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Abstract

Personal experiences of inflation strongly influence the hawkish or dovish leanings of central bankers. For all members of the Federal Open Market Committee (FOMC) since 1951, we estimate an adaptive learning rule based on their lifetime inflation data. The resulting experience-based forecasts have significant predictive power for members' FOMC voting decisions, the hawkishness of the tone of their speeches, as well as the heterogeneity in their semi-annual inflation projections. Averaging over all FOMC members present at a meeting, inflation experiences also help to explain the federal funds target rate, over and above conventional Taylor rule components.

JEL Classification: E50, E03, D84

Keywords: monetary policy, Experience effects, Availability bias, Inflation forecasts, Federal Funds Rate

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The Making of Hawks and Doves*

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1. Introduction

Members of central-bank committees, such as the Federal Open Market Committee (FOMC) or the European Central Bank (ECB) Governing Council, often disagree on future inflation rates and whether to loosen or tighten monetary policy. Why do these highly educated and well-informed experts differ in their forecasts and recommendations when they have access to the same data and tools? Why do their expectations deviate from forecasts produced by their staff, as documented by Romer and Romer (2008)?

Existing macroeconomic models of optimal monetary policy do not offer much of an explanation. Monetary policy makers, if modeled at all, assign the same weights to inflation and output stabilization, based on private-sector agent preferences and objective data, when maximizing social welfare (see, e. g., Rotemberg and Woodford (1999)). Even in models with learning, such as Sargent (1999), policy makers form beliefs based on objective historical data, which leaves no room for subjective disagreement.[4]

These modeling approaches are hard to square with the discussions among practitioners and in the media classifying central bankers as 'hawks' or 'doves.' Debates about new appointments and their policy implications typically refer to appointees' background and personal experiences. For example, when Charles Plosser and Richard Fisher retired as the Philadelphia and Dallas Federal Reserve Bank Presidents in 2014, much of the news coverage was about the generational shift rooted in personal inflation experiences: *"Annual inflation in the United States has averaged 3.8 percent during*

[4] Outside of macroeconomics, research on group decision-making has explored sources of heterogeneity among monetary policy committee members, including variation in preferences such as career-concerns, and differential information. For an overview, see Sibert (2006).

Mr. Plosser's adult life. By contrast, inflation has averaged just 2.5 percent during the adult life of Narayana Kocherlakota, president of the Federal Reserve Bank of Minneapolis, who at 50 is the youngest member of the policymaking committee and who has become the most outspoken proponent of expanding the Fed's stimulus campaign."[5]

In this paper, we argue that personal experiences exert a measurable and statistically significant longterm influence on FOMC members. Whether and at what age they experienced the Great Inflation or other inflation realizations affects their stated beliefs about future inflation, their monetary-policy decisions, and the tone of their speeches on monetary-policy issues. We further show that time-variation in the average inflation experiences of all FOMC members present at a given meeting helps explain deviations of the federal funds rate from a conventional forward-looking Taylor rule.

Our research hypothesis and design build on a growing literature on *experience effects*, a term first coined by Malmendier and Nagel (2011) in the context of stock-market investment. As the existing literature shows, personal experiences of macro-finance, labor-market, or political outcomes appear to be a strong determinant of individual attitudes and willingness to take risks in these areas in the long run. For example, prior lifetime experiences of stock-market returns predict individual willingness to invest in the stock market investment; prior experiences with IPOs predict future participation in IPOs; and prior experiences in the bond market predict future bond investment.[6] Evidence in line with experience effects is also found among college students who graduate in recessions, among consumers who live through economic booms or busts, and in

[5] See "Charles Plosser and Richard Fisher, Both Dissenters, to Retire From Fed," by Binyamin Appelbaum, New York Times Sept. 22, 2014, www.nytimes.com/2014/09/23/business/fed-official-critical-of-policies-set-to-retire-in-march.html.

[6] Cf. Vissing-Jorgensen (2003), Kaustia and Knüpfer (2008), Chiang et al. (2011), Malmendier and Nagel (2011), and Strahilevitz et al. (2011). There is similar evidence for the housing market (Malmendier and Steiny, 2017; Botsch and Malmendier, 2016), and the insurance markets (Gallagher, 2014).

the political realm in terms of the long-term consequences of living under communism, its surveillance system, and propaganda.[7] Most closely related, Malmendier and Nagel (2016) show that life-time experiences of inflation significantly affect beliefs about future inflation, and that this channel explains the substantial disagreement between young and old individuals in periods of highly volatile inflation, such as the 1970s.

The monetary-policy setting in this paper is different. FOMC members are presumably highly educated and well informed about macroeconomic history, and monetary policy is generally considered a technocratic and model-driven area of economic policy. Experience effects may thus seem much less plausible than for the consumers and individual investors examined in earlier studies. Nevertheless we find a robust influence of personal experiences on FOMC members' stated beliefs and decisions, consistent with views in the media about generational origins of 'hawkishness.'

This analysis ties directly to the findings of Malmendier and Nagel (2016) on inflation experiences predicting beliefs about future inflation in the Michigan Survey of Consumers (MSC). We apply their model of experience-based learning, which maps each member's lifetime history of experienced inflation, with more weight given to recent experiences than those early in life, into regression estimates of long-run mean and persistence of inflation. Based on these parameter estimates, we then construct an experience-based inflation forecast for each FOMC member at each point in time. These forecasts differ not only across cohorts in each period, but also change within each cohort over time as beliefs are updated in response to new inflation realizations. Hence, the identifying variation that we rely on to explain FOMC member behavior is

[7] Cf. Kahn (2010) and Oreopoulos et al. (2012) for labor markets; Malmendier and Shen (2017) for consumption expenditures (controlling for financial constraints and wealth); and Alesina and Fuchs-Schündeln (2007), Lichter et al. (2016), Fuchs-Schuendeln and Schuendeln (2015), or Laudenbach et al. (2018) for political experiences. Experience effects might also be at work in the "female socialization" of congress persons when they have daughters (Washington, 2008).

not spanned by fixed age, time, and cohort effects.[8]

As our first outcome variable, we analyze the inflation forecasts FOMC members submit for the semi-annual Monetary Policy Reports (MPRs) to Congress. The individual forecasts are made available with a 10-year lag, starting in 1992. We relate each member's experience-based forecast at a given time directly to their MPR forecast at that time. Despite the limited sample period, our estimation provides robust evidence that members put a substantial weight—37% or more, depending on the specification—on their experience-based forecasts. Hence, differences in members' lifetime experiences of inflation explain an economically significant portion of the differences in their inflation forecasts.

