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Abstract

There is a growing interest in studying the disagreement of economic agents. Most studies, however, focus on the disagreement regarding one specific variable, hereby neglecting that disagreement may be comoving with disagreement on other variables. In this paper we explore to which extent disagreement regarding the interest rate is driven by disagreement on inflation and on unemployment. This relationship can be motivated by the existence of the Taylor rule. Using micro survey data for both professional forecasters and consumers, we provide evidence that disagreement on the future interest rate is mainly driven by disagreement on inflation. Exploring further determinants, we confirm that central bank transparency as well as news on money and credit conditions significantly influence disagreement.

Keywords: Disagreement, inflation expectations, microdata.

JEL classification: E31, E58, D84, C33.

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1 Introduction

Survey data of inflation forecasts from both households and professional forecasters frequently show considerable disagreement, with time-variation in relation to macroeconomic conditions (Mankiw et al., 2004; Lahiri and Sheng, 2008). This has important economic consequences: If agents' forecasts are dispersed, one of the main assumptions underlying the hypothesis of rational expectations is violated. Consequently, agents form their expectations on the basis of different information sets, or interpret signals differently. This may lead to non-converging beliefs in a Bayesian learning model (Acemoglu et al., 2007), or staggered beliefs in sticky information or rational inattention models (Woodford, 2001; Mankiw and Reis, 2002; Sims, 2003), thus causing inertia in price dynamics. If signals from monetary policy changes are misinterpreted, excess volatility in asset markets may arise, highlighting the need for a clear communication of policy (Sims, 2009).

The sources for disagreement in survey expectations have, to our knowledge, so far been analysed almost exclusively for inflation expectations and mostly for disagreement among professional forecasters. Furthermore, existing studies focus mainly on one measure of disagreement and neglect that disagreement on one economic variable might be strongly related to the disagreement on a different economic variable. There are now a few papers that enter these research gaps. For instance, Dovern (2014) uses the measure proposed by Banternghansa and McCracken (2009) to look into some properties of multivariate disagreement based on data from professional forecasters.

This paper contributes to the literature by exploring the potential comovement in a more structural way. If we believe in the Taylor rule, which is a very prominent concept to describe and forecast interest rate movements of central banks, any disagreement or uncertainty regarding inflation and/or economic growth should feed into the disagreement regarding the expected interest rate. Consequently, in this paper we evaluate if and to which extent disagreement on nominal interest rates can be explained by disagreement on inflation and unemployment.

We employ a clear identification using cohort-specific cross-sections for our measures of disagreement, making use of the rotating panel structure of the University of Michigan Survey of Consumers where consumers are interviewed at least twice within six months. This allows us to identify and track the cohorts of consumers who enter the rotating panel together. We then construct an overlapping micropanel dataset, with two disagreement observations per cohort. As a natural benchmark, we also estimate disagreement in a Taylor rule setting for the quarterly cross-section of forecasters in the Survey of Professional Forecasters (SPF) in the US.

In our estimation, we additionally account for a broad set of other variables. We highlight the role of economic news observed by consumers and of changes in the Fed's communication policy. Furthermore, we control for specific subsamples, e.g., for the initial

period of high and volatile inflation in the 80s, for the Great Moderation period as well as for the recent zero lower bound (ZLB) period.

Overall, we find evidence that disagreement regarding the future interest rate is dominated by disagreement on future inflation. By contrast, disagreement on unemployment is either insignificant or even shows a negative link with the disagreement on interest rates. This negative link only emerges in the analysis of consumers' disagreement and seems to be related to opposite movements of disagreement over the business cycle. In addition, we can document that central bank communication and news regarding the monetary policy stance significantly influence interest rate disagreement. Notably, we can explain at least 11% of the variation. Hence, the measured link is not only statistically significant, but also economically relevant.

There are several papers in the literature related to our approach. Dovern et al. (2012), Andrade et al. (2014) and Dovern (2014) study disagreement of professional forecasters on several macroeconomic variables. Dovern et al. (2012) evaluate disagreement of professional forecasters from the G7 countries regarding future prices, nominal interest rates and real GDP growth separately and relate reduced disagreement on prices to a stronger anchoring of inflation expectations and more independent central banks. Andrade et al. (2014) evaluate the term structure of disagreement of professional forecasters for expectations on real GDP growth, CPI inflation and the Federal Funds rate from the Bluechip Survey. Since forecasts are given up to 6-11 years ahead, the implied term structure covers a relatively long horizon. The authors relate their results to different models of imperfect information and sticky information and show that the model simulations imply that professionals perceive a central bank reaction function with a strong degree of interest-rate smoothing and disagreement on the inflation target and the growth rate of potential output. In a similar vein, Dovern (2014) combines professionals' forecasts on several variables to derive a multivariate measure of disagreement and shows that the resulting patterns could be explained with theories of heterogeneous information and learning.

The papers by Lahiri and Sheng (2008, 2010) test factors explaining disagreement of professional forecasters and the term structure of disagreement in the context of a Bayesian learning model. They find that differences in initial prior beliefs explain disagreement especially at longer forecast horizons up to two years ahead, while differences in the interpretation of public information are particularly important for disagreement at short horizons. Using the term structure of fixed-target forecasts with decreasing forecast horizon, Patton and Timmermann (2010) posit that professional forecaster's disagreement is driven mainly by differences in priors or models, rather than differences in information sets. Additionally, disagreement is found to vary over time and is higher during recessions, in line with theories suggesting higher macroeconomic uncertainty in downturns.

