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The Role of Media for Inflation Forecast Disagreement of Households and Professional Forecasters*

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Abstract

This paper investigates the effects of media coverage and macroeconomic conditions on inflation forecast disagreement of German households and professional forecasters. We adopt a Bayesian learning model in which media coverage of inflation affects forecast disagreement by influencing information sets as well as predictor choice. Our empirical results show that disagreement of households depends on the content of news stories (tone) but is unaffected by reporting intensity (volume) and by the heterogeneity of story content (information entropy). Disagreement of professionals does not depend on media coverage. With respect to the influence of macroeconomic variables we provide evidence that disagreement of households and professionals primarily depends on the current rate of inflation.

JEL classification: E31, E37, D83

Keywords: forecast disagreement, inflation expectations, media coverage, Bayesian learning

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1 Introduction

Survey data on inflation expectations reveals that households as well as professional forecasters generally disagree about the course of inflation over the next 12 months. Relying on data from the University of Michigan Surveys of Consumers, Mankiw, Reis, and Wolfers (2003) document substantial heterogeneity in households' inflation expectations.¹ Albeit on lower levels than disagreement of households, disagreement among professional forecasters is still considerable as shown by Lahiri and Sheng (2008a, 2008b) for G7 countries and by Mankiw, Reis, and Wolfers (2003) for the U.S.

Recent theoretical contributions emphasize that disagreement can be persistent and may significantly affect economic allocations. Acemoglu, Chernozhukov, and Yildiz (2007) show that if Bayesian agents are uncertain about the interpretation of signals their beliefs may not converge in the limit. Omitting the typically assumed convergence significantly alters outcomes in various game theoretic and asset market settings, as Acemoglu, Chernozhukov, and Yildiz (2007) further demonstrate. On entirely different theoretical grounds, the sticky information model of Mankiw and Reis (2002, 2006) establishes a relation between disagreement and macroeconomic dynamics. In the sticky information model agents inform themselves only sporadically about the economy. As a result, information sets differ across agents, generating disagreement in expectations. Mankiw and Reis (2006) show that a model with staggered updating at the side of firms, workers, and consumers reproduces empirical patterns such as the acceleration phenomenon and the smoothness of real wages. That disagreement about inflation expectations is relevant for monetary policy is highlighted by Sims (2008). Relying on a frictionless two period model, Sims (2008) demonstrates that disagreement among asset market participants may produce over-investment in real assets and may potentially delay and distort monetary policy actions.

Regarding the empirical side, however, the literature on determinants of disagreement

¹In the University of Michigan Surveys of Consumers, disagreement in terms of the interquartile range of one year ahead expected inflation averages at about 4% after 1990. Using various surveys, other authors find that inflation expectations differ significantly across socioeconomic groups, see, e.g., Souleles (2004), Bryan and Venkatu (2001), and Jonung (1981).

is relatively small and centers on professional disagreement.² Our paper contributes to the understanding of disagreement by investigating one particular source of information that is most relevant for households: the mass media. The important role of the media for belief formation is underlined by Blinder and Krueger (2004). Based on a representative survey of U.S. households, these authors find that television and newspaper news are the predominant information sources that households consult to form their expectations about economic issues.³ That media coverage directly affects inflation expectations has, to the best of our knowledge, been shown by two papers so far. Using quarterly U.S. data from 1981 to 2000, Carroll (2003) investigates how the accuracy of consumers' inflation expectations is related to the number of news stories on inflation in two important newspapers. Carroll (2003) finds that the accuracy of inflation expectations is positively related to the amount of media reporting. Moreover, it is shown that in an epidemiological model households update their beliefs more frequently in periods of intense media reporting. Relying on detailed monthly media content data for Germany from 1998 to 2007, Lamla and Lein (2008) additionally consider how the tone of media coverage affects inflation expectations. In line with Carroll (2003), the authors find that accuracy of expectations is positively related to the intensity of reporting, but that reports on rising inflation may bias households' expectations.⁴

To conceptually understand the role of media coverage for inflation forecast disagreement we adopt a Bayesian learning model. In our model, agents update their prior expectations about inflation by absorbing news transmitted by television and newspapers. Each media report only contains a noisy signal about future inflation. Consequently, agents face a signal extraction problem. The basic structure of our model is borrowed from Kandel and Zilberfarb (1999) and Lahiri and Sheng (2008a) who propose a simple approach

²See, e.g., Lahiri and Sheng (2008a, 2008b), Capistrán and Timmermann (2008), Batchelor (2007), Döpke and Fritsche (2006), Giordani and Söderlind (2003), and references therein. For empirical research on household disagreement see Mankiw, Reis, and Wolfers (2003) and Branch (2004, 2007).

³Fullone et al. (2007) provide similar evidence for Italy based on data from the OECD.

⁴Other studies consider the relation of media activity and consumer sentiment about real economic activity rather than inflation and confirm the relevance of media reporting, see Doms and Morin (2004) and Soroka (2006).

to introduce heterogeneous forecasting models into the standard learning model. In our model media coverage affects forecast disagreement by influencing information sets as well as by influencing how people interpret information. We empirically test the effects of the intensity (volume) of media reporting about inflation, the heterogeneity of story content, and the tone of media coverage conditional on a set of macroeconomic determinants of disagreement. As opposed to macroeconomic variables, we expect that media coverage only affects disagreement of households. Professional forecasters should generally have incentives to acquire the most recent information and select forecasting models irrespective of media activity.

This paper is structured as follows. Section 2 develops the theoretical framework and the hypotheses on the effects of media coverage and the macroeconomic state on inflation forecast disagreement of consumers and professionals. Section 3 presents the data and the quantitative measures of disagreement and media activity. Section 4 discusses the empirical results. In a first step we investigate a specification that explains disagreement by macroeconomic variables only. In a second step we examine the conditional effects of media coverage. Section 5 concludes.

2 Modeling Disagreement

Beliefs about future inflation may differ across respondents due to differences in information sets and forecasting models. Put more formally, survey respondent i forms a belief $z_{i,t}$ about future inflation such that:

$$z_{i,t} = f_{i,t}(I_{i,t}) \quad (1)$$

where $I_{i,t}$ is the information set and $f_{i,t}(\cdot)$ the forecasting model employed by respondent i at time t . A possible measure of disagreement d_t is the cross-sectional variance of beliefs:

$$d_t = \frac{1}{N-1} \sum_{i=1}^N (z_{i,t} - \bar{z}_t)^2 \quad (2)$$

where N is the number of respondents and \bar{z}_t the cross-sectional mean of forecasts in period t . Understanding disagreement thus requires a framework that explains the time-varying heterogeneity of information sets and forecasting models across respondents. Mankiw and Reis (2002) suggest an information delay model in which agents update their information sets only sporadically due to costs associated with acquiring and processing information. A related model is proposed by Carroll (2003). In his model only a fraction of agents encounters news about inflation at a given time, resulting in epidemiological dynamics of aggregate expectations and disagreement. But as Sims (2003) and Williams (2003) argue, information delay models seem less appropriate for explaining disagreement among (professional) forecasters who have incentives to employ the most recent information. Relying on information theory, Sims (2003) more generally models economic agents as having finite capacity to acquire and process information. Disagreement in expectations then results from idiosyncratic information processing errors and from heterogeneous objective functions and information processing constraints.⁵

We adopt a related signal extraction model to conceptually understand the role of media coverage. In our model, agents update their prior expectations about inflation by absorbing news transmitted by television and newspapers. Each media report only contains a noisy signal about future inflation. Consequently, agents update their prior beliefs by Bayesian learning. The model's basic structure is borrowed from Kandel and Zilberfarb (1999). These authors suggest a simple approach to introduce heterogeneous forecasting models into the standard learning framework. Our model allows for two distinct mechanisms by which media coverage affects recipients' beliefs. First, the media transmits information relevant for predicting inflation, consistent with a traditional economic view of the media. Second, media coverage affects what recipients concern to be important and, consequently, how they form their forecasts. This second mechanism is motivated by agenda setting theories which play an important role in contemporary media effects research.

⁵Alternative explanations of expert disagreement include strategic behavior (Laster et al., 1999), herding, conservatism, optimism (Batchelor, 2007) or asymmetric loss functions (Capistrán and Timmermann, 2008).

