The Role of Media for Consumers' Inflation Expectation Formation*

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Abstract

This paper analyzes the impact of the media on consumers' inflation expectations. We distinguish two channels through which media can influence expectations. First, the intensity of coverage of inflation reports plays a role (volume channel). Second, the contents of these reports matter (tone channel). Employing a unique data set capturing media reports on inflation in Germany comprising 01/1998–09/2007 we are able to discriminate between these two effects. We find that the volume effect generally improves the accuracy of consumer forecasts while the tone channel induces a media bias.

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1 Introduction

Nowadays, central banks often emphasise that managing consumers' inflation expectations has become one of their most important tasks. However, given the prominent role inflation expectations play for monetary policy, still surprisingly little is known about the way consumers form their expectations. This paper attempts to shed some light on the black box of consumers' inflation expectation formation by investigating the role of the media as transmitters and filter of news.

There has been a keen interest in the literature to adequately capture expectation formation. Many recently developed models relax the assumption of perfectly informed, fully rational consumers. Rather, consumers are assumed to posses only constrained information on current economic developments or limited capabilities in processing information.

A well-known theoretical approach by Mankiw and Reis (2002) develops the idea that information is sticky, which means that economic agents update their expectations only from time to time. Outside their updating periods, consumers are inattentive. Carroll (2003) estimates the information updating frequency for the U.S. He provides evidence that consumers update inflation expectations once per year. Doepke et al. (2008a) show that in the euro area, consumers update their expectations once every 18 months.[1] One reason for this behaviour may be that updating and processing of information in the spirit of Sims (2003) and Moscarini (2004) is costly. In sum, those studies highlight two issues. First, people do not update their information set continuously. Second, they rely on certain common sources to reduce costs of information acquisition.

We assume that consumers get their macroeconomic views from the media instead of investing time into constantly tracking the latest statistics to produce their own macroeconomic forecast. This assumption is supported by empirical evidence provided in Blinder and Krueger

[1] Empirical support for the sticky information hypothesis is also provided in Mankiw et al. (2003) and Doepke et al. (2008b) for the U.S. and Europe, respectively.

(2004). In a survey of a random sample of the U.S. population, television and newspapers are identified as the two most important sources of economic information.[2] This plausible assumption also underlies the empirical model in Carroll (2003). He tests this hypothesis and finds that more frequent media reporting makes consumers' expectations more accurate as it triggers an updating of their beliefs. Therefore, the more the media report on inflation, the more likely it is that consumers read these reports and update their beliefs with the new information. Carroll assumes that the media transmit rational inflation forecasts.[3]

The latter assumption may be precarious. This paper argues that it is essential not only to focus on *how often* media report on inflation, but also to take into account *what* is reported. Media reports often discuss whether inflation is or will be rising or falling, and the views expressed therein are not necessarily a rational forecast. Hence, some media reports may be biased. Thus, people consuming a report utilise the potentially biased information provided in the article to update their beliefs.

Therefore, it is necessary to distinguish *two* channels how media reports may affect consumers' inflation expectations. First, in line with Carroll (2003), the intensity of reporting about inflation matters. This is incorporated in our *volume* channel. If newspapers and TV broadcasts deliver more reports on inflation, the likelihood that consumers obtain new information on inflation developments increases.[4] As a consequence this implies that consumers' forecast accuracy improves with higher media coverage.

Second, the *tone* channel captures the content of news reports. The tone of news gives consumers signals in which direction to revise their expectations. Thus, if the media transmit rational forecasts, the tone channel should improve the forecast of consumers.

[2]According to Blinder and Krueger (2004), in all, 46.7 percent of the respondents stated that their most important source was television, followed by newspapers (18.6 percent).

[3]A rational forecast is defined as the forecast of professional economists.

[4]Here, we also follow Carroll and assume not every person pays close attention to all macroeconomic news; instead, individual people absorb the economic content of news stories probabilistically, such that not every person consumes every inflation report.

Notably there are good reasons to believe that media do not submit the best possible forecast but slants the information.[5] Hence, the *tone* channel can also deteriorate the forecast accuracy if the media report is biased.

To shed light on the importance of the volume and the tone channel, we employ a very detailed media data set for Germany. We find support for both channels. The number of reports on inflation leads to a tightening of the gap between consumers' and professional forecasters' expectations. On the other hand, the tone within the report points towards the existence of a media bias. The intensity of news claiming that inflation is rising impairs the accuracy of consumers' expectations. The latter is especially true in the aftermath of the euro cash changeover. Furthermore, we find that news on rising inflation has a stronger effect on expectations than news on falling inflation.

Our findings suggest that the media themselves are not just transmitters of unbiased news. As inflation expectations may materialise in a self-fulfilling manner (Leduc et al., 2007), such a media bias can have important effects on the economy. Furthermore, Berger et al. (2006) show that the media cover central bank issues intensively and therefore play an important role in monetary policy communication.

This paper is organised as follows. Section 2 derives the hypothesis we test. Section 3 introduces the data and explains the methodology we utilise. In Section 4 the results are presented and discussed. Section 5 concludes.

[5] In practice, sources of media bias include the inability of journalists to report all available stories and facts within the space or air time allocated for inflation reports. Also, the ownership structure, the selection of staff or the preferences of an intended audience can lead to sensationalism and biased reporting. For further details see Hamilton (2004). For empirical evidence see also Groeling and Kernell (1998) or Lamla et al. (2007).

2 Model and Hypotheses

In this section we briefly outline a theoretical model describing the influence of media reporting on consumers' inflation expectations.

We assume that media report on inflation expectations and consumers update their information sets by reading a news report in the newspaper or watching news broadcasts on TV. Media give only a noisy signal about the rational expectation of the rate of inflation. Hence, consumers rationally deduct their beliefs from that signal by Bayesian updating. As consumers know about the existence of a media bias, they are fully rational in updating their beliefs. We also consider the case of media persuasion, where consumers do not recognize the full extent of media bias. This theoretical model is an adapted version of the politician ability model in DellaVigna and Kaplan (2007).

The model assumes that in each period media report on inflation expectations, each report contains the opinion of a professional forecaster. The number of all reports a given consumer observes is denoted by J. The overall number of professional forecasters is denoted by K. On average, professional forecasters make rational predictions. Hence, the average forecast for inflation $\frac{1}{K}\sum_{k=1}^{K} E_t[\pi_{k,t+1}] = \overline{E_t[\pi_{t+1}]}$ in each period is rational. However, some forecaster deviate from the average. The true differential between the interviewed forecaster in media report i and the rational average of all forecasts is denoted by $\theta_i = E_t[\pi_{i,t+1}] - \overline{E_t[\pi_{t+1}]}$.[6] We assume that θ_i is drawn from the distribution $N(0, \sigma_\theta^2)$. The media observe all forecasts and know about the difference between the interviewed forecaster and the rational forecast. However, as media want to deliver exiting stories, they report with a time invariant bias b. The media bias is on average b_0 and i.i.d. distributed: $b \sim N(b_0, \sigma_b^2)$. Hence, the media report on the forecast of the interviewed economist but it does not reveal how far this economist lies from the average. The consumer thus observes

[6] Note that we drop subindex t in this model as it is static.

the media report with content ψ_i

$$\psi_i = \theta_i + b. \tag{1}$$

The consumer observes J media reports and learns about the media bias by Bayesian updating and makes his or her forecast for the period $J+1$ based upon the J previous media reports. As the consumer cannot observe θ_i and b perfectly, he or she is faced with a signal extraction problem. A positive ψ_i could be due to the fact that the inflation projection of the interviewed forecaster lies above the average ($\theta_i > 0$) and the bias is very small or due to the fact that the interviewed forecaster is rational ($\theta_i = 0$) but the media report contains a large bias ($b > 0$), or both. The consumer is assumed to know the distributions of θ_i and b, hence he or she uses the conjugate prior to form the Bayesian estimate for b after observing J news reports with average $\bar{\psi} = \frac{1}{J}\sum_{i=1}^{J}\psi_i$. The posterior estimate after observing J reports thus is

$$\widehat{b_J} = w\bar{\psi} + (1-w)b_0 \tag{2}$$

with

$$w = \frac{\frac{J}{\sigma_\theta^2}}{\frac{J}{\sigma_\theta^2} + \frac{1}{\sigma_b^2}}.$$