Lamla and Maag (2012) as well as Badarinza and Buchmann (2009) and Badarinza and Gross (2012) analyze the role of media news of both consumers' and professional forecasters' disagreement on inflation. Generally, news are found to reduce disagreement between

consumers in line with hypotheses from rational inattention or Bayesian learning models, whereas professional forecasters seem more affected by macroeconomic developments.

2 Using Disagreement to Measure Consumers' Perception of the Taylor Rule

The basic Taylor rule relationship derived in Taylor (1993) and used extensively in macroeconomic models relates interest rates set by the central bank to deviations of inflation from a desired target value and the output gap or a related measure for economic activity (Clarida et al., 1999). Using the unemployment rate, the Taylor rule can be described by:

$$i_t = \gamma + \alpha(\pi_t - \pi^*) + \beta u_t \quad \text{with} \quad \alpha > 1, \beta < 0 \tag{1}$$

where i_t denotes the nominal interest rate, π_t is inflation and u_t gives the unemployment rate. From (1) we derive the resulting relationship of disagreement on nominal interest rates, inflation and the unemployment rate. Taking expectations of (1) and measuring disagreement by the variance σ^2 of expected variables within a cohort, we get:

$$\sigma^2(i_t^e) = \alpha^2\sigma^2(\pi_t^e) + \beta^2\sigma^2(u_t^e) + 2\alpha\beta cov(\pi_t^e, u_t^e) \tag{2}$$

If the Taylor rule relationship holds, disagreement on expected nominal interest rates should thus be positively related to both disagreement on expected inflation and the expected unemployment rate, as well as a measure of the covariance of inflation and unemployment expectations. We can thus use the relation in equation (2) to test if consumers' disagreement on macroeconomic variables moves in line with a Taylor rule relation. In that sense, equation (2) amounts to an implicit test of consumers' perception of the central bank's reaction function.

The Taylor rule is often augmented with a lagged term in order to account for the observed inertia in nominal interest rates as central banks prefer a smooth transition to the target interest rate. Allowing for this inertia has the following implications for the estimation equation:

$$i_t = \rho i_{t-1} + (1-\rho)\left(\gamma + \alpha(\pi_t - \pi^*) + \beta u_t\right) \quad \text{with} \quad \rho < 1, \alpha > 1, \beta < 0 \tag{3}$$

$$\begin{aligned}\sigma^2(i_t^e) = {} & \rho^2\ \sigma^2(i_{t-1}^e) + (1-\rho)^2\alpha^2\ \sigma^2(\pi_t^e) + (1-\rho)^2\beta^2\ \sigma^2(u_t^e) \\ & + 2(1-\rho)^2\alpha\beta\ cov(\pi_t^e, u_t^e) + 2\rho(1-\rho)\alpha\ cov(i_{t-1}^e, \pi_t^e) + 2\rho(1-\rho)\beta\ cov(i_{t-1}^e, u_t^e)\end{aligned} \tag{4}$$

3 The Dataset

For our analysis, we employ the micro dataset of the University of Michigan Survey of Consumers as well as the Survey of Professional Forecasters (SPF) in the US, conducted at the Philadelphia Fed. The microdata of the Michigan Survey is available from January 1978 to September 2013. The survey is representative of the U.S. population and via telephone collects monthly data on consumers' macroeconomic expectations, personal income expectations, purchasing attitudes, perceived economic news, wealth position as well as demographic characteristics.[1] A special feature of the survey is its rotating panel component: About 40% of each monthly sample are chosen to be re-interviewed after six months, so that each survey cross-section contains about 80% of respondents that have their first or second interview within the rotating panel. We use the rotating panel dimension to identify the relevant cohort for our analysis of disagreement: Rather than calculating disagreement measures within each cross-section in time, as is frequently done in the literature, we calculate disagreement only within the group of respondents that enter the rotating panel together. Thereby, we obtain an overlapping panel structure, with two disagreement observations per cohort, one for their first interview and one for their second interview. This gives us a clear identification of the relevant peer group and furthermore allows us to analyze changes in disagreement within the cohort. In order to avoid extreme values affecting our results, we truncate the sample and exclude observations with quantitative short- or long-run expectations outside the upper or lower 1% of the distribution. Moreover, due to changes in the survey design and the sample size, we use only observations from 1983 onwards.

The survey collects both quantitative and qualitative measures of consumers' inflation expectations, as well as their qualitative nominal interest rate and unemployment expectations. The questions on inflation, interest rate and unemployment expectations are phrased as follows:

A12 "During the next 12 months, do you think that prices in general will go up, (go up at the same rate), go down, or stay where they are now?"

A12b "By about what percent do you expect prices to go up/down on the average during the next 12 months?"

A11 "No one can say for sure, but what do you think will happen to interest rates for borrowing money during the next 12 months – will they go up, stay the same, or go down?"

A10 "How about people out of work during the coming 12 months – do you think that there will be more unemployment than now, about the same, or less?"

[1] For further details on the University of Michigan Survey of Consumers, see http://www.sca.isr.umich.edu.

Arguably, question A11 asks about the interest rate for borrowing money and not directly about the Federal Funds rate. However, there is a strong empirical correlation between the loan rates at different maturities and the policy rate, as highlighted in Carvalho and Nechio (2014). The Michigan Survey further asks respondents whether they observed any economic news:

A6. "During the last few months, have you heard of any favorable or unfavorable changes in business conditions?"
1. Yes 2. No

If the question is answered with "Yes", an open question with two possible answers follows:

A6a. "What did you hear? (Have you heard of any other favorable or unfavorable changes in business conditions?)"