Assume that at the beginning of month t agent i has an initial prior belief about the future inflation rate (prior forecast). The prior belief $\Pi_{i,t}$ is normally distributed with mean $\pi_{i,t}$ and variance $a_{i,t}$:

$$\Pi_{i,t} \sim N(\pi_{i,t}, a_{i,t}) \quad (3)$$

During each month the agent absorbs a number V of media reports. We assume that each media report only contains noisy information relevant for predicting future inflation. In addition, agents may disagree in their forecasts even if their information sets are identical because they employ different predictors. Conditional on a media report $\tilde{L}_{v,t}$ agent i derives the following estimate of future inflation:

$$\pi_{v,i,t+1} = \tilde{L}_{v,t} - \mu_{i,t} = L_{v,t} - \mu_{i,t} - \varepsilon_{v,t}, \quad \varepsilon_{v,t} \sim N(0, b_t) \quad (4)$$

This equation states that each media report contains the signal $L_{v,t}$ (the rational forecast of inflation) and a noise term $\varepsilon_{v,t}$ which cannot be discerned by the agent. The noise term allows for heterogeneity in the content of media reports about inflation, with the degree of heterogeneity being captured by b_t . Assuming that media reports are unbiased such that $E(\varepsilon_{v,t}) = 0$ is not restrictive for the purpose of understanding disagreement, as will be shown below. Unlike in the standard learning setting, the above equation models the estimate of inflation to be individual specific by allowing agents to interpret the same media report differently. Following Kandel and Zilberfarb (1999) and Lahiri and Sheng (2008a) we model this by including the individual specific term $\mu_{i,t}$. The $\mu_{i,t}$ is unknown to the agent and reflects that some agents form more optimistic or pessimistic forecasts given the same information $\tilde{L}_{v,t}$. More generally, $\mu_{i,t}$ captures heterogeneity in forecasting models across agents.⁶

Agent i thus faces a signal extraction problem. Given the prior belief about future inflation and V units of noisy media reports the agent has to infer $L_{v,t}$. The agent updates

⁶This is the so called differential interpretation hypothesis put forward by Kandel and Zilberfarb (1999).

his prior belief according to Bayes' rule:

$$k_i(\pi_{i,t+1}|\{\tilde{L}_{v,t}\}) \propto \prod_{v=1}^V f_i(\tilde{L}_{v,t}|\pi_{i,t})h(\pi_{i,t}) \quad (5)$$

where $h(\cdot)$ is the prior density, $f_i(\cdot)$ the conditional density of the observed public information given the prior belief $\pi_{i,t}$, and $k_i(\cdot)$ the resulting posterior density given media reports $\{\tilde{L}_t\} = \tilde{L}_{1,t}, \dots, \tilde{L}_{V,t}$. Under the normality assumptions the posterior distribution is again normal with mean:

$$E\left(\pi_{i,t+1}|\{\tilde{L}_{v,t}\}\right) = \rho_{i,t}\pi_{i,t} + (1 - \rho_{i,t})\left(\bar{L}_t - \mu_{i,t}\right) \quad (6)$$

where $\bar{L}_t = V^{-1} \sum_{v=1}^V \tilde{L}_{v,t}$. The mean of the posterior distribution (henceforth posterior forecast $\pi_{i,t+1}$) is a weighted average of the prior mean and the average noisy signal obtained from the media. The weight on the prior mean is given by:

$$\rho_{i,t} = \frac{\frac{1}{V}b_t}{a_{i,t} + \frac{1}{V}b_t} = \frac{\alpha_{i,t}}{\alpha_{i,t} + \beta_t} \quad (7)$$

where $\alpha_{i,t} = \frac{1}{a_{i,t}}$ and $\beta_t = \frac{1}{\frac{1}{V}b_t}$ are the precision of the prior and the precision of the public signal. Under the assumption that $\tilde{L}_{v,t}$, $\rho_{i,t}$, and $\mu_{i,t}$ are mutually independent for any t it can be shown that the cross-sectional variance of the posterior forecast is:⁷

$$\begin{aligned} Var(\pi_{i,t+1}) &= Var(\pi_{i,t}) \left(Var(\rho_{i,t}) + E(\rho_{i,t})^2 \right) \\ &+ Var(\mu_{i,t}) \left(Var(\rho_{i,t}) + (1 - E(\rho_{i,t}))^2 \right) \\ &+ Var(\rho_{i,t}) \left(E(\bar{L}_t) - E(\mu_{i,t}) - E(\pi_{i,t}) \right)^2 \end{aligned} \quad (8)$$

Let us first assume that no differential interpretation of information exists, i.e. $Var(\mu_{i,t}) = 0$ and that weights on priors are identical across agents, i.e. $Var(\rho_{i,t}) = 0$. Then, equation

⁷See Kandel and Zilberfarb (1999) or Lahiri and Sheng (2008a) for a derivation of this result.

(8) reduces to:

$$Var(\pi_{i,t+1}) = Var(\pi_{i,t})\rho_t^2 \quad (9)$$

In this simple case, a higher volume of media reporting, reflected in a higher number of media reports V , reduces disagreement. If the number of media reports V goes to infinity the weight on prior beliefs goes to zero and all agents adopt the identical information set. If agents do not absorb any news such that $V = 0$, no updating takes place and disagreement is determined by the dispersion of prior beliefs. That the amount of media reporting about inflation is positively related to the absorption of new information by households is also suggested by empirical results of Carroll (2003) and Lamla and Lein (2008). This leads to the following hypothesis:

H1: The higher the volume of media reporting, the lower is inflation forecast disagreement of consumers.

Not only the volume of media reporting matters, but also its content.⁸ In particular, the model suggests that the more homogeneous media statements about inflation are, represented by a lower variance b_t of the noise term, the lower is disagreement. If all media reports contain the identical message such that the variance of the noise component collapses to 0, information sets become homogeneous. We empirically capture the heterogeneity of media reporting by computing the information entropy of media statements within a given month. This measure will be introduced in the next section. The second hypothesis reads:

H2: The lower the heterogeneity (information entropy) of statements about inflation, the lower is inflation forecast disagreement of consumers.

Note that in the Bayesian model heterogeneity in media coverage does not directly cause forecast disagreement. Rather, heterogeneity is averaged out in the process of Bayesian updating and exerts only an indirect effect as it determines the weight agents put on

⁸Previous research of Lamla and Lein (2008) shows that the content of media reporting affects accuracy of consumers' inflation expectations.

their (heterogeneous) prior beliefs. More importantly, the Bayesian model illustrates that the above relations are ambiguous once agents interpret media reports differently, i.e. if $Var(\mu_{i,t}) > 0$. In the general case, disagreement is driven by four main components: the cross-sectional variance of prior beliefs ($Var(\pi_{i,t})$), the extent of different interpretation of the public signal ($Var(\mu_{i,t})$), the average weight that agents assign to their prior forecasts ($E(\rho_{i,t})$), and the cross-sectional variance of prior weights ($Var(\rho_{i,t})$). The marginal effects of the variance terms on forecast disagreement is nonnegative, while the marginal effect of $E(\rho_{i,t})$ is ambiguous. Ignoring the indirect effect on its own variance, the marginal effect of $E(\rho_{i,t})$ depends on the dispersion of the priors and the extent of differential interpretation:

$$\frac{\partial Var(\pi_{i,t+1})}{\partial E(\rho_{i,t})} = (Var(\pi_{i,t}) + Var(\mu_{i,t})) 2E(\rho_{i,t}) - 2Var(\mu_{i,t}) \quad (10)$$

This expression tends to be positive if the cross-sectional variance of prior expectations is large relative to the extent of differential interpretation, and/or if the average weight on priors is large. If information is not interpreted differentially a lower average weight on heterogeneous prior beliefs always decreases forecast disagreement. But if new information is interpreted differentially, then updating with new information may raise forecast disagreement above initial prior disagreement.⁹

We expect that the extent of differential interpretation $Var(\mu_{i,t})$ can be affected by media coverage. This conjecture is motivated by agenda setting theories in media effects research.¹⁰ Agenda setting theories suggest that the primary role of media lies in influencing what people concern to be important. In traditional agenda setting models the amount of media reporting (so called media salience) affects where an issue ranks on recipients' agendas. On empirical grounds Sheafer (2007) extends the traditional notion, arguing that not only the volume but also the tone of media coverage is relevant. The findings of Sheafer

⁹Moreover, if the weights on prior beliefs are heterogeneous ($Var(\rho_{i,t}) > 0$) then the level of the rational forecast may in itself play a role for disagreement. This follows from the last line of equation (8): if the information transmitted by the media diverges from prior expectations, then disagreement will rise if updating varies across agents. Only in this case a systematic media bias could affect inflation forecast disagreement.