To estimate the quality of the forecaster observed in the J-th media report, the consumer subtracts the estimate of the media bias from the observed signal ψ_J. His or her prior for θ_J thus is

$$
\begin{aligned}
\widehat{\theta_J}^P &= \psi_J - \widehat{b_J} \\
&= \psi_J - \frac{\frac{J}{\sigma_\theta^2}}{\frac{J}{\sigma_\theta^2}+\frac{1}{\sigma_b^2}}\bar{\psi} - (1 - \frac{\frac{J}{\sigma_\theta^2}}{\frac{J}{\sigma_\theta^2}+\frac{1}{\sigma_b^2}})b_0 \qquad (3) \\
&= \frac{\frac{1}{\sigma_b^2}(b-b_0) + (\frac{J-1}{\sigma_\theta^2}+\frac{1}{\sigma_b^2})\theta_J - \frac{1}{\sigma_\theta^2}\sum_{i=1}^{J-1}\theta_i}{\frac{J}{\sigma_\theta^2}+\frac{1}{\sigma_b^2}}. \qquad (4)
\end{aligned}
$$

The estimated variance of $\widehat{\theta_J}^P$ thus is

$$
Var(\widehat{\theta_J}^P) = \frac{\frac{1}{\sigma_b^2}+\frac{J-1}{\sigma_\theta^2}}{(\frac{J}{\sigma_\theta^2}+\frac{1}{\sigma_b^2})^2} \equiv W. \qquad (5)
$$

Hence, the Bayesian estimate of θ_J is

$$
\begin{aligned}
\widehat{\theta_J} &= \frac{\frac{1}{\sigma_\theta^2}}{\frac{1}{\sigma_\theta^2}+\frac{1}{W}} * 0 + (1 - \frac{\frac{1}{\sigma_\theta^2}}{\frac{1}{\sigma_\theta^2}+\frac{1}{W}})(\psi_J - \widehat{b_J}) \\
&= \frac{\frac{1}{W}}{\frac{1}{\sigma_\theta^2}+\frac{1}{W}}(\psi_J - \widehat{b_J}). \qquad (6)
\end{aligned}
$$

Proposition 1: *Consumers correctly identify the media bias and their forecast equals the average of all forecasters in the limit, i.e.* $lim_{J\to\infty}\widehat{\theta_J} = 0$. *This also implies that the effect of media bias on beliefs is zero in the limit:* $lim_{J\to\infty}\frac{\partial\widehat{\theta_J}}{\partial b} = 0$

The proof follows immediately from $lim_{J\to\infty}\frac{1}{W} \setminus (\frac{1}{\sigma_\theta^2}+\frac{1}{W}) = 1$ and $lim_{J\to\infty}w = 1$, thus $lim_{J\to\infty}\widehat{b_J} = \bar{\psi}$ and hence $lim_{J\to\infty}\widehat{\theta_J} = 0$.

This model implies that consumers' estimates on average converge to the true value of the media bias and thus converge to the rational forecast of inflation. We now introduce a simple form of media bias where consumers are subject to persuasion. λ measures the degree of persuasion, with $0 \leq \lambda \leq 1$. Consumers believe that the news report equals $\psi_i = \theta_i + (1-\lambda)b$. Hence, a positive λ implies that consumers systematically believe that

a part of the biased news report is actually true. Thus, the estimate of θ_J is

$$\widehat{\theta_J^{\lambda}} = \frac{\frac{1}{W}}{\frac{1}{\sigma_\theta^2} + \frac{1}{W}}(\psi_J - (1-\lambda)\widehat{b}_J). \tag{7}$$

From this equation we can derive following proposition:

Proposition 2: *If persuasion is positive, i.e.* $\lambda > 0$*, the effect of the media bias on estimated forecaster quality is positive for finite* T*, i.e.* $\frac{\partial \widehat{\theta_J}}{\partial b} > 0$*. In the limit the effect of the media bias is equal to the degree of persuasion* λ*:* $lim_{J\to\infty}\frac{\partial \widehat{\theta_J}}{\partial b} = \lambda$*.*

The proof follows directly the proof of proposition 1.

2.1 Dynamics of Aggregate Inflation Expectations

We model the expectation formation process, in the spirit of Carroll (2003) as follows. For the formation of inflation expectations over time we assume that only a fraction of consumers reads the news in a given period. The other fraction of consumers remains inattentive and sticks the same views as in the previous period.[7] For inflation expectations, this implies that the inflation expectation of consumers in period t for the following period $t+1$, $E_t[\pi_{t+1}] \equiv C_t$, is the sum of the share that updates expectations and the share of consumers that remain inattentive.

$$C_t = \rho(V_t)C_t^{new} + (1-\rho(V_t))C_{t-1}. \tag{8}$$

The share that updates expectations is denoted by $\rho(V_t)$, where V_t is the news volume in period t. Those consumers that update their expectations obtain their information from

[7]These assumptions are based upon theories of rational inattention. For example, Reis (2006) shows that if consumers face costs of acquiring, absorbing and processing information, they rationally choose to only sporadically update their information. It is unlikely that each consumer has full understanding of macroeconomic dynamics and constantly reviews the latest statistics to produce his own inflation forecast. Furthermore, not every person is able to read every article in the continuum of news provided every day. Hence, if there are many news stories on inflation within a given month, it is more likely that a consumer reads or watches this news, and updates his information set (Carroll, 2003).

the media, and deduct the inflation expectation from it. It is denoted by C_t^{new}.

We assume that each consumer absorbs each media report with a constant probability. More news reporting provides information to consumers, makes them more attentive and triggers the updating of their expectations. Hence, the higher the intensity of media reporting, the higher is the share of consumers that update their expectations, i.e. $\partial\rho(V_t)/\partial V_t > 0$. We furthermore assume that consumers have already observed many reports and already converged to the value of persuasion λ prior to the start of our observation period $t = 0$. Under proposition 1, persuasion is zero, and hence there is no effect of media bias on expectations. On average, consumers thus update with the rational average of all professional forecasters $P_t \equiv \overline{E_t[\pi_{t+1}]}$ and as $\widehat{\theta}_{Jt} = 0$ in the limit, $C_t^{new} = P_t$. Hence, the absolute error consumers make is a decreasing function of the volume of news reported in t. Thus, the absolute deviation from the optimal inflation forecast for each period is given by

$$\begin{aligned} \mid C_t - P_t \mid &= \mid \rho(V_t)P_t + (1-\rho(V_t))C_{t-1} - P_t \mid \\ &= \mid (1-\rho(V_t))(C_{t-1} - P_t) \mid . \end{aligned} \tag{9}$$

Under these conditions more reporting on inflation in the media reduces the absolute error consumers make. The proof is straightforward. For $C_{t-1} - P_t \geq 0$

$$\begin{aligned} \frac{\partial \mid C_t - P_t \mid}{\partial V_t} &= \frac{\partial(1-\rho(V_t))(C_{t-1} - P_t)}{\partial V_t} \\ &= -\frac{\partial\rho(V_t)}{\partial V_t}(C_{t-1} - P_t) \leq 0 \end{aligned} \tag{10}$$

and for $C_{t-1} - P_t < 0$

$$\begin{aligned} \frac{\partial \mid C_t - P_t \mid}{\partial V_t} &= \frac{\partial(1-\rho(V_t))(P_t - C_{t-1})}{\partial V_t} \\ &= -\frac{\partial \rho(V_t)}{\partial V_t}(P_t - C_{t-1}) < 0. \end{aligned} \tag{11}$$

These consideration leads us to our first hypothesis.

