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Costly Inflation Misperceptions

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Thomas A. Eife and
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Abstract

One of the consequences of the euro changeover in 2002 was that for a period of several years people considerably overestimated actual inflation. The goal of this paper is to study whether misperceptions of this kind may have real effects, that is, whether they induce people to alter their behaviour. We also discuss the question how far the euro changeover and the ensuing discussion about price stability contributed to the recession that followed the changeover. Looking at the German restaurant sector, we find that people's misperceptions can have significant negative effects. The contraction this sector experienced in the months after the changeover was too pronounced to be explained by normal business cycle movements. We provide a discussion about the causes of these misperceptions and how to avoid them in future changeovers.

Key Words: euro changeover, perceived inflation

JEL Classification: D12, E21, C22

1 Introduction

One of the consequences of the euro changeover in 2002 was that for a period of several years people considerably overestimated actual inflation rates. This paper studies whether misperceptions of this kind may have real effects and tries to shed some light on the question how far the euro changeover and the ensuing discussion about price stability contributed to the recession that followed the changeover.

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The possibility that inflation misperceptions may have real effects has been discussed before (e.g. Bundesbank 2003 and Corsetti 2007), but we are not aware of a paper that estimates the effect of these misperceptions on real economic activity as we attempt here. In this paper we will restrict ourselves to the German restaurant industry, an industry that contracted significantly after the changeover and returned to its pre-changeover growth levels only two years later. We will argue that this contraction cannot be explained by normal business cycle movements and that the decline in economic activity was caused by people's misperceptions.

The decline in economic activity appears to be driven by two factors. First, many consumers were confused by the alleged price increases and reduced consumption; in some cases apparently to "punish" retailers. The consumer strikes organized in countries like Italy or Germany in summer 2002, several months after the changeover, illustrate this behaviour. Second, the changeover and the discussion about price stability appear to have had a profound negative impact on consumer confidence and on people's perceptions of their own financial situation. Both factors affect consumption not only in the restaurant sector so that even if this study focuses on one sector, the underlying mechanisms that lead to the real effects are more general.

A difficulty with the exercise of estimating how misperceptions affect actual behaviour is that it requires some information about how people would have behaved without them. It is for this difficulty that we have chosen to focus on the restaurant sector. People complained especially about prices of services such as hairdressing, restaurants or dry cleaning and if misperceptions have any real effects, it is likely to observe them in the services sector. Furthermore, it may often be easier to reduce the consumption of services than of many other items. For the German restaurant sector we were able to get monthly data for a period of more than 25 years so that we are fairly confident when claiming that the unusual movements observed in 2002 and 2003 are changeover-related.

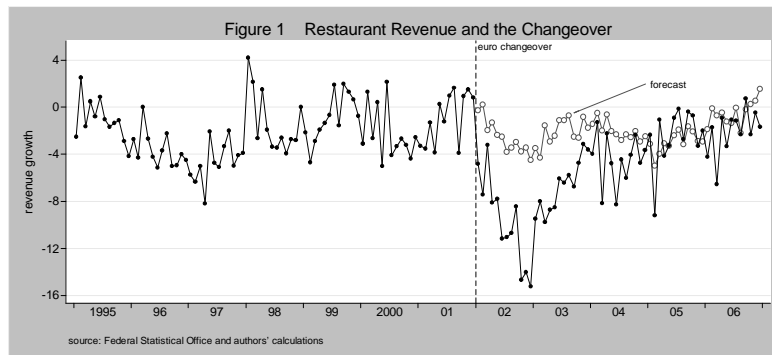


Figure 1 depicts revenue growth of the German restaurant industry from 1995 until 2006. Note that the contraction we mentioned before was gradual. It started with the changeover but reached its peak only about a year later. After two or three years the growth rates appear to have returned to their pre-changeover level. The figure also shows growth as predicted by the model of section 2 below (“forecast”).