This first finding helps explain the puzzling time-series evidence in Romer and Romer (2008) that the central tendency of FOMC members' inflation expectations often deviates from the Federal Reserve staff's Greenbook forecast, even though their deviations *reduce* forecast accuracy. Our results imply that, to a large extent, the deviations are explained by reliance on personal inflation experiences. Hence, while our research design emphasizes between-member differences in experiences and outcomes, the estimates are also useful to understand why FOMC members as a group deviate from objective benchmarks.

Next, we turn to differences in decision-making. We study FOMC votes, which allow us to study clearly defined policy decisions over a sample period spanning several decades, from March 1951 to January 2014. The FOMC meets at least four (and typi-

[8] We also explored heterogeneity in output-gap experiences as a possible determinant of FOMC member disagreement about policy. Using unemployment as a proxy for the output gap, we estimate a very small degree of cross-sectional heterogeneity in the resulting experienced-based forecasts. Unlike for inflation, the unemployment process parameter estimates remain similar when we vary the length of the unemployment histories, e. g., for 20 versus 40 years of past data. In other words, the empirical properties of the unemployment time series preclude experience-based disagreement about unemployment to play an economically significant role in explaining heterogeneity in voting and speeches.

cally eight) times per year. To analyze whether FOMC members' voting decisions are influenced by the inflation experiences they have accumulated during their lifetimes, we have to map their experience-based forecasts from the first step of our analysis into a voting decision. For this second step, we link the experience-based inflation forecasts to the desired level of nominal interest rates using a subjective version of the Taylor (1993) rule in which FOMC members evaluate deviations from the inflation target in terms of their own experience-based inflation forecasts. In addition, to control for potentially confounding effects, we allow FOMC members to differ, based on their personal characteristics, in their weights on the inflation and output stabilization objectives as well as in their views about the appropriate inflation and output targets and the natural interest rate. We estimate a highly significant relationship between inflation experiences and voting decisions. A one within-meeting standard-deviation increase in the experience-based inflation forecast raises the probability of a hawkish dissent by about one third, and it lowers the probability of a dovish dissent also by about one third, relative to the unconditional dissent probabilities.

The voting outcome is a clear indication that experiences significantly affect FOMC members' behavior; but it is also coarse, given the well-known reluctance of FOMC members, in particular governors, to formally cast a dissenting vote. To tease out more subtle differences in desired interest rate changes, we analyze, in a third step, the opinions FOMC members express in their speeches. We construct a data set of all "Speeches and Statements" from the Federal Reserve Archival System for Economic Research (FRASER) as well as hand-collected speeches from the websites of the regional Federal Reserve Banks (FRBs). We classify the language in these speeches and discussions as hawkish or dovish using the automated search-and-counts-approach of Apel and Grimaldi (2014). Applied to our sample, their *Net Index* of hawkishness reveals that FOMC members use a significantly more hawkish tone when their lifetime experiences imply a higher experience-based inflation forecast.

Finally, we turn from the cross-sectional analysis of individual behavior to the time series of the federal funds rate target. Traditionally, the FOMC implements monetary policy by setting a target for the federal funds rate, i. e., the interest rate at which banks lend overnight to each other. Within the forward-looking Taylor rule framework, we show that the federal funds rate target is tilted away from the Federal Reserve Board staff's Greenbook forecast of inflation and towards the experience-based inflation forecasts of the voting members present at the FOMC meeting.[9] Moreover, the strength of the tilt that we estimate here is broadly consistent with the tilt away from the staff forecast and towards personal experiences in our initial analysis of FOMC member inflation forecasts. We quantify the implied effect in a rough calculation that abstracts from the equilibrium consequences of a different interest-rate path. We find that, relying only on the staff forecast and *not* on members' own inflation experiences, a counterfactual FOMC would have chosen a similar interest-rate path in the late 1980s and 1990s, but 50 to 100 basis points lower in the 2000s.

The four sets of empirical results can be parsimoniously explained by a model of experience effects, in which personal inflation experiences affect subjective beliefs about future inflation. Under such a model of *experience-based learning*, individuals overweight realizations of past inflation that they have experienced in their lives so far, consistent with earlier evidence on experience effects in individual inflation expecta-

[9] The Federal Reserve staff tends to make forecasts collectively rather than individually. Staff forecasts are therefore less likely to exhibit experience effects. According to Reifschneider et al. (1997), the Fed forecasting procedure starts with a "coordinator" providing the participants with the key assumptions. Given these assumptions, the participating economists produce projections for their sectors. These forecasts are then assembled by the coordinator into projections for aggregate output, income, inflation, and interest rates, and then relayed back to the sector economists, who may further adjust the forecast for their sector.

tions (Malmendier and Nagel, 2016). In addition, there might be a preference-based link between inflation experiences and aversion to inflation: It is possible that FOMC members' preferences for inflation are not stable over time and vary with their lifetime experiences as well.[10] A preference-based explanation does not suffice, though, to explain all of our findings for at least two reasons. First, the preference channel does not easily explain the link between inflation experiences and FOMC members' stated beliefs in their MPR forecasts. While it is possible that the MPR forecasts reflect members' inflation preferences rather than their beliefs, this is not the standard interpretation of these data (e.g., Romer and Romer (2008)). Second, it is not clear why experience-based forecasts generated by an adaptive learning rule, which our empirical analysis employs, would be a good way to summarize FOMC members' inflation preferences. Ultimately, pinning down the precise channel is not essential for the validity of our findings.[11] Irrespective of the preferred explanation, our findings show that heterogeneity in lifetime experiences has significant explanatory power for the heterogeneity in monetary-policy views and for the decisions of the experts on the FOMC.

Our findings add to a growing literature that studies experience-related heterogeneity in economic decisions and macroeconomic expectations. Relative to the macro and finance literature on experience effects cited above, our analysis stands out in that

[10] Such a preference-based explanation has to spell out, then, not individual preferences regarding inflation but "preferences" about what is best for the U.S. economy in light of the Federal Reserve Bank's dual mandate — and separate them from "beliefs" about what is best for the U.S. economy.