Hypothesis 1: *If consumers are not subject to persuasion by a media bias, more media reporting brings consumers' forecasts closer to the rational forecast.*

Hypothesis 1 corresponds to the line of argumentation in Carroll (2003). He assumes that the media report the views of professional forecasters, who themselves make rational forecasts. This would imply that consumers update their expectations with the rational forecast. This assumption, however, might not be valid in general. This brings us to the second aspect we need to consider. The first channel concentrates only on the consequences of changes in the intensity of the coverage without considering the potential effect of a media bias through persuasion of the media. We therefore also take into account the *content* of media reports.

In principle, under the assumption that consumers are not persuaded by the biased content of media reports, the tone of a report should give the correct information and therefore improve the forecasts of consumers. However, there is some evidence that a media bias may exists. For instance, the quotation taken from *The Economist*:"Journalists are writing us into a recession" (4th of October, 2001), suggests that the media may not only provide information but also manipulate consumers' expectations. In a similar vein, Doms and Morin (2004) show that news affect consumers perception on the economy by using the R-word index from *The Economist* measuring the frequency of the word "recession" in the media. Further empirical evidence is presented in Shah et al. (1999) and

Groeling and Kernell (1998). They find that the media give only little attention to the economy when it is in good shape but report extensively when it is in bad shape.[8]

As Hamilton (2004) notes, "news is a commodity, not a mirror image of reality" (p. 7). The reason for this may be the profit maximising behavior of the media companies. In the decision process about which news to transmit, the media supply what is demanded: interesting and exciting stories.[9] For instance, exaggerating bad news might be the optimal profit maximising choice from a media company's point of view (Herman and Chomsky, 1988). Another reason can be provided by considering the supply side. Owner of the media outlets may restrict the journalist or just select journalist that write in their favor (Gentzkow and Shapiro, 2006).[10]

Overall, these studies suggest that the media play an important role in opinion making. Hence, we look at the model outcome with the existence of a media bias and persuasion.

If media persuade consumers and $\lambda > 0$ then the effect of more media reporting on expectations is ambiguous. Because under Proposition 2, $\widehat{\theta}_{J_t} = \lambda$ in the limit, consumers update with $C_t^{new} = P_t + \lambda$. Hence the absolute error is given by

$$\begin{aligned} \mid C_t - P_t \mid &= \mid \rho(V_t)(P_t - \lambda) + (1 - \rho(V_t))C_{t-1} - P_t \mid \\ &= \mid (1 - \rho(V_t))(C_{t-1} - P_t) - \rho(V_t)\lambda \mid . \end{aligned} \tag{12}$$

The consequence is that the effect of more news coverage becomes ambiguous.

[8] Also political outcomes may be affected by the media. For example, DellaVigna and Kaplan (2007) provide evidence that the introduction of biased news reporting has significantly affected voting in the U.S. Similarly, Hetherington (1996) puts forward that media consumption and attention through the mass media negatively shaped voters' retrospective economic assessments in the 1992 election.

[9] Hamilton (2004) discusses the choices media have about the question which news to bring into their reports. He shows that "hard news" (such as facts about government and politics) become more and more replaced by "soft news" (human interest and entertainment figures) to give more return to media outlets.

[10] See also Gentzkow and Shapiro (2006) and Mullainathan and Shleifer (2005) for models where biased reporting is the optimal choice for the media.

For $(1-\rho(V_t))(C_{t-1}-P_t)-\rho(V_t)\lambda > 0$:

$$\begin{aligned}\frac{\partial \mid C_t - P_t \mid}{\partial V_t} &= \frac{\partial((1-\rho(V_t))(C_{t-1}-P_t)-\rho(V_t)\lambda)}{\partial V_t} \\ &= -\frac{\partial \rho(V_t)}{\partial V_t}(C_{t-1}-P_t+\lambda) < 0. \end{aligned} \tag{13}$$

The latter result follows from the fact that $\frac{\partial \rho(V_t)}{\partial V_t} > 0$ and $C_{t-1} - P_t > 0$ under the assumption above. Under the same assumption, the effect of more persuasion is also negative. This can easily be shown by

$$\frac{\partial \mid C_t - P_t \mid}{\partial \lambda} = -\rho(V_t) < 0.$$

For $(1-\rho(V_t))(C_{t-1}-P_t)-\rho(V_t)\lambda \leq 0$ the effect of an increase in the volume is ambiguous:

$$\begin{aligned}\frac{\partial \mid C_t - P_t \mid}{\partial V_t} &= \frac{\partial(\rho(V_t)\lambda-(1-\rho(V_t))(C_{t-1}-P_t))}{\partial V_t} \\ &= \frac{\partial \rho(V_t)}{\partial V_t}(C_{t-1}-P_t+\lambda) > 0. \end{aligned} \tag{14}$$

Thus, equation 14 is positive for $C_{t-1} - P_t + \lambda > 0$, negative for $C_{t-1} - P_t + \lambda < 0$ and zero for $C_{t-1} - P_t + \lambda = 0$. The effect of more persuasion is always positive in this case.

$$\frac{\partial \mid C_t - P_t \mid}{\partial \lambda} = \rho(V_t) > 0.$$

The intuition behind these results is straightforward. More media reporting has two effects. First, more media reporting implies that more consumers have the newest infor-

mation, and therefore the error they make is smaller. Second, more media reports also implies that more people are subject to persuasion and therefore their forecast error becomes larger. For a relatively small λ or a relatively large gap between consumers' and professional forecaster expectations more reporting improves the accuracy of consumer inflation forecast. However, for a larger λ and a relatively smaller gap, the second effect may dominate. This, however, is only true for a region where $C_{t-1} - P_t > 0$, but $(1 - \rho(V_t))(C_{t-1} - P_t) - \rho(V_t)\lambda \leq 0$. Hence, the effect of media on consumer expectations depends on the content of media reports. If media articles are very biased and persuasive, the content of media reports will reflect this bias and affect the accuracy of expectations. Hence, the effect of media reports on expectations depends on *tone* of media reports. Thus, our second hypothesis is:

> **Hypothesis 2:** *If consumers are subject to persuasion by a media bias, the tone of media reports may impair the accuracy of consumer forecasts.*

The existence of a media bias and persuasion also implies that the volume of reporting has an ambiguous effect on the accuracy of consumer forecasts.

3 Data and Methodology

For our empirical analysis, we employ data for inflation expectations of consumers and the rational forecasts of professional economists as well as a measure for the intensity and content of reporting on inflation in the media in a given period.

3.1 Media Data

For the media reports we rely on data kindly provided by the media research institute Mediatenor.[11] The data comprises articles and media releases on a monthly frequency for

[11] See www.mediatenor.de for details on media content analysis.

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.[12] The coding is based on the standards of the media content analysis and the data contain different specifications.[13] We are provided with the overall number of reports in that given period, the amount of reports dealing with rising or falling inflation, if the development is judge to be good or bad, whether the focus of the report was mainly the present, the past or the future, if it was distributed via TV or newspaper and whether it is located on the title page or not. From this set, the following explanatory variables are generated.

The measure of news intensity (*Volume*) is the number of inflation reports within a given month. Following Carrol this variable should improve the accuracy of inflation forecasts. Given the potential media bias the volume channel may be insignificant.In order to test the attention hypothesis of the volume channel we have to disentangle the content of each statement.