¹⁰See McCombs and Shaw (1972) for a seminal contribution. Recent surveys of the agenda setting literature are conducted by Dearing and Rogers (1996) and McCombs (2004).

(2007) suggest that in particular negative news indicating that inflation is worrisome should raise the perceived importance among recipients. In contrast, a neutral or positive tone of news might not affect how concerned agents are with inflation or might even decrease perceived issue importance.

We argue that in economic terms agenda setting affects the perceived costs and benefits agents assign to forecasting inflation. If agents are more concerned about inflation then the cost-benefit ratio of forecasting becomes more favorable towards forming an elaborate and costly forecast. That households indeed choose predictors by rationally evaluating predictor costs and benefits is confirmed by Branch (2004, 2007).¹¹ If inflation moves up the public agenda then one would expect predictors to become more homogeneous. Agents that normally are not concerned with forecasting inflation begin to form more elaborate forecasts and their predictors converge towards predictors of agents that employ elaborate predictors independently of media reporting.

Apart from the effects of the volume and the dispersion of story content for the transmission of information, we thus expect that the extent of differential interpretation is lower in times when the amount of media reporting is high and when the tone of media coverage suggests that inflation is rising. Since $\frac{\partial Var(\pi_{i,t+1})}{\mu_{i,t}} > 0$ we obtain the following hypothesis:

H3: A high volume and in particular media coverage indicating rising inflation decreases disagreement among consumers.

As opposed to consumers, professional forecasters should generally be well informed and select predictors independently of media coverage. The last hypothesis thus reads:

H4: Media reporting does not affect disagreement of professional forecasters.

Media coverage of inflation will to some extent reflect the actual macroeconomic state. Moreover, not only professionals but also households will rely on various information

¹¹Building on the Brock and Hommes (1997) theory of rational predictor selection, Branch (2004, 2007) estimates a model in which consumers rationally chose from a set of predictors by evaluating costs and benefits of each predictor. Branch (2004, 2007) finds such a model to be consistent with response behavior in the University of Michigan Surveys of Consumers.

sources to form an inflation forecast. In particular, households obtain information from their daily economic interactions as consumers or workers. Hence, information about the macroeconomic state will directly affect expectations and thereby forecast disagreement, independently of the amount of reports, the heterogeneity of story content, or the tone of reporting. By consequence, to identify the intrinsic relevance of media coverage we need to control for confounding macroeconomic factors. Motivated by empirical findings of Mankiw, Reis, and Wolfers (2003) we consider three potential macroeconomic control variables: the inflation rate, inflation volatility, and relative price variability.¹²

The inclusion of these variables is also theoretically justified, although the relation with disagreement ambiguous. Theories of rational inattention (Sims, 2003) and theories of rational predictor selection (Branch, 2004, 2007) suggest that the inflation rate is, to some extent, negatively correlated with survey disagreement. As inflation is rising, incentives to closely track inflation may rise too and sticking to outdated information may become more costly. If inflation exceeds some threshold, however, uncertainty about the choice of a forecasting model and disagreement about the interpretation of available information might rise as well. This effect is expected to be particularly relevant once inflation significantly deviates from the monetary policy target level or in times of a regime change (Kandel and Zilberfarb, 1999). For consumers we might thus observe a nonlinear effect of inflation on disagreement. At low levels a rise in inflation draws the attention of households who are subject to the economic incentives to track inflation more closely, lowering overall disagreement since information sets become more homogeneous. At higher levels however, uncertainty about the choice of a forecasting model and differential interpretation of public information raise forecast disagreement, despite high levels of attention and homogeneous information sets. Since professional forecasters' information sets should not depend much on the level of inflation, differential interpretation should dominate for them.

¹²Using U.S. data Mankiw, Reis, and Wolfers (2003) find that the inflation rate is a robust predictor both of consumer and professional disagreement, while inflation volatility and relative price variability are primarily relevant for consumers. Mankiw, Reis, and Wolfers (2003) additionally consider the output gap which is significant for consumer disagreement in some specifications. All variables are found to be positively related to disagreement.

The effect of inflation volatility might be similar to the effect of the inflation level. Theories of rational inattention suggest that consumers spend more time observing the inflation rate when it is volatile. But if inflation is highly volatile uncertainty about how to predict it might be high, too. Hence differential interpretation of the same information becomes more important. That forecast disagreement is rising in inflation volatility is also suggested by the sticky information model of Mankiw and Reis (2002, 2006). In this model, any change in the rate of inflation raises the heterogeneity of information sets across economic agents. Again, one would expect that the effect of attention primarily concerns consumers. The third macroeconomic variable we consider is relative price variability, i.e. the variation of inflation rates across subcomponents of the consumer price index. We expect that this variable is positively correlated with disagreement of households and professionals. In particular, results of Souleles (2004) and Bryan and Venkatu (2001) suggest that households may not necessarily have the official inflation rate in mind, but may rather refer to inflation as observed in their private consumption basket. Hence, relative price variability should directly raise forecast disagreement since it induces heterogeneity in the information sets of households. A positive correlation with professional disagreement might once more reflect uncertainty about the choice of an adequate forecasting model.

3 Data

Households' beliefs about actual and future consumer price inflation are taken from the Joint Harmonized EU Consumer Survey. Within this framework a representative sample of roughly 1'500 German households is surveyed every month.¹³ Inflation expectations are captured by asking households: "By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months? They will...". Respondents express their beliefs on a five-option scale: "increase more rapidly, increase at the same rate, increase at a slower rate, stay about the same, fall".¹⁴

¹³The consumer survey consists of 15 qualitative questions that relate to the household's financial situation, perceived economic conditions, and planned savings and spending, see European Commission (2007).

¹⁴Survey respondents may also opt for a "don't know" answer.

Survey results are publicly available as aggregate shares over qualitative response categories. We quantify inflation forecast disagreement of households by computing an index of qualitative variation (IQV) based on the response shares in the 5 categories:

$$Q(X) = \frac{K}{K-1} \left(1 - \sum_{i=1}^K p(x_i)^2 \right) \quad (11)$$

where $K = 5$ is the number of categories in the EU consumer survey question on expected inflation, and $p(x_i)$ the fraction of answers in category x_i . The scaling factor $\frac{K}{K-1}$ ensures that $0 \leq Q(X) \leq 1$. Maag (2009) finds that the IQV closely traces the actual standard deviation of quantitative responses in a survey that records both qualitative and quantitative inflation expectations. Moreover, the study shows that the IQV outperforms other quantification approaches, such as the probability method or the disconformity index.¹⁵

Disagreement of professional forecasters is based on quantitative point forecasts taken from the Consensus Economics survey. Consensus Economics has been surveying roughly 30 experts of private and public institutions in Germany on a monthly basis over the entire sample period. Unlike the consumer survey, the Consensus Economics survey asks for (fixed event) forecasts of inflation over the current and the upcoming calendar year. We adopt the weighting approach commonly used in the literature to compute 12 months ahead (fixed horizon) forecasts.¹⁶ As a measure of disagreement we follow Giordani and Söderlind (2003) and employ the quasi-standard deviation (QSD) defined as half the difference between the 84th and 16th percentile of the point forecasts as a measure of disagreement. The quasi-standard deviation is robust to outliers and corresponds to the usual standard deviation if point forecasts are normally distributed.

