown in Figure 4 that referred to the corresponding month in the previous year 2003, shows markedly lower base effects.

In this Figure, as in Figure 4, three distinct periods can be made out. The period before euro introduction extends, as with *IPI(2.0)*, until January 2001. In that month, the *IPI(2.0;−2)* suddenly jumps to twice the value of the CPI, after having previously lain clearly below the CPI. The euro-introduction period extends significantly longer than with IPI(2.0) because the extreme base effect of the *IPI(2.0)* in June 2003 disappears. It extends from January 2001 through December 2002. The period after euro introduction starts in January 2003.

From January 1997 through December 2000, the average IPI inflation rate as measured by the *IPI(2.0;−2)* was 2.5%. During the euro-introduction period from January 2001 through December 2002 it rose to 7.0%. I.e., during the euro-introduction period, the average perceived inflation as measured by the *IPI(2.0;−2)* lay more than four times higher than the official CPI.

In the period after the euro introduction it decreased again to an average level of 3.6%. It can be seen that perceived inflation as measured by *IPI(2.0;−2)* since January 2003 lies only slightly above the level it showed before introduction of euro notes and coins. In other words: the "normal" perceived inflation has nearly normalised itself by that time. But only "nearly": it oscillates steadily between 2.5 and 4.5%, with an average that hovers at 3.9% since January 2005, i.e. almost one and a half percentage points above the level before euro introduction.

A fundamental feature of the *IPI(2.0;−2)* is that it uses only euro prices as reference since January 2004. The habit, still common in 2005, of converting current euro prices in DM prices and then estimating price increases with respect to a previous DM price cannot be modelled with it. On the basis of the IPI concept, there are several modelling possibilities to capture the inflation perceived by consumers who still convert to DM.

A first, extreme possibility is to continuously use the last DM prices as reference prices. This model of perceived inflation is depicted in Figure 7 by the evolution of the *IPI(2.0;DM anchor fix)*. This index coincides until December 2002 with the *IPI(2.0;−2)* and runs after that along the red curve. The enduring reference to last DM prices means of course that the inflation perceived tends to climb steeply, as the growing distance in time between the current prices and the last DM prices cannot but make inflation increase.

Examination of the IPI with this fixed "DM anchor" shows that for consumers who even in 2005 convert prices into DM the perceived inflation rises relentlessly since the beginning of the year 2001. The inflation perceived by these consumers hovers since January 2003 at an average of 11.5%, since January 2005 already at an average of 14.7%. By clinging to the old currency, consumers indulged in a kind of "inflation masochism" that in 2005 could not be taken seriously any longer.

A significantly more interesting possibility to model the inflation perceived by consumers who still convert prices into DM consists of using as reference prices late DM prices, but correct them as time progresses with previous euro prices and weight them increasingly lower. This model of inflation perception is represented in Figure 7 by the yellow *IPI(2.0;DM anchor corr)* curve. Of course, this index also coincides until December 2002 with *IPI(2.0;−2)*.

Just like this index, for the euro-introduction period from January 2001 through December 2002, it showed an average perceived inflation of 7%.

However, during the period after euro introduction this index remained approximately at this level, with an average of 7.1%. Thus, as compared to both alternatives *IPI(2.0;−2)* and *IPI(2.0;DM anchor fix)*, it occupies a middle level that still is very high as compared to the CPI level. According to this model, perceived inflation lies four years after introduction of euro notes and coins persistently at a level almost three times higher than before.

The *IPI(2.0;DM anchor corr)* model appears to be extraordinarily suitable to explain the still in 2005 widespread perception in Germany of a constantly high inflation rate since introduction of the euro. It is based upon an empirically well-based theory of inflation perception. Furthermore, the Adjustment Level Theory provides a psychological foundation for modelling perception of inflation after introduction of the euro in such a way that it accounts for the practice of converting current prices into DM prices: the reference prices result from the arithmetic mean of a last DM price and all subsequent euro prices. Thereby, the weight of the last DM price is then lowered progressively. The initial idea behind this model is that the "normal" referencing to the average prices of the two previous years is distorted by the exogenous "shock" of adopting a new currency.

The three models *IPI(2.0;−2)*, *IPI(2.0;DM anchor fix)* and *IPI(2.0;DM anchor corr)* for inflation perception after introduction of the euro notes and coins differ in the intensity with which reference to old DM prices is made when assessing current prices. The stronger this reference, the higher the inflation perceived. An analysis for Austria cited by FLUCH AND STIX (2005) showed that people who always or often convert euro prices into schillings indeed perceived a higher inflation than those who do not make the conversion.