The answers to the open news question are coded into categories by the Michigan Survey of Consumers. For our analysis, we calculate the shares of respondents within each cohort reporting that they observed news on *"high/higher prices, inflation"* ($share\_newsprices\_high$) and on *"stable prices, less inflation, falling prices, deflation"* ($share\_newsprices\_low$). Similarly, we calculate the shares reporting news on *"tight money, interest rates high"* ($share\_newstightmoney$) or on *"easier money, credit easy to get, low interest rates"* ($share\_newseasymoney$).

Regarding the data for professional forecasters in the SPF, we obtain quantitative expectations on one-year-ahead 3-months Treasury Bill rates, CPI inflation and the unemployment rate, available from 1981q4 onwards. The SPF also contains a panel component, since professional forecasters often stay within the survey for several periods.

Additionally, we control for effects of major changes in monetary policy communication on disagreement. To do so, we construct dummy variables for the announcement of changes in the Federal Funds Target rate in February 1994 ($fft94$), the publication of the "balance of risks" statement in January 2000 ($bofrisk00$), the publication of the votes after an FOMC meeting in March 2002 ($votes02$), the introduction of the Chairman's press conference after the release of projections in April 2011 ($presscon f11$) and the announcement of the explicit inflation target of 2% in January 2012 ($fedtarget12$). All communication dummies take on the value of 1 at the month of the introduction of the measure and all subsequent months, so that the coefficients measure the additional effect of this particular communication measure to the ones introduced previously.

4 Measuring Disagreement

In the following analysis, we evaluate professional forecasters' and consumers' disagreement with respect to disagreement on nominal interest rates, inflation and unemployment

in a Taylor rule relationship. Since the SPF contains quantitative expectations regarding interest rates, inflation and the unemployment rate, we employ a standard measure of disagreement and take the interquartile range of expectations within the quarterly cross-section of forecasters. Regarding consumers in the Michigan Survey, only inflation expectations are available as a quantitative measure. However, since the Michigan Survey records only full integer values, the IQR would not be an appropriate measure of disagreement, so that we use the standard deviation of expectations within the relevant cohort instead.

In order to measure disagreement of consumers with respect to qualitative expectations of nominal interest rates and the unemployment rate, we use two measures frequently applied in the literature, namely the index of qualitative variation (IQV) and the measure of ordinal variation (MOV). The index of qualitative variation (IQV), first introduced by Gibbs and Poston (1975), is defined as:

$$IQV_{s,t} = \frac{K}{K-1}\left(1 - \sum_{i=1}^{K} s_{i,s,t}^2\right), \tag{5}$$

where $K = 3$ is the number of answer categories in the qualitative questions, and $s_{i,s,t}$ is the fraction of responses in category i for cohort s and time t. A related measure is the measure of ordinal variation (MOV) by Blair and Lacy (2000). Disagreement measured by MOV is given by $MOV = 1 - l^2$, where l^2 is a measure of concentration defined as follows:

$$l_{s,t}^2 = \frac{\sum_{i=1}^{K}\left(F_{i,s,t} - \frac{1}{2}\right)^2}{(K-1)/4}, \tag{6}$$

where $F_{i,s,t}$ denotes the cumulative answer share in category i for cohort s and time t. Both the IQV and the MOV criteria are restricted to lie in the range $(0, 1)$, where a value of 0 implies that answers fall into a single category, and the maximum is reached when the answers are distributed evenly across the categories in the case of IQV, and when the answers are polarized in the outer categories in the case of MOV. Both the IQV and the MOV for short-run qualitative inflation expectations from consumers in the Michigan Survey are shown to be highly positively correlated with the corresponding cross-sectional standard deviation of quantitative inflation expectations in Mokinski et al. (2015). In that sense, both measures should be viable. However, the study of inflation expectations from a pentachotomous survey in Maag (2009) shows that the IQV for qualitative inflation expectations fares best in matching the corresponding standard deviation and this measure is also used in Lamla and Maag (2012) to measure disagreement. Hence, we present results for the IQV in the regression analysis and report the results using the MOV as a robustness check in the Appendix.

We check whether our qualitative disagreement measures relate well to the corresponding quantitative ones in the case of inflation expectations, where both qualitative

Table 1: Correlation of Quantitative and Qualitative Disagreement Measures for Short-Run Inflation Expectations within Cohorts

	IQV	MOV	SD	IQR
IQV	1.000			
MOV	0.980	1.000		
SD	0.145	0.191	1.000	
IQR	0.451	0.449	0.484	1.000

Note: Sample 1983m1-2013m4, 725 observations.

and quantitative questions are available. This is analyzed in detail for consumers in the Michigan Survey in Mokinski et al. (2015). However, our dataset differs slightly since we use a different truncation as well as sample period and calculate disagreement not within the full cross-section at each moment in time, but within the rotating panel cohort. Pairwise correlations between IQV, MOV, the standard deviation (SD) and the interquartile range (IQR) for both short- and long-run inflation expectations are shown in Table 1. As expected, the two qualitative and the two quantitative measures are highly positively correlated, where the lower correlations between SD and IQR arise from the fact that IQR has only full integer values since the Michigan survey records only integer expectations. Regarding the link between disagreement from qualitative and from quantitative questions, we find reasonably high positive correlations between the qualitative measures and the IQR, while the link is considerably weaker in the case of comparing the SD. This suggests that survey expectations extracted from qualitative and quantitative questions are not entirely substitutable, a result which is also confirmed in Dräger and Lamla (2012). Nevertheless, we argue that the measures are close enough to employ the IQV of short-run qualitative inflation expectations together with the corresponding disagreement measures for nominal interest rate expectations and unemployment expectations.[2]

