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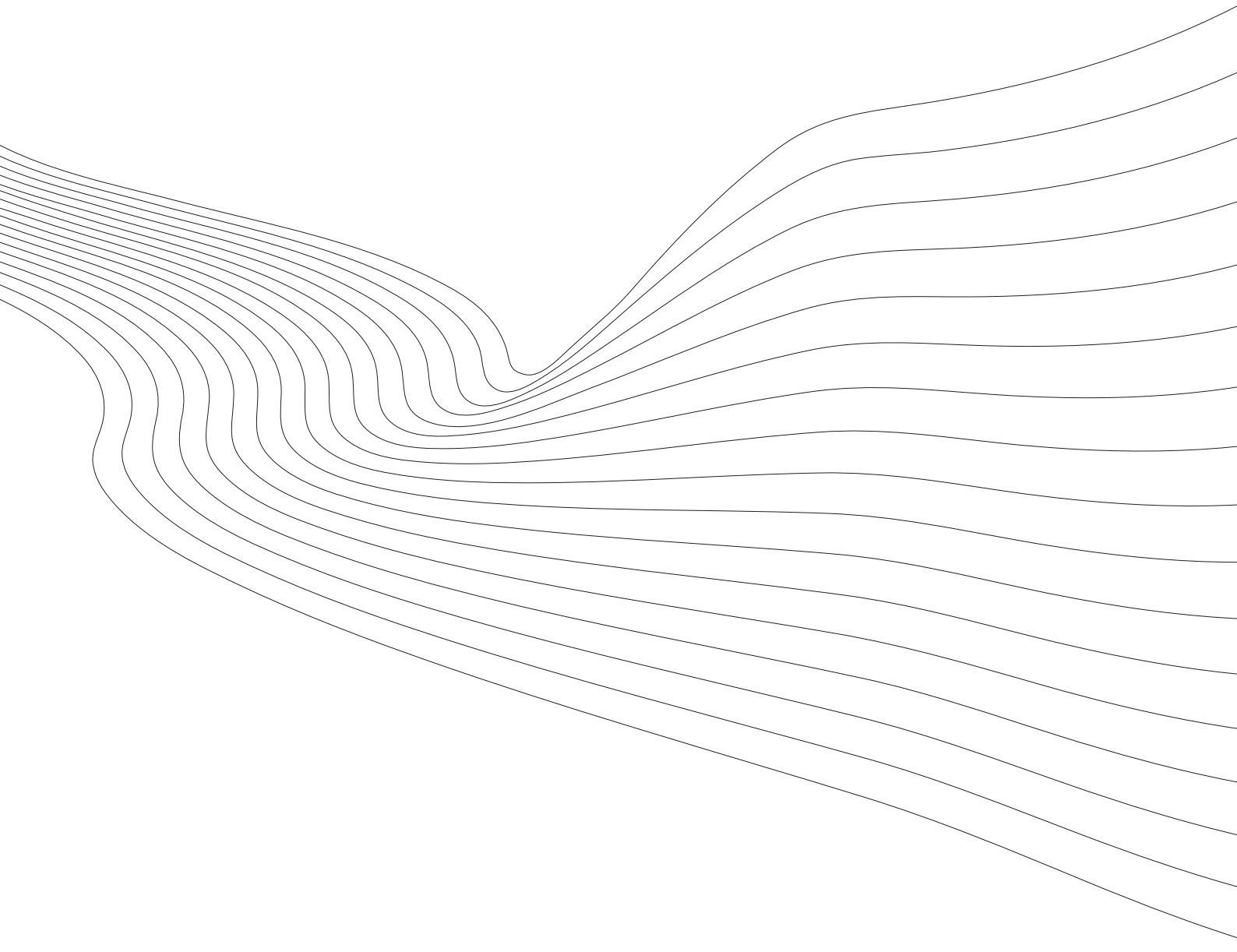

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Anchoring of Consumers' Inflation Expectations: Evidence from Microdata

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Abstract

In this paper we explore the degree of anchoring of consumers' long-run inflation expectations. If expectations are firmly anchored, short- and long-run expectations should show no comovement in response to transitory shocks. Utilizing the University of Michigan Survey of Consumer's rotating panel microstructure, we can identify changes in inflation expectations of individual consumers over time. Our results indicate that long-run inflation expectations became more anchored over the last decades. While the degree of comovement fell significantly after 1996, the probability of a joint adjustment stayed constant. Regarding the possible determinants, we find that consumers' rising interest rate expectations and perceived news on the monetary policy stance have a detrimental effect on the anchoring of long-run expectations. This effect is no longer present in the post-1996 period. Notably, a positive effect of perceived news on government debt on the degree of comovement emerges after 1996, alluding to a potentially problematic link between fiscal and monetary policy.

Keywords: Anchoring, inflation expectations, microdata, news.

JEL classification: E52, D84.

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1 Introduction

To anchor inflation expectations around an implicit or explicit inflation target is one of the most important tasks of monetary policy aiming to stabilize inflation (Bernanke, 2007). Well-anchored expectations enables inflation-targeting central banks to achieve greater stability of output and employment in the short-run, while ensuring price stability in the long-run (Orphanides and Williams, 2007). Consequently, central bank communication frequently talks about how well anchored inflation expectations are. Especially since the outbreak of the recent financial crisis and the following ultra-expansionary monetary policy stance, politicians and central bankers closely monitor the degree of anchoring.

In this paper, we investigate how anchored consumers' inflation expectations are by analyzing the comovement between short- and long-run inflation expectations of individual consumers. Ideally, if inflation expectations are firmly anchored, a transitory shock should influence the short-run inflation expectations but have no effect on long-run inflation expectations. Consequently, a transmission from short- to long-run expectations would be judged unfavorably.

Our analysis is based on individual consumers' inflation expectations in the US taken from the University of Michigan Survey of Consumers. For a sound identification of the adjustments of individual expectations, we use the rotating panel dimension of the survey, where 40% of the respondents are re-interviewed after six months. Hence, we can identify individual consumer expectation formation over time. As the survey captures both short- and long-run expectations as well as perceived economic news of the surveyed individuals, we can test for the strength of the comovement of short- and long-run inflation expectations and at the same time control for effects of macroeconomic variables and news.