5 Conclusion

This study was triggered by a publication in the Summer of 2004 in which Destatis wanted once and for all to emphasise again all its previous studies that had shown that the euro was no *teuro*. How could it be that even experienced consumers still in 2004 commented this publication with disbelief?

Section 2 of this article pointed out that no one to date had provided a really satisfying explanation for the immense gap observed between consumer price index and perceived inflation in the years after introduction of euro notes and coins. The findings presented in this article show that the newly developed *perceived inflation index* (*IPI*) provides a psychologically, economically and statistically well-founded instrument that gives an explanation for this phenomenon.

This index has a psychological foundation because its defining features, such as the asymmetrical assessment of price changes, the weighting of price changes by purchasing frequency and the utilisation of averaged reference prices are derived from psychology of perception findings.

The perceived inflation index has an economic foundation because it disregards "moon prices" of goods enthusiastically referred to by certain consumers and news media which, on account of low demand are not purchased at all. Only those prices are considered that, on account of demand for the corresponding goods, have economic relevance. Inflation-

distorting subjective price conversions, resulting from a rejective attitude towards the euro by some consumers, are likewise disregarded.

Finally, the perceived inflation index has a sound statistical foundation because it is built on a generalisation of a classic formula, the well-known Laspeyres formula. The *IPI* belongs to the same family of indices as the standard *CPI* and is therefore based on the same conceptual preconception of what is understood as inflation. This assures comparability of *IPI* and *CPI*. Reasonably the prices used are the same average prices as used for calculating the German *CPI*. Conversion errors like the one of multiplying euro prices by 2 are excluded.

The purpose of the perceived inflation index is to quantify the subjective, i.e. individual, perception of inflation by an average household. The index itself is a construction that attempts to capture *objectively* the subjective perception of inflation inasmuch as it seeks to correspond to the degree of perceived inflation free of judgments or subjective distortions. The *IPI* does not measure at all the irrational psychological distortions that affect consumers when perceiving inflation. It shows clearly which factors fuel the perception of inflation. The *IPI* is, like the *CPI*, an "incorruptible statistic" (SINN, 2002).

The analyses presented in this article show that the introduction of the euro notes and coins was not a "non-event". In the year 2001 something structurally fundamental happened regarding the change in the prices of consumer goods: above-average price increases were applied precisely to those goods characterised by an above-average purchasing frequency. The event thus features a sudden positive correlation between price change and frequency of purchase, something that had not happened previously and that shows an astounding persistence to the end of 2005.

Why were, however, in particular the prices of goods purchased frequently increased above average prior to the introduction of the euro? The reasons can here only be speculated on. Destatis has collected indications (see BUCHWALD *et al.*, 2002a) that especially in the retail sector prices were increased significantly in anticipation of the introduction of the euro notes and coins in order to, afterwards, "generously" correct the prices downwards to an "attractive" price in euros. The evolution of the *IPI* (see Figure 4) points however to another explanation: during 1999 and 2000 an extraordinarily low inflation was perceived. During that time there was apparently a significant price war in the retail business that benefited the consumers. Directly afterwards the resulting too low price level was quickly corrected upwards.

Which conclusions can and should be drawn from the insights gained through computation of the *IPI*? First: when a gap appears between the perception of an economic phenomenon and its official measurement, it may not be construed as meaning that one of the sides is wrong. It can well be that the official agency measures something different from that which attracts the public interest. Divergence of public perception of inflation and officially measured inflation does not speak against the *CPI* or against public perception.

Quantification of public perception of inflation is not the goal of the *CPI*. It has to be ascertained that the *CPI* is not in a position to depict a special price evolution structure such as that observed shortly before and after introduction of the euro as legal tender. An expenditure-weighted price index such as the *CPI* is insensitive to the appearance of inordinately high price increases of frequently purchased goods and tends to mask such inflation structures. Shielded by the *CPI*, the retail sector could then quietly introduce sometimes massive price increases. It must be pointed out, however, that the *CPI* cannot be faulted for this: it was developed for a totally different purpose.

Lastly, these analyses show that, contrary to what could be read in the German press in 2005, it cannot be asserted that in 2005 no significant gap existed anymore between perceived inflation and consumer price index. A realistic model of inflation perception for the period after introduction of the euro notes and coins shows that in 2005 perceived inflation had stabilised at the level of the euro-introduction period. If the German economy has any interest in sustainably reviving consumption it should work towards significantly lowering the perception of inflation among consumers. The *IPI* shows what's to be done.

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