Figure 1 depicts the IQV for the nominal interest rate and unemployment expectations, as well as the standard deviation of quantitative inflation expectations, where shaded areas denote NBER recessions. All disagreement measures vary cyclically over time, with a relatively large volatility especially for the disagreement measures of inflation and interest rate expectations. Notably, consumers' disagreement on inflation and interest rates tends to rise during recessions, while we observe the opposite movement in the disagreement on unemployment. Thus it seems that while consumers are unsure about future inflation and interest rates in recessionary periods, they seem to agree that unemployment will increase. Figure 2 shows the corresponding disagreement measures for professional forecasters in the SPF, measured by the interquartile ranges of quantitative expectations in the quarterly

[2]Alternatively, qualitative disagreement could be quantified with the probability approach, as suggested in Mokinski et al. (2015). In the present context, we leave this for future research.

Figure 1: Consumers' Disagreement on Interest Rate, Inflation and Unemployment Expectations

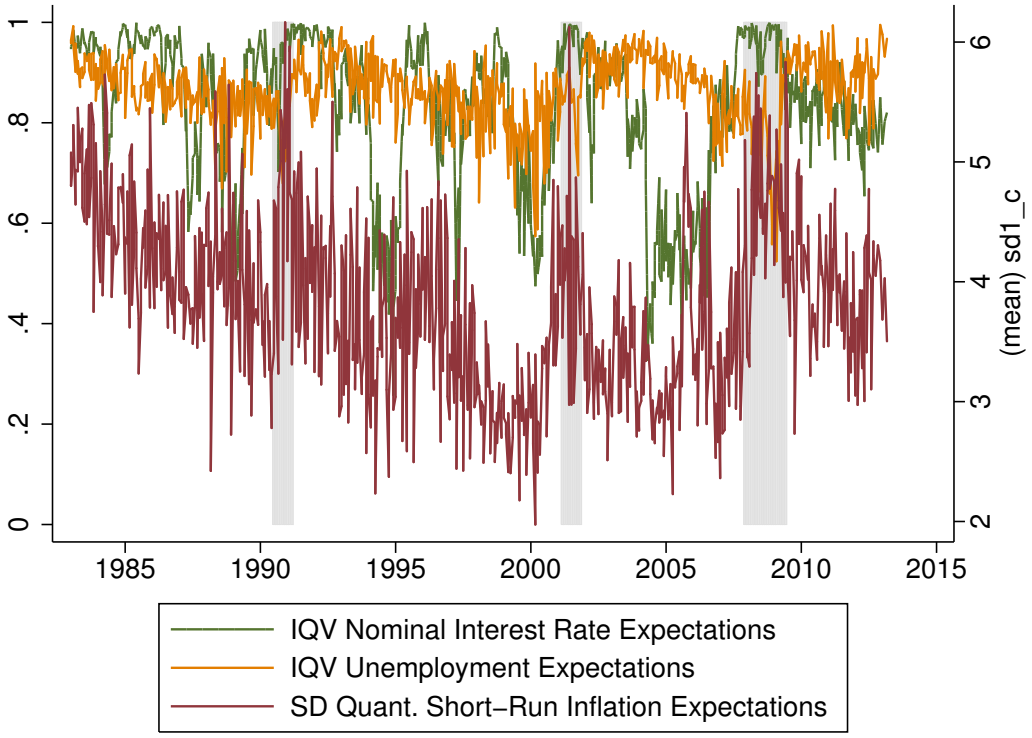
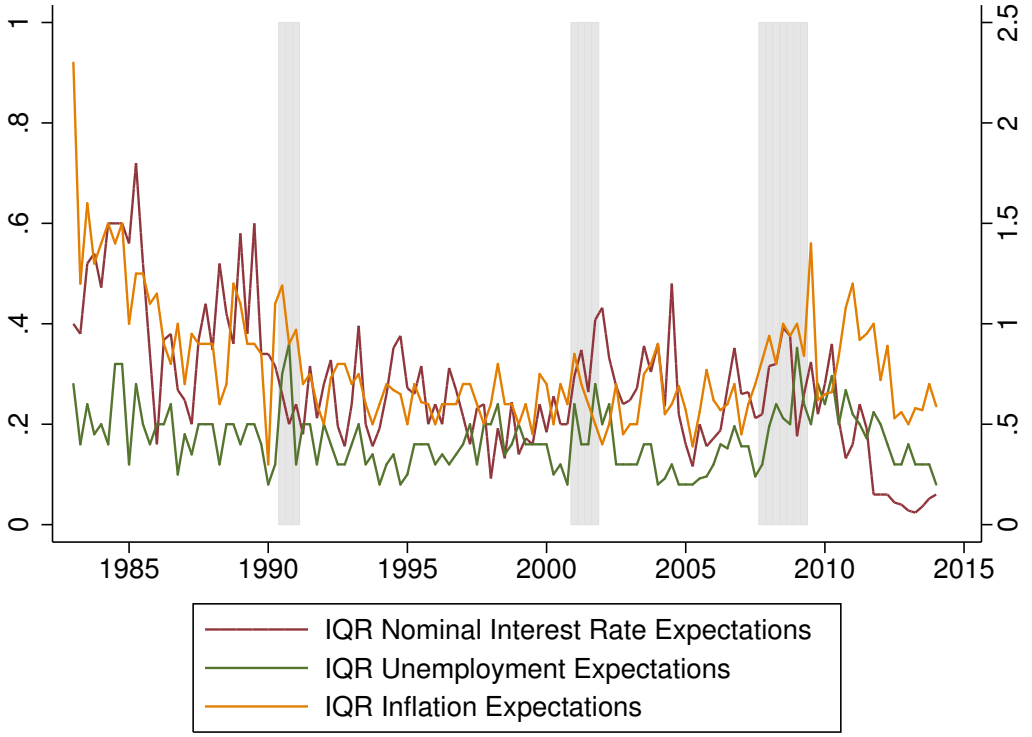