To capture the content of the news stories, we construct a variable summarising the number of reports on rising inflation (*ToneRisInfl*). In a similar fashion *ToneFallInfl* denotes reports containing news on falling inflation. Neutral statements with regards to inflation, i.e. statements that do not contain information regarding rising or falling inflation, are denoted by *ToneNeutDir*. Corresponding to that we also capture the assessment and judgement of each statement. Denoted by *ToneGood* we count all statements that conclude that the development of inflation is good. Critical statements on inflation are

[12]In detail following news sources are analyzed: Daily press: Frankfurter Allgemeine Zeitung, Welt, Süddeutsche Zeitung, Frankfurter Rundschau, Tageszeitung, Bild, Neue Züricher Zeitung, Berliner, Volksstimmer, Sächsische, Westdeutsche Allgemeine Zeitung, Kölner Stadt-Anzeiger, Rheinischer Merkur; daily TV-News: ARD Tagesschau, Tagesthemen, ZDF Heute, Heute Journal, RTL Aktuell, SAT.1 18:30, ProSieben Nachrichten; Weekly Press: Spiegel, Focus, Die Woche, Wochenpost, Welt am Sonntag, Bild am Sonntag, Die Zeit.

[13]Media Content Analysis is a scientific method to capture the content of text passages. Inter-coder reliability tests guarantee a high quality of the data. Specifically, they allowing to capture the objective contend of each statement while being reproducible.

captured by *ToneBad* and finally neutral judgement are termed by *ToneNeutJudg*. These variables are our core and most important set of explanatory variables which allow us to test our model hypothesis. Specifically the coefficient on the impact of neutral statements should allow us to identify whether the volume channel is relevant. If the coefficient would be negative more neutral news would reduce the gap between the forecast of consumers and professionals.

Above that we consider another set of variables that might be important to qualify the relationship in greater detail. We distinguish the news stories with regards to the time structure, i.e. whether the story is related to past (*VolumePast*), present or future inflation (*VolumeFut*). Arguably, *VolumeFut* should have a greater impact on expectation as these articles contain relevant information on future developments. We also control for news stories on inflation transmitted via TV (*VolumeTV*) and those made public via the newspapers (*VolumeNewspaper*). Our results could be driven by a specific type of media. Controlling for the main channels we will be able to account for this. Newspapers allow to deal with the issue inflation in greater detail while news presented in the TV are rather short and may not cover all relevant information. To distinguish between more and less visible stories in the news, we create a measure that captures the number of news stories on inflation that have been on a title page (*VolumeTitle*) and those that have been on a title page in the business section of a newspaper (*VolumeTitleBusiness*). Stories located as the title stories should catch the readers' attention. However, they may be more prone to a media bias. [14]

Finally, 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

[14] Carroll (2003) divides all series by the maximum number of reports in the sample period to scale the variables between zero and one. We re-run our analysis following his suggested transformation and the results are virtually the same.

database of media articles. We use two popular terms to back up our line of argumentation. 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 the currency changeover. The word "Teuro", however, clearly presumes that inflation has been and/or will be rising. Given that there is no evidence that the euro introduction has affected prices in Germany significantly, the Teuro-discussion is an example for a media exaggeration.

3.2 Inflation Expectation Data

Data on consumers' inflation expectations are taken from the EU business and consumer survey and are available on a monthly frequency. German consumers are being asked whether they expect prices to rise, fall or remain unchanged in the upcoming 12 months (expected inflation). To obtain quantitative measures of inflation expectations from the qualitative survey data, we use the methodology proposed by Berk (1999).[15] The method assumes that expectations are normally distributed and does not impose unbiasedness *ex ante*. One advantage of the quantification method is that it directly links the expected inflation rates to the currently perceived inflation rates.

Inflation expectations from professional forecasters for Germany are constructed from Consensus Economics. In that survey, several professional economists are asked about the inflation prospects of the contemporary and upcoming year.[16]

[15]The inflation expectations data has been kindly provided by the Bundesbank. The calculation is described in detail in the Monthly Bulletin of November 2007.

[16]Consensus Economics is a macroeconomic survey company. The survey of experts of private and public institutions in Germany asks for economists' expectations of inflation for the rest of the current and the entire upcoming year. The consensus forecast, used in the paper as a measure of expert expectations, is the mean of these forecasts in Germany. As the time horizon used in this paper is always the 12 month ahead expectation, the data have been transformed to obtain this fixed forecast horizon. We follow the approach commonly used for this type of data and transform the forecast as follows: for month m of a given year t , the expectation of inflation is defined as $(13-m)/12$ times the forecast for year t plus $(m-1)/12$ times

To measure the deviation of consumers from an optimal forecast we calculate the absolute value of the gap of the difference between the consumers survey (C_t) inflation expectations and those of the consensus economics professional forecasters (P_t) as $absGapExp_t = |C_t - P_t|$.[17]

Table 1: Summary statistics

Variable	Mean	Std Dev	Min	Max	N
Inflation Expectations Professional Forecasters	1.52	0.34	0.83	2.24	117
Inflation Expectations EU Consumer Survey	1.45	0.71	0.70	3.90	117
Inflation Rate (HICP)	1.42	0.62	0.10	2.80	117
absGapExp	0.56	0.43	0	2.26	117
ToneNeut	15.95	9.76	3	69	117
ToneBad	8.82	8.98	0	43	117
ToneGood	5.71	5.00	0	26	117
ToneFallInfl	5.03	4.75	0	22	117
ToneRisInfl	7.97	7.46	0	42	117
VolumeNeut	13.21	11.86	0	71	117
Teuro	16.14	31.10	0	177	117
EuroIntro	13.66	17.25	0	117	117

The summary statistics of our main set of variables are given in Table 1. Concerning the variables that form our dependent variable we see that consumers and professionals have quite similar inflation expectations.[18] The difference is not statistically significant. Moreover, consumers' inflation expectations are more volatile. With respect to the ability to forecast inflation, Mestre (2007) shows that professional forecasters from consensus economics outperform the forecast of consumers. The latter contains even a small bias. Overall, both seem reasonable and consumers' expectations do not fare badly compared to simple parametric alternatives for forecasting inflation. To compare the forecast performance of these series in our sample, we employ statistics measuring the forecasting

the forecast for year $t + 1$.

[17] In the original specification, Carroll used the squared gap. However, as this measure might overweight specific incidences we opt to employ the absolute value. Notably, the qualitative results do not change when using the squared gap. Moreover, using the absolute distance makes our measure easier to interpret.

[18] In that table consumers seem to perform well. This figures may be misleading as while on average consumers might be closer to the real inflation they might be wrong in almost all the time.

accuracy. We use the mean squared error (MSE), the root mean squared error (RMSE) and the Theil's U statistic. The results are presented in Table 2. These statistics reveal that, as expected, professional forecasters perform better in forecasting inflation.

Table 2: Accuracy of inflation expectations

	MSE	**RMSE**	**Theil's U**
Inflation Expectations Professional Forecasters	0.519	0.720	0.207
Inflation Expectations EU Consumer Survey	1.240	1.113	0.494

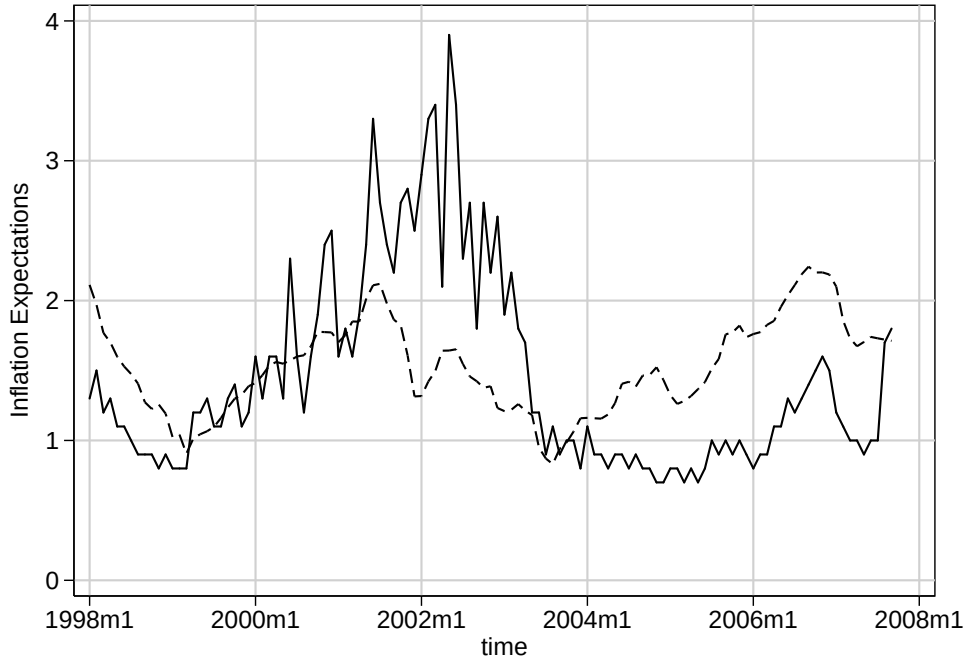
Moreover, we see that the media has a propensity to report more on rising inflation ($ToneRisInfl > ToneFallInfl$) and judge the developments to be mostly worringly ($ToneBad > ToneGood$). Given that rather low inflation rate during our sample period this was clearly not justified.