[11] We also note that the distinction between a beliefs channel and a preference channel is tenuous when considering the role of inflation experiences on inflation forecasts as there is no clearly determined probability distribution of possible future inflation rates. In the realm of subjective probabilities à la Savage (1954), probabilities are not relative frequencies as in the expected-utility framework of von Neumann and Morgenstern (1944), but simply weights that are designated to represent (subjective) probabilities (cf. Anscombe and Aumann (1963)), and the mapping to beliefs versus preferences becomes somewhat arbitrary. Thus, attempts to separate out the respective roles of preferences and beliefs might ultimately be vain.

it is the first paper to provide evidence of personal experiences affecting policy experts. As such, this paper contributes to the behavioral literature that goes beyond the traditional restriction to small investors and consumers and provides evidence of successful professionals and leaders making decisions and forming beliefs that are hard to reconcile with the traditional neo-classical model (cf. Malmendier (2019)).[12]

This provides a new perspective on macroeconomic models in which monetary policy makers learn about the economy's stochastic processes (see Sargent (1999), Cho et al. (2002), and Primiceri (2006), among others). A common assumption in these models is that policy makers update their beliefs (e. g., about the natural rate of unemployment, the slope of the Philips curve, or inflation persistence) using a constant-gain updating scheme that leads to perpetual learning with exponential downweighting of data in the past. However, it is unclear why policymakers would update beliefs with a constant gain. One (standard) explanation is structural change in the stochastic processes agents learn about. Our findings point to an alternative: Data in the distant past carries low weight because policy makers overweight personal experience relative to objective historical data.[13]

In addition, our results highlight sources of belief heterogeneity that the standard representative policy-maker approach in the literature would miss: the age distribution of the policy committee, as well as the differences in such age effects over time. As such, the evidence in this paper sheds light on the likely consequences of choosing specific

[12] While there is no existing evidence yet for policy experts, there are empirical findings that professional agents exhibit experience effects, e.g., mutual fund managers who experienced the stock market boom of the 1990s (Greenwood and Nagel, 2009), CEOs who grew up in the Great Depression (Malmendier and Tate, 2005; Malmendier et al., 2011), and even lenders in 18th century Amsterdam (Koudijs and Voth, 2016).

[13] In fact, Malmendier and Nagel (2016) show that the average experience-based belief of a group of individuals can be closely approximated by a constant-gain learning rule, and hence experience effects can provide an approximate "microfoundation" for constant-gain learning.

individuals as central bankers—a topic much discussed in practice. Romer and Romer (2004) provide narrative evidence that the Federal Reserve chairs are heterogeneous in their views about the workings of the macroeconomy and the potency of monetary policy. They argue that this heterogeneity affects policy choices. Accordingly, Reis (2013) suggests that the choice of a central banker shapes the effective objective function for the central bank. Our evidence suggests that heterogeneity in macroeconomic experiences influence the beliefs that enter as inputs into this objective function.

Our evidence on the role of inflation experiences also adds a new dimension to a prior literature that links monetary policy decisions to the personal characteristics of FOMC members. Chappell et al. (1993, 1995); Chappell and McGregor (2000) document that a number of characteristics, including the role of regional Federal Reserve president versus Federal Reserve governor, are associated with differences in voting.[14] While this earlier literature views policy maker characteristics as determinants of their preferences or incentives, our approach is motivated by a subjective beliefs channel. In support of this channel, we show that lifetime experiences explain FOMC members' stated beliefs about future inflation. In this regard, our analysis also relates to the finding in Hansen et al. (2014) that heterogeneity in private assessments of economic conditions plays an important role in monetary policy committee decision-making. We highlight personal experiences as one source of such disagreements.

Finally, our analysis of the tone in FOMC members' speeches relates to the literature on textual analysis in monetary policy. Apel and Grimaldi (2014) measure the tone of the Swedish central bank minutes and use it to predict policy rate decisions. Numerous other text-mining approaches have recently been employed, for example by Hansen and

[14] Harris et al. (2011) find some of these effects are absent or different on the Bank of England Monetary Policy Committee.

McMahon (2016a,b). We focus on how personal experiences explain tone differences across FOMC members' speeches outside their meetings.

The rest of the paper is organized as follows. In the next section, we lay out the methodology underlying our empirical approach and specify FOMC members' learning rule. We show that the resulting experience-based forecasts of inflation help predict the MPR inflation forecasts of FOMC members. In Section 3, we map the experience-based inflation forecasts into desired interest rates and show that they help explain dissenting votes. In Section 4, we perform a similar analysis for FOMC members' speeches. Section 5 relates the average inflation experiences of all FOMC members at each meeting to the federal funds rate decision, and Section 6 concludes.

2. Inflation Experiences and Inflation Forecasts

We start our analysis by examining the stated inflation expectations of FOMC members in the Semiannual Monetary Policy Report (MPR). This data set provides us with an inflation forecast for each individual FOMC member twice a year during the period from 1992 to 2004. We test whether we can detect experience-related heterogeneity in inflation expectations, even among the highly educated and professionally trained individuals on the FOMC: Does their personal lifetime experience of more or less inflationary environments affect their stated beliefs about future inflation? Do they attach higher weights to past realizations of inflation if they happen to have personally lived through those times?

2.1. Learning from Experience

Experience-based learning is a variant of adaptive learning where economic agents have a perceived law of motion for the variable they want to forecast, which may be a simple approximation of some unknown true law of motion. The agents estimate the parameters of this law of motion based on observed data and then use the estimated model to construct forecasts. As new observations arrive, they update the parameter estimates and forecasts. (See, e.g., Bray (1982), Marcet and Sargent (1989), Sargent (1993), and Evans and Honkapohja (2001).) The key modification of the standard approach that introduces learning from experience is that we allow the learning gain, i. e., the strength of updating in response to surprise inflation, to depend on age. Young individuals react more strongly to an inflation surprise than older individuals who already have accumulated a longer data set of lifetime observations. As a result, experience-based forecasts at a given point in time are heterogeneous by age (or, equivalently, across cohorts). Moreover, since individuals update their beliefs in response to new observations, experience-based forecasts vary within person, and hence within cohort. There are no fixed cohort effects.