Figure 2: Professionals' Disagreement on Interest Rate, Inflation and Unemployment Expectations



cross-sections. In contrast to the data for consumers, the figure suggests a strong positive comovement between all three disagreement measures.

Looking at the cross-correlations between the disagreement measures for consumers and professional forecasters in Tables 2 and 3, we observe a strong positive correlation between disagreement on interest rates and disagreement on inflation for both groups. By contrast, consumers' disagreement on interest rates is negatively correlated with their disagreement on unemployment, although with a very low correlation coefficient. This is not the case for professionals, where we observe a positive correlation of interest rate disagreement also with unemployment disagreement, albeit less strongly than for inflation disagreement.

Table 2: Cross-Correlations of Disagreement Measures for Consumers

Variables	$IQV(i^e)$	$SD(\pi^e)$	$IQV(u^e)$
$IQV(i^e)$	1.000		
$SD(\pi^e)$	0.318	1.000	
$IQV(u^e)$	-0.074	0.032	1.000

Table 3: Cross-Correlations for Disagreement Measures for Professional Forecasters

Variables	$IQR(i^e)$	$IQR(\pi^e)$	$IQR(u^e)$
$IQR(i^e)$	1.000		
$IQR(\pi^e)$	0.579	1.000	
$IQR(u^e)$	0.382	0.527	1.000

Looking at this negative relation between unemployment and interest rates in detail, we find evidence that especially during recessions forecast disagreement regarding unemployment goes down substantially. The measured disagreement $IQV(u^e)$ is 0.87 in normal times and reduces to 0.82 in recessions, as defined by the NBER dating committee. Formulating a t-test, this difference is statistically significant (t-stat 7.23, dof 805).

5 Explaining Interest Rate Disagreement in a Taylor Rule Setting

In this section, we analyse to which extent disagreement on interest rates can be explained in a Taylor-rule type way, i.e. as a combination of disagreement on inflation and disagreement on unemployment. We begin our analysis by looking at professional forecasters and continue with an in-depth analysis with respect to consumers. For professional forecasters we estimate the relation with standard OLS with robust standard errors. Since the dataset of consumers contains two observations per cohort, we investigate this relationship using a random effects panel estimator.

Table 4 shows the results for professional forecasters with respect to the Taylor rule relationship derived in equation (2). In column (1) we observe a strong positive link between disagreement on inflation and disagreement regarding the interest rate. While the unemployment effect is positive, it is only significant at the 15 percent level. The covariance term included in column (2) shows statistical significance as well, with the expected positive sign. In column (3) we account for the potential inertia or persistence of interest rate disagreement, which could be motivated by interest rate smoothing. This persistence term is statistically highly relevant. Again, inflation disagreement has a significant effect, while disagreement regarding unemployment does not. To conclude, we can show that professional forecasters' disagreement regarding interest rates is dominated by their disagreement on future inflation, while disagreement on unemployment exerts no statistical influence. This is quite surprising as one could have imagined that professionals are well aware of how the FED sets the interest rate and that the uncertainty regarding both, inflation and unemployment, should play a significant role.

Table 4: Disagreement *à* la Taylor Rule for Professional Forecasters

Interest Rate Disagreement	(1) Baseline Model	(2) Covariance Inflation and Unemployment	(3) Inertia
$IQR(i^e)_{t-1}$			0.676***
			(0.137)
$IQR(\pi^e)_t$	0.852***	0.815***	0.204*
	(0.240)	(0.248)	(0.118)
$IQR(u^e)_t$	0.343	0.499	0.196
	(0.345)	(0.336)	(0.192)
$cov(\pi^e, u^e)_t$		1.439**	0.542
		(0.617)	(0.539)
$cov(\pi^e_t, i^e_{t-1})_t$			0.303
			(0.326)
$cov(u^e_t, i^e_{t-1})_t$			-0.596
			(0.770)
Constant	-0.073	-0.072	-0.025
	(0.189)	(0.191)	(0.119)
Observations	131	131	130
Adj. R^2	0.333	0.358	0.665

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

Next, Table 5 contains our main results for the consumers testing for the Taylor rule relation derived in equation (2). In column (1) we include the measures of disagreement on inflation and the unemployment rate. Interestingly, disagreement regarding inflation one year ahead has a statistically significant positive effect on disagreement regarding interest rates, while the effect of disagreement on unemployment shows a negative sign. Given that both unemployment as well as inflation should have a positive impact on interest rate