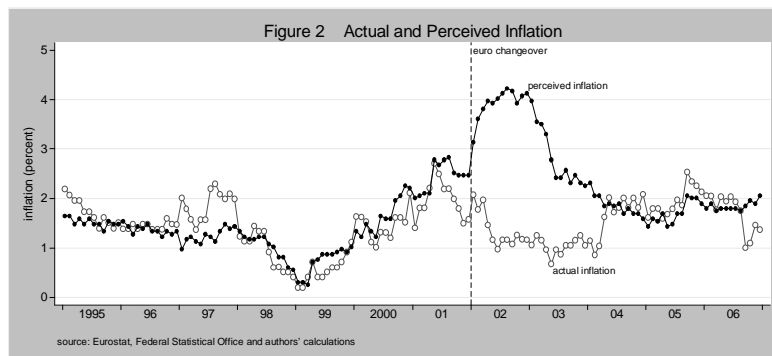


Figure 2 shows actual inflation and a measure of perceived inflation in Germany from 1995 until 2006. The data on perceived inflation are constructed using survey data from the Consumer Confidence Barometer of the European Commission.¹ Perceived inflation follows actual inflation relatively closely but both series start to diverge when the euro was introduced. After about two, maybe three, years, both series converge again. The phenomenon of people

¹More information about how we constructed the index of perceived inflation is given in the appendix. See also the discussion in the next section.

misperceiving actual inflation rates was observed in all twelve euro countries; Germany differed only insofar as the gap between actual and perceived inflation closed sooner than in many other countries so that the effect we describe here could even be larger in other countries.

The gap between actual and perceived inflation is well documented in the literature, and several explanations have been suggested for this phenomenon.² Most explanations are based on the idea that consumers are in some respect “non-rational”. While many of these “behavioural” arguments seem plausible, they give the impression that inflation misperceptions are a sort of “unavoidable side-effect” of a currency changeover. Rather than being something unavoidable, we will argue that inflation misperceptions were caused by policy mistakes.

A paper related to ours is Wunder, Schwarze, Krug and Herzog (2006), who study the changeover’s impact on people’s satisfaction with their income. The authors use data from the German Socio-Economic Panel (SOEP) and confront these with a comparable panel from Britain where the euro was not introduced. Doing this enables controlling for factors other than the changeover that might have had an effect on people at the time such as the terrorist attacks in September 2001. The authors find that the changeover had a “clear negative impact on financial satisfaction”. A compensation for this loss would require an increase in household income of around thirty percent. Wunder et al. do not consider actual changes in behaviour, but it seems unlikely that an impact as large as that estimated would not affect people’s consumption decisions.

In the next section we will present the data, the estimation procedure and the results. Policy implications will be discussed in section 3 and a summary concludes the paper.

2 Estimation

We estimate the impact of people’s misperceptions on revenue in the restaurant sector by a standard OLS regression. The dependent variable is real annual revenue growth in the German restaurant sector measured as $\frac{x_t - x_{t-12}}{x_{t-12}} \times 100$ where x_t is the level of real revenue in period t . The data are monthly and the

²See, for example, Del Giovane and Sabbatini (2005); Aucremanne, Collin and Stragier (2006); European Commission (2005); European Central Bank (2005); Fluch and Stix (2005).

sample includes the 26 years from January 1981 until December 2006. Testing for stationarity, we cannot reject the hypothesis that revenue growth is stationary. By computing growth as a year-on-year change we get rid of the pronounced seasonality of the original data. Restaurants sell significantly more in the summer and around Christmas. The effect of the changeover is captured by a dummy variable (“changeover”) that takes the value 1 in the 24 months after the changeover (January 2002 until December 2003) and zero otherwise. The estimation results are shown in table 1.³

The model explains about 61 percent of the variation in annual growth (adjusted R-squared = 0.611). The residuals seem normally distributed and no autocorrelation appears.⁴