To illustrate the data we use, we present several graphs.

As our dependent variable is calculated as the difference between expectations of consumers as well as professionals, we plot both series in Figure 1. We observe three phases. In the first period, until mid 2001, consumers and professionals assessed future inflation about equally. This picture changes in 2001 when consumer inflation expectations increased substantially while the expectations of economists started to ease. After a peak in mid 2002, consumer inflation expectations began to fall again. Beginning in 2004, expectations of professional economists increased while consumer expectations remained at a rather low level. In the course of 2007 both series again converged.

An important issue is how media coverage is related to current inflation. Figure 2 illustrates the variable *Volume* and inflation. We can observe that in phases where high inflation was present, coverage in the media increased. See for instance mid 2001, where due to a bad harvest the prices of vegetables substantially increased, HICP inflation picks up and also media coverage increases. A similar effect is observed in 2007. Rising energy prices spur up inflation and simultaneously the media coverage. Note, however, that despite

Figure 1: Inflation expectations: Consumers vs. professionals



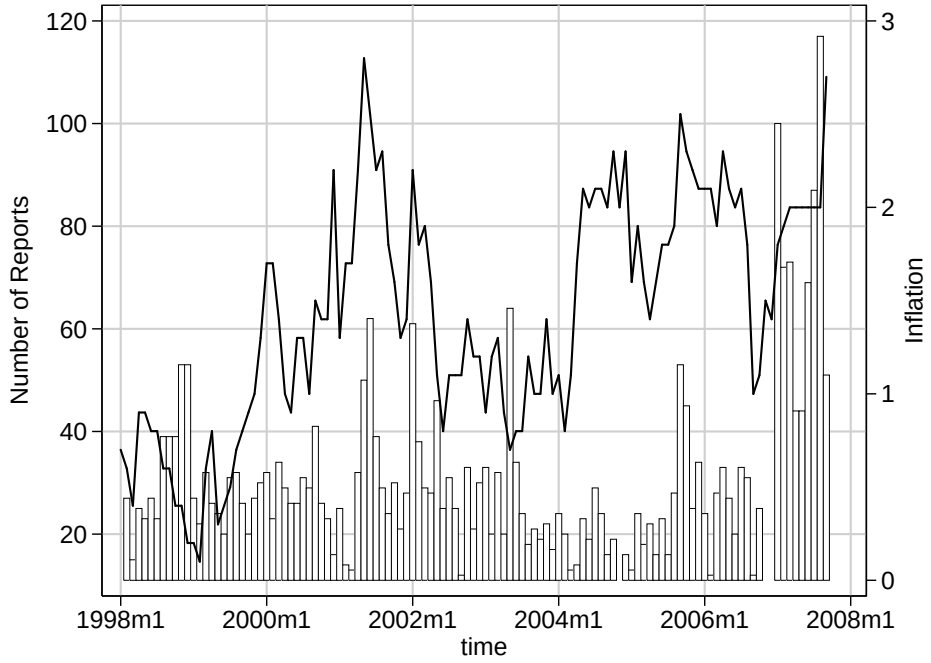
Solid line: Inflation expectations of German consumers; dashed line: Economists' inflation expectations for Germany from Consensus Economics.

HICP was as high as in 2001 the coverage of media was much higher in 2007. Moreover, there are cases where media coverage was relatively high, despite inflation was quite low. Examples for this phenomenon can be found in mid 2002 as well as in the beginning of 2003. Thus, media coverage does not necessarily co-move with the level of inflation.

To illustrate the tone of news reports, we plot reports dealing with rising and falling inflation and plot them together with actual inflation in Figure 3. As can be seen, media agencies capture the direction of changes in inflation correctly in general. However, the amount of reporting does not necessary match the magnitude of price changes. Comparing the spikes in 2002 and 2004, illustrates that although the level of inflation was about equally high the coverage in the media was remarkably different. Moreover, it seems that there is a higher propensity to report more on rising inflation than on falling inflation.

In the next Figure 4 we plot these count variables with our dependent variable. The

Figure 2: Media coverage and inflation

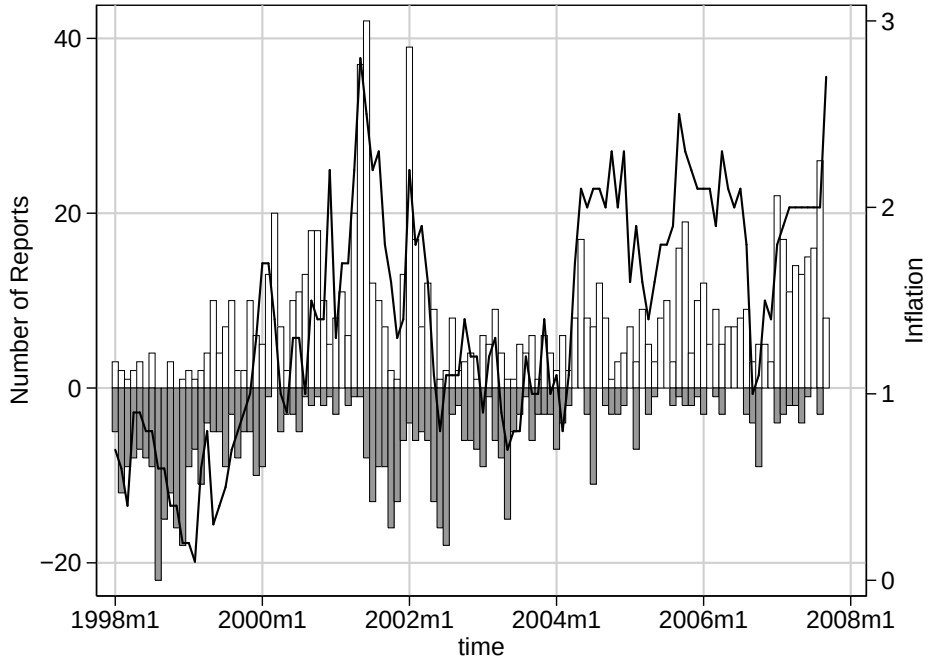


Solid line: Growth rate HICP Germany; bars: Amount of inflation reports in the German media.

interesting observation is that while the euro cash changeover is a prominent topic in the German print media until February 2002, the Teuro discussion dominates afterwards. Moreover, this intense discussion lasts for more than one year. It also shows that there appears a positive correlation between the amount of articles containing the word "Teuro" and the gap between consumer and professional inflation expectations. This effect is especially predominant during 2002 and the beginning of 2003. Concerning the articles dealing with the introduction of the euro coins, the correlation with the dependent variable seems to disappear after 2001.

Finally, we plot in Figure 5 our dependent variable together with the volume. A mixed picture emerges. While on some occasion, for instance at the end of our sample period more reporting reduces the gap, in 2002 the opposite is the case. This might hint us to the importance to not only consider the amount of media statements but also their content.

Figure 3: Media tone and inflation



Solid line: Growth rate HICP Germany; bars: Amount of reports dealing with rising inflation; shaded bars: Amount of reports dealing with falling inflation.