We utilize the learning-from-experience model of Malmendier and Nagel (2016) to generate FOMC members' experience-based inflation forecasts based on their experienced inflation histories, which we then compare with FOMC members' actual inflation forecasts. In the learning-from-experience framework of Malmendier and Nagel (2016), individual consumers perceive inflation as an AR(1) process, and use data on experienced inflation to estimate the AR(1) parameters and construct their forecasts. As they experience new inflation realizations, they update the AR(1) parameters and revise their forecasts. Intuitively, the AR(1) assumption implies that experienced inflation is summarized in terms of long-run mean and the persistence of shocks.[15]

[15] We focus on univariate models of inflation since the existing empirical evidence on inflation forecasting, as reviewed in Stock and Watson (2009), suggests that multivariate models, e.g., Phillips curve forecast models that also include output variables, do not outperform univariate models. Moreover, there exist standard models that are consistent with a lack of incremental forecastability based on output. In the version of the New Keynesian model reviewed by Clarida et al. (1999), output does

We modify this framework in a minor way to address seasonality. Especially towards the end of our sample period, the seasonal component of inflation accounts for a substantial share of its variance,[16] and we expect experts to be aware of the pattern. While the seasonality adjustment is not material for the results, it avoids seasonality-induced volatility in experienced-based forecasts in the later part of the sample, which plays a bigger role in the analysis here than in the Malmendier and Nagel (2016) sample that reached back to the 1950s. Hence, we model their perceived law of motion as a mixed seasonal AR(1) process,

$$\pi_{t+1} = \alpha + \phi_1 \pi_t + \phi_4 \pi_{t-3} - \phi_5 \pi_{t-4} + \eta_{t+1}, \tag{1}$$

where the $t-3$ and $t-4$ lags capture a four-quarter seasonal pattern.[17]

FOMC members use least-squares to estimate the vector b of parameters in (1), $b \equiv (\alpha, \phi_1, \phi_4, \phi_5)'$. Expressed recursively, the least-squares estimates of an FOMC

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not have incremental information about future inflation over and above current inflation. Given this evidence, it is not unreasonable for FOMC members to form views about future inflation based on univariate properties of experienced inflation.

[16] Bryan and Cecchetti (1995) show that the relative variance share of the seasonal component rose as inflation became more stable after 1982, and Gospodinov and Wei (2015) note a strong seasonal component since the financial crisis in 2008.

[17] With the restriction $\phi_5 = \phi_4 \phi_1$, this is a standard $ARIMA(1,0,0) \times (1,0,0)_4$ model, and a special case of the seasonal ARIMA model discussed, e.g., in Box et al. (2015). We do not impose this restriction in the learning algorithm (which does not affect consistency), so that the belief updating formulas still retain a recursive least-squares form. Inclusion of seasonal dummies, a potential alternative method, would not properly capture the stochastic seasonality in the CPI series and, for example, its consequences for the autocorrelation of the series. Another potential alternative would be to use seasonally-adjusted data. However, seasonally-adjusted data is available only back to 1947. Moreover, standard seasonally-adjusted data suffers from a potential look-ahead bias as the seasonal adjustment factors applied to the CPI time-series are estimated and retroactively updated by the Bureau of Labor Statistics using ex-post realized data over the full sample. The unrevised vintages would be available from the ALFRED database, but only starting in 1972, which is much too short for our purposes.

member born in quarter s are updated every quarter as follows:

$$b_{t,s} = b_{t-1,s} + \gamma_{t,s} R_{t,s}^{-1} h_{t-1}(\pi_t - b'_{t-1,s} h_{t-1}), \tag{2}$$

$$R_{t,s} = R_{t-1,s} + \gamma_{t,s}(h_{t-1} h'_{t-1} - R_{t-1,s}), \tag{3}$$

The vector $h_t \equiv (1, \pi_t, \pi_{t-3}, \pi_{t-4})'$ collects the observed inflation inputs, and $R_{t,s}$ is the recursively updated moment matrix for h_t. Based on the newly revised estimates of $b_{t,s}$, members of cohort s form their subjective expectation of next period inflation as

$$\pi^e_{j,t+1|t} = b'_{t,s} h_t. \tag{4}$$

The sequence of gains $\gamma_{t,s}$ in (2) and (3) determines how strongly cohort s revises the parameter estimates when faced with an inflation surprise, $\pi_t - b'_{t-1,s} h_{t-1}$, at time t. Following Malmendier and Nagel (2016), we specify the gain as

$$\gamma_{t,s} = \begin{cases} \frac{\theta}{t-s} & \text{if } t - s \geq \theta, \\ 1 & \text{if } t - s < \theta. \end{cases} \tag{5}$$

That is, while the recursive least-squares set up follows standard implementations of adaptive learning (cf.; (Evans and Honkapohja, 2001)), the gain specification is different. In standard adaptive-learning models with decreasing gain, the gain is decreasing in the total size of available historical data and is the same for everybody. In contrast, the gain in (5) is decreasing in the size $t - s$ of the *lifetime* data of cohort s at time t. As a consequence, younger individuals have a higher gain and react more strongly to an inflation surprise than older individuals. Hence, the variation in gains is the source of between-cohort heterogeneity in inflation forecasts, as well as within-cohort heterogeneity (over time), in our framework.

The parameter $\theta > 0$ is constant and determines how much weight the forecaster puts on recent data versus data in the distant past. For example, $\theta = 1$ implies equal weighting of recent data and data earlier in life, while $\theta > 1$ implies that recent data receives more weight than early experiences. Throughout the paper, we conduct our baseline estimation by setting $\theta = 3.044$, which is the value Malmendier and Nagel (2016) estimate from the data on inflation expectations in the *Michigan Survey of Consumers* (MSC). This value of θ implies that weights on past observations decline a little faster than linearly, going back from the current period to a weight of zero at birth.[18] By using this value of θ, we impose consistency with earlier evidence and tie our hands with regards to this parameter, rather than picking θ to best fit the FOMC member data. We test the robustness of our results to using a range of values around this point estimate. We also reestimate θ on the sample of college graduates in the MSC, which makes it plausibly more representative of the typical FOMC member. Our results are unaffected when we use the resulting parameter estimate of $\theta = 3.334$.