Analyzing the degree of comovement between US consumers' short- and long-run inflation expectations, i.e. the degree of anchoring, we find that the strength of comovement has fallen considerably over time, implying a stronger anchoring of expectations. Interestingly, our results suggest that the turning point for the anchoring of inflation expectations was not the Volcker disinflation, but the period of preemptive tightening by the Greenspan Fed after 1996. Furthermore, we find that the probability of a simultaneous adjustment of both short- and long-run expectations remains relatively constant over time.

With regard to the determinants, we find that higher interest rate expectations of consumers increase both the degree and the probability of comovement, and thus have a detrimental effect on the degree of anchoring. However, this channel becomes insignificant in the post-1996 period, thus reinforcing our previous result that long-run inflation expectations became more anchored during this period. Notably, interest rate shocks increase the probability of comovement throughout. Furthermore, news on the monetary policy stance matter. Again the effect becomes substantially weaker in the post-1996 era. Finally, we report an additional positive effect of perceived news on government debt on the degree of comovement, which emerges in the post-1996 period. This might indicate

that consumers are uncertain whether rising levels of fiscal debt during the financial crisis may translate into higher future inflation.

There exists a large body of literature on the anchoring of inflation expectations that our paper is related to. Notably, there is no unified approach to identifying "anchored inflation expectations". Approaches used in the literature range from investigating the movements of individual time series, like for instance deviations of inflation expectations from an explicit inflation target or the dispersion of inflation expectations, to strategies using advanced econometrics techniques that consider the response of high frequency financial market data.

Straightforward strategies to measure the anchoring of inflation expectations include analyzing the level, the volatility and the dispersion of expectations from survey data. Coibion and Gorodnichenko (2010) derive a rationality test for expectations under the alternative hypothesis of information frictions affecting the expectation formation process. The test may be extended to allow for an effect of anchoring due to inflation targeting or central bank independence, where the authors argue that both measures should reduce inflation volatility and, hence, also attention towards inflation. Dovern et al. (2012) analyze disagreement among professional forecasters and state that anchored expectations imply that mean expectations stabilize at some target level and that cross-sectional dispersion is reduced. Both Coibion and Gorodnichenko (2010) as well as Dovern et al. (2012) report evidence that central bank independence improves the anchoring of inflation expectations.

Another strand of the literature defines expectations at different horizons as anchored if changes in expectations are insensitive to macroeconomic news. Inflation expectations are derived from high-frequency financial markets data, where forward rates for different maturities correspond to inflation expectations at different horizons. Studies by Beechey et al. (2011), Levin et al. (2004) and Gürkaynak et al. (2007, 2010) generally find that long-run expectations are more anchored, i.e. less sensitive to economic news, than short-run expectations. Similarly, inflation expectations in inflation targeting countries appear better anchored.[1]

Under the definition closest to our approach, inflation expectations are assumed to be anchored if changes in short-run expectations have no or little impact on long-run expectations. This is measured with the inflation pass-through criterion in Jochmann et al. (2010) and Gefang et al. (2012). Both studies extract short- and long-run inflation expectations from high-frequency data on forward inflation compensation in the US and the UK bond markets. The authors test for the hypotheses of anchored, unmoored or contained expectations. Results suggest that inflation expectations are contained, i.e. they are not fully anchored, but move within a bounded interval. In the UK, results suggest that inflation expectations are contained within an interval around the inflation target.

[1] Applying a nonlinear estimation framework on the level of inflation expectations, Strohsal and Winkelmann (2012) report a contrasting result, where short-run expectations are more anchored than long-run expectations.

While the literature evaluates the anchoring of inflation expectations from professional forecasters or from financial market data, this paper assesses the anchoring of consumers' inflation expectations. This should be of equal importance to monetary policy makers, since through their wage-setting and consumption-saving decisions, this group has a great impact on an economy's price developments. To our knowledge, the only approach that studies the anchoring of consumers' expectations so far is the study by Easaw et al. (2012). The authors extend the epidemiological model by Carroll (2003) to test whether households anchor their expectations to professionals' forecasts or on the official inflation target. For a dataset of Italian consumers, the authors report that households anchor more on professionals' inflation forecasts than on the ECB's inflation target.

The remainder of the paper is structured as follows. Section 2 provided the theoretical foundation for the comovement of inflation expectations. We discuss the dataset from the University of Michigan Survey of Consumers in section 3. In Section 4 we calculate and discuss the degree of anchoring of inflation expectations over time, while Section 5 tests for the effects of macroeconomic determinants and news. Finally, section 6 summarizes and concludes.

2 Theoretical Motivation for the Anchoring of Inflation Expectations

From a theoretical perspective, the degree of anchoring of inflation expectations depends to a large extent on the expectations formation process. This affects both the strength of an inflation shock on expectations in general as well as the degree of comovement between short- and long-run inflation expectations. Beechey et al. (2011) present a model with imperfect knowledge and recursive learning as in Orphanides and Williams (2004, 2007) and use the models' implications to show that the anchoring of long-run inflation expectations, i.e. their sensitivity to an inflation shock, differs with the monetary policy regime.

This model gives important insights for our analysis. First, it shows that there is always comovement between short- and long-run expectations. Second, this comovement becomes stronger, the more uncertain people are about monetary policy targets and the smaller the reaction of the central banks to inflation deviations (θ) is. In the upcoming paragraph, we will lay out the model and offer simulations for specific monetary policy regimes.

The model economy consists of an aggregate supply curve, an aggregate demand curve and a monetary policy reaction function:

$$\pi_{t+1} = \phi\pi^e_{t+1/t} + (1-\phi)\pi_t + \alpha y_{t+1} + e_{t+1}, \quad e \sim \text{iid}(0, \sigma_e^2) \tag{1}$$

$$y_{t+1} = -\zeta(r_t - r^*) + u_{t+1}, \quad u \sim \text{iid}(0, \sigma_u^2) \tag{2}$$

$$r_t - r^* = \frac{\theta}{\zeta}(\pi_t - \pi^*) + k_t \quad k \sim \text{iid}(0, \sigma_k^2), \tag{3}$$

where π_t is the inflation rate, $\pi^e_{t+1/t}$ denotes inflation expectations for period $t+1$ formed in t, y_t is the output gap, $(r_t - r^*)$ is the deviation of the real interest rate from its long-run value and π^* is the central bank's inflation target. Given that agents form rational expectations, the solution for the dynamics of inflation is given by:

$$\pi^e_{t+1/t} = \frac{\alpha\theta}{1-\phi}\pi^* + \frac{1-\phi-\alpha\theta}{1-\phi}\pi_t \tag{4}$$

Note that if agents form their expectations under imperfect knowledge, they cannot obtain the solution in (4). Instead, Beechey et al. (2011) assume that they infer the dynamics of inflation via recursive learning, as they recursively estimate a reduced form of (4):

$$\pi_t = \hat{c}_{1,t} + \hat{c}_{2,t}\pi_{t-1} + \nu_t \tag{5}$$

While the long-run value r^* is assumed to be common knowledge, agents estimate the central banks' inflation target π^* to be $\hat{c}_{1,t}/(1-\hat{c}_{2,t})$. The learning problem is thus simplified if the central bank announces an explicit inflation target since this removes the constant term from equation (5). By contrast, if the central bank's inflation target is not made official and even varies over time, the learning problem becomes more advanced.