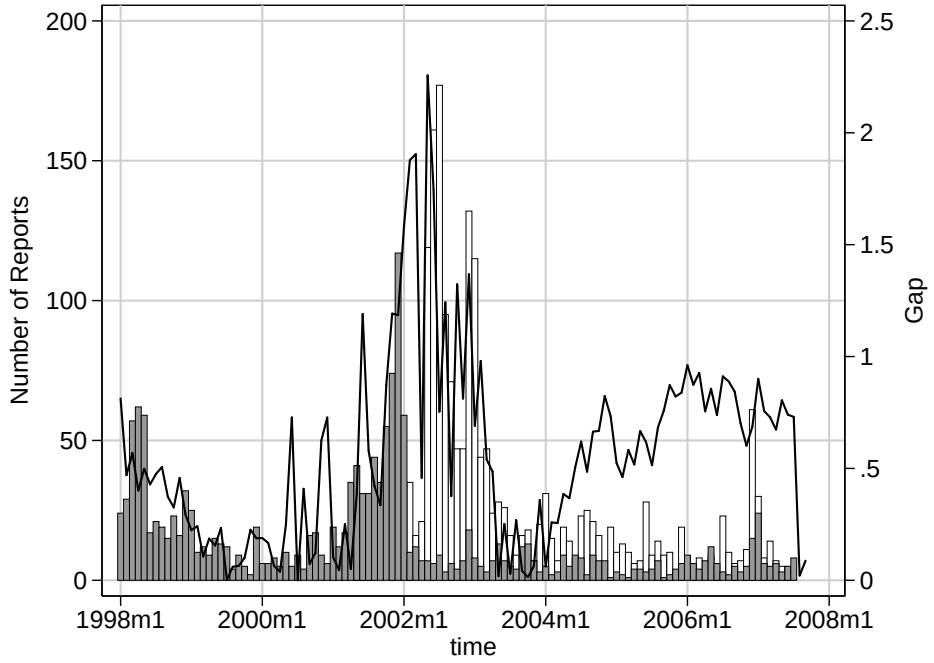
3.3 Methodology

Referring our model setup we also include the lag dependent variable as a explanatory variable in our regression setup. We estimate this equation via OLS with robust standard errors. The results of this preferred setup are presented in Table 4.

This specification is similar as in Carroll (2003) except that we employ, in accordance with our model, the first lag of the dependent variable and lag our explanatory variable(s) by one month to take into account potential endogeneity. Here we deviate from the specification of Carroll. This has been done to reduce the possible impact of reverse causation. We explore this possible pitfall in more detail when analyzing this issue in a more dynamic setting in section 4.1.[19] To test for the influence of the news volume channel we estimate

[19]Note also that we considered other different ways to estimate this single equation including for instance quantile regressions with block bootstrapping. We also estimated a version without the lag of the dependent

Figure 4: Teuro and euro cash changeover vs. gap expected inflation



Solid line: Absolute gap inflation expectations; Bars: Amount of reports dealing containing Teuro; Shaded bars: Amount of reports dealing with the euro introduction.

the following equation

$$absGapExp_t = \alpha + \beta Volume_{t-1} + \gamma absGapExp_{t-1} + \varepsilon_t. \tag{15}$$

Second, we introduce the variable *Tone* to capture the impact of the *tone* channel. Thus the above equation amends to

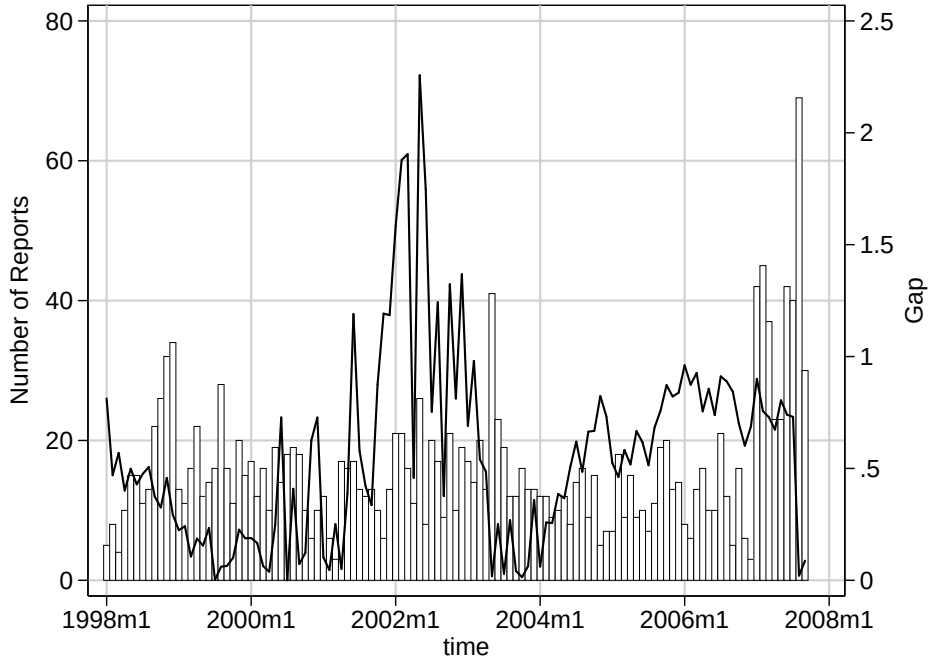
$$absGapExp_t = \alpha + \beta_1 ToneNeutDir_{t-1} + \beta_2 ToneRisInfl_{t-1} + \beta_3 ToneFallInfl_{t-1} + \gamma absGapExp_{t-1} + \varepsilon_t \tag{16}$$

where *Tone* is measured by *TonePos*, *ToneNeg* and *ToneNeutral*.

For $\beta_1 < 0$ hypothesis 1 is confirmed and the gap between consumers' and professional

variable.

Figure 5: Neutral Tone and Gap



Solid line: Absolute gap inflation expectations; Bars: Amount of inflation reports containing neutral tone in the German media.

forecasters' inflation expectations narrows with higher news intensity. The media bias hypothesis would imply that the coefficient estimate for β_2 or β_3 would be statistically significant. In a similar fashion be set up the equation for our measures of judgement:

$$absGapExp_t = \alpha + \beta_1 ToneNeutJudg_{t-1} + \beta_2 ToneGood_{t-1} + \beta_3 ToneBad_{t-1} + \gamma absGapExp_{t-1} + \varepsilon_t \quad (17)$$

4 Results

This section presents and discusses the estimated coefficients for our different specifications. Table 4 summarises the coefficient estimates of the regression setup. First, we test the impact of the volume on the precision of the inflation expectations estimating equation

Table 3: Results - Lag Dependent Variable

	(1)	(2)	(3)
L.Volume	0.000		
	(0.001)		
L.ToneNeutDirection		-0.003	
		(0.002)	
L.ToneNeutJudgement			-0.008**
			(0.004)
L.ToneRisInfl		0.009	
		(0.006)	
L.ToneFallInfl		-0.002	
		(0.007)	
L.ToneGood			-0.000
			(0.006)
L.ToneBad			0.012**
			(0.005)
L.absGapExp	0.449***	0.436***	0.370***
	(0.115)	(0.119)	(0.124)
Deuro= 2002	0.471**	0.465*	0.531**
	(0.232)	(0.238)	(0.219)
Constant	0.254***	0.238***	0.326***
	(0.067)	(0.080)	(0.075)
Observations	116	116	116
adj. R^2	0.470	0.483	0.510

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

15. We use all observations but control for the euro cash changeover period by including a dummy that is equal to one for the year and zero otherwise. We choose this period due to the fact that during the euro cash changeover period, inflation perceptions displayed very unusual patterns in Germany, which might also feed into expectations. In Table 4 we used alternatively a step dummy to control for the euro cash changeover. This implies that the dummy variable is zero until 2002 and one afterwards. Notably, this does not affect our results.