For a given θ, we calculate the experience-based inflation forecast $\pi^e_{j,t+1|t}$ of member j at time t based on inflation data since j's birth year. Our data source is the quarterly CPI series from Shiller (2005) that goes back to 1871Q1.[19] We measure inflation rates

[18] We find that the inflation forecast of an adult is not sensitive to the precise starting point of the experience accumulation for a fairly wide range of values around $\theta = 3.044$. In Malmendier and Nagel (2016), we stretch and compress the weighting function to include years before birth into the experience accumulation or start later (e.g., at the age of 18) without much effect, also because the initial years in an adult's lifetime carry relatively little weight. In Appendix J we redo our main results in this paper with a different starting point.

[19] See the updated long-term stock, bond, interest rate and consumption data at `http://www.econ.yale.edu/~shiller/data.htm`. Shiller's inflation rate series is based on the CPI-U (Consumer Price Index-All Urban Consumers) published by the U.S. Bureau of Labor Statistics from 1913 onwards, and on the Warren-Pearson wholesale price index before 1913. Since the earlier price index is focused on commodities, it is more volatile. Appendix H replicates key parts of our analyses excluding pre-1913 data, i.e., restricting the sample to FOMC members born after 1913. The results on voting remain essentially unchanged, as do the results on speech tone; the other two sets of analyses do not use

as annualized quarterly changes in the log CPI. As in Malmendier and Nagel (2016), we iterate on the perceived law of motion (1) at each cohort's quarter-t parameter estimates to construct experience-based forecasts of the average inflation rate over the relevant horizon (which is four quarters in most of our applications, unless otherwise noted).

In Appendix A, we illustrate the resulting heterogeneity in expectations and learning-from-experience dynamics in more details. There, we plot how the perceived persistence and long-run mean of inflation evolve over time, separately for different age groups. The graphs highlight the two key features of experience-based expectations formation. First, since individuals update their beliefs in response to new inflation observations, experience-based forecasts vary within person (and hence also within cohort) over time. Second, since younger individuals have a shorter life-time data set and place a higher weight on recent inflation surprises than older individuals, expectations are heterogeneous by age, but in a time-varying way. As a consequence, a linear combination of time, age, or cohort fixed effects cannot absorb experience-based expectations heterogeneity. For this reason, our approach to estimating experience effects is not subject to the age-time-cohort collinearity problem that plagues methods that are based on estimation of cohort fixed effects. (See (Malmendier and Nagel, 2016) for a more general discussion of this point.)

2.2. Inflation Forecast Data

We obtain individual inflation forecasts of FOMC members from the Semiannual MPR.[20] Twice a year, in February and July, the FOMC submits an MPR to Congress, which

pre-1913 data.

[20] `www.philadelphiafed.org/research-and-data/real-time-center/monetary-policy-projection`

contains the FOMC members' inflation forecasts. In February, the forecasts concern the time period from Q4 of the previous year to Q4 of the current year. In July, two sets of forecasts are included in the report: one for Q4 of the previous year to Q4 of the current year, and another one for Q4 of the current year to Q4 in the next year.

We supplement the individual FOMC members' forecasts with forecasts in the "Greenbooks" that are prepared by Federal Reserve staff about a week prior to each FOMC meeting.[21] We use the Greenbooks for the February and July FOMC meeting and match them with the member forecasts from the MPR. As Romer and Romer (2008) discuss, the FOMC members have access to the Greenbook forecasts when they prepare their forecasts before the FOMC meeting that precedes the MPR. They also have an opportunity to revise their forecast after seeing other members' economic views and staff's summary of the other members' forecasts. Romer and Romer (2008) show that the central tendency of FOMC members' forecasts deviates from the staff forecast in the Greenbooks, and that this deviation from the staff forecasts reduces the forecast accuracy.

Our objective here is to test whether the deviations from staff forecasts reflect the influence of their personal inflation experiences. For this purpose, we extract the individual inflation forecasts contained in the MPRs (rather than the central tendency that Romer and Romer (2008) analyze) to construct a panel data set. The individual FOMC members' forecasts become available only with a 10-year lag, and the earliest ones available are from 1992. Hence, our sample runs from 1992 to 2004, covering 26 FOMC meetings. This data set of individual forecasts is introduced and described in Romer (2010).

[21] www.federalreserve.gov/monetarypolicy/fomc_historical.htm

2.3. Econometric specification

Our estimating equation relates FOMC members' deviation from the staff forecasts to their personal inflation experiences. We start from modelling FOMC member j's forecast at time t, $\tilde{\pi}_{j,t+1|t}$, as a weighted average of j's experience-based forecast $\pi^e_{j,t+1|t}$ and the staff forecast $\tilde{\pi}_{t+1|t}$ reported in the most recent Greenbook:

$$\tilde{\pi}_{j,t+1|t} = \phi \pi^e_{j,t+1|t} + (1 - \phi)\tilde{\pi}_{t+1|t}. \tag{6}$$

Subtracting $\tilde{\pi}_{t+1|t}$ on both sides, we obtain our estimating equation

$$\tilde{\pi}_{j,t+1|t} - \tilde{\pi}_{t+1|t} = a + \phi(\pi^e_{j,t+1|t} - \tilde{\pi}_{t+1|t}) + \varepsilon_t, \tag{7}$$

where we include a constant and a residual to account for other unobserved variables that could influence the FOMC members' forecasts.

One complication when estimating equation (7) is that the forecasted inflation variable switched in February 2000 from the consumer price index (CPI-U) to the price index for personal consumption expenditure (PCE). Our construction of $\pi^e_{j,t+1|t}$ is based on the history of the CPI, and from 2000 to the end of our sample in 2004, the average CPI inflation rate was about 0.40% higher than the PCE inflation rate. We take two approaches to address this discrepancy. First, we simply re-calculate $\tilde{\pi}_{j,t+1|t}$ post-1999 by adding the difference in CPI and PCE inflation rates over the 12 months prior to the meeting to the FOMC member forecast. Second, we estimate a version of equation (7) with time fixed effects. As long as views about the CPI-PCE discrepancy are similar among FOMC members, the effect of the discrepancy will be absorbed by the time fixed effects. In this case, the coefficient ϕ is identified purely from (time-varying) cross-sectional differences between FOMC members in their forecasts and their inflation experiences.