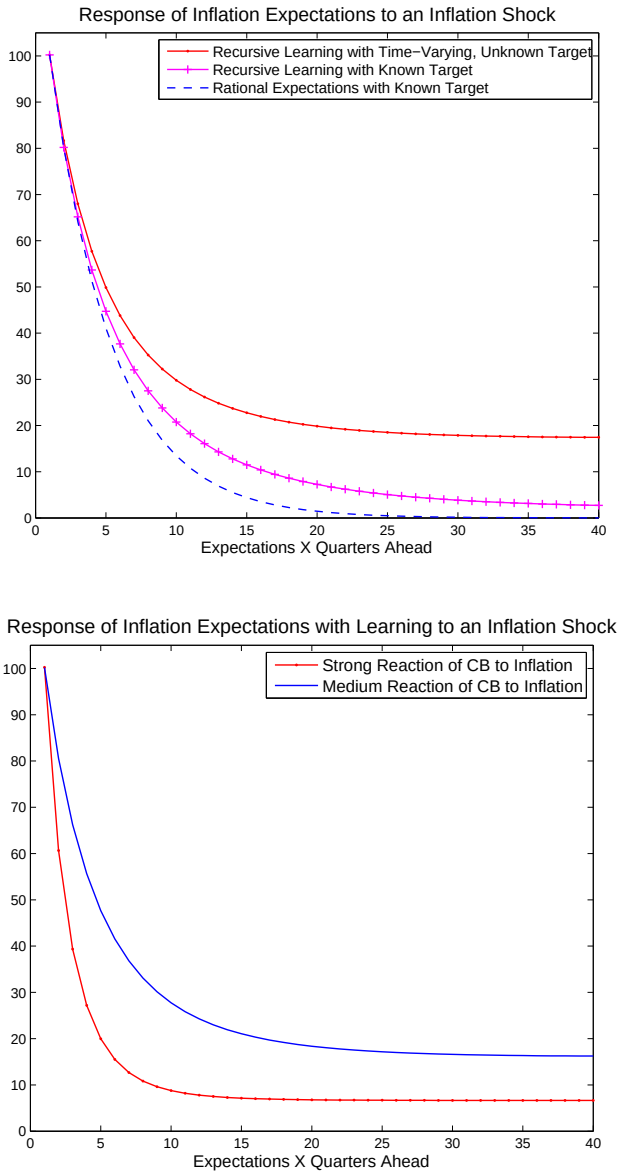
From numerical simulations of the model, we derive the impact of an inflation shock e_t on inflation expectations at different horizons and under different monetary policy regimes. The results of the simulations are shown in Figure 1.[2]

In the first graph, we observe that even under rational expectations, an inflation shock is associated with a positive change in medium-run inflation expectations. Hence, a certain comovement of short- and long-run expectations in response to economic shocks can be expected, but short-run expectations should be more volatile than long-run expectations. If agents have to recursively learn the models' solution, the importance of a credible monetary policy regime becomes evident: Inflation expectations will generally be more anchored if the central bank has an explicit inflation target, as this reduces agents' learning problem. By contrast, under an unknown and time-varying target, both short- and long-run inflation expectations will be more responsive to inflation shocks. Similarly, the second graph shows that inflation expectations with recursive learning are considerably more anchored if the central bank reacts strongly to deviations of inflation from its target. This is due to the fact that a higher parameter θ in equation (4) reduces the effect of

[2]The model code for the simulations in Beechey et al. (2011) was obtained from the supplementary material at http://www.aeaweb.org/articles.php?doi=10.1257/mac.3.2.104.

actual inflation on inflation expectations and increases the effect of the inflation target, thus anchoring expectations more closely to the target.

Figure 1: Comovement in the Recursive Learning Model in Beechey et al. (2011)



Note: Mean coefficients from 600 simulations.

3 The Data

We employ the microdata from the University of Michigan Survey of Consumers, which is available for the sample period January 1978 to July 2012 on a monthly frequency.

For the analysis of the dynamics of individuals' inflation expectations, we exploit the fact that the Michigan Survey of Consumers includes a rotating panel: Each month, a randomly determined sub-sample of households is chosen to be re-interviewed six months after the first interview. The complete cross-section each month includes about 40% of

individuals that are interviewed for the second time.[3] Via the rotating panel structure of the survey, we are able to identify changes in expectations on an individual consumer level.

In order to identify individual changes in inflation expectations at a micro level, we follow Souleles (2004) and Pfajfar and Santoro (2013) and restrict our sample to households where the same person answered both interviews. We thus keep all pairs of observations in the rotating panel, where the interviews were six months apart and where the respondent reported the same sex, race as well as month and year of birth. Additionally, we control for the age of the respondent and only allow increases by one year between interviews. In order to rule out extreme values for inflation expectations, we further truncate our sample by excluding the upper and lower 2.5% of the distribution of both short- and long-run quantitative inflation expectations.[4]

For the evaluation of changes in individuals' inflation expectations, we use the questions from the survey asking for individuals' quantitative estimates of short-run and long-run inflation expectations. The precise questions of the survey read:

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

A13b. "By about what percent per year do you expect prices to go (up/down) on the average, during the next 5 to 10 years?"

Time series of consumers' mean quantitative short- and long-run inflation expectations from the Michigan Survey are presented in Figure 2. Both short- and long-run inflation expectations declined considerably during the disinflation period in the 1980s. After a period of stabilization, it seems that short-run expectations became more volatile after 2002, while long-run expectations remained stable at around 3%.