Table 1: Regression Output				
Dependent Variable: revenue (%_y)				
Method: Least Squares				
Sample(adjusted): 1982:01 2006:12				
Included observations: 300 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
constant	-1,28	0,47	-2,74	0,01
changeover	-5,07	0,56	-9,00	0,00
trend	-0,01	0,00	-5,11	0,00
gdp (%_y)	0,34	0,09	3,78	0,00
consumer confidence (Δ)	-0,07	0,01	-4,78	0,00
unemployment rate (%_y)	-0,07	0,01	-5,39	0,00
interest rate spread (Δ)(-3)	1,11	0,47	2,34	0,02
temperature	0,29	0,09	3,11	0,00
temperature (Δ)	0,15	0,07	2,09	0,04
restaurant prices (%_m)	0,00	0,00	1,09	0,27
revenue (-1) (%_y)	0,21	0,05	4,21	0,00
revenue (-12) (%_y)	-0,34	0,04	-8,23	0,00
R-squared	0,625	Mean dependent var	-2,34	
Adjusted R-squared	0,611	S.D. dependent var	3,19	
S.E. of regression	1,986	Akaike info criterion	4,25	
Sum squared resid	1136,30	Schwarz criterion	4,40	
Log likelihood	-625,44	F-statistic	43,72	
Durbin-Watson stat	2,06	Prob(F-statistic)	0,00	

³The abbreviations in the table are:

- Δ (first difference),
- %_y (year-on-year percentage change, $\frac{x_t - x_{t-12}}{x_{t-12}} \times 100$) and
- %_m (month-on-month percentage change, $\frac{x_t - x_{t-1}}{x_{t-1}} \times 100$)

⁴The actual and the fitted data over the whole sample period are shown in the appendix together with the residuals.

The regression constant is negative indicating that this sector is declining over the sample period. Revenue growth appears to have a small but significant negative trend over the sample period. Note that the restaurant series does not include company canteens, an industry that increased over the last decades. The point estimate on the changeover dummy is -5.07 , that is, annual growth in the restaurant sector in the 24 months after the changeover is more than 5 percentage points below of what can be explained by the other variables in the model. Or else, using our interpretation, annual growth in the restaurant sector would have been 5 percentage points higher in 2002 and 2003 if the changeover had not taken place.

Restaurant revenue growth is slightly pro-cyclical; an increase in real GDP growth of 1 percent increases restaurant revenue by about a third of a percentage point. An increase in consumer confidence appears to decrease restaurant output. Consumer confidence is a good indicator for consumption spending on durable goods and it might be that the more people spend on such items, the less time and money they have to eat out. The estimates of the other variables have the expected sign. An increase in the growth of the unemployment rate decreases revenue growth. We add the three-month-lagged yield spread between ten-year government bonds and the three-month money market rate. A steepening of the yield curve can be interpreted as agents' expectations of an improvement in future general economic conditions.

The variable "temperature" measures deviations from the long run monthly average temperature in Germany. The estimates show that people spend more eating out during relatively warm weather. Interestingly, also the first difference in temperature affects consumption. All else equal, people spend more eating out in a relatively warm month that follows a relatively cold one. Here it appears as if people have a certain budget (of time or money) they would like to spend in restaurants and if their plans are cut short by bad weather, rather than cancelling, they tend to postpone eating out until the weather gets nicer.

In Germany, restaurant prices increased somewhat with the changeover and we have to be careful that the decline in revenue we describe was not caused by these price changes. Adding inflation in restaurant prices on the right hand side does not help to predict revenue growth (t-statistic = 0.27). This is the result

we expected mainly because price increases happened in the sample at other times as well without any noticeable effect on revenue. Dropping the variable *restaurant prices* leaves the point estimate on the changeover dummy unaffected. Note that restaurant inflation enters as month-on-month changes $\left(\frac{x_t - x_{t-1}}{x_{t-1}}\right) \times 100$, unlike revenue growth, for example, which is measured as a year-on-year change. This is eventually an assumption about consumers' behaviour; about whether consumers compare current prices with last month's prices or with last year's prices. We have opted for the first assumption because it seemed more plausible but the results do not change much under the alternative assumption. We also included revenue growth lagged one period and lagged twelve periods. Both variables are significant.