Figure 1 shows inflation forecast disagreement of consumers and professionals. The

¹⁵Maag (2009) reports that the correlation of the IQV with the standard deviation of actual quantitative responses is about 0.8 using monthly micro-data from the Swedish consumer survey, 1996–2008. An alternative to the IQV can be derived by quantifying the survey data with the Carlson and Parkin (1975) approach or a related probability method. Under the assumption of normality this method allows to derive the implied standard deviation of beliefs. However, Maag (2009) finds that this measure is only weakly correlated with actual dispersion of inflation expectations.

¹⁶The 12 months ahead inflation expectation formed in month m of year t is given by $\frac{13-m}{12}\pi_t^c + \frac{m-1}{12}\pi_{t+1}^c$, where π_t^c is the inflation expectation for year t .

sample average of the IQV for consumers is 0.86, the average QSD for professionals 0.39%. Disagreement of consumers and professionals show considerable variation over time with standard deviations of 0.06 and 0.08% respectively. Consumer disagreement exhibits a level shift around 01/2002, coinciding with the euro cash changeover. Since our focus does not lie on understanding this particular event we account for the shift by including an indicator variable that is equal to unity from 01/2002. Professional disagreement also rises after the euro cash changeover, but falls back to its initial level in 2004. The figure indicates that consumer and professional disagreement are only weakly correlated: the correlation coefficient is 0.39. Also, disagreement of professionals appears to be less persistent than disagreement of consumers. Overall, the figure suggests that different drivers are relevant for consumer and professional disagreement.

Our set of explanatory macroeconomic variables is based on the Harmonized Index of Consumer Prices (HICP) as published by Eurostat. The inflation rate is computed as the year-over-year percentage change of the HICP. As a measure of inflation volatility we use the squared monthly change in the inflation rate, averaged over three months (i.e. between t and $t - 2$).¹⁷ Finally, following the literature we compute relative price variability as a weighted standard deviation of inflation rates in HICP subcomponents (see, e.g., Jarmarillo, 1999):

$$RPV_t = \sqrt{\sum_i^I w_{i,t} (\pi_{i,t} - \pi_t)^2} \quad (12)$$

where $w_{i,t}$ is the weight of HICP subindex i , $\pi_{i,t}$ the inflation rate in subindex i , and π_t the overall HICP inflation rate. Our measure is based on 39 monthly HICP subcomponents and annual weights obtained from Eurostat.¹⁸

Figure 2 shows the macroeconomic variables. While the HICP inflation rate exhibits only moderate variation, relative price variability is comparatively high and volatile. In

¹⁷We have also considered the squared monthly change and the absolute monthly change, with identical qualitative results.

¹⁸The 39 subcomponents correspond to the COICOP 3-digit aggregates as provided by Eurostat. All series are available from 01/1995 onwards.

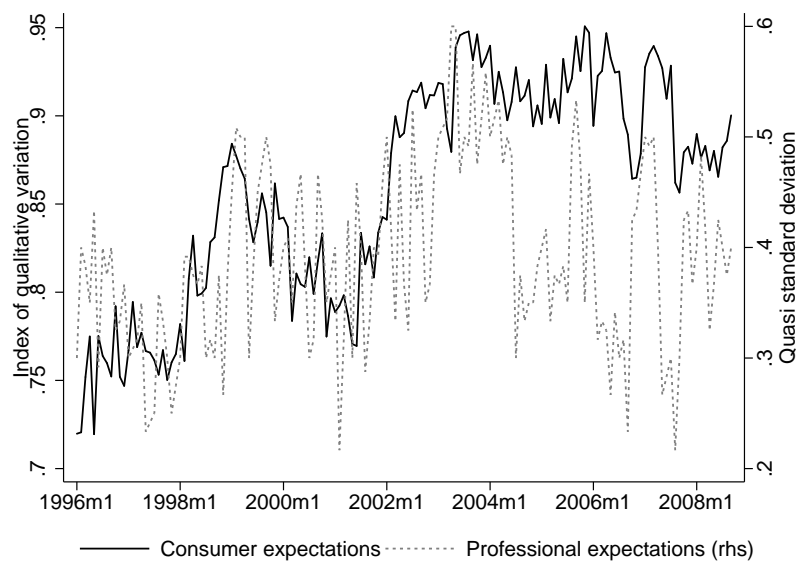


Figure 1: Disagreement among consumers and professionals

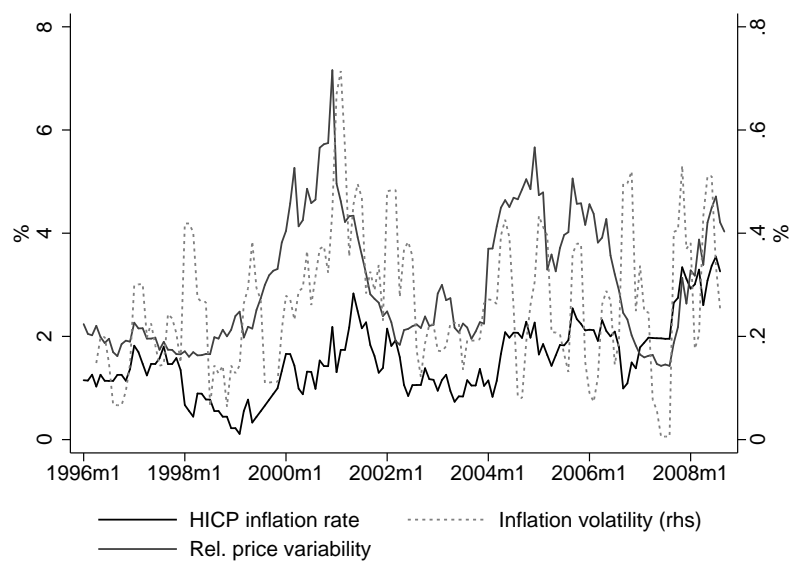


Figure 2: Macroeconomic variables

the periods 2000–2001, 2004–2006, and in 2008 relative price variability attains levels of above 4%. The series is positively correlated with the inflation rate, with a correlation coefficient of 0.41. Inflation volatility is only weakly correlated with the inflation rate and relative price variability, correlation coefficients are 0.28 and 0.33 respectively. The figure also indicates that no simple linear relation between the macroeconomic variables and disagreement exists in this period of relatively low inflation.

The media content data has been kindly provided by the media research institute Mediatenor. The data-set covers a wide range of newspapers and television news on a monthly frequency for the time span 01/1998 to 09/2007 in Germany. It covers all 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.¹⁹ The coding is based on the standards of media content analysis (see, e.g., Holsti, 1969). Media content analysis allows to capture the content of each statement, while being objective and reproducible. This is achieved by continuous training of the coding specialist, a solid definition of the code book, and regularly executed inter-coder reliability tests. For each media report, the direction inflation is taking according to this report is encoded using the three categories “rising”, “unchanged”, and “falling”.

Based on this data we generate a number of explanatory variables that capture media activity. The volume of media coverage (V) is simply given by the overall sum of media reports that mention inflation in a given month. Our measure of heterogeneity of media reports (variance b_t) is based on the direction of news. Given the shares $p(x_i)$, $i = 1, 2, 3$, of reports stating that inflation is rising, unchanged, or falling we compute Shannon’s

¹⁹In detail following news sources are analyzed: Daily press: Frankfurter Allgemeine Zeitung, Welt, Süddeutsche Zeitung, Frankfurter Rundschau, Tageszeitung, Neue Zürcher 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.

measure of information entropy which is given by:

$$H(X) = - \sum_{i=1}^K p(x_i) \ln(p(x_i)) \quad (13)$$

where $K = 3$ is the number of values of characterizing the direction of media reports. Under the convention that $0 \ln(0) = 0$ this measure is bounded such that $0 \leq H(X) \leq \ln(3) \approx 1.1$.

Figure 3 shows the overall sum of reports and the information entropy. The figure indicates that the volume is relatively high in the years 2000–2003 and in 2007, coinciding with the euro cash changeover and the rise in inflation due to energy prices at the end of the sample period. Correlation of the inflation rate with the volume of media reports is only 0.30, however. The entropy of statements about the direction inflation is taking is a highly volatile process. Only towards the end of the sample, information entropy shows a declining tendency.

