Rational Inattention, Inflation Perceptions and the Media: Lessons from the Euro Cash Changeover *

Michael J. Lamla† and Sarah M. Lein‡

February 2012

Abstract

According to the concept of rational inattention people do not absorb and process all available information. Given that most people obtain their information about the economy from the media, press coverage of the economy may exert influence on peoples’ attitudes. This paper tests for this influence by examining consumers’ inflation perceptions in the aftermath of the euro cash changeover, which serves as a natural experiment. Using a new data set that quantifies the intensity and tone of media reports, we document that media reporting has had a statistically significant and economically meaningful impact on inflation perceptions and contributed to their sharp rise in the aftermath of the euro cash changeover and to the divergence between inflation perceptions and actual inflation rates.

JEL classification: E52; D83

Keywords: Inflation perceptions, rational inattention, media coverage, euro cash changeover.

---

*We thank participants of the Swiss Society of Economics and Statistics Meeting 2009, Geneve, Switzerland and the Royal Economic Society Annual Meeting 2010, Guildford, U.K. for helpful comments and suggestions. Financial support by the Swiss National Science Foundation (SNF) and the DG ECFIN is gratefully acknowledged. The views expressed in this paper reflect solely the views of the authors and not necessarily those of the Swiss National Bank or the KOF.

†KOF, ETH Zurich, CH-8092 Zurich, Switzerland, E-mail: lamla@kof.ethz.ch
‡Swiss National Bank, Börsenstrasse 15, CH-8022 Zurich, Switzerland, E-mail: sarah.lein@snb.ch
1 Introduction

The introduction of the euro coins in January 2002 led to a surprising surge in inflation perceptions in many euro area countries. For example, the balanced statistic of inflation perceptions published by the European Commission for Germany rose from about 30 in the end of 2001 to 60 in the beginning of 2002 and remained at a historically high level for a protracted period of time. Using quantified figures calculated from this qualitative survey, consumers’ inflation perceptions edged up from 2.4% in December 2001 to 6.1% in May 2002.\(^1\) This jump in inflation perceptions is puzzling because at the same time official HICP rates fell from 1.4% to 1.1%.

Meanwhile, the mismatch between inflation perceptions and actual inflation rates after the euro cash changeover serves as a welcome natural experiment to test for the influence of media reporting on consumers’ opinions. This paper argues that, while this mismatch is difficult to reconcile with fully rational consumers in a perfect information world, it is consistent with rationally inattentive consumers who obtain their information from the media. Using a detailed media data set, we show that exaggerated media reporting significantly contributed to the jump in inflation perceptions. According to our estimates, media reporting explains more than 15% of the jump in inflation perceptions observed in January 2002. Actual inflation accounts for only 1%.

Theoretically, the idea that people have imperfect information about economic developments can be motivated by models of sticky information or rational inattention. For example,\(^{2}\) argues that consumers face cognitive capacity problems and cannot digest all available information. Consequently, they update their information sets sluggishly and use sources of information that allow them to obtain new information relatively easily.

\(^1\)Quantified inflation perceptions are kindly provided by the Bundesbank. The calculation is described in detail in the Bundesbank Monthly Bulletin November 2007.
for instance price developments any headlines covered in leading media may attract their attention and bring them to update their information set. In addition, media outlets help to give an interpretation to economic news and therefore do part of the job of processing economic information. This is corroborated by survey evidence. According to Blinder and Krueger (2004), people obtain their information on current economic conditions mainly through the media, especially through TV broadcasts and newspapers. More precisely, 82% say that they receive their information from TVs and 52% from newspapers.

Our paper is related to Eife and Coombs (2007), who show that media reporting intensified around the introduction of the euro. They conjecture that media shaped consumers’ perceptions. In a similar fashion, Del Giovane and Sabbatini (2006) collect media data for Italy until 2003 and report a positive correlation between the amount of news about inflation and the level of inflation perceptions. This paper extends these ideas. Both papers suggest a positive correlation. However, it is not clear why the amount of news should increase inflation perceptions. Hence, to analyze the impact of news it is necessary not to count the news but identify their content. We are able to identify the content using a comprehensive data source of daily media data over ten years for 26 media outlets.

Understanding how inflation perceptions are formed is also useful for gaining insights into consumers’ economic behavior and the potential feedback on other economic variables. As argued in Eife and Meier (2007) high inflation perceptions may have real effects. They show that the contraction in the restaurant sector experienced in the months after the changeover is partly due to the observed overshooting of inflation perceptions. Furthermore, higher perceived inflation rates may lead to an underestimation of the purchasing power of households and therefore to a reduction in spending (see Hofmann et al. 2009; Stix, 2009). Moreover, inflation perception might feed into inflation expectations, which have consequences for wage claims, saving and investment decisions (Ehrmann, 2011). In addition, inflation expectations may lead to higher future inflation rates as they may be self-fulfilling (Leduc et al. 2007). Thus, although inflation perceptions may play an important role for consumers’ economic

---

2Evidence for a possible spillover from inflation perception to inflation expectations is provided by Fluch and Stix (2005). This finding was recently supported by the survey of the Bank of England and Blanchflower and Mizen (2003), who conclude that consumers’ price expectations are influenced by past experience of inflation.
actions, we still know remarkably little about the formation of inflation perceptions (Lein and Maag, 2011).

The remainder of this paper proceeds as follows: In Section 2 we shortly review the related literature. Section 3 presents the data, while Section 4 presents the econometric results of our analysis, detailed results for different socioeconomic groups and robustness checks. Finally, Section 5 concludes.

2 Literature review

This section briefly outlines the related literature. Our empirical setup is related to two different strands of the literature. The first comprises the determinants that contributed to the observed break in the relationship between inflation perceptions and the officially reported inflation rate in the aftermath of the euro cash changeover. The second studies the influence of media reporting on peoples’ behaviour, such as voting behaviour or economic expectations.