The point estimate on the changeover dummy can be used to estimate the absolute losses the German restaurant sector incurred in the months following the changeover. The average revenue during the whole sample excluding 2002 and 2003, the two years in which the dummy takes the value 1, is 21.28 billion euros. The sector thus incurred losses of more than 2 billion euros ($21.28 \times 2 \times 0.0499 = 2.1$). With around 90 000 restaurants in Germany, the losses amount to more than 20 000 euros per restaurant.⁵

A different way to estimate the effect of people's inflation misperceptions is to include them as an explanatory variable in the model. Doing this (the regression output is shown in the appendix) shows that misperceptions are highly significant and the explanatory power of the model increases somewhat. We have, however, decided to use the model with the dummy variable as the central one of this paper. This for the following reason.

Inflation misperceptions are the difference between actual and perceived inflation. While data on actual inflation are readily available, perceived inflation needs to be constructed from survey data. A possible choice is the survey conducted by the European Commission and is the one we use here. The "perceived inflation" index calculated from the survey data is a balance statistic and is the difference between the percentage of respondents stating that prices have increased and the percentage of respondents stating that prices have decreased.⁶ The perceived inflation index is, therefore, not directly comparable to the actual

⁵Since the dummy covers two entire years we ignored the seasonality in this calculation.

⁶The exact question asked, the possible answers and their respective weights in the balance statistic are shown in the appendix.

inflation rate and needs to be quantified which is usually done by matching the first and second moments of both series for the time span for which a stable relationship between both series is assumed to exist (for a discussion on this procedure see Aucremanne et al. 2007). The resulting series was shown in figure 2. The reason why we have chosen not to continue with this model is that we felt uncomfortable to include a variable (misperceptions) on the right hand side which - by construction - is a function of the changeover and to use this variable to predict the effect of the changeover itself. The dummy variable approach avoids this circularity.

We conclude this section with a short discussion about causality. The dummy variable in the regression captures unusual changes in revenue growth in the two years after the changeover and we interpret the negative impact as caused by people's inflation misperceptions. There is, however, the possibility that the decline in revenue is unrelated to the changeover and that the estimates are spurious. In principle, it is not possible to establish causality, there are, however, strong signs that suggest that the changeover triggered the decline. The model tracks revenue growth quite well over a period of more than 25 years, but would largely overestimate revenue growth in 2002 and 2003 had we not introduced the changeover dummy. During our sample period, Germany experienced three recessions (1982, 1993 and 2002), and as we have seen above, the restaurant industry is procyclical and declines during economic downturns but the contraction we observed in 2002 is considerably larger than what can be expected from normal business cycle movements. A look at yearly data confirms this impression. Yearly data for the restaurant industry are available from 1963 onward. The contraction of -8.1 percent we observed in 2002 is by far the largest in the last 46 years. The second largest decrease occurred in 2003 with -4.6 percent. Another sign suggesting a causal relationship between the decline in revenue and people's misperceptions is the timing of the decline. This point is resumed in the next section.

3 Discussion and Policy Implications

From a historical perspective, the contraction suffered by the German restaurant sector in 2002 and 2003 is remarkably strong. Noteworthy is also that the main part of the contraction occurred only several months after the changeover. This matches the pattern of the public outcry which - judging by press reports - was

relatively contained in the months immediately following the changeover and only started to intensify in summer 2002. The ECB (2002) reports that at the beginning of 2002, some negative stories appeared in the media but that “the tone overall was very positive”. Isengaard and Schneider (2006) term the press coverage at the time “extremely positive” and argue that only few complaints about rising prices appeared. The swing in public opinion and in the press occurred about five months after the changeover. For a discussion of possible reasons for this pattern see Eife and Coombs (2007).

In order to understand what drives the contraction in the restaurant sector, it seems useful to distinguish between two effects of people’s misperceptions. The first effect is that the discussion in the media and in the public about whether or not firms tried to profit from the changeover appears to have confused consumers and might have encouraged them to cut back on consumption and “punish” retailers for their “excessive pricing”. The consumer strike organised in Germany in July 2002, seven months after the changeover, illustrates this behaviour.