The variables that capture the tone of media coverage are based on the shares of reports indicating a particular direction of inflation relative to the monthly total number of reports about inflation. We consider the tone, computed as the difference between the fraction of reports stating that inflation is rising and the fraction of reports stating that inflation is falling. A positive tone thus reflects that news indicating rising inflation predominate. Moreover, we consider the share of reports stating that inflation takes a particular direction. Figure 4 shows the tone as well as the shares of reports indicating that inflation is rising and falling. The figure reveals that the share of articles with rising direction is particularly high in the years 2000–2001 and at the end of the sample period. This is also reflected in the tone of media coverage. On average the tone is slightly positive but highly volatile with a standard deviation of about 0.3.

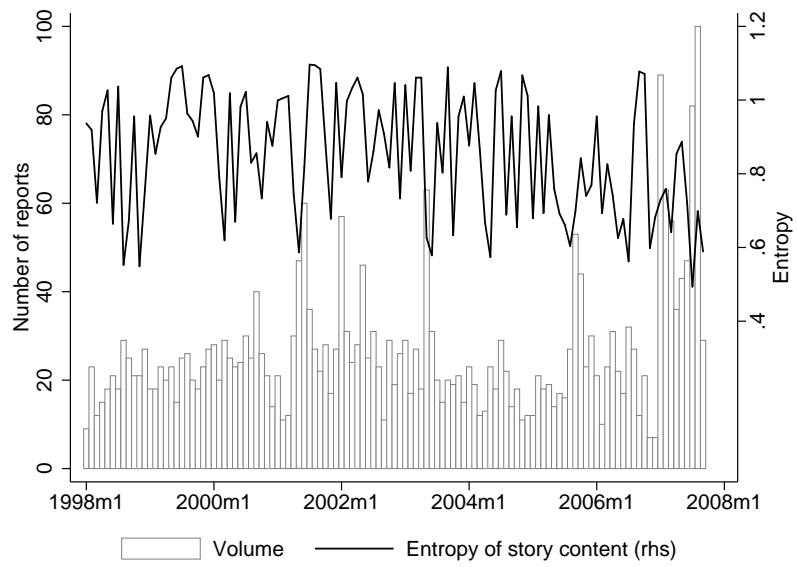


Figure 3: Volume and entropy of media coverage

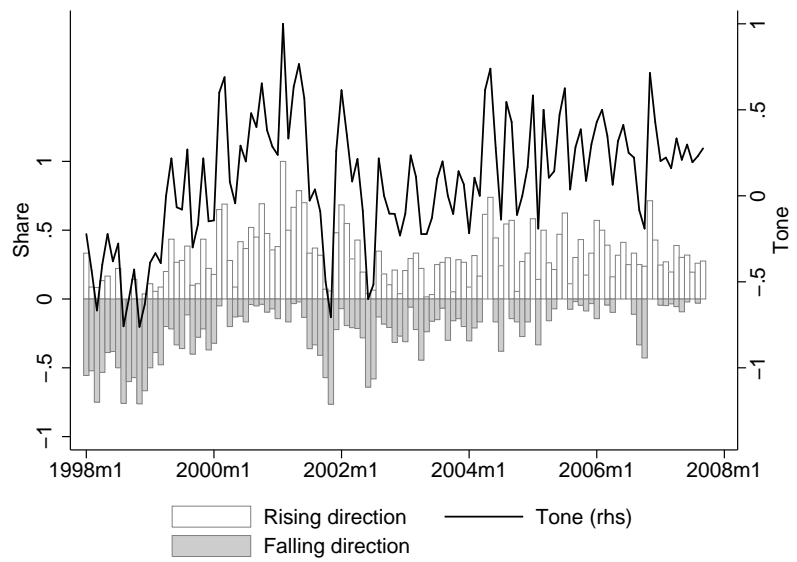


Figure 4: Tone of media coverage

4 Estimation Results

4.1 Macroeconomic Determinants of Disagreement

Our empirical analysis of disagreement begins by looking at the macroeconomic determinants that have been motivated in the previous sections. We aim at identifying a baseline specification of disagreement to which the media variables will be added in a second step. The analysis centers on linear regressions of the following form:

$$Var(\pi_{i,t}) = \beta_1 Var(\pi_{i,t-1}) + \beta_2 \pi_{t-1} + \beta_3 \pi_{t-1}^2 + \dots + \beta_{p-1} + \beta_p d + \varepsilon_t \quad (14)$$

The dependent variable is the index of qualitative variation for consumers and the quasi standard deviation for professionals. The specifications control for the euro cash changeover by including a step dummy d which is unity from 2002 onwards. To account for the publication lag of macroeconomic information we include the macroeconomic correlates, e.g. actual HICP inflation π_{t-1} , with a one month lag. Moreover, the model contains a lagged dependent variable. This is motivated by equation (8) which illustrates that the dispersion of prior beliefs is a potentially important determinant of survey disagreement.²⁰ In an attempt to move closer to the Bayesian model we additionally report results for the following specification:

$$Var(\pi_{i,t}) = Var(\pi_{i,t-1}) (\beta_1 + \beta_2 \pi_{t-1} + \beta_3 \pi_{t-1}^2 + \dots) + \beta_{p-1} + \beta_p d + \varepsilon_t \quad (15)$$

In this model, the macroeconomic covariates indirectly influence forecast disagreement by affecting the weight on the proxy of prior beliefs $Var(\pi_{i,t})$. Both models are estimated using ordinary least squares.²¹

²⁰The lagged dependent variable is of course only an approximate measure of prior disagreement because the underlying forecasts refer to a one month lagged target horizon.

²¹All estimations allow for heteroscedasticity. Estimations of models without lagged dependent variables additionally allow for serial correlation by employing the Newey-West estimator. We have tested for residual correlation in specifications with a lagged dependent variable using the Breusch-Godfrey LM test of no serial correlation.

Table 1: Macroeconomic models of survey disagreement

	(1)		(2)		(3)		(4)	
	Cons.	Prof.	Cons.	Prof.	Cons.	Prof.	Cons.	Prof.
Inflation(t-1)	-0.0434*** (0.0166)	-0.1015* (0.0531)	-0.0381** (0.0181)	-0.0848 (0.1544)	-0.0427** (0.0167)	-0.0767 (0.0532)	-0.0265*** (0.0089)	-0.1016*** (0.0249)
Inflation squared(t-1)	0.0122** (0.0058)	0.0177 (0.0199)	0.0104* (0.0062)	-0.0023 (0.0492)	0.0120** (0.0058)	0.0137 (0.0199)	0.0050** (0.0020)	0.0180*** (0.0065)
Inflation volatility(t-1)	-0.0128 (0.0157)	0.0674 (0.0549)	-0.0304 (0.0187)	0.0701 (0.1676)			0.0047 (0.0140)	0.0747 (0.0473)
Rel. price var.(t-1)	0.0004 (0.0018)	0.0060 (0.0055)	0.0011 (0.0023)	0.0095 (0.0132)			0.0018 (0.0016)	0.0049 (0.0044)
Lagged dependent	0.5425*** (0.0853)	0.4574*** (0.0726)	0.5722 (0.0689)	0.5826*** (0.1348)	0.5682*** (0.0812)	0.4868*** (0.0740)	0.6657*** (0.0652)	0.4283*** (0.0666)
Constant	0.4078*** (0.0775)	0.2555*** (0.0442)	0.3776*** (0.0609)	0.1807*** (0.0300)	0.3839*** (0.0736)	0.2628*** (0.0447)	0.2863*** (0.0569)	0.2671*** (0.0361)
Dchangeover	0.0476*** (0.0100)	0.0479*** (0.0157)	0.0462*** (0.0085)	0.0317* (0.0169)	0.0456*** (0.0098)	0.0351** (0.0155)	0.0403*** (0.0088)	0.0515*** (0.0128)
Observations	117	117	117	117	117	117	149	149
R-squared	0.87	0.42	0.87	0.38	0.87	0.40	0.89	0.45

Notes: Monthly data, 01/1998–09/2007. Columns (1) and (3)–(4) show OLS estimation results of model (14). Column (4) is based on the unrestricted sample period 04/1996–09/2008. Column (2) presents estimation results of equation (15), where the coefficient in the column for the lagged dependent variable corresponds to β_1 . Dependent variable for consumers is the index of qualitative variation, dependent variable for professionals is the quasi standard deviation of quantitative survey responses. White standard errors in parentheses allowing for heteroscedasticity. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level.