Table 4: Results - Lag Dependent Variable different Euro Dummy

	(1)	(2)	(3)
L.Volume	-0.000		
	(0.002)		
L.ToneNeutDirection		-0.007**	
		(0.003)	
L.ToneNeutJugdement			-0.009**
			(0.004)
L.ToneRisInfl		0.015**	
		(0.007)	
L.ToneFallInfl		0.016*	
		(0.009)	
L.ToneGood			0.006
			(0.008)
L.ToneBad			0.010*
			(0.006)
L.absGapExp	0.579***	0.473***	0.512***
	(0.108)	(0.112)	(0.123)
Deuro> 2002	0.133*	0.270***	0.166*
	(0.068)	(0.101)	(0.095)
Constant	0.162**	0.022	0.198***
	(0.066)	(0.084)	(0.072)
Observations	116	116	116
adj-Rsquared	0.413	0.467	0.437

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Turning back to our results. We can observe that the coefficient estimate capturing the volume effect is highly negative and only on specification negative. From the overall amount of news articles provided by the media we cannot confirm the idea that more reporting improves the forecast and narrows the gap. As announced we disentangle the volume of the media by content in columns (2) and (3). We observe that specifically neutral statements trigger an updating of consumers' information sets and, in line with hypothesis 1, improves consumers the accuracy expectations. This result seems plausible, as a neutrally toned media report on inflation still contains information, such as the actual rate of inflation, for example. This effect is especially dominant of we consider judgement. A neutral judgement can even contain a direction but phrased in a neutral way without highlighting its dangerous expectations. This is in line with Carroll's hypothesis, i.e. that more media reporting improves forecast accuracy of consumers.

With respect to the directional information or the judgement the tone seems to drive away consumers' expectations from professionals. This is especially relevant when media reports about bad developments with respect to inflation. On the other hand good news with respect to inflation have almost no impact. Thus, we can also report an asymmetric response to media.

Overall, our results support the findings of Carroll (2003) that more news triggers updating and information processing which finally transmits into an improved consumer inflation forecast (smaller gap). However, the relationship between the media and inflation expectations is more complex. Arguing in favour of a second channel, our findings show that the media can introduce a bias as reporting especially on bad developments is exaggerated and induces people to deviate from the rational forecast. Thus, we provide evidence that indeed both channels matter.

4.1 Robustness

In this section we deal with the robustness of our results. First we test our hypothesis by using alternative date. This specification specifically takes into account the media discussion regarding the euro cash changeover and the Teuro:[20]

$$absGapExp_t = \alpha + \delta Teuro_{t-1} + \varepsilon_t, \tag{18}$$

where $TEuro$ specifies either the number of articles containing the expression "euro cash changeover" or, in a further specification, the word "Teuro". Table reports the estimates of regressing equation 18 where we include the number of news stories using the terms "Teuro" and "euro changeover". As expected, the number of news stories discussing a Teuro effect increases the gap between consumers' and professional forecasters' inflation expectations. The more neutral "euro changeover" expression does not have a significant effect. Note that if we exclude the euro changeover period the "euro changeover" variable becomes negative and significant. Thus we can confirm, using these rather plain measures compared to (1) and (2), Carroll's hypothesis. In addition, we find evidence for the deteriorating effect the media can have on expectations by using the variable "Teuro".

Next we deal with the issue endogeneity and causality with our main dataset. One could argue that news is partly demand driven, and as a consequence newspapers are biased towards consumers' prior opinions (Gentzkow and Shapiro, 2006). However, there

[20]Especially inflation perceptions were affected by the euro cash changeover. Ehrmann (2006) shows that the gap between perceived and actual inflation widened a lot in Germany during the cash changeover. He finds that the complexity of conversion rates explains the variation in this gap across euro Area countries. Lamla and Lein (2007) provide evidence that also media reporting play an important role in explaining this discrepancy. As current inflation perceptions are arguably an important component of inflation expectations, it seems sensible to discuss how to account for the effects associated with the euro cash changeover. One obvious way would be to implement dummy variables. With this option one has to decide upon the start and end date of the effect. In order to avoid this possible pitfall we decided to utilize the coverage in the media dealing with the euro cash changeover. While this setup seems to be in line with our media focus we also considered using various dummy variables with different lengths. Even if excluding the rather broad time frame covering 01/2001 until 12/2002 the qualitative results remain.

Table 5: Results: Teuro vs. Euro Introduction

	(1)	(2)
EuroIntro	0.003	
	(0.003)	
Teuro		0.007***
		(0.001)
Constant	0.517***	0.456***
	(0.077)	(0.058)
Observations	117	117

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

are some good reasons that this issue does not play a crucial role in the setup chosen in this work. In the estimation the media variables are introduced with one period lag, using data covering news of the weeks before the survey is conducted. Thus, per definition, news of the last period cannot be demanded by expectations today. We nevertheless report some robustness checks.

A widely acknowledged way to deal with endogeneity issues as well as to investigate whether a specific notion of causality is present, is to employ vector autoregressions (VAR). For this purpose, we set up a system consisting of the Tone variables and *absGapExp*. A dummy variable for the cash changeover is also included in every equation. Lag selection test reported in Table 6 are inconclusive whether one or two lags are appropriate.

To secure for this we always estimate the VAR with two lags. Estimating the system and employing Granger causality tests as reported in Tables 7 and 8 reveal that the volume channel and the bad news and news on rising inflation affect the gap but not vice versa. Thus, we do not suffer from reverse causality. Notably, this does not mean that there is no impact from the gap on our media variables but it clearly shows that other channel going from the media on the gap is much more important.

Table 6: Lag Selection VAR

Lag	FPE	AIC	HQIC	SBIC
1	31.368	3.268	**3.512**	**3.871**
2	**27.379**	**3.128**	3.618	4.335
3	30.921	3.242	3.977	5.053
4	32.528	3.279	4.259	5.693

The Table reports likelihood-ratio test statistics for the lag order tests according to final prediction error (FPE), Akaike's information criterion (AIC), Schwarz's Bayesian information criterion (SBIC), and the Hannan and Quinn information criterion (HQIC). The figures in bold are indicate the selected lag. The upper panel reports the tests for the VAR with the volume variable, the lower panel for the three tone variables.

Table 7: Granger Causality Tone Judgement

Equation	Excluded	df	p-value
absGapExp	ToneNeut	2	0.008
	ToneGood	2	0.802
	ToneBad	2	0.009
ToneNeut	absGapExp	2	0.410
	ToneGood	2	0.055
	ToneBad	2	0.027
ToneGood	absGapExp	2	0.044
	ToneNeut	2	0.821
	ToneBad	2	0.890
ToneBad	absGapExp	2	0.618
	ToneNeut	2	0.068
	Tonegood	2	0.400

Pairwise Granger causality tests for the variables absGapExp and Tone. The first column reports the contemporaneous variable, the second the variable that is included with a lag. The p-value corresponds to the Wald test that tests the null that the variable in the second column does not Granger-cause the variable in the first.