The second effect is that the changeover and the discussion about prices appear to have had a profound negative impact on consumer confidence and on people’s perceptions of their own financial situation. An interesting study is Wunder, Schwarze, Krug and Herzog (2006) that we already mentioned in the introduction. The authors use data from the German Socio-Economic Panel (SOEP) and the British Household Panel Survey (BHPS) to estimate the impact of the changeover on people’s satisfaction with their income. Using a difference-in-differences approach, Wunder et al. estimate a common model for Germany and Great Britain in which the introduction of the euro is considered a treatment effect. The British population serves as the control group. The authors argue that the new currency caused a “clear negative impact on financial satisfaction”. A compensation for this loss in financial satisfaction would require an increase in household income of around thirty percent. Wunder et al. do not estimate actual changes in behaviour, but it seems unlikely that an impact as large as that estimated would not affect people’s consumption decisions.

People’s inflation misperceptions are not restricted to the restaurant sector in particular and the question that arises here is whether the misperceptions had macroeconomic consequences as well. By focusing on only one sector, our estimates do not answer this question but the results are suggestive. The public

outrage about excessive pricing concerned nearly all goods and services and even more important is the changeover's impact on people's perceptions of their financial situation. It seems possible that the recession in 2002 was at least partly changeover-related though more research in this direction seems warranted.

An important issue here is whether people's misperceptions could have been avoided. There are a number of papers that address the question why people have the impression that the changeover had such a strong impact on prices while the actual impact was relatively small.⁷ As we mentioned already in the introduction, nearly all explanation are based on the assumption that people are in some form non-rational; that they have difficulties to remember old prices or that they remember price increases more than price decreases. It is argued, for example, that consumers more powerfully perceive price changes for goods they buy more frequently than for goods they buy less frequently. The tendency of retailers to price at pricing points (such as 1.99 or 24.90) forces them to round up or down when converting prices and if half of the prices go up and the other half down, it is argued, people would have the impression of a rising price level.

Many of these explanations seem plausible and we understand that it is sometimes useful to explain certain phenomena in economics with non-rational behaviour, but most papers on this subject give the impression that the misperceptions are something policy makers cannot do much about. Rather than some unavoidable side-effect of a currency changeover, the misperceptions seem to be caused by policy mistakes.

The 2002 changeover offers a number of policy mistakes that contributed to people's misperceptions. In order to illustrate the point we want to make here, we will discuss a few of the more severe mistakes. For a detailed analysis see Coombs and Eife (2007) and Eife and Coombs (2007).

The inflation misperceptions we observed after the changeover are a sign that people did not consider the authorities' statements about actual inflation rates credible and the question we have to ask is what caused this distrust in the official data. A possible explanation is the inconsistency of the authorities' responses to complaints about rising prices. The ECB's position, for example,

⁷Cestari, Del Giovane and Rossi-Arnaud (2007) and Del Giovane and Sabbatini (2005) give a good overview.

seems to have changed from that there was “no evidence” for an impact in February 2002 to that there “appears to be some impact” in July 2002. Correcting previous statements gives the impression of being unprepared and confused and might explain why people turned away from the official reports to the media to get information about what really happened to prices. This was a drawback because media reports on the subject were often unbalanced and sometimes based on small and biased data samples. Given the size and the quality of their data bases, the publications by the statistical offices remained surprisingly unnoticed in the public discussion and in the press and here too, the lack of credibility seems part of the explanation. Statistical offices need to take care that their publications are considered credible. Failing to do so seems more a policy problem and should not be blamed on the non-rationality of the people.

The impact of a currency changeover on people’s lives is easily underestimated. The changing of coins and banknotes and in particular the changing of all nominal prices provides difficulties, especially for the elderly. Fears that such an event would bring disadvantages are likely and some complaints about rising prices, right or wrong, are probably inevitable. The outcry we observed in 2002, the consumer strikes, and the confusion about what really happened to prices seem, however, unnecessary.