Another complication is that forecast horizons vary. To match the forecasts in the February MPR (from the end of the previous-year Q4 to the end of the current-year Q4), we construct the experience-based forecast using data until the end of previous-year Q4 and then iterate to construct a four-quarter-ahead forecast. To match the same (previous-year Q4 to current-year Q4) forecast in the July MPR, we average the two-quarter-ahead experience-based forecast (from end of Q2 to end of current-year Q4) and the realized inflation over the past two quarters (from end of last-year Q4 to end of Q2). To match the next-year forecast (from current-year Q4 to next-year Q4) in the July MPR, we subtract the same two-quarter-ahead experience-based forecast from the six-quarter-ahead experience-based forecast (from end of Q2 this year to end of Q4 next year).

Panel A in Table 1 reports summary statistics for the dependent and explanatory variables in (7), separately for each forecast horizon. The mean column shows that the FOMC members' actual MPR forecast exceeds the Greenbook forecast on average over the 1992-2004 sample period by between 0.17 to 0.32 percentage points. Interestingly, the same pattern, but at a greater magnitude, holds for FOMC members' experience-based forecast. This is a first hint that partial reliance on personal inflation experiences could be the reason why FOMC members deviate from the Greenbook forecast. The standard deviation column shows that actual and experience-based forecast deviations from the Greenbook have a standard deviation of around 0.50 percentage points for the February MPRs, and around 0.40 to 1.10 percentage points for the two July MPR forecasts. These means and standard deviations are large relative to the magnitudes of a typical federal-funds-rate target change of 0.25 percentage points that the FOMC might consider in a meeting.

The table also reports the within-member standard deviation of the actual and the experience-based forecast. This statistic reveals that member fixed effects do not absorb much of the variation. The much smaller within-meeting standard deviation in the next column indicates that much of the total standard deviation reflects time-series variation of the average members' deviation from the Greenbook forecast, rather than cross-sectional dispersion between members in a given FOMC meeting. This is a consequence of the fact that the sample period for these forecast data features relatively low and stable inflation rates. As a consequence, the heterogeneity in FOMC members' experience-based forecasts is limited. Our analysis of voting and speeches, which we turn to below, will instead cover the 1970s in its sample period, which bring in substantially greater dispersions in experience-based forecasts.

2.4. Estimation Results

The estimation results are in Panel B in Table 1. The panel reports the OLS estimates of the weight ϕ on the experience-based forecasts, relative to the staff forecasts, in equation (7). We find that the experience-based inflation forecast plays a significant role in explaining the variation of members' reported inflation forecasts. The specification in column (i) uses the total variation without fixed effects. The resulting estimate of 0.37 (s.e. 0.10) implies that FOMC members put about 37% weight on their experience-based forecast and 63% on the staff forecast. Figure 1 presents the scatter plot corresponding to this regression, comparing individual members' actual inflation forecast $\tilde{\pi}_{j,t+1|t}$ to their experience-based forecast $\pi^e_{j,t+1|t}$. The scatter plot illustrates the high R^2 of 34.7% in this regression.

The estimate of ϕ remains very similar when we add member×forecast-horizon fixed effects, i. e., FOMC member dummies interacted with dummies for the three types of forecast in Panel A. As shown in column (ii), the coefficient estimate is now

0.40 (s.e. 0.12). This stability of the estimate implies that the results are not driven by cohort fixed effects (which are absorbed by the member fixed effects in this regression). Experience-based learners update their beliefs over time, and this time-variation in expectations is not captured by cohort fixed effects. Instead, the estimate is identified from variation in cross-sectional differences over time. The estimates in column (ii) also show that any alternative explanation based on fixed member characteristics (e.g., educational background) cannot explain the results.[22]

The estimates so far largely reflect the time-series comovement of the average FOMC member's forecasts and experiences at a given meeting. Periods in which the average FOMC member submits an inflation forecast above the Greenbook forecast also tend to be periods in which the average FOMC member's experience-based forecast is above the Greenbook forecast. It is interesting that the time-series variation in these variables lines up so closely, as evident also from Figure 1. To rule out that that some omitted time-series factor is driving this co-movement, it is useful to focus on within-meeting variation. For this reason, we include meeting×forecast-horizon fixed effects in the estimations in columns (iii) and (iv). The magnitude of the ϕ estimate roughly doubles. However, only a small amount of variation remains after including this extensive set of fixed effects, and so the standard errors become fairly large. As a consequence, we cannot reject that the estimates are unchanged compared to those in column (i) and (ii). Nevertheless, even though pinning down the precise magnitude of the effect is difficult, it is reassuring that the results are qualitatively similar and remain significant when we identify ϕ only from within-meeting variation.

Finally, we note that the estimates in column (iv) also include member fixed effects,

[22] In addition, in Appendix K we show that the experience effects on inflation forecasts, and also on voting and speeches, have similar strength among FOMC members with an an economics PhD and among those without.

on top of the meeting × forecast-horizon fixed effects. This estimation illustrates the point made earlier that the heterogeneity in experience-based inflation forecasts is not fully absorbed by time and member fixed effects. This dimension of identification constitutes the key difference between our approach and methods that try to capture experience effects through cohort fixed effects (which would be absorbed by the member fixed effects in column (iv)).

We conclude that the estimates are consistent with the view that heterogeneity in lifetime experiences of inflation results in significant heterogeneity in FOMC members' beliefs about future inflation. In terms of magnitude, while the focus on within-meeting variation in columns (iii) and (iv) is useful to achieve identification, independent of any correlated omitted time-series variables, the relevant variation for the assessment of experience effects and for counterfactual exercises is the total variation plotted in Figure 1, including the large between-meeting component. For example, to predict the policy stance of the committee, one may want to know by how much experience-based learning could shift the average member's inflation expectation away from the Greenbook forecast.

The large economic effect of personal inflation histories on FOMC members' stated beliefs has a similar order of magnitude as the effect estimated in the MSC. Among households surveyed in the MSC, Malmendier and Nagel (2016) find that that survey respondents put a weight of 0.67 on their experience-based forecasts. Considering the estimation uncertainty, it is difficult to make a precise comparison, but broadly, the weight put on personal experiences when forming inflation expectations appears quite similar across FOMC members and the households surveyed in the MSC.