As we are also interested in evaluating the role of news effects on the stability of inflation expectations, we employ the question in the Michigan Survey of Consumers asking for news on the economy heard by the respondent as a measure of perceived news regarding inflation and other potentially relevant topics. The wording of the question is as follows:

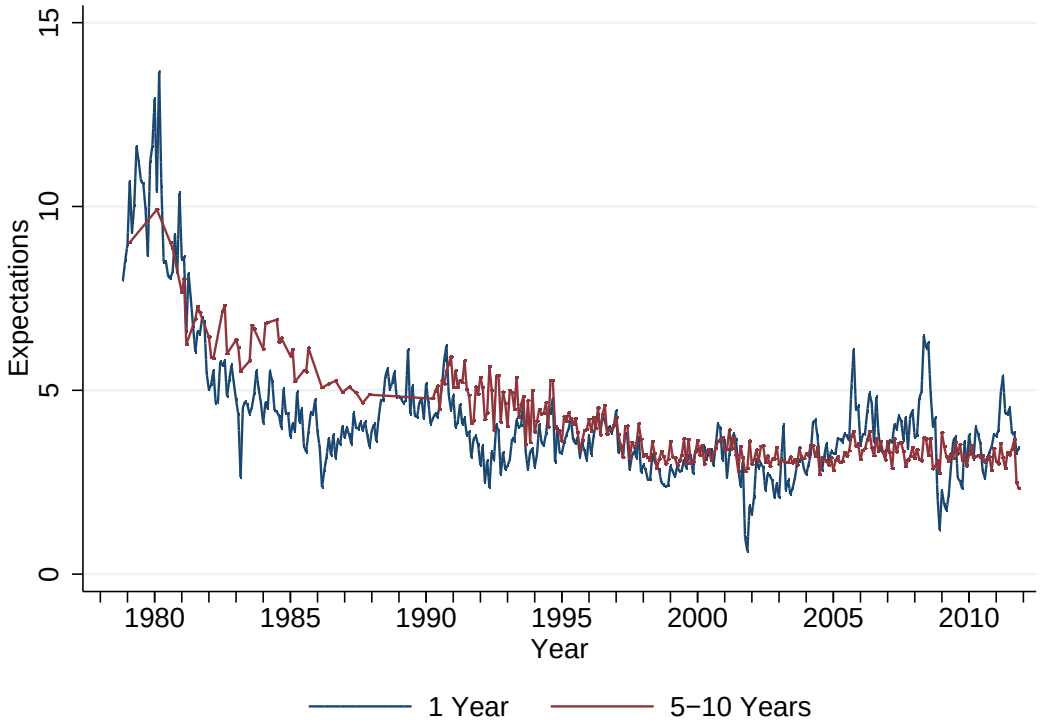
A6. "During the last few months, have you heard of any favorable or unfavorable changes in business conditions?"
1. YES 2. NO

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

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

[4] For a detailed description of the rotating panel dimension of the Michigan Survey of Consumers and our identification of individuals in the rotating panel, see Dräger and Lamla (2012).

Figure 2: Short- and Long-run Inflation Expectations



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

The answers are coded into categories by the Michigan Survey of Consumers. For our purposes, we construct dummy variables on perceived news regarding monetary conditions as well as fiscal and private debt. Specifically, we distinguish between favorable and unfavorable news heard about inflation or prices with the dummy variables *newsprices_bad* and *newsprices_good*. We code news on *"higher prices/inflation is good"* and on *"lower, stable prices/less inflation"* as favorably perceived by the respondent, while news on *"falling prices/deflation"* and *"high prices/inflation"* are coded as unfavorable news. News on money and credit conditions are measured by the dummy variables *newsmoney_tight* and *newsmoney_easy*, where the former takes on the value of one if the consumer reports news heard on *"tight money, interest rates high"*, while the latter includes news on *"easier money, credit easy to get, low interest rates"*. Finally, news heard in the categories *"fiscal policy, budgets, deficits"* are summarized in the dummy variable *newsgovdebt*, while news on *"low debts, higher savings/assets, investment"* as well as on *"high(er) debts, lower savings/assets"* are reported in the dummy variable *newsprivdebt*.

Furthermore, we control for a number of sociodemographic characteristics captured in the Michigan Survey of Consumers such as age and sex of the respondent as well as income quartiles and a categorical variable measuring education of the respondent in six categories. These are defined as follows: *Educ1* – "*Grade 0-8, no high school diploma*", *Educ2* – "*Grade 9-12, no high school diploma*", *Educ3* – "*Grade 0-12, with high school*

diploma", *Educ4* – "*4 yrs. of college, no degree*", *Educ5* – "*3 yrs. of college, with degree*" and *Educ6* – "*4 yrs. of college, with degree*".

In addition to the microdata from the Michigan Survey of Consumers, we aim at capturing monetary policy surprises by evaluating the conference calls held by the Federal Open Market Committee of the Fed. These conference calls are unscheduled meetings that usually take place after surprising events or in times of economic turmoil which may require monetary policy action before the next scheduled meeting. Monetary policy surprises are then identified by the dummies *i_shock* and *alt_mp_shock*, where the former identifies those periods where the Fed decided on an interest rate adjustment during the conference call and the latter measures those periods where alternative monetary policy measures, such as quantitative easing, where decided.

4 Anchoring of Inflation Expectations Over Time

To analyze the time-varying degree of anchoring of inflation expectations, we run the following rolling regression:

$$y_{it}(n) = X_{it}(n)\beta_t(n) + \varepsilon_{it}, t = 1, \ldots, T$$

where $y_{it}(n)$ is an $(n \times 1)$ vector of observations on the individual responses in t, $X_{it}(n)$ is an $(n \times k)$ matrix of explanatory variables, $\beta_t(n)$ is an $(k \times 1)$ vector of regression parameters and $\varepsilon_{it}(n)$ is an $(n \times 1)$ vector of error terms. The n observations in $y_{it}(n)$ and $X_t(n)$ are the n most recent values from times $t - n + 1$ to t. For our purpose, we estimate the following model:

$$\Delta\pi_{it}^{e(5-10y)} = \alpha_t + \beta_t \Delta\pi_{it}^{e(1y)} + \varepsilon_{it}, \tag{6}$$

where $\Delta\pi_{it}^{e(5-10y)}$ is the individual change in 5-10 years ahead inflation expectations over the six months between interviews and $\Delta\pi_{it}^{e(1y)}$ is the corresponding change in short-run inflation expectations. We are interested in the strength of the comovement between an adjustment in long-run expectations and short-run expectations. If long-run expectations are firmly anchored, the coefficient β_t should be statistically insignificant. However, the proposed theory suggests that if people cannot identify shocks and have to learn the policy response function of the central bank, a positive comovement emerges. To quantify this comovement, we first run this model for a rolling window of six months. However, when testing the determinants we will analyze the effects based on a regression model for each month separately. This is done to match the monthly frequency of our explanatory variables.