Table 5: Disagreement *à* la Taylor Rule for Consumers, Micropanel

Interest Rate Disagreement	(1) Baseline Model	(2) Covariance Inflation and Unemployment	(3) Long-Run Inflation Expectations
$SD(\pi^e)_{i,t}$	0.044***	0.046***	0.045***
	(0.006)	(0.006)	(0.011)
$IQV(u^e)_{i,t}$	-0.122*	-0.096	-0.195**
	(0.064)	(0.066)	(0.076)
$cov(\pi^e, u^e)_{i,t}$		0.014*	0.018**
		(0.008)	(0.009)
$SD(\pi^{e,5-10yrs})_{i,t}$			0.025**
			(0.011)
Constant	0.764***	0.741***	0.756***
	(0.062)	(0.063)	(0.072)
Observations	807	807	628
Number of cohorts	404	404	321
Random Effects	Yes	Yes	Yes
Overall R^2	0.112	0.116	0.167

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

disagreement according to a Taylor rule, this result is quite surprising. Notably, while the result regarding inflation remains robust throughout all specifications, unemployment disagreement looses statistical significance in several models. This could be indicative of a perception by consumers that the Fed places stronger weight on the inflation targeting objective of monetary policy. Furthermore, we observe that consumers disagree less on unemployment in recessions, while they disagree more on inflation. Our results could thus also be related to different movements in disagreement over the business cycle.

In column (2) we add the covariance between inflation and unemployment expectations, which is statistically significant with a positive effect on interest rate disagreement as expected. Furthermore, unemployment becomes statistically insignificant. In column (3) we control for the disagreement regarding quantitative long-run inflation expectations. Disagreement on long-run inflation also has a statistically significant positive effect on interest rate disagreement, albeit with a smaller coefficient than short-run inflation disagreement. As monetary policy is expected to be forward-looking and show strong inertia, uncertainty regarding longer-term inflation expectations should feed into one-year-ahead expectations of interest rates. In terms of explanatory power, however, it does not add much to the regression. Furthermore, since it does not significantly change the coefficient estimate of one-year-ahead inflation disagreement, we discard long-run expectations in the upcoming model specifications.

In Table 6, we control for additional variables that might influence disagreement on interest rates, such as monetary news observed by the cohort and monetary policy com-

Table 6: Disagreement *à* la Taylor Rule for Consumers, Micropanel with News and Communication

Interest Rate Disagreement	(1) Full Sample	(2) Disinflation pre-1996	(3) Great Moderation 1996-2007	(4) Financial Crisis post-2007
$SD(\pi^e)_{i,t}$	0.058***	0.053***	0.032***	0.012
	(0.005)	(0.007)	(0.011)	(0.010)
$IQV(u^e)_{i,t}$	-0.276***	-0.074	-0.124	-0.213***
	(0.061)	(0.086)	(0.107)	(0.060)
$cov(\pi^e, u^e)_{i,t}$	0.015**	0.013	0.008	0.017**
	(0.007)	(0.009)	(0.014)	(0.008)
$fft94_t$	-0.071***	-0.132***		
	(0.015)	(0.028)		
$bofrisk00_t$	0.056***		0.068***	
	(0.019)		(0.018)	
$votes02_t$	-0.022		-0.096***	
	(0.020)		(0.022)	
$presconf11_t$	0.018			-0.047***
	(0.017)			(0.015)
$fedtarget12_t$	-0.059***			-0.041**
	(0.020)			(0.019)
$share\_newsprices\_high_{i,t}$	-0.431***	-0.337**	-0.757***	0.159***
	(0.093)	(0.147)	(0.165)	(0.051)
$share\_newsprices\_low_{i,t}$	0.044	-0.167	0.647**	0.411
	(0.173)	(0.202)	(0.302)	(0.434)
$share\_newstightmoney_{i,t}$	-1.189***	-0.854***	-1.881***	0.495
	(0.139)	(0.154)	(0.260)	(0.332)
$share\_newseasymoney_{i,t}$	0.754***	0.767***	1.140***	0.855***
	(0.134)	(0.174)	(0.244)	(0.263)
Constant	0.915***	0.741***	0.832***	1.003***
	(0.060)	(0.079)	(0.101)	(0.079)
Observations	807	399	280	128
Number of cohorts	404	203	146	67
Random Effects	Yes	Yes	Yes	Yes
Overall R^2	0.440	0.465	0.581	0.587

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

munication changes. Our main results regarding the Taylor rule decomposition of disagreement remain unchanged.

Furthermore, we can confirm that the important milestones in central bank communication, except for the balance of risk assessment, significantly reduced consumers' disagreement of interest rate expectations. This is an interesting result as it emphasizes the effectiveness of the improvements in transparent policy communication also on consumers' disagreement. In addition, we can show that perceived news matter for the level of disagreement. News on money and credit conditions in the economy affect disagreement significantly and are also economically important. Notably, news heard about tight money and credit conditions generally reduce interest rate disagreement, while news on easy credit conditions have the reverse effect. Regarding news on prices, we mainly find that negative news on high prices or inflation reduce the disagreement regarding interest rates.

Additionally, we check for time-variation in the disagreement relationship, differentiating between the Disinflation period between 1978-1995, the Great Moderation between 1996-2007 and the Financial Crisis period from 2008 onwards. Most results remain robust between the Disinflation and the Great Moderation period. Inflation disagreement is statistically relevant for interest rate disagreement only until the recent crisis. By contrast, we observe that the negative effect of unemployment disagreement is mainly driven by the recent financial crisis. Recalling that we use the disagreement of a categorical variable, this result could suggest that now more people agree that unemployment will be rising. Additionally, in the ZLB period of the recent financial crisis news effects become insignificant or weaker. Interestingly, the effect of news perceived on high prices changes its sign, where we now find a positive effect on interest rate disagreement. This might be indicative of the fact that as inflation was no issue during the recent years, monetary policy focused more on stabilizing the financial sector and the real economy, thereby deviating from a classical Taylor-rule-type policy.