2.1 Perceptions and the Euro Cash Changeover

The strong and persistent rise in inflation perceptions in the aftermath of the euro cash changeover gave rise to a debate on the causes and consequences of inflation perceptions. Eife and Meier (2007) show that there are real consequences: after the euro cash changeover, revenue in the restaurant sector decreased in response to the misperception of inflation in that sector. As for the causes of inflation perceptions, previous research has identified several determinants of inflation perceptions: price movements in frequently bought products and asymmetry in the perception of price increases relative to price decreases, a priori expected price movements, the complexity of conversion rates, and, finally, media coverage. We discuss research on each of these determinants in more detail below.

Consumers may pay more attention to frequently bought products and products that experience price increases. Thus, the weights these products receive in inflation perceptions may be disproportionately high. There is not much evidence, however, that a strong rise in the prices of frequently bought products can explain gap between perceived and actual inflation.
in the aftermath of the euro cash changeover. For example, Aucremanne et al. (2007) find no evidence that strong rises in prices of frequently bought products can explain the rise in inflation perceptions. Also Doehring and Mordonu (2007) show that the out-of-the-pocket expenditure HICP index does not perform any better as the all items containing HICP index in explaining inflation perceptions. There is more evidence that consumers pay more attention to price increases than price reductions. Vogel et al. (2009) test find strong support for this.

Consumers like to see their ex ante expectations confirmed. Traut-Mattausch et al. (2001) present experimental evidence that links high inflation perceptions in 2002 to the existence of a priori expectations of high price increases before the cash changeover. In their line of argumentation people selectively update only the share of information that complements their own expectations. Thus, if they expect prices to rise, they will most likely focus and react to upward price changes. However, a priori expectations, although significant, have not been sufficiently high to explain the break in the tight relationship between perceived and actual inflation (Doehring and Mordonu, 2007).

Other explanations look at the process of converting the old currencies into euro prices. Ehrmann (2011) compares several euro area countries and finds that the gap is larger in countries with simpler conversion rates, where people are more aware of price increases. Dziuda and Mastrobuoni (2009) find that the longer people stick to converting the euro prices into their old currency the more likely it is that they will overestimate current inflation. The obvious explanation for this phenomenon is that they neglect price increases that would have happened if they stuck to their old currency.

2.2 The Role of Media

A large body of the literature in political economy and media science deals with the impact of media on peoples’ decisions. For example, DellaVigna and Kaplan (2007) find that media can influence voting behaviour. Similarly, Hetherington (1998) puts forward that media consumption and attention through the mass media negatively shaped voters’ retrospective economic assessments in the 1992 election. Other studies find that media tend to bias economic news
in general. Hence, there is not only convincing evidence regarding the importance of media reporting on perceptions in other fields of research but also that there have been occasions where media slanted information.

Regarding the impact of media on economic figures Carroll (2003) and Lamla and Lein (2008) provide empirical evidence that media reporting influences the formation of consumers’ inflation expectations. They find that media reporting has a strong effect on the accuracy of inflation expectations of consumers compared to professional forecasters.

3 Data

To quantify the intensity of media coverage, we rely on data kindly provided by the media research institute Mediatenor. The data comprises articles and media releases on a daily frequency for the time span 01/1998 to 09/2007 in Germany covering statements dealing with inflation which are at least five lines long in the case of printed media and last at least five seconds for television broadcasts. The coding is based on the standards of the ‘media content analysis’. Given the content analysis of the reports we can identify whether the news states that inflation is rising or falling.

In addition, we employ simple count variables that capture how often a specific terminology is mentioned in the media. These variables are mainly used as a test for robustness of our main results. The count measures are obtained by searching through LexisNexis, an online database of media articles. First, we count the articles using the term “Teuro” (Teuro). “Teuro” is a concatenation of the words “teuer”, the German equivalent for expensive, and the word euro. Analogously, we count the expression “euro introduction” (euro). The latter per se does not contain a particular tone as it just reminds the public of a particular event related to their currency. The word “Teuro”, however, clearly presumes that inflation has

---


5See www.mediatenor.de for details on media content analysis.
been and/or will be rising and is related to the cash changeover in 2002. Given that there is no evidence that the euro introduction has affected prices in Germany significantly, the Teuro discussion serves as an example for an exaggeration made by the media.

As the measure for perceived inflation we employ survey data collected by the EU Consumer Survey. Inflation perceptions are captured by asking households: “How do you think that consumer prices have developed over the last 12 months? They have...”. Respondents express their beliefs on a five-option ordinal scale: “risen a lot, risen moderately, risen slightly, stayed about the same, fallen”. We use the balance figures as calculated by Eurostat, i.e. the difference between positive and negative answers (in percentage points of total answers).

Figure 1: Inflation, Inflation Perceptions and Media Coverage

![Figure 1](image)

(a) Inflation and Inflation Perceptions
(b) Inflation and Media Coverage

Dashed line: Perceived inflation rate of German consumers; solid line: Actual inflation rate (HICP) Germany.

Notes: The left panel shows the inflation (HICP, solid line) and perceived inflation figures of consumers (dashed line) for Germany. The right panel shows inflation (HICP, solid line) and the number of media reports related to inflation (rhs, bars). Sources: Eurostat, Mediatenor.

The series of inflation perceptions tracks the HICP inflation rate relatively closely prior to 2002 (Figure 1, left panel). After the euro cash changeover, this comovement between the two series breaks down. Regarding media coverage, the link between inflation and media reporting is not clear either. Even though a high volume of media reporting usually coincides with a high level of inflation, the reverse is usually not true. There can be high media coverage and low rates of inflation and vice versa. Examples for this phenomenon can be found in mid 2002
as well as in the beginning of 2003 (right panel). Thus, media coverage does not necessarily co-move with inflation.