In column (1) of Table 1 we provide an initial specification of disagreement which is estimated over the sample period 01/1998–09/2007 for which media content data is available. This specification includes HICP inflation, inflation volatility, and relative price variability. Following the theoretical line of argumentation we allow for a nonlinear effect of the inflation rate, reflecting that inflation affects agent’s attentiveness as well as uncertainty about the choice of a forecasting model. The estimations show that inflation and inflation squared are highly significant for consumers. For professional disagreement, only the level of inflation is significant. In contrast to our anticipation, inflation volatility and relative price variability are insignificant both for consumers and professionals. The lagged dependent variable is highly significant in all specifications. The coefficient estimates suggest that disagreement of consumers is more persistent than disagreement of professionals, but that both variables are stationary. The lower persistence of professional disagreement is in line with the anticipation that professional forecasters are more responsive to new information than consumers.

Column (2) presents estimation results of the alternative model specified in equation (15) including the same set of macroeconomic variables. The estimations confirm the above findings. But while inflation still exerts a significant nonlinear effect on consumer disagreement, the level of inflation is not significant for professional disagreement anymore.

Relying on these results, column (3) presents our preferred macroeconomic specification which excludes inflation volatility and relative price variability. While professional disagreement is unaffected by both variables, the nonlinear effect of inflation on consumer disagreement remains highly significant. Figure 5 illustrates this effect. The dots represent actual observations and the dashed lines offer the 95% confidence interval. The figure reveals that if inflation is below a threshold of about 1.8%, disagreement is declining in inflation. After this threshold, however, disagreement is rising in inflation. A possible interpretation of this pattern along the lines of Kandel and Zilberfarb (1999) is that agents begin to disagree about which forecasting model is adequate in an uncertain environment with inflation rates that diverge from the 2% level the ECB considers to be in line with price stability. A negative marginal effect of inflation is also consistent with rational the-

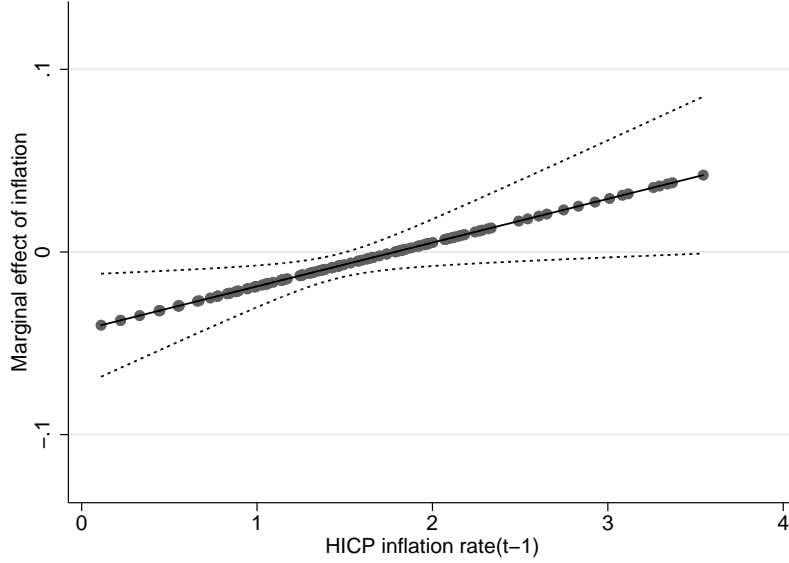


Figure 5: Marginal effect of inflation on consumer disagreement

Notes: The dots represent actual observations and the dashed lines offer the confidence bands of two standard deviations width. Underlying regression is shown in Table 1, column (3).

ories of predictor selection that suggest that the incentives to update information sets are increasing in inflation. Column (3) indicates that in the reduced specification professional disagreement is not significantly affected by inflation.

The findings regarding the significance of macroeconomic variables are only partially consistent with results of Mankiw, Reis, and Wolfers (2003) for the U.S. These authors report the inflation rate is a robust predictor of consumer disagreement. In contrast to our results however, Mankiw, Reis, and Wolfers (2003) find that (in specifications without a lagged dependent variable) relative price variability and inflation volatility are significant, too. Regarding professional disagreement, they report that the estimated effect of the inflation rate is significant and positive. These differences to our results might be explained by their sample horizon which covers 30 years and includes periods of very high inflation rates and inflation volatility. Contrary to that, our sample horizon is characterized by relatively low levels of inflation and inflation volatility, with inflation ranging between 0.1% and 2.8%. We therefore provide results for an extended sample period that includes

the episode of high inflation in 2007 and 2008.²² The estimation results are presented in column 4 of Table 1. While the effects of inflation on consumer disagreement are confirmed, inflation also exerts a significant nonlinear effect on professional disagreement. Professional disagreement is rising in inflation once inflation exceeds a level of about 2.7%. Thus, we presume that this non-linear effect has general validity for disagreement.

In sum the above results show that one month lagged inflation has a significant non-linear effect on consumer disagreement. Professional disagreement is less persistent than consumer disagreement and only depends on inflation in one specification but is otherwise unrelated to the considered set of macroeconomic variables. But in a longer sample period that includes the recent episode of high inflation we also detect a nonlinear effect of inflation on professional disagreement. We therefore include the first lags of inflation and inflation squared as control variables in evaluating the effects of media coverage.

4.2 Effects of Media Reporting on Disagreement

This section systematically adds media variables to the baseline macroeconomic specification presented in column (3) of Table 1. In a first step, we investigate the media variables which, according to the Bayesian learning model, are relevant for the dispersion of information sets. According to Hypothesis (1), an increase in the amount of media reports on inflation raises the ratio of signal to prior precision which lowers disagreement among consumers. Similarly, Hypothesis (2) states that the lower information entropy of story content is, the less weight households will put on their (heterogeneous) prior beliefs and the lower consumer disagreement will be. In column (1) of Table 2 we test these hypotheses by including the monthly number of reports dealing with inflation and the information entropy of statements about the direction of inflation. In contrast to our hypotheses, both variables are insignificant.²³ From the model viewpoint this suggests that households interpret new information differentially such that the marginal effect of updating on forecast disagreement (equation 10) is zero. Consistent with Hypothesis (4), professional disagreement is

²²This sample period covers 04/1996–09/2008 and is defined by HICP data availability.

²³A separate inclusion of volume and entropy does not change this result.

unaffected by media variables.

In a second step, we add the media variables that are expected to affect the dispersion of predictors. Column (2) of Table 2 includes the tone of media coverage, represented by the difference of the share of articles indicating that inflation is rising and the share of articles indicating that inflation is falling. The tone of media coverage is highly significant for consumers. Notably, we can also disentangle the effect of the tone into the effects of reports indicating that inflation is rising or falling. Column (3) reveals that consumer disagreement is decreasing in the share of media reports that signal rising inflation. The estimated coefficient is highly significant. The volume of media reporting which might also be relevant for the agenda setting function remains insignificant. Hence, rather than the absolute volume the relative tone of reporting is important. In line with Hypothesis (3), these results suggests that consumer disagreement is lower if media coverage emphasizes that inflation is rising. This result is consistent with the model view that by setting the agenda media coverage influences predictor choice and thereby forecast disagreement.

Column (4) presents estimation results of the alternative model specified in equation (15). The estimations confirm the above findings and indicate that the share of media reports pointing to rising inflation directly affect the weight consumers put on their prior beliefs.

Excluding the lagged dependent variable and the euro cash changeover dummy, the adjusted R-squared of a linear regression that only includes media variables is 0.33 for consumers, as compared to an R-squared of 0.05 from a regression that only includes macroeconomic variables.²⁴ The higher R-squared of a specification including only the media variables is in line with the notion that the media transmit macroeconomic variables and additionally interpret these variables. Therefore, the media variables contain more information than just the macroeconomic variables. Regarding the quantitative importance of the identified effects, column (3) of Table 1 suggests that if the share of reports pointing to rising inflation increases from 0 to the maximum of 1 forecast disagreement declines by 0.04. This may seem low given the IQV's standard deviation of 0.06, but it is economically

²⁴Detailed results are available upon request.