Table 1 gives the summary statistics of the time-varying coefficient β_t from the six-months rolling window cross-section estimations. In addition, Figure 3 picture the time variation of the coefficient β_t. With regard to the summary statistics, we can see that a

1% increase in short-run inflation expectations leads to an increase of 0.27% in long-run expectations on average. Notably, this comovement varies. It can rise up to 0.63% and be as low as 0%.[5] The six-months rolling window estimations includes 446 individual consumers on average per window.[6]

Table 1: Summary Statistics of Comovement

Variable	Mean	Std. Dev.	Min.	Max.
β_t	0.273	0.137	0	0.628
standard error	0.041	0.018	0	0.166
Observations	445.8	167.5	0	795

Note: Results based on 405 regressions.

Table 2: Sample Split Comovement

Variable	before 1996	after 1996
β_t	0.371***	0.207***
	(0.0200)	(0.0130)
Observations	15,016	14,152
R^2	0.118	0.082
t-test $\beta_t^{before96} - \beta_t^{after96} = 0$	5.52***	

Note: *** p<0.01, ** p<0.05, * p<0.1

Figure 3 plots a moving average of the comovement coefficient β_t over time together with the corresponding confidence bands. It shows that over the recent 30 years, a decoupling of short- and long-run expectations has taken place. Until 1996, the comovement of inflation expectations was much stronger and fell substantially afterwards.[7] As shown in Table 2, this difference is statistically significant: Up to 1996, an one-percentage change in short-run inflation expectations induced a 0.37% change in long-run expectations. After 1996, this value decreases substantially, as an one-percent change in short-run inflation expectations induces only a 0.21% change in long-run expectations. This difference is significant at the 1% level (t-stat=5.52).

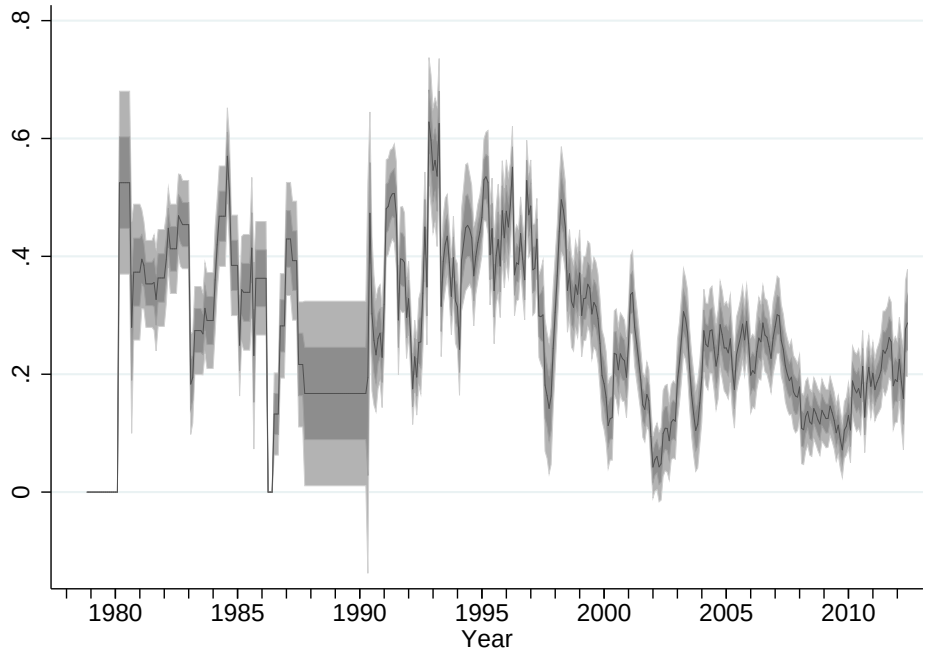
Hence, even after the Volker Disinflation until 1987 when inflation rates were already quite low, inflation expectations were, according to our definition, still not very well anchored. This changed after the Greenspan Fed's first preemptive actions against inflation over the years 1994 to 1996. They triggered a substantial anchoring of inflation

[5]Estimating this equation in levels instead of first differences leads to very similar results. The coefficient estimate for a one-unit increase in short-run inflation expectations increases from 0.27% to 0.43% on average and is again highly significant.

[6]0 Observation refer to periods before 1989m11 where the long-run forecast was not surveyed on a monthly frequency.

[7]The constant period from 1988 until 1990 is explained by missing long-run expectations in the Michigan survey.

Figure 3: The Strength of Comovement Between Changes in Short- and Long-Run Inflation Expectations



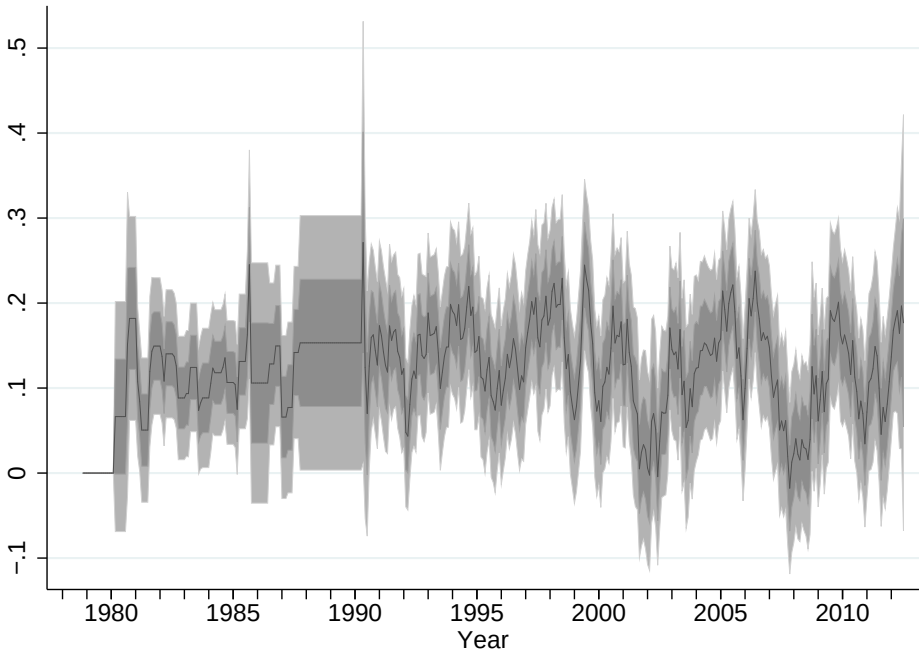
Note: The regression coefficient β_t from equation (1) is plotted, showing the coefficient estimate of a change in one year ahead inflation expectations on the change of 5-10 years ahead expectations. Shaded areas denote confidence bands at the 5% and the 10% level.