**Figure 2: Inflation Perceptions and Content of Media Reports**

(a) Perceptions and Media Tone
(b) Perceptions and “Teuro”

Dashed line: Perceived inflation rate of German consumers; solid line: Actual inflation rate (HICP) Germany.

*Notes:* The left panel shows inflation perceptions, Germany (line, rhs) and the number of media reports that claim inflation is rising or falling (bars, lhs). The right panel shows inflation perceptions (line, rhs) and the amount of reports containing the word “Teuro” in German print media (bars, lhs). Sources: Eurostat, Mediatenor.

To gain more insights into these relationships, we disentangle all reports into reports dealing with rising prices news (*Rising Inflation*) and falling prices news (*Falling Inflation*) and plot them together with HICP in the left panel of Figure 2. We can observe that if inflation is rising, media reports that inflation is rising and vice versa. Thus, media agencies capture the overall dynamics rightly. However, the amount of reporting does not necessarily match the magnitude of price changes. Comparing the spikes in 2002 and 2004 shows that although inflation was as high, the coverage in the media was very different. Moreover, it seems that there is a higher propensity to report more on rising inflation than on falling inflation.

The sharp rise in inflation perception corresponds with the repeatedly wording of “Teuro”. The right panel in Figure 2 shows the relationship between teuro and inflation perceptions. Given the fact that the word “Teuro” was chosen “the word of the year 2002”, it is not
surprising that the euro introduction was one of the main topics in these year reviews. During the year 2003 both media reports and perceived inflation fall back to a relatively low level.

4 Estimation and Results

This section comprises two parts. First, we quantify the impact of media on inflation perceptions. Second, we test whether the impact of media reporting has changed over the time.

4.1 Linear Framework

Our starting regression rests on the empirical model proposed by Doehring and Mordonu (2007). They motivate an empirical regression that explains inflation perceptions by the determinants discussed in Section 2. The other determinants are lags of perceptions, inflation expectations, HICP inflation and a dummy variable controlling for the euro cash changeover. We estimate models in the following form:

\[ \pi_{perc} = \alpha + \beta_1 \pi_{perc,t-1} + \beta_2 \pi_{exp,t-6} + \beta_3 \pi_t + \beta_4 D_{>2002} + \Gamma Media_t + \varepsilon_t. \]

Inflation perceptions are denoted by \( \pi_{perc} \) and inflation expectations by \( \pi_{exp} \). Following Forsells and Kenny (2004) we use a six month lag of expectations as an explanatory variable.\(^6\) Current inflation is included as the growth rate of the HICP index (\( \pi \)).\(^7\) The dummy variable is constructed according to Doehring and Mordonu (2007). It is zero until 2002 and one afterwards. \( \Gamma Media \) represents a vector of media variables that will be added to the specification.

The Teuro debate in the media has had a significant impact on inflation perceptions. This is shown in the first column in Table 1. The variable counting the number of times “Teuro” has been mentioned in the print media has a significant positive impact on inflation perceptions. This is reasonable as there the main message of those articles was indeed to

\(^6\) A 12 month lag produces similar results.
\(^7\) Note that we also employed the out-of-the-pocket expenses index, as calculated by Eurostat as a measure for inflation. This motivation is that the index should better reflect that perceptions could be more affected by prices of frequently purchased items. The out-of-the-pocket expenses index does not outperform the HICP in statistical terms as well as economically.
Table 1: Determinants of Inflation Perceptions

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5) 2SLS</th>
<th>(6) GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\pi_{t-1}^{\text{perc}}$</td>
<td>0.891***</td>
<td>0.925***</td>
<td>0.775***</td>
<td>0.939***</td>
<td>0.920***</td>
<td>0.923***</td>
</tr>
<tr>
<td></td>
<td>(0.032)</td>
<td>(0.025)</td>
<td>(0.069)</td>
<td>(0.036)</td>
<td>(0.026)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>$\pi_{t-6}^{\text{exp}}$</td>
<td>0.161***</td>
<td>0.162***</td>
<td>0.002</td>
<td>0.166***</td>
<td>0.141***</td>
<td>0.148***</td>
</tr>
<tr>
<td></td>
<td>(0.050)</td>
<td>(0.039)</td>
<td>(0.082)</td>
<td>(0.038)</td>
<td>(0.052)</td>
<td>(0.048)</td>
</tr>
<tr>
<td>$\pi_t$</td>
<td>2.494***</td>
<td>0.547</td>
<td>4.969***</td>
<td>1.005</td>
<td>-0.277</td>
<td>-0.048</td>
</tr>
<tr>
<td></td>
<td>(0.716)</td>
<td>(0.570)</td>
<td>(1.547)</td>
<td>(0.983)</td>
<td>(0.720)</td>
<td>(0.681)</td>
</tr>
<tr>
<td>Teuro</td>
<td>0.036***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Euro</td>
<td>0.002</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.025)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rising Inflation</td>
<td>0.169**</td>
<td>0.058</td>
<td>0.190***</td>
<td>0.308**</td>
<td>0.274**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.082)</td>
<td>(0.108)</td>
<td>(0.068)</td>
<td>(0.147)</td>
<td>(0.127)</td>
<td></td>
</tr>
<tr>
<td>Falling Inflation</td>
<td>-0.054</td>
<td>-0.083</td>
<td>0.078</td>
<td>0.001</td>
<td>-0.043</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.081)</td>
<td>(0.100)</td>
<td>(0.131)</td>
<td>(0.225)</td>
<td>(0.213)</td>
<td></td>
</tr>
<tr>
<td>$\text{Dummy}_{&gt;2002}$</td>
<td>1.646</td>
<td>2.888**</td>
<td>3.460***</td>
<td>3.293***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.575)</td>
<td>(1.104)</td>
<td>(1.092)</td>
<td>(1.038)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-5.293***</td>
<td>-4.770***</td>
<td>-0.725</td>
<td>-3.854</td>
<td>-4.608***</td>
<td>-4.599***</td>
</tr>
<tr>
<td></td>
<td>(1.738)</td>
<td>(1.423)</td>
<td>(2.403)</td>
<td>(2.409)</td>
<td>(1.571)</td>
<td>(1.488)</td>
</tr>
<tr>
<td>Observations</td>
<td>102</td>
<td>102</td>
<td>42</td>
<td>60</td>
<td>102</td>
<td>102</td>
</tr>
</tbody>
</table>