In terms of interpretation, one potential concern specific to the FOMC setting is that strategic considerations might affect the forecasts stated in the MPR, including the desire to appear consistent or to send a message. This concern is somewhat muted because *individual* forecasts are actually not revealed in the MPR; they are made public only with a 10-year lag. The focus of public attention is usually on the published summary measures, especially the central tendency of the distribution of member forecasts. Also, as always with data on reported beliefs, it is important to keep in mind that it may not be possible to cleanly separate beliefs from preferences. Nevertheless, a direct effect of inflation experienced on beliefs about future inflation provides the most straightforward explanation of these results.

3. Inflation Experiences and Voting

Our first finding that FOMC members put substantial weights on their personal inflation experiences when forming inflation expectations raises the possibility that differences in experiences also give rise to differences in FOMC members' monetary policy stance. To find out, we examine how FOMC members' voting records relate to their inflation experiences. This analysis allows us to turn to actual monetary-policy decisions, and also to considerably expand the sample period backwards in time, compared to the relatively short sample period of MPR inflation expectations.

3.1. Policy Rule

In order to isolate the effects of inflation experiences on FOMC members' monetary-policy stance, we need a framework that allows us to map their beliefs about future inflation into their monetary-policy views. Such a framework should also allow for other sources of heterogeneity in policy preferences and incentives that could affect members' policy views.

We model monetary policy makers as following, explicitly or implicitly, an interest-rate rule that pins down their desired interest rates. We use the Taylor (1993) rule as a starting point, and augment it to allow for heterogeneity.

The standard Taylor rule implies a nominal interest rate

$$i_t^* = r + \pi^* + \lambda(\pi_t - \pi^*) + \gamma(y_t - y^*) \qquad \text{with } \lambda > 0,\ \gamma > 0, \tag{8}$$

where π_t is the inflation rate, π^* is the inflation target (assumed to be 2 percent by Taylor), y_t denotes output, y^* is potential output, and r is the "natural" real interest rate consistent with an output gap $y_t - y^*$ of zero. Orphanides (2003) shows that this rule explains well the evolution of the Federal Reserve's policy rate (federal funds rate) all the way back to the 1950s, with the exception of a few years in the early 1980s during the "Volcker disinflation." This does not mean that the FOMC explicitly followed such a rule; but its policy decisions are well described by this rule.

In forward-looking versions of the Taylor rule (see, e.g., (Clarida et al., 1999)), deviations from the inflation target are evaluated in terms of expected values instead of the realization π_t. Orphanides (2001, 2003) finds that a forward-looking Taylor rule fits the federal funds rate better than one based on realized data. We introduce such a forward-looking element into the rule, but with the twist that it reflects each individual FOMC member's experience-based inflation expectations, $\pi^e_{j,t+1|t}$.[23] In addition, to control for potentially confounding heterogeneity, we allow preferences for input versus output stabilization, reflected in the weights λ, γ, as well as members' subjective views about the targets π^*, y^*, and the natural rate r, to depend on member characteristics. With these sources of heterogeneity incorporated into the policy rule, FOMC member

[23] Through the lens of a macro model, one can interpret the heterogeneity in FOMC members' subjective expectations as a reflection of implicit differences in their subjective views about underlying structural parameters such as the central bank's inflation target, the persistence of cost-push shocks, and the slope of the Phillips curve. We describe this in more detail in Appendix B.

j's desired nominal interest rate at time t becomes

$$i^*_{j,t} = r_{j,t} + \pi^*_{j,t} + \lambda_{j,t}(\omega\pi^e_{j,t+1|t} + (1-\omega)\pi_t - \pi^*_{j,t}) + \gamma_{j,t}(y_t - y^*_{j,t}), \quad \text{where}\, 0 \leq \omega \leq 1. \tag{9}$$

The parameter ω represents the weight that FOMC members put on their own subjective expectation $\pi^e_{j,t+1|t}$ rather than the objective information π_t.

To make the policy rule fully forward-looking, one could also replace π_t with objective forecasts such as those from the Greenbook. We will do this in the last part of our analysis where we look at the time-series of the federal funds rate and where subtleties of time dynamics matter. But the Greenbook forecasts are available only for a much shorter sample period. For our analysis of voting and speeches, we therefore stick to realized inflation. As we will show now, in these analyses, we identify experience effects from cross-sectional heterogeneity and the common π_t component of the Taylor rule matters only to a very limited extent through interactions with control variables.

We specify the heterogeneity of FOMC members' Taylor rule parameters as follows:

$$\begin{aligned} \lambda_{j,t} &= \lambda_0 + (x_{j,t} - \mu_x)'\lambda_1, & \gamma_{j,t} &= \gamma_0 + (x_{j,t} - \mu_x)'\gamma_1, \\ \pi^*_{j,t} &= \pi^* + (x_{j,t} - \mu_x)'\alpha_1, & y^*_{j,t} &= y^* + (x_{j,t} - \mu_x)'\alpha_2, \\ r_{j,t} &= r + (x_{j,t} - \mu_x)'\alpha_3, \end{aligned} \tag{10}$$

where $x_{j,t}$ is a vector of characteristics of FOMC member j at time t with population mean μ_x. After substituting these expressions into equation (9), we perform a first-order Taylor approximation of $i_{j,t}$ as a function of $(\pi^e_{j,t+1|t}, x'_{j,t})$ around (π_t, μ'_x); cf. Appendix C. We obtain

$$i^*_{j,t} \approx a_t + \lambda_0\omega\pi^e_{j,t+1|t} + \kappa' x_{j,t} + \pi_t x'_{j,t}\lambda_1 + (y_t - y^*)x'_{j,t}\gamma_1, \tag{11}$$

where a_t is a time fixed effect and κ is a vector of constants. We use this version of the Taylor rule to derive individual desired interest rates and corresponding policy views, whether expressed in voting decisions or speech tones.

3.2. Data on the FOMC Voting History

We study the FOMC voting history from March 1951 to January 2014. The starting point is dictated by the Treasury-Federal Reserve Accord of 1951, with which the Federal Reserve System regained its independence from the Department of Treasury after World War II.