expectations which is observed from the lower comovement until the mid-2000s. Another explanation could be the emerging believe at that time that higher growth rates at lower inflation rates were possible due to technological change. In a different approach, Leigh (2005) evaluates the implicit inflation target in the U.S. and finds that the implicit target was lowered after the 1990/91 recession which supports the timing of our structural break.

Slightly before the onset of the financial crisis, we observe a sharp drop in the comovement, with a subsequent rise from 2010 onwards. While factors related to the financial crisis will certainly have contributed to this development, in our view it may be best explained by the sharp rise and fall of oil prices in 2008. The decoupling of short- and long-run inflation expectations after the oil price shock seems to suggest that consumers realized the transitory nature of this shock. Hence, after the shock died out, we see an increase in the comovement of short- and long run expectations since 2010 to pre-shock and pre-crisis levels. An important question is whether this trend will continue and overshoot the pre-crisis level of comovement, i.e. lead to lower anchoring in the medium term.

So far, we have looked at the strength of the comovement between short- and long-run inflation expectations. Now, we would like to evaluate the probability that short- and long-run expectations are adjusted simultaneously. Specifically, we are interested in whether we see a similar pattern over time than the one observed in Figure 3. Figure

Figure 4: The Probability of Simultaneous Adjustment of Short- and Long-Run Inflation Expectations



Note: The marginal effect β_t from equation (2) is plotted, measuring the probability of a change in one year ahead expectations inducing a change in 5-10 years ahead inflation expectations. Shaded areas denote confidence bands at the 5 % and the 10% level.

4 plots the time-varying probability that a change in short-run expectations induces an adjustment in long-run expectations. It stems from a probit regression similar to equation (1), where the change in inflation expectations is replaced by an indicator variable being 1 if expectations are adjusted and 0 otherwise:

$$P(y_{it} = 1|X) = \Phi(X_{it}\beta_t) \tag{7}$$

where P is the probability of y_{it} being 1, i.e. the probability that individual long-run expectations are adjusted within six months, Φ is the cumulative distribution function (CDF) of the standard normal distribution and X_{it} is an indicator variable with value equal to one if individual short-run expectations were adjusted in t with respect to the interview six months before. Again, we estimate a rolling window regression with a window of six months, where the time-varying parameter β_t is estimated by maximum likelihood.

The time-varying marginal effect β_t of an individual change in short-run inflation expectations on the probability of an adjustment in long-run expectations is plotted in Figure 4. Interestingly, we cannot observe a corresponding change in the marginal effect of adjustments in short-run expectations over time. By using the same sample split as in the previous paragraph, the marginal probability changes only insignificantly around a value of 13%. A statistical test confirms that we cannot reject the hypothesis that the two coefficients of the subsamples are statistically speaking the same. This indicates that while the strength of the comovement between short- and long-run inflation expectations has decreased over time, individual consumers keep on adjusting short- and long-run expectations simultaneously. This is an interesting result. It would imply that anchoring means that people continue thinking about the relation between short and long-run expectations but simply and willingly do not adjust long-run expectations as much as before.

While we estimate both the probability of comovement and the degree of comovement separately, the two measures for the anchoring of expectations should be interrelated. A high comovement should also imply that the probability of a joint adjustment has increased. To check this, we calculate the correlation and find that it is reasonably high at a value of 0.32.

Table 3: Summary Statistics Probability of Comovement

Variable	Mean	Std. Dev.	Min.	Max.
Marginal Effect β_t	0.122	0.054	-0.018	0.271
Standard Error	0.05	0.015	0	0.13
Observations	446.42	165.808	0	795

Note: Results based on 405 regressions.

Table 4: Sample Split Probability of Comovement

	before 1996	after 1996
β_t	0.128***	0.132***
	(0.00913)	(0.00876)
Observations	14,152	15,016
t-test $\beta_t^{before96} - \beta_t^{after96} = 0$	-1.30	

Note: *** p<0.01, ** p<0.05, * p<0.1

5 News Effects and Anchoring

In the previous section, we conclude that the anchoring of consumers' inflation expectations in the US has changed over time. This section sheds light on the determinants that may affect the anchoring of expectations and checks whether their influence has changed over the sample period. Specifically, we assess the effect of a set of determinants on both the degree of comovement and on the probability of comovement.

As we believe that the probability and the degree of comovement are interrelated, we estimate the same conditioning set of variables for both dependent variables, but analyze the implications of the results jointly in order to be able to draw a more complete picture of the overall underlying dynamics. For this purpose, it seems necessary to first consider how specific combinations of probability adjustments and changes in the strength of comovements might work together. First of all, it seems sensible that a variable that triggers joint updating also affects the degree of comovement and *vice versa*. However, it is not clear ex-ante whether a variable that triggers joint updating will increase or decrease the strength of comovement. Hence, it may work in both directions.

In line with the previous literature on the anchoring of inflation expectations, we concentrate on the effects of economic news and shocks.[8] News perceived by the consumer are captured by the Michigan Survey itself. Our news measure thus has the great advantage of capturing those news that are indeed absorbed and recalled by the consumers (i.e. the receiver perspective). We test for effects of news related to the monetary policy stance by measuring good and bad news on prices (*newsprices_good* and *newsprices_bad*) as well as news on easy or tight money conditions (*newsmoney_easy* and *newsmoney_tight*). Hence, it will be interesting to see how perceived news on tight and easy monetary policy will affect the beliefs of the public. Finally, given the recent debate on the sustainability of government debt and its possible consequences for monetary policy, we add variables capturing perceived news on government debt and private debt (*newsgovdebt* and *newsprivdebt*).