Next, we break up the panel dimension to account for the potential persistence in disagreement motivated by the widely observed interest rate inertia in the Taylor rule. We thus calculate disagreement within a cohort separately for the first and the second interview. This allows us to test for the inertia in disagreement by explaining disagreement regarding interest rates at the second interview by the disagreement in the first interview (the inertia term) and disagreement regarding inflation and unemployment taken from the second interview as shown theoretically in (4). Given the strong support for inertia using the SPF data, this approach seems sensible. Results are presented in Table 7. In columns (1) and (2) we now show the results for the first and second interview separately. While the results are similar in sign and statistical significance for disagreement on inflation, we find little statistical support regarding the disagreement on unemployment. Column (3) contains the specification of interest including the interest rate inertia term. Notably, we have to add two additional covariance terms for the covariance between lagged interest rate

expectations and inflation as well as unemployment expectations. The results show that disagreement on interest rates indeed shows a degree of persistence as the disagreement in the first interview explains disagreement in the second interview. Given the strong persistence of interest rates in level estimations of the Taylor rule, this is as expected. Again, we see that disagreement on inflation expectations has a significantly positive effect on interest rate disagreement, while disagreement on unemployment has a marginally significant negative effect. Differentiating again between the different time periods, the results mirror the findings of Table 4.

As a final robustness check, we also estimate the relationship taking the differences between first and second interviews within the cohort. Results are shown in Table 7. Explaining changes in disagreement on interest rates between interviews for a specific cohort with changing disagreement regarding inflation and unemployment does not alter our conclusions, although significance levels are reduced. Disagreement on inflation influences interest rate disagreement significantly in the earlier sample period. Disagreement on unemployment has a negative effect mainly driven by the recent crisis. Regarding the additional control variables, we find again supportive evidence for the importance of news and central bank transparency with similar patterns between time periods.

Table 7: Disagreement *à* la Taylor Rule, First and Second Interviews

Interest Rate Disagreement	(1) First Interview	(2) Second Interview	(3) Inertia	(4) Disinflation pre-1996	(5) Great Moderation 1996-2007	(6) Financial Crisis post-2007
$SD(\pi^e)^{first}_{i,t}$	0.052***					
	(0.007)					
$IQV(u^e)^{first}_{i,t}$	-0.108					
	(0.095)					
$cov(\pi^e, u^e)^{first}_{i,t}$	0.043					
	(0.052)					
$IQV(i^e)^{first}_{i,t-1}$			0.440***	0.271***	0.504***	0.429***
			(0.056)	(0.103)	(0.062)	(0.136)
$SD(\pi^e)^{second}_{i,t}$		0.053***	0.031***	0.026***	0.034*	0.016
		(0.007)	(0.007)	(0.010)	(0.020)	(0.018)
$IQV(u^e)^{second}_{i,t}$		0.005	-0.139*	0.101	-0.350*	-0.256**
		(0.084)	(0.084)	(0.137)	(0.180)	(0.106)
$cov(\pi^e, u^e)^{second}_{i,t}$		0.005	-0.043	-0.030	-0.036	-0.109*
		(0.053)	(0.046)	(0.089)	(0.074)	(0.064)
$cov(i^{e,first}, u^{e,second})_{i,t}$			0.041	0.079	-0.002	-0.007
			(0.032)	(0.056)	(0.055)	(0.032)
$cov(i^{e,first}, \pi^{e,second})_{i,t}$			-0.008	-0.007	-0.027	0.001
			(0.013)	(0.015)	(0.017)	(0.016)
Constant	0.703***	0.629***	0.467***	0.429***	0.571***	0.662***
	(0.082)	(0.078)	(0.086)	(0.135)	(0.191)	(0.189)
Observations	409	404	403	196	140	67
Adj. R^2	0.118	0.107	0.308	0.172	0.322	0.344

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

Table 8: Disagreement *à* la Taylor Rule, Differences between Interviews

Interest Rate Disagreement	(1) Baseline Model	(2) Covariance	(3) Long-Run	(4) add. Vars	(5) Disinflation pre-1996	(6) Great Moderation 1996-2007	(7) Financial Crisis post-2007
$d(SD(\pi^e))_t$	0.019*	0.021*	0.014	0.025**	0.031*	0.020	0.011
	(0.011)	(0.011)	(0.013)	(0.010)	(0.016)	(0.016)	(0.013)
$d(IQV(u^e))_t$	-0.246***	-0.232**	-0.262***	-0.185**	-0.138	-0.138	-0.202*
	(0.090)	(0.093)	(0.101)	(0.086)	(0.151)	(0.141)	(0.119)
$d(cov(\pi^e, u^e))_t$		0.009	0.010	0.009	0.016	0.002	0.001
		(0.010)	(0.010)	(0.008)	(0.013)	(0.020)	(0.013)
$d(SD(\pi^{e,5-10yrs}))_t$			0.082				
			(0.070)				
$fft94_t$				-0.001	-0.001		
				(0.022)	(0.054)		
$bofrisk00_t$				0.041		0.026	
				(0.031)		(0.034)	
$votes02_t$				-0.052*		-0.039	
				(0.027)		(0.033)	
$presscon f11_t$				0.007			-0.007
				(0.022)			(0.022)
$fedtarget12_t$				-0.053**			-0.041*
				(0.026)			(0.024)
$d(share\_newsprices\_high)_t$				-0.284***	-0.343	-0.278	-0.021
				(0.098)	(0.218)	(0.241)	(0.105)
$d(share\_newsprices\_low)_t$				0.126	-0.095	0.515	0.092
				(0.224)	(0.278)	(0.420)	(0.620)
$d(share\_newstightmoney)_t$				-1.147***	-1.039***	-1.585***	0.084
				(0.207)	(0.254)	(0.337)	(0.483)
$d(share\_newseasymoney)_t$				0.498***	0.364	1.014***	1.012***
				(0.189)	(0.276)	(0.275)	(0.339)
Constant	0.011	0.012	0.007	0.014	0.018	0.016	0.006
	(0.007)	(0.007)	(0.008)	(0.010)	(0.012)	(0.015)	(0.014)
Observations	403	403	292	403	196	140	73
Adj. R^2	0.0258	0.0251	0.0314	0.276	0.214	0.400	0.109