Table 8: Granger Causality Tone Direction

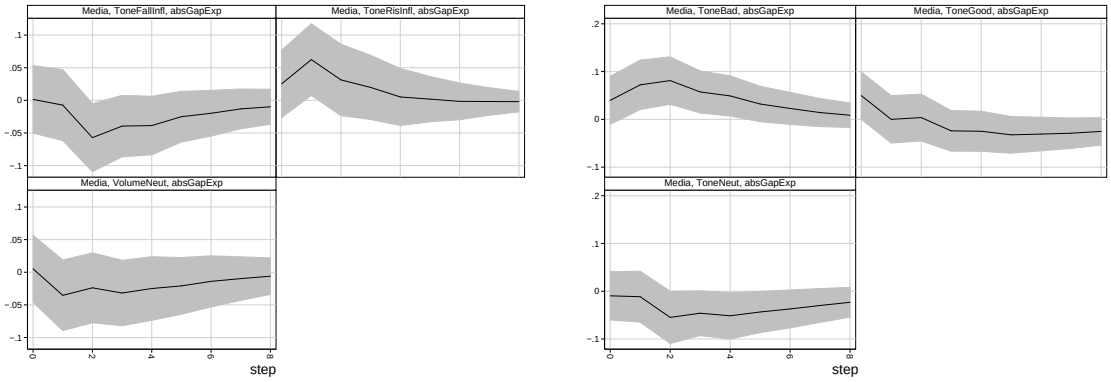
Equation	Excluded	df	p-value
absGapExp	ToneFallInfl	2	0.221
	ToneRisInfl	2	0.050
	ToneNeut	2	0.177
ToneNeut	ToneFallInfl	2	0.055
	ToneRisInfl	2	0.416
	absGapExp	2	0.374
ToneRisInfl	ToneFallInfl	2	0.007
	ToneNeut	2	0.014
	absGapExp	2	0.644
ToneFallInfl	ToneRisInfl	2	0.342
	ToneNeut	2	0.071
	absGapExp	2	0.100

Pairwise Granger causality tests for the variables absGapExp and Tone. The first column reports the contemporaneous variable, the second the variable that is included with a lag. The p-value corresponds to the Wald test that tests the null that the variable in the second column does not Granger-cause the variable in the first.

Rearranging the decomposition accordingly gives us the impulse responses.[21] The impulse responses in Figure 6 show the impact of the media variables on the the absolute gap. In both sets of responses neutral statement seem to reduce the gab while statements on rising inflation respectively bad news on inflation seem to deteriorate the forecast of consumers. Comparing both sets of impulse responses, the judgement variables have a much clearer impact structure in terms of magnitude and significance than the response to the reported directions. This is not surprisingly as the are correlated and a response to rising inflation in combination with a bad assessment should be a greater deal to the public. From this section we can infer that our results are robust towards the measurement of media and more importantly to the econometric specification.

[21] The ordering is based on the granger causality analysis media variables and gap. Confidence bands are bootstrapped but symmetric.

Figure 6: Impulse Response Functions



(a) Tone Direction (b) Tone Judgement

Impulse Response of absolute gap between consumers and professionals to one s.d. shock in media variables.

4.2 Further Results

In Table 4.2 we present further results using the preferred specification of Table 4. First we check if the effect of the Volume depends on the time horizon it addresses, i.e. whether the article reported addresses issues concerning the future, the present or the past. We present results in column (1). We do no evidence that articles related to the future, the past or present affect the expectations gap systematically. In column (2) we distinguish reports by both, the time dimension they refer to and the tone. In other words, we interact the time dimension with the tone. Our results show that articles related to the future do not have an significant impact. This finding is rather surprising given that expectations are related to the future and therefore news about future inflation should have an impact on consumers expectations. However, we find a positive and significant effect for articles that have an unfavourable tone and are related to the present. This suggests that consumers rather rely upon articles that are related to the present and are unfavourably toned at the same time. The finding could be explained by the period of the euro cash changeover, which was discussed in the media extensively during the year 2002, and thus often related to the present. As outlined in the introduction, the period of the

Teuro discussion might be an example for a media bias. As news about the Teuro were both, related to the present and unfavourably toned, the result we obtain corroborates our earlier claim that the media may bias expectations. At the same time, we obtain a negative and statistically significant coefficient for the variable counting news reports that are related to the present but do not contain a specific tone. This effect is in line with the volume effect discussed earlier. Media reports provide information about current inflation, provide new information and thus result in an updating of information. As new information about the present is arguably relevant for forming expectations about the future, this result lends support to the volume effect. In column (3) we add a further dimension of media reporting: the source of media news. We distinguish news that are transmitted via TV and news transmitted via the printed press. Interestingly, the news transmitted via TV have a positive and significant effect on the expectations gap. Print media do not have a significant effect. This finding suggests that TV news bias inflation expectations systematically. This finding can be explained by two possible effects. First, TV broadcasts are often very selective with the news they report and therefore they may only report about inflation if inflation developments are worrisome. Second, certain types of consumers, which are more prone to a media bias, rely on TV news as their only source of information. In column (4) we look in more detail at paper based media. We examine the effect of headline news reported in newspapers and magazines. According to the results, the variables capturing the effect of title page stories and title pages of the business section in a newspaper are insignificant. Hence, the visibility of news does not have a systematic effect on consumers expectations.

Table 9: Further Results - Newey West

	(1)	(2)	(3)	(4)
L.VolumeFut	0.009			
	(0.007)			
L.VolumeContemp	-0.003			
	(0.005)			
L.VolumePast	0.002			
	(0.012)			
L. Tonegoodfut		-0.013		
		(0.067)		
L. Tonebadfut		0.005		
		(0.018)		
L. Toneneutfut		0.033		
		(0.028)		
L. Tonegoodcontemp		-0.005		
		(0.015)		
L. Tonebadcontemp		0.013**		
		(0.006)		
L. Toneneutcontemp		-0.024***		
		(0.009)		
L. Tonegoodpast		0.048		
		(0.051)		
L. Tonebadpast		0.015		
		(0.046)		
L. Toneneutpast		-0.010		
		(0.020)		
L.VolumeTv			0.018**	
			(0.008)	
L.VolumeNewspaper			-0.005	
			(0.003)	
L.VolumeTitle				0.011
				(0.016)
L.VolumeTitleBusiness				-0.006
				(0.005)
L.absGapExp	0.372**	0.287*	0.392***	0.435***
	(0.145)	(0.166)	(0.125)	(0.117)
Deuro=2002	0.508**	0.665***	0.450**	0.489**
	(0.241)	(0.223)	(0.222)	(0.233)
Constant	0.382***	0.496***	0.306***	0.294***
	(0.101)	(0.117)	(0.096)	(0.073)
Observations	80	80	116	116
adj-Rsquared	0.403	0.455	0.494	0.469

Robust standard errors in parentheses *** p<0.01 ** p<0.05 * p<0.1.

5 Conclusions

In this paper we identify two channels via which the media influence consumers' inflation expectations. On the one hand, the *quantity* of media reports matters. A higher intensity of reporting makes consumers more likely to pick up news on inflation, induces an update of their expectations and brings them closer to the full information rational forecast. This is what we call the *volume* channel. On the other hand, the *quality* of reporting matters. Media reports often contain an opinion or a tone, which is then taken up by consumers. This is what we label as the *tone* channel. If media reports are biased, i.e. if they transmit exaggerated or incomplete information, consuming these reports distorts the accuracy of forecasts.

Using a detailed media data set for Germany, we provide evidence that both channels play a role. Overall, our results support the view of Carroll (2003) that indeed more news leads to more updating and information processing which finally eventuates in better inflation forecasts. Furthermore, we highlight that, contrary to the positive impact of the amount of news, the specific content of news can impair consumers' forecasts. Specifically, our results indicate the significant effect of euro cash changeover discussion in the media landscape. Especially, the "Teuro" debate has significantly increased the gap. Looking at further dimensions in media reporting, we show that: (i) the effect of reporting is asymmetric–news on rising inflation induces a media bias whereas news on falling inflation does not. (ii) The content of news matters with respect to the time horizon it addresses: the inflation reports that transmit a message related to the present and future significantly improve the quality of expectations, whereas reports dealing with past inflation deteriorate the precision of consumers' expectations. (iii) Articles from newspapers narrow the gap, especially if they are located in the headers of the business sections. (iv) TV news induces a relatively strong media bias. Our results hold if we additionally control for potential

endogeneity issues as well as shocks in real time inflation figures.

Our findings have important implications for the discussions on modelling expectation formation, the role of media agencies and the assumptions on rationality of consumers' economic behaviour: the media have the power to bias consumers' expectations. Such a media bias can have important effects on the economy, as inflation expectations can be self-fulfilling (Leduc et al., 2007). Hence, for understanding expectation formation and inflation dynamics, more research on the role of the media would be desirable.

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