[8]Note that we have tested for effects of a broad set of determinants including macroeconomic variables, professionals' inflation expectations and measures of economic uncertainty in order to check the robustness of our results.

Monetary policy shocks are measured with the dummy variables i_shock and alt_mp_shock, which account for months in which interest rate adjustments or alternative monetary policy measures were decided during a Fed conference call. Additionally, we control for consumers' one-year-ahead interest rate expectations ($i^{e(1y)}$). Moreover, we evaluate the effect of the introduction of the explicit inflation target by the Fed and include a dummy variable $fedtarget$ which takes on the value of one after 2012m1.

To test for the influence of our set of news and economic shocks on the strength of the comovement, we first take the monthly coefficient β_t of equation (1) as a dependent variable. Since the models have a monthly time structure, we calculate the monthly shares of consumers who reported news from the individual news variables and include the balance statistic of qualitative interest rate expectations.[9] Afterwards, we estimate bi-probit models with the individual microdata where we test which factors affect the joint probability of adjusting both short- and long-run inflation expectations simultaneously. Given that the results of the previous section suggest a shift in the degree of anchoring of inflation expectations around 1996, we report additional results for the pre- and post-1996 period.

We estimate a bivariate probit model of the form:

$$\begin{aligned} Pr(Y_{1it}=1, Y_{2it}=1) &= \int_{-\infty}^{u_{1it}} \int_{-\infty}^{u_{2it}} \phi_2(X_{1it}\beta_1, X_{2it}\beta_2, \rho) du_{1it} du_{2it} \\ &= \Phi_2(X_{1it}\beta_1, X_{2it}\beta_2, \rho) \end{aligned} \tag{8}$$

where Φ_2 denotes the bivariate normal cumulative distribution function, where $Y_{1it}=1$ represents the probability that short-run expectations are adjusted and $Y_{2it}=1$ is the probability that long-run expectations are adjusted. β_1 and β_2 are the corresponding coefficients of the determinants X_{1it} and X_{2it}, respectively. Finally, ρ is a "correlation parameter" denoting the extent to which the two residuals u_{1it} and u_{2it} covary. Furthermore, we assume that the errors are $\{u_{1it}, u_{2it}\} \sim \phi_2(0,0,1,1,\rho)$. If there is no comovement between short- and long-run expectations, the estimated coefficients boil down to the univariate probit estimates. After the estimations of both probit models, we calculate the bivariate predicted probability $Pr(Y_{1it}=1; Y_{2it}=1)$ of a simultaneous adjustment. Overall, we find a strong and significant comovement in all of our biprobit regressions, since the correlation parameter ρ is significant according to the Wald test in every specification. This indicates that similar factors drive the adjustment in both short- and long-run expectations.

Tables 5 and 6 present the results from the models explaining the degree and probability of comovement, respectively. Generally, we find that there are significant news effects driving the comovement of short- and long-run inflation expectations. With respect to

[9] The balance statistic is defined as the monthly difference between the number of consumers expecting rising versus falling interest rates in relation to the overall number of consumers reporting interest rate expectations.

the structural break identified in the previous section, we can confirm that many variables become insignificant after 1996, suggesting that expectations have indeed become more anchored. There is, however, one notable exception: News on government debt significantly increase the degree of comovement in the post-1996 period.

The results for the determinants of the strength of comovement are reported in Table 5. In order to avoid the generated regressors problem, we show results with bootstrapped standard errors. Additionally, we account for time-specific effects by including yearly time-dummies.

A relatively larger share of consumers expecting rising interest rates is found to increase the level of comovement and, thus, reduces the anchoring of long-run inflation expectations. This is, in general, not a good sign for monetary policy as this may imply that people do not believe that the central bank is hawkish enough to fight inflation (e.g. raises interest rates enough to fight inflation). Interestingly, this effect dies out in the post-1996 sample, which may be interpreted again in favor of a recently more credible and hawkish monetary policy.

Regarding our set of news variables related to prices and money, we find no significant effect of either good or bad news on prices. However, the size of the effect of bad developments regarding prices seems more pronounced pre-1996 than afterwards. With respect to news on the monetary policy stance we can report a significantly positive effect of news on monetary easing on the degree of comovement, thus reducing the anchoring of long-run inflation expectations. While this effect is no longer significant in the pre- or post-1996 periods, the size of the effect is again much higher before 1996. Overall, this lends support to the conclusion that inflation expectations become more anchored by reducing the transmission of transitory shocks (news and macroeconomic shocks) to long-run inflation expectations.

In addition, we control for news on government and private debt. All variables remain insignificant in the pre-1996 period. However, perceived news on government debt have a significantly positive effect on the degree of comovement in the post-1996 period. This could indicate that people fear that high government debt might affect the stance of monetary policy and, thereby, may lead to higher inflation rates in the long run.

Table 6 comprises the results on the determinants of the individual probability of comovement, where we control for demographic characteristics and yearly time-effects. The marginal effects of joint adjustment are reported within the table. To be consistent with the previous models, we use the same set of variables in the same econometric specifications.

Regarding consumers' interest rate expectations, we again find that higher expectations have a detrimental effect on the anchoring of long-run inflation expectations, and again this effect is only relevant in the pre-1996 era. In that sense, our earlier result that the Fed may be perceived as being more credible and hawkish since 1996 seems to be