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

6 Conclusion

In this paper we investigate whether disagreement on interest rates is driven by disagreement on inflation and unemployment. Motivated by the Taylor rule people might take into account the dual mandate of monetary policy in stabilizing inflation and unemployment when forecasting future policy rates. Using detailed microdata on consumer expectations as well as professional forecasters we provide evidence that disagreement regarding the future interest rate is mainly driven by disagreement regarding future inflation. It might thus reflect the focus of the FED on price stability as perceived by both consumers and professional forecasters. Disagreement on unemployment has no statistical effect on disagreement on interest rates for professionals. For consumers it is insignificant in several specifications but exerts a negative effect during the financial crisis. These results provide little evidence for Taylor-rule type disagreement. Especially, the negative link for consumers during the recent crisis warrants further research.

In addition, we can report that changes in central bank transparency and perceived news on money and credit conditions are very relevant for interest rate disagreement. Improvements in transparency helped reduce disagreement on interest rates. Especially the announcement of the federal funds target in 1994 as well as the introduction of the Fed inflation target in 2012 significantly lowered disagreement on future interest rates.

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7 Appendix

7.1 Robustness Check: Results with MOV Disagreement Measures

Table A.1: Disagreement *à* la Taylor Rule, MOV Measures

Interest Rate Disagreement	(1) Baseline Model	(2) Covariance Inflation and Unemployment	(3) Long-Run Inflation Expectations
$SD(\pi^e)_{i,t}$	0.058***	0.062***	0.057***
	(0.006)	(0.006)	(0.011)
$MOV(u^e)_{i,t}$	-0.143**	-0.102	-0.189***
	(0.061)	(0.062)	(0.071)
$cov(\pi^e, u^e)_{i,t}$		0.022***	0.027***
		(0.008)	(0.009)
$SD(\pi^{e,5-10yrs})_{i,t}$			0.033***
			(0.011)
Constant	0.555***	0.526***	0.506***
	(0.048)	(0.048)	(0.053)
Observations	807	807	628
Number of cohorts	404	404	321
Random Effects	Yes	Yes	Yes
Overall R^2	0.176	0.188	0.232

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

Table A.2: Disagreement *à* la Taylor Rule with News and Communication, MOV Measures

Interest Rate Disagreement	(1) Full Sample	(2) Disinflation pre-1996	(3) Great Moderation 1996-2007	(4) Financial Crisis post-2007
$SD(\pi^e)_{i,t}$	0.065***	0.060***	0.038***	0.011
	(0.006)	(0.007)	(0.012)	(0.012)
$IQV(u^e)_{i,t}$	-0.245***	-0.101	-0.130	-0.268***
	(0.061)	(0.084)	(0.105)	(0.096)
$cov(\pi^e, u^e)_{i,t}$	0.017**	0.014	0.006	0.024**
	(0.007)	(0.011)	(0.013)	(0.012)
$fft94_t$	-0.071***	-0.110***		
	(0.014)	(0.026)		
$bofrisk00_t$	0.084***	0.000	0.111***	
	(0.022)	(0.000)	(0.020)	
$votes02_t$	-0.068***	0.000	-0.138***	
	(0.022)	(0.000)	(0.022)	
$presscon f11_t$	-0.025	0.000	0.000	-0.076***
	(0.020)	(0.000)	(0.000)	(0.021)
$fedtarget12_t$	-0.065***	0.000	0.000	-0.044*
	(0.023)	(0.000)	(0.000)	(0.023)
$share\_newsprices\_high_{i,t}$	-0.315***	-0.260	-0.630***	0.246***
	(0.095)	(0.168)	(0.150)	(0.080)
$share\_newsprices\_low_{i,t}$	-0.002	-0.339*	0.884***	0.638
	(0.188)	(0.199)	(0.300)	(0.569)
$share\_newstightmoney_{i,t}$	-0.912***	-0.622***	-1.733***	1.038**
	(0.146)	(0.173)	(0.256)	(0.430)
$share\_newseasymoney_{i,t}$	0.897***	0.826***	1.347***	1.515***
	(0.150)	(0.191)	(0.288)	(0.371)
Constant	0.657***	0.574***	0.616***	0.807***
	(0.048)	(0.060)	(0.081)	(0.095)
Observations	807	399	280	128
Number of cohorts	404	203	146	67
Random Effects	Yes	Yes	Yes	Yes
Overall R^2	0.448	0.401	0.571	0.628

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