Table 2: The effect of media coverage on survey disagreement

	(1)		(2)		(3)		(4)	
	Cons.	Prof.	Cons.	Prof.	Cons.	Prof.	Cons.	Prof.
Volume	0.0000 (0.0002)	0.0003 (0.0006)	0.0000 (0.0002)	0.0003 (0.0006)	-0.0000 (0.0002)	0.0003 (0.0006)	-0.0001 (0.0003)	0.0008 (0.0013)
Entropy	-0.0079 (0.0114)	0.0318 (0.0414)	-0.0108 (0.0103)	0.0336 (0.0424)	-0.0051 (0.0105)	0.0414 (0.0418)	-0.0060 (0.0118)	0.0540 (0.1106)
Tone			-0.0152*** (0.0052)	0.0072 (0.0256)				
Direction rising					-0.0383*** (0.0132)	-0.0232 (0.0540)	-0.0480*** (0.0151)	-0.0974 (0.1271)
Direction falling					-0.0109 (0.0130)	-0.0417 (0.0541)	-0.0086 (0.0162)	-0.1091 (0.1521)
Lagged dependent	0.5692*** (0.0826)	0.4760*** (0.0758)	0.5801*** (0.0766)	0.4694*** (0.0784)	0.5345*** (0.0824)	0.4645*** (0.0800)	0.6105*** (0.0709)	0.5738*** (0.1708)
Inflation(t-1)	-0.0425** (0.0171)	-0.0773 (0.0519)	-0.0290* (0.0153)	-0.0836 (0.0529)	-0.0328** (0.0156)	-0.0844 (0.0540)	-0.0190 (0.0192)	-0.0511 (0.1646)
Inflation squared(t-1)	0.0118* (0.0060)	0.0133 (0.0191)	0.0088 (0.0054)	0.0146 (0.0191)	0.0102* (0.0054)	0.0152 (0.0196)	0.0065 (0.0066)	-0.0084 (0.0513)
Constant	0.3892*** (0.0747)	0.2322*** (0.0614)	0.3729*** (0.0691)	0.2379*** (0.0612)	0.4237*** (0.0776)	0.2545*** (0.0648)	0.3497*** (0.0646)	0.1916*** (0.0335)
Dchangeover	0.0449*** (0.0100)	0.0372** (0.0158)	0.0434*** (0.0093)	0.0378** (0.0151)	0.0439*** (0.0092)	0.0326* (0.0168)	0.0382*** (0.0087)	0.0194 (0.0173)
Observations	117	117	117	117	117	117	117	117
R-squared	0.87	0.40	0.88	0.41	0.88	0.41	0.88	0.39

Notes: Monthly data, 01/1998–09/2007. Columns (1)–(3) show OLS estimation results of the linear model. Column (4) presents estimation results of equation (15), where the coefficient in the column for the lagged dependent variable corresponds to β_1 . Dependent variable for consumers is the index of qualitative variation, dependent variable for professionals is the quasi standard deviation of survey responses. White standard errors in parentheses allowing for heteroscedasticity. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level.

more relevant than the effect of the inflation rate. Evaluated at the sample mean of the respective series the marginal effect of a one standard deviation shock to the share of positive reports is -0.008, while the marginal effect of a one standard deviation shock to inflation is -0.002.²⁵ The finding that media coverage has a stronger impact on consumer disagreement than the raw macroeconomic figure itself relates to the recent literature on macroeconomic literacy. In particular, results of Blinder and Krueger (2004), Fullone et al. (2007), and Lusardi and Mitchell (2007) show that while consumers are incompletely informed about macroeconomic and financial issues, television and newspaper reports are the most important sources of information for them. In sum, these results suggest that it is primarily through the transmission and interpretation of information by the media that macroeconomic information becomes useful for consumers.

In order to account for the highly unlikely case of a possible reverse causation running from disagreement of professionals and consumers to media reporting Table A.1 in the Appendix provide estimates that include the media variables with a one month lag. In specifications excluding a lagged dependent variable, the effect of share of reports indicating rising inflation remains highly significant. Including a lagged dependent variable, the effects of lagged media reporting are not significant anymore. This indicates that the information contained in lagged media reports has already been incorporated into prior expectations, represented by the lagged dependent variable.

Carroll (2003) and Lamla and Lein (2008) assume that the media transmit professional forecasts. Thus, the significant effect of the tone variable might be confounded by publicly available views and expectations of professional forecasts. Column (1) of Table 3 therefore includes the mean and the quasi standard deviation of one month lagged professional forecasts taken from the Consensus Economics survey as additional control variables. The estimations show that the coefficients on the media variables virtually unaffected. In particular, the share of reports indicating rising inflation remains highly significant and negative.²⁶ Interestingly, while the mean of professional forecasts is insignificant, consumer

²⁵These results rely on the estimations presented in column (3) of Table 2.

²⁶This also holds for the tone variable which is not shown in the table.

Table 3: Robustness checks and results by educational groups

	(1)	(2)–(4)			(5)–(6)	
	<i>Cons.</i>	<i>Primary</i>	<i>Secondary</i>	<i>Tertiary</i>	<i>Within</i>	<i>Between</i>
Volume	-0.0000 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	0.0002 (0.0003)	-0.0000 (0.0002)	0.0362 (0.0382)
Entropy	-0.0121 (0.0101)	-0.0214* (0.0116)	-0.0071 (0.0129)	-0.0090 (0.0240)	-0.0044 (0.0095)	-3.6711 (2.2238)
Direction rising	-0.0419*** (0.0135)	-0.0366** (0.0172)	-0.0569*** (0.0153)	-0.0900*** (0.0289)	-0.0579*** (0.0172)	-0.7549 (2.7510)
Direction falling	-0.0037 (0.0127)	-0.0070 (0.0183)	-0.0069 (0.0138)	-0.0060 (0.0306)	-0.0131 (0.0172)	-0.5572 (3.6485)
Prof. expectation(t-1)	-0.0100 (0.0070)	-0.0120 (0.0086)	-0.0090 (0.0078)	-0.0452*** (0.0161)	-0.0231*** (0.0071)	1.6481 (1.4053)
Prof. disagreement(t-1)	0.0570** (0.0252)	0.0451 (0.0278)	0.0589** (0.0290)	0.0963* (0.0567)	0.0514** (0.0250)	7.6709 (6.0541)
Lagged dependent	0.4745*** (0.0795)	0.4335*** (0.0816)	0.3827*** (0.0897)	0.0502 (0.1092)		
Inflation(t-1)	-0.0237 (0.0154)	-0.0309 (0.0193)	-0.0215 (0.0212)	-0.0835* (0.0440)	-0.0209 (0.0234)	-3.0460 (3.1525)
Inflation squared(t-1)	0.0095* (0.0053)	0.0116* (0.0059)	0.0099 (0.0069)	0.0305* (0.0155)	0.0084 (0.0078)	1.0332 (1.0511)
Constant	0.4626*** (0.0775)	0.5181*** (0.0817)	0.5316*** (0.0864)	0.8746*** (0.1197)	0.6626*** (0.0282)	0.5232 (1.1684)
Dchangeover	0.0442*** (0.0088)	0.0490*** (0.0105)	0.0509*** (0.0101)	0.0672*** (0.0130)	0.0591*** (0.0051)	5.2248 (3.8311)
Observations	117	117	117	117	117	117
R-squared	0.89	0.85	0.85	0.60	0.79	0.11

Notes: Monthly data, 01/1998–09/2007. Dependent variable in columns (1)–(4) is the index of qualitative variation. Professional disagreement is measured by the quasi-standard deviation. White standard errors in parentheses allowing for heteroscedasticity. Within group variation in column (5) is measured as the average index of qualitative variation over educational groups. Between group variation in column (6) is measured as the standard deviation of group mean expectations. Mean expectations are quantified using the balance statistic. For column (5)–(6) Newey–West standard errors are reported using the bandwidth $n = 4 \approx 4(T/100)^{2/9}$ (Newey and West, 1994). *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level.

disagreement is positively related to one month lagged professional disagreement.