Newey-West corrected standard errors standard errors in parentheses *** p<0.01 ** p<0.05 * p<0.1. Dependent variable is the inflation perception at time $t$, $\pi_{t}^{\text{perc}}$. $\pi_{t}^{\text{exp}}$ denotes inflation expectations, $\pi_t$ the inflation rate in period $t$. Media variables: $\text{teuro}$ is the monthly number of articles dealing with the word $\text{Teuro}$, euro is the number of articles with the word euro, rising (falling) inflation is the number of articles reporting on rising (falling) inflation. $\text{Dummy}_{>2002}$ is a dummy that takes the value one after December 2001, and zero otherwise. Columns (1) and (2) report the results for the whole sample period, columns (3) and (4) for the sub-sample before and after 2002, respectively. Columns (1) to (4) are estimates with OLS, while columns (5) and (6) are instrumental variables estimation using 2SLS in column (5) and GMM in columns (6).

“warn” the public of rising prices with respect to the introduction of the euro. Notably the discussion on the euro introduction itself reveals no such impact. The results for the control variables are in line with the findings in Doehring and Mordonu (2007). We can confirm that the own lag of perceptions measure as well as the expectations act in a self-fulfilling manner. Finally, people also incorporate actual statistical information as proxied by the HICP.

News on rising inflation significantly raise inflation perceptions, while news on falling inflation do not have a statistically measurable impact (column 2). Thus, there is an asymmetry in the relationship between media reporting and inflation perceptions. Interestingly, the in-
flation figure is no longer significant. Hence, this suggests that the statistical information is provided by media reports and that consumers do not react to statistical news that are not discussed in the media.\(^8\) Given the evidence on macroeconomic illiteracy among consumers (Blanchflower and Kelly, 2008) this result is not surprising; consumers have difficulties to interpret an inflation figure as such and hence need the media reports, which help them to understand what the figure means and what it implies – for example their consumption expenditures.

In the next step we split the sample into two sub-samples: one before the euro cash changeover and one after. Interestingly, media had no explanatory power before the cash changeover, but the HICP figure is highly significant (column 3). In contrast, after the introduction of the euro, consumers relied on information provided by the media as well as on their past expectations (column 4). This suggests that the effect of reporting about rising inflation on inflation perceptions is a phenomenon that arose after the cash changeover.\(^9\) Moreover, the result that inflation expectations are insignificant in the period before the cash changeover suggests that there is no evidence for the expectation confirmation bias before 2002 (Traut-Mattausch et al., 2004). In sum the estimation result clearly indicate that media is an statistically important driver of inflation perceptions. Especially news on rising inflation have a strong influence.

One could content that media reports about inflation may influence inflation perceptions and those perceptions might also drive media reporting or, put differently, media agencies might cater to the prejudice of their readers and therefore react to inflation perceptions. We address this endogeneity problem in various ways. First, we use an instrumental variable approach. Second, we perform Granger causality tests. Both suggest that there is a causality from media to perceptions and that our results are not driven by reverse causality.

First, we instrument the media variables by applying instrumental variables estimators using two stage least squares (2SLS) and general methods of moments (GMM). The variables

---

\(^8\)Note, that this result is not influenced by multicollinearity among the regressors, as the correlation between the regressors is well below 0.6.

\(^9\)The effect may be persistent, as suggested by “agenda-setting approaches” which imply a threshold effect; once the reporting on a certain topic achieves a certain intensity, it is perceived as a “hot topic” and remains visible for a longer time (Vogel et al., 2009).
Table 2: Granger Causality

<table>
<thead>
<tr>
<th>Equation</th>
<th>Excluded</th>
<th>F</th>
<th>df</th>
<th>dfr</th>
<th>Prob &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\pi_{perc})</td>
<td>Rising Inflation</td>
<td>2.5130129</td>
<td>4</td>
<td>86</td>
<td>0.04742569</td>
</tr>
<tr>
<td>(\pi_{perc})</td>
<td>Falling Inflation</td>
<td>0.972532</td>
<td>4</td>
<td>86</td>
<td>0.42689236</td>
</tr>
<tr>
<td>(\pi_{perc})</td>
<td>All</td>
<td>2.2133115</td>
<td>8</td>
<td>86</td>
<td>0.03398656</td>
</tr>
<tr>
<td>Rising Inflation</td>
<td>(\pi_{perc})</td>
<td>1.5282531</td>
<td>4</td>
<td>86</td>
<td>0.20114295</td>
</tr>
<tr>
<td>Rising Inflation</td>
<td>Falling Inflation</td>
<td>0.97134935</td>
<td>4</td>
<td>86</td>
<td>0.42753571</td>
</tr>
<tr>
<td>Rising Inflation</td>
<td>All</td>
<td>1.1748409</td>
<td>8</td>
<td>86</td>
<td>0.32364854</td>
</tr>
<tr>
<td>Falling Inflation</td>
<td>(\pi_{perc})</td>
<td>0.89341582</td>
<td>4</td>
<td>86</td>
<td>0.47155867</td>
</tr>
<tr>
<td>Falling Inflation</td>
<td>Rising Inflation</td>
<td>2.59415</td>
<td>4</td>
<td>86</td>
<td>0.04198934</td>
</tr>
<tr>
<td>Falling Inflation</td>
<td>All</td>
<td>1.684462</td>
<td>8</td>
<td>86</td>
<td>0.11372139</td>
</tr>
</tbody>
</table>

*rising inflation* and *falling inflation* are instrumented with their own four lags and the remaining exogenous variables in the model (columns (5) and (6)). For 2SLS the \(\chi^2\)-test of overidentification cannot reject the null hypothesis that our instruments are valid. The test statistic is 5.14, the associated p-value is 0.53. For the GMM estimation the corresponding \(J\)-test has a p-value of 0.63 and leads to the same conclusion. The relevance of instruments is supported by first stage Shea’s (1997) partial \(R^2\) statistics, which amount to 0.25 for *rising inflation* and to 0.2 for *falling inflation*. Concerning our estimates, the size of the effect of news about rising inflation becomes even larger when using the instrumental variables approach.