4 Conclusion

The goal of this paper was to study whether inflation misperceptions may have real effects, that is, whether they induce people to alter their behaviour. Inflation misperceptions were observed in Europe after the euro changeover in January 2002 when people considerably overestimated actual inflation rates for a period of several years. Looking at the German restaurant sector, we found that inflation misperceptions caused people to alter their behaviour. The contraction this sector observed was too pronounced to be explained by normal business cycle movements.

In this study we restricted ourselves to the German restaurant industry mainly because of data availability. The outcry about rising prices and the misperceptions can, however, be found in the whole euro-zone so that the real effects we describe are probably not a specific German phenomenon. Here, more research seems necessary.

We also discussed the question how far the euro changeover and the ensuing discussion about price stability contributed to the recession that followed the changeover. Focusing on only one sector, the paper does not answer the question but the results are suggestive. People's inflation misperceptions are not restricted to the restaurant sector in particular and even more important is the changeover's negative impact on people's perceptions of their financial situation. It seems, therefore, possible that the recession in 2002 was at least partly changeover-related though, here too, more research is warranted.

Finally, we discussed policy implications of the findings and took the position that both the misperceptions and the resulting real effects could have been avoided with a better policy. The confusion in the public about the changeover's impact on prices and on inflation appears to a large extent caused by an inconsistent and confusing official communication. What was missing were clear and credible statements from the authorities about what really happened to prices. Some complaints about rising prices are probably inevitable, but the outcry we observed in 2002, the confusion about prices and eventually the real effects seem avoidable in future changeovers.

5 Literature

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A Appendix

A.1 Regression with Misperceptions

Table 2: Regression Output				
Dependent Variable: revenue (%Δ)				
Method: Least Squares				
Sample(adjusted): 1986:01 2006:12				
Included observations: 252 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
constant	-2,34	0,62	-3,78	0,000
gap (misperceptions)	-1,16	0,16	-7,27	0,000
trend	0,00	0,00	-0,20	0,839
gdp (%Δ)	0,30	0,10	3,06	0,002
consumer confidence (Δ)	-0,07	0,02	-3,95	0,000
unemployment rate (%Δ)	-0,10	0,02	-5,50	0,000
interest rate spread (Δ)	1,54	0,51	3,01	0,003
temperature	0,26	0,10	2,61	0,010
d(temperature)	0,18	0,08	2,41	0,017
restaurant prices (%Δ mom)	0,00	0,00	-0,07	0,941
revenue (-1) (%Δ)	0,24	0,06	4,28	0,000
revenue (-12) (%Δ)	-0,27	0,05	-6,03	0,000
R-squared	0,650	Mean dependent var	-2,33	
Adjusted R-squared	0,634	S.D. dependent var	3,29	
S.E. of regression	1,99	Akaike info criterion	4,26	
Sum squared resid	950,74	Schwarz criterion	4,43	
Log likelihood	-524,88	F-statistic	40,51	
Durbin-Watson stat	2,05	Prob(F-statistic)	0,00	

Table 2 shows the regression with misperceptions (“*gap*”) as an explaining variable. This variable replaced the changeover dummy, all other variables are the same as in table 1. Appendix A2 describes how we estimated people’s misperceptions.

A.2 Estimating the gap between actual and perceived inflation

Inflation misperceptions are the difference between actual and perceived inflation. In this section we will first show how the perceived inflation series is constructed from survey data and then transform this series to make it comparable to actual inflation data.

Inflation perceptions are estimated from the Consumer Confidence Barometer Survey of the European Commission. The specific question is: “How do

you think that consumer prices have developed over the last 12 months?" Six possible answers are given:

- $A(1)$ "risen a lot",
- $A(2)$ "risen moderately",
- $A(3)$ "risen slightly",
- $A(4)$ "stayed about the same",
- $A(5)$ "fallen",
- $A(6)$ "do not know".