Columns (2)–(4) of Table 3 further investigate the robustness of these results by separating the incidence of media coverage across educational groups. Our anticipation about the relevance of the tone variables is mixed. On the one hand, higher educational groups might be more affected by the tone of media coverage as they should consume more newspaper reports and TV-news. On the other hand, higher educational groups might be less affected by media coverage as they should form more elaborate inflation expectations similar to professional forecasters. The results in Table 3 indicate that the tone of media coverage affects all educational groups, but that the absolute magnitude of the effect increases in education.²⁷ Consistently, the mean professional expectation and lagged actual inflation are only significant for the highest educational group. Also, the coefficient on the lagged dependent variable is declining in education, suggesting that higher educational groups are more responsive to new information. Consequently, this implies that the high educated are also the best informed. A reason for this is, as we show, the higher pace of updating to new macroeconomic information and the responsiveness to news content provided by the media. This result is in line with findings of Souleles (2004) and Bryan and Venkatu (2001) on accuracy of inflation expectations or Lusardi and Mitchell (2007) on financial literacy across educational groups.

The estimates across educational groups are consistent with aggregate results and suggest that overall forecast disagreement is declining in the tone of media reporting because disagreement within each educational group is declining. Columns (5) and (6) of Table 3 confirm this finding by splitting effects on overall forecast disagreement into effects on within group disagreement and between group disagreement. Within group disagreement is given by the average index of qualitative variation across the three educational groups. Between group disagreement is measured by the standard deviation of mean expectations across educational groups.²⁸ The estimations show that the tone of media coverage lowers

²⁷The disaggregate results for educational groups do not depend on the inclusion of mean and dispersion of professional forecasts.

²⁸Mean expectations are quantified employing the balance statistic defined as $p_1 + 0.5p_2 - 0.5p_4 - p_5$, where p_1 is the share of respondents opting for the qualitative answer that prices will “increase more

forecast disagreement by lowering disagreement within educational groups. Between group disagreement is unaffected by media variables.

In sum, the above results confirm that media play a role for disagreement of consumers, but not for disagreement of professionals. Consistent with Hypothesis (3) we find that a higher share of reports that indicate rising inflation reduces disagreement. According to the model view this may result from a decline in predictor heterogeneity, caused by an increased importance consumers assign to predicting inflation. In contrast with our hypotheses, however, the volume and information entropy of media coverage do not affect disagreement of consumers. All results are conditional on a set of macroeconomic control variables and are robust to the inclusion of the mean and dispersion of professional forecasts.

5 Conclusion

While the evidence on the drivers of inflation expectations is increasing, research on disagreement of expectations remains scant at best. Meanwhile, recent theoretical contributions show that disagreement significantly affects economic allocations and may have important consequences for monetary policy. In this paper we contribute to the understanding of disagreement by investigating the role of media coverage on inflation for inflation forecast disagreement of German households and professional forecasters. This focus is motivated by the literature on macroeconomic literacy which shows that television news and newspaper reports are the predominant sources of economic information for households. To embed the effect of media coverage we propose a Bayesian learning model which follows Kandel and Zilberfarb (1999) in allowing for heterogeneous predictors. We assume that media coverage may affect forecast disagreement by influencing information sets and predictor choice of recipients. In our model, forecast disagreement is governed by the dispersion of prior beliefs and by the amount, the heterogeneity, and the tone of media reports about consumer price inflation. Since agents obtain signals from various sources our empirical specifications control for a set of macroeconomic variables. Motivated by rapidly”.

findings of Mankiw, Reis, and Wolfers (2003) and by rational theories of inattention this set includes the inflation rate, inflation volatility, and relative price variability.

We show empirically that inflation forecast disagreement of consumers and professionals is affected by macroeconomic variables. The estimations suggest that the level of inflation is a robust driver of consumer disagreement. Interestingly, inflation affects disagreement in a non-linear fashion. At low levels of inflation, broadly in line with price stability as defined by the ECB, disagreement is declining in inflation, whereas at higher levels of inflation disagreement is rising again. A possible interpretation of this nonlinear effect is that agents begin to disagree about which forecasting model is adequate in an uncertain environment with inflation rates substantially diverging from the policy target. We detect a similar pattern for professional disagreement in an extended sample period that includes the recent episode of relatively high inflation. Inflation volatility and relative price variability are insignificant in all specifications.

Conditional on a macroeconomic specification we then test for the effects of media coverage on inflation. The inclusion of the macroeconomic control variables allows to avoid confounding effects as the media (also) transmit relevant information about the macroeconomic state. Our results confirm that media coverage plays a role for disagreement of consumers, but not for disagreement of professionals. This finding is in line with the conjecture that professional forecasters have incentives to acquire the most recent information and to select forecasting models irrespective of media coverage. The effects on consumer disagreement are limited to the tone of media reporting. Our results robustly show that if the tone of media reporting is negative, emphasizing that inflation is rising, disagreement of consumers declines. This is consistent with the model view that by setting the agenda, media coverage induces a more homogeneous predictor distribution among households.

Our results suggest that examining the differential effects of media coverage on information sets and predictor choice is an important topic for future work. A possible approach is to simultaneously consider inflation perceptions, which should more closely reflect information sets. Moreover, in light of the results on the tone variables relative measures of volume and information entropy should be further investigated.

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Appendix

Table A.1: The effect of lagged media reporting on survey disagreement, direction

	(1)		(2)		(3)		(4)	
	Cons.	Prof.	Cons.	Prof.	Cons.	Prof.	Cons.	Prof.
Volume(t-1)	-0.0001 (0.0003)	-0.0003 (0.0008)	-0.0001 (0.0003)	-0.0003 (0.0008)	-0.0000 (0.0001)	-0.0006 (0.0004)	-0.0000 (0.0001)	-0.0005 (0.0005)
Entropy(t-1)	-0.0126 (0.0153)	0.0034 (0.0441)	-0.0042 (0.0147)	0.0003 (0.0469)	-0.0036 (0.0119)	-0.0155 (0.0407)	-0.0054 (0.0124)	-0.0287 (0.0426)
Tone(t-1)	-0.0131 (0.0087)	0.0320 (0.0285)			-0.0033 (0.0067)	0.0166 (0.0229)		
Direction rising(t-1)			-0.0414** (0.0188)	0.0425 (0.0491)			0.0040 (0.0149)	0.0594 (0.0466)
Direction falling(t-1)			-0.0202 (0.0207)	-0.0197 (0.0731)			0.0113 (0.0160)	0.0343 (0.0536)
Lagged dependent					0.5660*** (0.0717)	0.4837*** (0.0808)	0.5819*** (0.0775)	0.4950*** (0.0815)
Inflation(t-1)	-0.0612*** (0.0223)	-0.1356** (0.0669)	-0.0648*** (0.0219)	-0.1343** (0.0668)	-0.0381** (0.0160)	-0.1074* (0.0544)	-0.0366** (0.0163)	-0.1011* (0.0547)
Inflation squared(t-1)	0.0171** (0.0073)	0.0236 (0.0235)	0.0185*** (0.0070)	0.0231 (0.0235)	0.0107** (0.0052)	0.0243 (0.0176)	0.0102* (0.0053)	0.0222 (0.0177)
Constant	0.8750*** (0.0216)	0.5047*** (0.0573)	0.8901*** (0.0217)	0.4992*** (0.0610)	0.3866*** (0.0635)	0.3102*** (0.0586)	0.3691*** (0.0711)	0.2827*** (0.0642)
Dchangeover	0.1020*** (0.0073)	0.0665*** (0.0211)	0.0974*** (0.0080)	0.0682*** (0.0189)	0.0454*** (0.0084)	0.0375** (0.0156)	0.0450*** (0.0084)	0.0439*** (0.0167)
Observations	117	117	117	117	117	117	117	117
R-squared	0.79	0.20	0.79	0.20	0.86	0.40	0.87	0.41

Notes: Monthly data, 01/1998-09/2007. Dependent variable for consumers is the index of qualitative variation, dependent variable for professionals is the quasi standard deviation of survey responses. White standard errors in parentheses allowing for heteroscedasticity. For column (1)-(2) Newey-West standard errors are reported using the bandwidth $n = 4$. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level.