Second, Granger causality tests do not indicate that the results are driven by reverse causality. As a further robustness check, we estimate the impact of media reporting in a dynamic setting. A vector autoregression (VAR) setup allows us to account for the dynamics between the different variables, especially between perceived inflation and the media variables. Hence, these variables are set endogenous in the system. Exogenous variables are the six-month lag of expectations, the HICP and the changeover dummy. We use four lags according to the Akaike information criterion. The results of the Granger causality analysis are presented in Table 2. Lagged media variables significantly affect perceptions but the reverse causality link is not statistically significant. This confirms that, although reverse causality might be present, the dominating channel is the influence of media on inflation perceptions and there is no measurable feedback effect from the level of perceptions.

Our results shown that media reports are statistically significant and robustly related to inflation perceptions. In the following we show that they are also economically important.
Media reporting explains more than 15% of the change in inflation perceptions observed during the cash changeover in January 2002. Actual inflation accounts for only 1%. These estimates are obtained by fitting the observed inflation perceptions in December 2001 and January 2002 to the equation estimated in column (2) and taking first differences.

Furthermore, media reporting on rising inflation is, after the lag of perceptions, the variable with the highest impact on inflation perceptions. To quantify the relative economic importance of media, we report the impact of each variable on inflation perceptions based on the impulse of a shock of one unit standard deviation of the respective series. Figure 3 illustrates this. As expected, the autoregressive parameter is the highest on impact. Above that the figure offers another interesting insight: the response to the rising inflation variable is found to be much higher compared to the remaining explanatory variables. To sum up, the estimation results give wide support for the effect of media for the perceptions of consumers.

Figure 3: Impact estimates of media on perceptions

Note: The graph compares the one period impulse responses of a one standard deviation shock of the explanatory variables on perceptions. Results based on the coefficient estimates of Table 1 column (2). Ordinate: change in the level of perceptions.
4.2 Socioeconomic Characteristics

In the next section we test whether the results established so far hold for different socioeconomic groups. Several studies provide empirical evidence that socioeconomic characteristics matter. For example, Palmqvist and Stroemberg (2004) find a u-shaped relationship between inflation perception and age as well as income in Sweden. People up to midst of their lifetime improve their inflation expectation which deteriorates when they become elderly. They find similar results for inflation expectations. Stix (2009) and Dziuda and Mastrobomni (2009) argue that household income, education level or age are factors determining changeover-induced inflation perceptions. Malgarini (2009) investigates the relationship between personal characteristics and the overestimation of inflation, showing that socioeconomic characteristics matter for the degree of overestimation of inflation figures. He notes that the degree of overestimation is lower the higher the level of education is. Furthermore, he shows that more optimistic respondents are prone to a lower degree of overestimation. Blanchflower and Kelly (2008) report very high non-response rates to inflation perceptions in surveys among the least educated, females, poorest and younger individuals. Furthermore, groups with biased perceptions form biased expectations as well. As Blinder and Krueger (2004) - in a survey for the US - show, people receive the bulk of information from media usage (TV mainly, with a large distance followed by newspapers), but do not actively search for information on economic issues. People with higher income as well as higher education are in general better informed. Furthermore, ideology plays a large role in the formation of public beliefs. Therefore the different usage structure of media by different household types might play an important role in explaining differences in perceptions.

The regressions summarized in Table 4.2 represent the main regressions estimated in Table 1 - the difference being that the dependent variable measures inflation perceptions calculated for each socioeconomic group separately. The explanatory variables remain the same. We focus on gender, earnings, education and age.

The more educated people are the stronger is the link between HICP and inflation perceptions. At the same time, the more educated people are the stronger they react to news on