Table 5: Determinants of the Strength of the Comovement

	(1)	(2)	(3) before 1996	(4) after 1996
β_{t-1}	-0.0851	-0.0686	-0.1150	-0.0129
	(0.0586)	(0.0593)	(0.1126)	(0.0909)
balance stat $i^{e(1y)}$	0.1810***	0.1686**	0.2097*	0.0986
	(0.0694)	(0.0700)	(0.1246)	(0.0976)
$fedtarget$	0.0818	0.0927		0.0923
	(0.0848)	(0.0765)		(0.0763)
$share_newsprices_bad$	0.2341	0.3093	0.9942	0.2667
	(0.2183)	(0.2002)	(0.6922)	(0.2232)
$share_newsprices_good$	0.2808	0.3283	-0.4475	0.8085
	(0.5422)	(0.5570)	(0.9676)	(0.7029)
$share_newsmoney_easy$	0.7793	0.9069*	1.0456	0.1489
	(0.4870)	(0.5013)	(0.7011)	(1.0415)
$share_newsmoney_tight$	0.3455	0.4281	0.2108	0.5664
	(0.3795)	(0.4620)	(0.5481)	(0.8532)
$share_newsgovdebt$		1.9055**	0.8428	2.4855*
		(0.9350)	(2.1459)	(1.3894)
$share_newsprivdebt$		0.0888	-0.5896	0.3609
		(0.5277)	(3.4327)	(0.5140)
i_shock		-0.0191	0.0005	-0.0484
		(0.0446)	(0.0563)	(0.0783)
alt_mp_shock		-0.0595	-0.0319	-0.1302
		(0.0540)	(0.0920)	(0.0897)
Constant	0.0782**	0.0464	0.3297***	0.0599
	(0.0357)	(0.0386)	(0.1159)	(0.0525)
Observations	379	379	180	199
Adj. R^2	0.207	0.210	0.143	0.169
Year Fixed Effects	Yes	Yes	Yes	Yes

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

Table 6: Determinants of the Probability of Comovement

	(1)	(2)	(3) before 1996	(4) after 1996
$i^{e(1y)}$	0.0110***	0.0111***	0.0147***	-0.0010
	(0.0036)	(0.0036)	(0.0045)	(0.0058)
$fedtarget$	-0.0939***	-0.0935***		-0.0719***
	(0.0014)	(0.0015)		(0.0022)
$newsprices_bad$	0.0207*	0.0204*	0.0289	0.0178*
	(0.0111)	(0.0112)	(0.0331)	(0.0103)
$newsprices_good$	0.0162	0.0166	0.0431*	-0.0320
	(0.0220)	(0.0221)	(0.0252)	(0.0298)
$newsmoney_easy$	-0.0285**	-0.0284**	-0.0276**	-0.0419*
	(0.0111)	(0.0113)	(0.0109)	(0.0246)
$newsmoney_tight$	-0.0147	-0.0149	-0.0147	-0.0185
	(0.0113)	(0.0116)	(0.0139)	(0.0182)
$newsgovdebt$		0.0358	0.0262	0.0449
		(0.0266)	(0.0350)	(0.0373)
$newsprivdebt$		-0.0135	0.0022	-0.0354
		(0.0286)	(0.0484)	(0.0337)
i_shock		0.0403***	0.0547***	0.0260***
		(0.0145)	(0.0179)	(0.0089)
alt_mp_shock		-0.0026	-0.0038	0.0026
		(0.0216)	(0.0260)	(0.0183)
Observations	25,862	25,862	13,451	14,499
Demographic Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Rho	0.216	0.216	0.233	0.207
Wald Test	284.6	285.3	344.1	107.9

Note: Marginal effects with standard errors clustered at the year level in parentheses. The columns show marginal effects from bi-probit models for simultaneous updates of both short- and long-run expectations. *** p<0.01, ** p<0.05, * p<0.1.

confirmed here. The established Fed inflation target reduces the probability of adjusting both short- and long-run inflation expectations and thus has the expected effect.

With respect to the news effects, we find that news on prices have a positive effect on the probability of adjusting short- and long-run expectations, which is mainly driven by negative news regarding prices and inflation. Interestingly, we find that news on an easy monetary policy stance reduce the probability of jointly updating expectations, and do so throughout the sample period. However, unexpected interest rate adjustments increase the probability of comovement both before and after 1996, while news on government and private debt have no significant effect. In line with our previous results, we thus find that some effects on the probability of comovement remain significant throughout the sample period, albeit with a smaller coefficient after 1996. Nevertheless, the fact that interest rate expectations are no longer significant after 1996, that the introduction of the inflation target coincides with a lower probability of comovement and that the news effects with respect to monetary policy weaken substantially suggest that these contributed to more anchored expectations also via the probability of a joint adjustment.

Overall, our results indicate that consumers' inflation expectations have indeed been more anchored since 1996 as the macroeconomic as well as the news effects become less relevant. However, a potential risk to the anchoring of long-run expectations emerges from unexpected interest rate shocks and from an adverse effect of perceived news on public debt after 1996.

6 Conclusion

In this paper we investigate the degree of anchoring of inflation expectations of consumers in the US. Specifically, we analyze the comovement of short- and long-run inflation expectations at the individual level over time. For a sound identification, we employ the rotating panel microstructure of the Michigan Survey of Consumers. This allows us to track the simultaneous adjustment of short- and long-run expectations of individuals over time.

Based on this set-up, we can report that since 1978 inflation expectations have become more anchored in the US: Changes in short-run inflation expectations induce smaller changes in long-run expectations. Interestingly, the comovement was substantially reduced not during the Volker Disinflation, but in the aftermath of the 1996 pre-emptive tightening policy by the Greenspan Fed. Looking at the probability of adjusting short- and long-run expectations simultaneously, we find no significant reduction over time. Hence, while the degree of comovement between short- and long-run expectations has decreased, the probability to think about and revise them jointly has not been affected.

Regarding the possible determinants of both the strength of comovement and the probability of a joint adjustment, we find that news and consumers' interest rate expectations affect both the degree and the probability of comovement. Especially higher interest rate

expectations as well as unexpected interest rate shocks increase the comovement and, thus, reduce the degree of anchoring. The effect of consumers' interest rate expectations, however, dies out in the post-1996 era. Similar results can be reported for perceived news on the monetary policy stance. While more news on expansionary monetary policy increased the comovement for the whole sample they become irrelevant in the post-1996 era.

To sum up, the results tell us an intriguing story on the determinants of the anchoring of consumers' long-run inflation expectations. The most important message here is certainly that the observed anchoring is established more firmly since 1996, as consumers are not irritated anymore by news regarding the monetary policy stance as well as prices and trust the Federal Reserve in setting the appropriate interest rate. This is so far good news. However, we have to highlight one result that needs further consideration. We find that perceived news on the fiscal budget deficit reduces the anchoring of long-run expectations. As all determinants loose explanatory power in the post-1996 sample, this effect gains significance. While this result is likely driven by the financial crisis, the link between monetary and fiscal policy and its effect on the anchoring of inflation calls for more attention and may be a welcome avenue for future research.

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