These survey results are summarized as the balance statistic B_{it} , calculated as the difference between the fraction of respondents stating that prices have risen and the fraction of consumers stating that prices have fallen or stayed about the same. The third and the sixth options are not used in the calculations. The fractions are weighted with the weights of the different answers are given as:

$$B_{it} = A_{it}(1) + 0.5A_{it}(2) + 0.5A_{it}(4) + A_{it}(5)$$

In order to make this measure comparable to actual inflation rate, we transform the original data by the following standardization:

$$\pi_t^P = \frac{(B_t - \bar{B})}{s_B} s_\pi + \bar{\pi}$$

where π_t^P is the quantified measure of perceived inflation at time t . \bar{B} and s_B stand for the mean and the standard deviation of the original balance statistic B_t and $\bar{\pi}$ and s_π are the corresponding statistics of officially measured inflation π_t (here CPI inflation). These means and standard deviations are computed over the sample period for which it is thought that a stable relation between measured and perceived inflation exists. In our case, this is the period from 1985:01 until 2001:12. For a discussion of this transformation see Aucremanne, Collin, Stragier (2007).⁸ Note that by transforming perceived inflation we do not take into account that this statistic is bounded from below and from above.

⁸An alternative way to quantify the balance statistic would be to regress the balance statistic on a constant and actual inflation as proposed by Ehrmann (2006).

A.3 Variables that appear in the Regressions

All variables are available over the entire sample period. The following abbreviations are used

- $\Delta = x_t - x_{t-1}$, first difference
- $\%_m = \frac{x_t - x_{t-1}}{x_{t-1}}$, month on month percentage change
- $\%_y = \frac{x_t - x_{t-12}}{x_{t-12}}$, year on year percentage change

1. revenue ($\%_y$)

Revenue growth in German restaurant sector, calculated as $\frac{x_t - x_{t-12}}{x_{t-12}} \times 100$ where x_t is level of revenue in period t . Indexed data, monthly, current prices, not seasonally adjusted. West Germany until 1991.

Source: Federal Statistical Office, Lange Reihen.

2. gdp ($\%_y$)

Annual growth in German Gross Domestic Product calculated as $\frac{x_t - x_{t-12}}{x_{t-12}} \times 100$ where x_t is level of GDP in period t . Indexed, current prices, quarterly data transformed into monthly by linear interpolation. West Germany until 1991.

Source: Federal Statistical Office.

3. consumer confidence (Δ)

1st difference in Consumer confidence indicator calculated as $x_t - x_{t-1}$ where x_t is the arithmetic average of the balances (in percentage points) of the answers to the questions on the financial situation of households, the general economic situation, unemployment expectations (with inverted sign) and savings, all over the next 12 months. Balances are seasonally adjusted.

Source: Datastream: BDCNFCONQ (Datastream – European Commission); European Commission consumer confidence index for Germany, diffusion index, +/- balance, , monthly.

4. unemployment rate ($\%_y$)

Yearly growth rate of German unemployment rate, monthly data, Pan-Germany from September 1990, not seasonally adjusted.

Source: Bundesanstalt für Arbeit

5. interest rate spread (Δ)

1st difference between German 10 year benchmark bond yield and 3 months middle rate, monthly, not seasonally adjusted.

Source: Datastream. BDBRYLD (10 year benchmark bond yield Germany) - GERMDRQ (GERMANY MONEY 3 MONTH - MIDDLE RATE).

6. temperature

Deviations from monthly average in degree centigrade, calculated as arithmetic mean of observations in Hamburg, Berlin, Frankfurt and Munich, monthly data, not seasonally adjusted.

Source: Deutscher Wetterdienst

7. temperature (Δ)

1st difference of temperature.

8. gap (misperceptions)

Difference between actual inflation and a measure of perceived inflation as calculated in the appendix.

9. restaurant prices ($\%_m$)

Month-on-month inflation in restaurant prices.

Source: Federal statistical office.

Actual, Fitted, Residual Graph