\[10^{th}\text{See also }\text{\cite{Curtin2007}}.\]
the “Teuro” as well as to news on rising inflation. On the one hand, this implies that they strongly update on existing statistical figures. On the other hand, especially in the aftermath of the euro introduction, they have been not fully insulated and also reacted to media reporting. Furthermore, consumers with further education (above secondary), do not respond significantly to news about rising or falling inflation. With respect to gender, the estimated coefficients are very similar independent of the regression setup. Concerning income and age no linear trend is observable. For different age groups, we find some evidence for an inverted u-shape relationship, in line with Palmqvist and Stroemberg (2004). For instance consumers in the age category \( ag2=30-49 \) neither respond to news about rising or falling inflation in the whole sample period nor do they respond in the period after 2002 to news about rising inflation, where all other groups responded, but they seem to follow closely the published inflation figures. This might be due to the fact that these groups are less affected by biased media reporting, because, for example they choose media outlets that report less biased. Concerning income those in the 3rd income quartile respond most to news on inflation as well as HICP for the full horizon. However, in the aftermath of the cash changeover income groups \( re2 \) and \( re4 \) respond substantially stronger. While those results may partly be less clear cut they certainly highlight the differences in the response due to socioeconomic characteristics. The more educated people are the more they rely on real HICP figures and are less influenced by biased media reporting. However, for all different socioeconomic groups, there is no statistically different response as the tests on the equality of the mean estimates fail to reject.
| Variable         | (1) total | (2) re1 | (3) re2 | (4) re3 | (5) re4 | (6) ed1 | (7) ed2 | (8) ed3 | (9) ag1 | (10) ag2 | (11) ag3 | (12) ag4 | (13) mal | (14) fem |
|------------------|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
| \( \pi \)       | 1.826***  | 1.988* | 1.763* | 2.031**| 1.718**| 1.516**| 2.039**| 2.778**| 1.425**| 2.085**| 1.976**| 1.504**|        |         |
|                  | (0.686)   | (0.906)| (0.946)| (1.005)| (0.902)| (0.648)| (0.789)| (1.382)| (0.639)| (0.850)| (0.779)| (0.737)|        |         |
| Dummy\(_{2002}\) | 0.935     | 1.009 | 1.501 | 1.536 | 1.562 | 0.926 | 1.341 | 0.494 | 1.471 | 1.095 | 1.345 | 1.065 |        |         |
|                  | (1.153)   | (1.316)| (1.471)| (1.595)| (1.451)| (1.255)| (1.250)| (1.839)| (1.345)| (1.325)| (1.188)| (1.379)|        |         |
| \( \pi \)       | 2.494***  | 2.689**| 2.950**| 3.282***| 2.315**| 2.158***| 2.853**| 3.724**| 2.012***| 2.804***| 2.887**| 2.224***|        |         |
|                  | (0.716)   | (0.974)| (1.050)| (1.064)| (0.993)| (0.689)| (0.826)| (1.470)| (0.650)| (0.900)| (0.804)| (0.804)|        |         |
| Euro             | 0.036***  | 0.042**| 0.075**| 0.067***| 0.039* | 0.035**| 0.045**| 0.072**| 0.036**| 0.042**| 0.064***| 0.029**|        |         |
|                  | (0.013)   | (0.021)| (0.030)| (0.021)| (0.020)| (0.015)| (0.016)| (0.027)| (0.019)| (0.015)| (0.019)| (0.014)|        |         |
| Rising Inflation | 0.169***  | 0.154 | 0.202**| 0.213**| 0.184**| 0.160**| 0.186**| 0.236 | 0.189**| 0.138 | 0.219***| 0.151* | 0.192**| 0.155* |
|                  | (0.082)   | (0.095)| (0.103)| (0.097)| (0.108)| (0.073)| (0.089)| (0.163)| (0.083)| (0.094)| (0.077)| (0.089)| (0.081)| (0.098)|
| Falling Inflation| -0.054    | -0.002| -0.053| -0.003| -0.076| -0.013| -0.038| -0.175| 0.007  | -0.029| -0.065| -0.107| -0.078| -0.015 |
|                  | (1.104)   | (1.245)| (1.625)| (1.497)| (1.406)| (1.178)| (1.245)| (1.891)| (1.346)| (1.260)| (1.205)| (1.466)| (1.156)| (1.234) |
|                  | (1.547)   | (1.640)| (2.501)| (2.592)| (1.992)| (1.375)| (1.747)| (3.187)| (1.604)| (1.761)| (1.758)| (2.233)| (1.520)| (1.713) |
| Rising Inflation | 0.058     | 0.068 | 0.040 | 0.106 | 0.029 | 0.052 | 0.052 | 0.020 | 0.012 | 0.042 | 0.115 | 0.009 | 0.061 | 0.054 |
|                  | (0.108)   | (0.130)| (0.153)| (0.131)| (0.118)| (0.099)| (0.102)| (0.206)| (0.102)| (0.118)| (0.098)| (0.103)| (0.094)| (0.120) |
| Falling Inflation| -0.083    | -0.013| -0.171| -0.159| -0.151| -0.037| -0.102| -0.199| -0.077| -0.009| -0.146| -0.195| -0.151| 0.004 |
| \( \pi \)       | 1.005     | 0.719 | -0.281| 1.784 | 0.001 | 0.328 | 1.295 | 0.118 | 0.227 | 1.642 | 0.323 | 0.685 | 0.946 | 0.832 |
|                  | (0.983)   | (1.537)| (1.849)| (1.681)| (1.642)| (1.255)| (1.290)| (2.308)| (0.924)| (1.461)| (1.288)| (1.092)| (1.064)| (1.142) |
| Rising Inflation | 0.190***  | 0.136* | 0.273**| 0.209*| 0.261**| 0.160*| 0.220***| 0.365***| 0.228***| 0.119| 0.255***| 0.223**| 0.246***| 0.141* |
|                  | (0.068)   | (0.080)| (0.094)| (0.112)| (0.110)| (0.088)| (0.072)| (0.124)| (0.064)| (0.106)| (0.075)| (0.080)| (0.071)| (0.072) |
| Falling Inflation| 0.078     | 0.144 | 0.196 | 0.227 | -0.003 | 0.133 | 0.136 | -0.137 | 0.251 | 0.119 | 0.032 | 0.009 | 0.029 | 0.150 |
|                  | (0.131)   | (0.202)| (0.189)| (0.189)| (0.180)| (0.130)| (0.151)| (0.284)| (0.172)| (0.149)| (0.131)| (0.176)| (0.116)| (0.170) |

\( \text{Total}\) stands for total, \( re1 \) to \( re4 \) distinguishes consumers by household income: \( re1=1st\ quartile, re2=2nd\ quartile, re3=3rd\ quartile, re4=4th\ quartile \). \( ed1 \) to \( ed3 \) distinguishes consumers by educational level: \( ed1=Primary\ education, ed2=Secondary\ education, ed3=Further\ education \). \( ag1 \) to \( ag4 \) distinguishes respondents by their age: \( ag1=16–29, ag2=30–49, ag3=50–64, ag4=65+ \). \( mal \) and \( fem \) distinguish respondents by sex. Note that the autoregressive parameter, inflation expectations and a constant are always included in the regressions but not reported in order to keep the table tractable.
4.3 Non-linear Framework

In this section, it is shown that the relationship between media reporting and perceptions differs during the euro cash changeover period, without ex ante imposing a break in the relationship. Thus, this section provides additional evidence on the structural break examined before and serves as a last robustness check.

To do so, we use an alternative way to test the effect of the introduction of the euro, which allows to estimate its effect more flexibly. We use a logistic smooth transition regression (LSTR), where we first test for nonlinearity in the relationship between media reporting and inflation perceptions and secondly estimate a model that defines the coefficient of media reporting as a function of various indicators, e.g., the time trend.

The LSTR model is defined as follows:

\[ y_t = \phi' z_t + \theta' z_t (1 + \exp\{-\gamma \prod_{k=1}^{K} (s_t - c_k)\}), \quad \gamma > 0 \]  

where \( \gamma > 0 \) is an identifying restriction. A more detailed explanation of the model is presented in Teräsvirta (2004). We test for the LSTR1 (\( K = 1 \)) and LSTR2 (\( K = 2 \)). In the LSTR1 model, the parameters change monotonically as a function of \( s_t \) from \( \phi \) to \( \phi + \theta \). In the LSTR2 model, they change symmetrically around the midpoint \((c_1 + c_2)/2\), where the logistic function has its minimum value. This minimum value is between zero (for \( \gamma \to \infty \)) and 0.5 (for \( c_1 = c_2 \)). When \( \gamma = 0 \), the LSTR2 model is equivalent to the linear model. This implies that in the LSTR1 model, the coefficient of interest changes from one regime to the other, whereas in the LSTR2 model, the regime is the same for high and low values of the transition variable \( s_t \), but differs in the middle range. We shall explain this in more detail below.

The transition variable \( s_t \) can be chosen as a stochastic variable contained in \( z_t \), but it may also be a variable that is not part of the set of other explanatory variables. Another interesting case for our purposes is that \( s_t \) is a linear trend \((s_t = t)\), which yields a linear model with deterministically changing parameters. In the following, we start our analysis by testing whether we need to specify a non-linear model, i.e. we test the linear model against
the LSTR model with different types (i.e., $K = 1$ and $K = 2$) and a set of potential transition variables $s_t$.

The transition variable plays an important role in the economic interpretation of our model. This variable determines the current slope coefficient. In other words, if the model selection tests show that the appropriate model is the LSTR1 model with media reporting, then the relationship between our dependent variable and the explanatory variables (in the non-linear part of the model) changes with the intensity of media reporting. The set of potential transition variables should be chosen from theory. As suggested earlier, we expect that the relationship between media reporting and inflation perceptions may change due to more media reporting, due to the euro cash changeover, or that during high inflation periods, the impact on perceptions was higher than during low inflation periods. Thus, we test the linear model against the LSTR1 and LSTR2 model, with different transition variables: the time trend, the intensity of media reporting, and the level of inflation.

Our model can be written as follows

$$
\pi_{t \text{perc}} = (\phi_1 \pi_{t-1 \text{perc}} + \phi_2 \pi_t + \phi_3 \text{media}_t) + (\theta_1 \pi_{t-1 \text{perc}} + \theta_3 \text{media}_t)(1 + \exp\left\{-\gamma \prod_{k=1}^{K} (s_t - c_k)\right\}) \quad (2)
$$

where we include subsequently the variables $\text{timetrend}$, $\text{media}_{t-1}$, $\pi_t$ and $\pi_{t-1 \text{perc}}$ into $s_t$, and test the LSTR1 and LSTR2 against the linear model. The testing procedure has two steps. First, the linear model is tested against the nonlinear model.

Like many nonlinear models, the LSTR model is only identified under the alternative, not the null hypothesis due to the nuisance parameters $\theta$ and $c$. Therefore, the transition function in the LSTR model is substituted by a third-order Taylor approximation around the null. The model LSTR1 is assumed, which allows testing both for LSTR1 and LSTR2\textsuperscript{11}. The test is based on the following auxiliary regression equation

$$
y_t = \beta_0' z_t + \sum_{j=1}^{3} \beta_j' \tilde{z}_t s_t^j + u_t
$$

\textsuperscript{11}This has been suggested by Teräsvirta (1998, 2004).
where \( z_t = (1, \tilde{z}_t) \) and \( u_t^* = u_t + R(\gamma, c, s_t)\theta' z_t \) with the remainder \( R(\gamma, c, s_t) \). The null hypothesis of linearity is \( H_0: \beta_1 = \beta_2 = \beta_3 = 0 \). Because under \( H_0 \), the asymptotic distribution theory is not affected if an LM-type test is used. The test statistic has an asymptotic \( \chi^2 \)-distribution when the null is valid. However, the statistic can be distorted in a small sample, and hence an F-statistic is computed instead, as the F-statistic has better small sample properties (the empirical size of the test remains close to the nominal size while the power is good), as shown by Granger and Teräsvirta (1993, Ch 7) and Teräsvirta (1998, 2004). Note, that if linearity was not rejected in the first step, the modelling cycle ends and the linear model is chosen. Then, when linearity is rejected, tests have to be performed to decide between the LSTR1 and LSTR2 model. The test makes use of the auxiliary regression

The following sequence of null hypotheses is defined

\[
\begin{align*}
H_4 & : \beta_3 = 0 \\
H_3 & : \beta_2 = 0 | \beta_3 = 0 \\
H_2 & : \beta_1 = 0 | \beta_3 = \beta_2 = 0
\end{align*}
\]

Granger and Teräsvirta (1993, ch 7) show that in this test sequence, if the rejection of \( H_3 \) is the strongest of the three tests, then a LSTR2 model is chosen. Otherwise a LSTR1 model is selected. All three hypotheses can be rejected simultaneously, hence the strongest rejection indicates the best choice of the model. Test results are reported in Table 4. The first column (F) reports the p-value for the F-statistic of the first step test (linearity), the following three columns (F4, F3, F2) report the p-values of the tests for the appropriate model, according to the null hypotheses defined in the second step testing sequence. The final column lists the suggested model. Each row reports the testing results for the respective transition variable.

<table>
<thead>
<tr>
<th>transition variable</th>
<th>F</th>
<th>F4</th>
<th>F3</th>
<th>F2</th>
<th>suggested model</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \pi_{t-1} )</td>
<td>0.458</td>
<td>0.517</td>
<td>0.761</td>
<td>0.144</td>
<td>Linear</td>
</tr>
<tr>
<td>( \pi_t )</td>
<td>0.383</td>
<td>0.130</td>
<td>0.536</td>
<td>0.543</td>
<td>Linear</td>
</tr>
<tr>
<td>Volume(t-1)</td>
<td>0.373</td>
<td>0.133</td>
<td>0.632</td>
<td>0.431</td>
<td>Linear</td>
</tr>
<tr>
<td>TREND*</td>
<td>0.017</td>
<td>0.990</td>
<td>0.003</td>
<td>0.262</td>
<td>LSTR2</td>
</tr>
</tbody>
</table>
The linearity tests suggested by Luukonen et al. (1988) and Ter"asvirta (1994) favor the LSTR2 model with the time trend as transition variable. The coefficient on inflation is set to remain linear, as we expect that the impact of the true inflation rate remains stable, when controlling for lagged perceptions and media reporting. Furthermore, we included the inflation rate in the non-linear part and it turned out to be insignificant. Thus, the autoregressive term and the intensity of media reporting are included in the non-linear part of the LSTR2 model.

Our results are reported in Table 5. The estimated transition function is illustrated in Figure 4.

We find that media reporting has had minor importance before 2002; the transition function is close to 1 up to 2002, which implies that the impact of media reports is $\phi_3 + \theta_3 = 0.53$. Then, during the year 2002, the transition function declines and attains its minimum value (0.5), which implies that the impact of media reporting rises to a maximum of $\phi_3 + \theta_3 * 0.5 = 5.3$. At the same time, the persistence of perceived inflation falls from 0.67 to -1.01 during the changeover period in 2002. Furthermore, the constant is higher during the changeover period. These findings suggest that, during the changeover in 2002, the dynamics of perceived inflation rates have changed and that media reporting gained importance. This result from the non-linear estimation complements the outcome from the linear regression model which...
indicates a substantial break in the inflation perception relationship in the aftermath of the cash changeover.

To go one step further, we investigate the role of the content of media reports. If the tone of media reports triggered the change in the relationship between inflation perceptions and media reporting, we should find that in our data. Thus, we test for the nonlinearity in our model adding rising inflation and falling inflation to the model. Again, we test the LSTR1 and LSTR2 against the linear model with all possible transition variables. Our results are reported in Table 6. Interestingly, when adding the tone variables, the non-linearity vanishes and the tests favor the linear model for all possible transition variables. This finding suggests that the change in the dynamics of inflation perceptions is indeed driven by the tone of media reports.
### Table 6: Linearity tests with tone variables

<table>
<thead>
<tr>
<th>transition variable</th>
<th>F</th>
<th>F4</th>
<th>F3</th>
<th>F2</th>
<th>suggested model</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\pi_{t-1}$</td>
<td>0.175</td>
<td>0.024</td>
<td>0.071</td>
<td>0.108</td>
<td>Linear</td>
</tr>
<tr>
<td>$\pi_t$</td>
<td>0.852</td>
<td>0.420</td>
<td>0.823</td>
<td>0.802</td>
<td>Linear</td>
</tr>
<tr>
<td>Volume(t-1)</td>
<td>0.052</td>
<td>0.021</td>
<td>0.222</td>
<td>0.524</td>
<td>Linear</td>
</tr>
<tr>
<td>VolumeNeut(t-1)</td>
<td>0.479</td>
<td>0.197</td>
<td>0.510</td>
<td>0.691</td>
<td>Linear</td>
</tr>
<tr>
<td>FallingInfl(t-1)</td>
<td>0.940</td>
<td>0.573</td>
<td>0.749</td>
<td>0.970</td>
<td>Linear</td>
</tr>
<tr>
<td>RisingInfl(t-1)</td>
<td>0.131</td>
<td>0.128</td>
<td>0.146</td>
<td>0.457</td>
<td>Linear</td>
</tr>
<tr>
<td>TREND</td>
<td>0.189</td>
<td>0.425</td>
<td>0.137</td>
<td>0.260</td>
<td>Linear</td>
</tr>
</tbody>
</table>

### 5 Conclusion

Rationally inattentive consumers do not constantly track the latest statistics and have own macroeconomic models in their mind that they continuously update because there are costs of acquiring and processing information. The media provide a low-cost source of information, which consumers use to update their economic information. Thus, the tone in media reports about the state of the economy feeds through into consumers’ economic perceptions. We test for the effect of media using the example of inflation perceptions.

Employing a detailed data set on media coverage for Germany over more than ten years we are able to confirm that media reporting has a strong influence on the inflation perceptions of consumers and that the large jump in inflation perceptions after the introduction of the Euro can to a large extent be explained by the presence of news on rising inflation.

This paper has some relevant implications for understanding the dynamics of inflation perceptions. First, it highlights that media affects inflation perceptions and thereby supports the theoretical concept of rational inattention. This influence varies over time and socioeconomic characteristics. Both issues are welcome avenues for future research. Given the strong deviation of inflation perceptions from official HICP inflation rates in the aftermath of the euro cash changeover, our paper also offers a policy implication: as discussed in Eife and Coombs (2007) and Eife (2006), it is necessary that the authorities engage actively in countermeasures if the perception of the public diverges from actual inflation rates.

22
References