The data comes from several sources. For meetings from January 1966 to December 1996, we use the data from Chappell et al. (2005). For meetings before January 1966 and after January 1997, we collect the data directly from FOMC meeting statements. Each statement reports all votes, typically followed by explanations of the dissenting opinions, if any. We exclude eight dissents that cannot easily be classified as hawkish or dovish.[24] Four FOMC members were both regional Fed presidents and governors at different points during their career, and we account for their varying roles in our empirical analysis.

We collect biographical information for each FOMC member from the Federal Reserve History Gateway[25] and the Who's Who database. The data includes the year and place of birth, gender, the highest degree earned, the program they graduated from, the role served in the Fed (board member or regional bank president), and the political party of the U.S president who was in office at the time of the member's first appointment.

We use these data to construct the vector $x_{j,t}$ of FOMC members' characteristics

[24] Details on the construction of the voting data set are in Appendix D.

[25] `http://www.federalreservehistory.org/People`

that we allow to influence the desired interest rate at meeting time t in equation (11). We include age to make sure the experience-based inflation forecast is not picking up an age effect, as well as other characteristics that the prior literature has found to be important determinants of FOMC voting (Chappell et al., 1993, 1995; Chappell and McGregor, 2000): gender, indicators for being a Regional Federal Reserve Bank President, for being appointed during the time a Republican U.S. president was in office, and for the U.S. president at the time of the first appointment being in the same party as the current president. For reasons we discuss below, we also include an interaction between the indicator for Regional Federal Reserve Bank President and an indicator for meeting times after November 1993.[26]

Table 2 presents the summary statistics. Our data covers 659 FOMC meetings with 7,350 votes. Overall, we have 160 dovish and 265 hawkish dissenting votes.

For the interpretation of the estimation results below, it is useful to keep in mind that the share of dovish and hawkish dissents is quite small, typically somewhere between 2.2% and 3.6%. These averages hide, however, a large degree of heterogeneity by role served and over time. Figure 2 shows the number of dissents in each FOMC meeting separately for Federal Reserve Board members (Panel a) and Regional Federal Reserve Presidents (Panel b). We can see that governors are much more likely to cast a dovish than a hawkish dissenting vote. The opposite holds for regional presidents, with a much higher fraction of hawkish dissents, as also indicated in Panel A of Table 2. Figure 2 also reveals a significant shift in voting behavior in November 1993, indicated by the red line. At that time, the Federal Reserve responded to pressure from Congress for

[26] In addition, we have checked the robustness to including further control variables and their interactions, such as tenure (as a possible control for expertise, cf. (Hansen and McMahon, 2016a)) and educational background. None of our results are affected if we include tenure, tenure squared, and controls for the school attended, the highest degree, and the field studied.

more transparency and accountability, and agreed to publish lightly edited transcripts of the FOMC meetings with a five-year lag ((Lindsey, 2003)). Before 1993, the Federal Reserve published individual votes and summary minutes, but not the full transcripts. Meade and Stasavage (2008) find that this change reduced the willingness of FOMC members to verbally express dissents in the meetings. They also find a decrease in the propensity of Federal Reserve board members to dissent in formal voting, but the effect is not statistically significant in their sample until 1997. Figure 2, however, shows a fairly clear pattern. Dissents among Federal Reserve Board members became almost non-existent after the increase in transparency in 1993 (only 6 subsequent dissents). In contrast, dissents among regional Federal Reserve presidents remained quite common (71 subsequent dissents). Thus, the thresholds for FOMC members to voice dissent seems to have changed in 1993, and differently so for governors and presidents. This is an important feature of the data that we will need to accommodate in our econometric specification.

Returning to Panel A of Table 2, we see that hawkish dissenters are older, have a longer tenure on the FOMC, are more likely to have a PhD, to have studied economics, to be male, and to be appointed when the U.S. president in office was from a different party than the current U.S. president. (All differences other than the doctoral degree and field of study are statistically significant.) At the bottom of Panel A, we show the mean and standard deviation of FOMC members' experience-based forecasts $\pi^e_{j,t+1|t}$, calculated as described in Section 2.1. The average experience-based inflation forecasts for dovish dissenters is 3.8% while the average for hawkish dissenters is 4.1%, though the difference is not significant, and the average among consenters is even lower (3.4%).

Panel B shows the pairwise correlations between the key variables. We note again the positive relationship between the role of Fed president and votes leaning in a hawkish direction, and the same for being male, older, and Republican. Experience-based forecasts and hawkish voting are also positively correlated, and the correlation is significant. Our empirical analysis will test whether this relationship persists when analyzing the between-member variation in experiences after controlling for all other characteristics and their interaction effects, as implied by the policy rule (11).

In order to illustrate the identifying variation in our estimations, we plot two measures of the cross-sectional differences in experience-based inflation forecasts. Panel (a) of Figure 3 shows the learning-from-experience forecasts $\pi^e_{j,t+1|t}$ of the youngest and oldest FOMC members at each meeting, both net of the forecast of the median-age member. The differences range from 0 to 1.5 percentage points, with the biggest differences occurring during the high-inflation years of the late 1970s and early 1980s. At that time, younger members' inflation experiences are dominated by the high and persistent inflation of the 1970s, more so than those of older members, and young members have the highest experience-based forecasts. From the mid-1980s onwards, younger members adapted more quickly to the now low rates of inflation and the relatively low persistence, and the lines cross. The perception of a low inflation persistence among younger members also contributes to the spike around 2010, when young members' learning-from-experience forecast is temporarily much higher than the median: When faced with the recession-driven low inflation rates at the time, young members expected a faster reversion of inflation rates up (towards the mean of slightly above 2%) than older members.

As a second measure of the heterogeneity in experience-based inflation forecasts, Panel (b) plots the time-series of the within-meeting standard deviation of $\pi^e_{j,t+1|t}$. There is a lot of variation in this dispersion measure over time. A typical value would be around 0.1 percentage points (the full-sample within-meeting s.d. is 0.10 pp). It is useful to keep these magnitudes in mind for the interpretation of our empirical results below. Overall, the within-meeting dispersion of the experience-based forecasts is higher than in our earlier 1992-2004 sample of FOMC member inflation expectations.

3.3. Econometric Specification

At each FOMC meeting, all current voting members cast a vote to either support or dissent from the proposal of the Fed chairperson. We classify the vote $V_{j,t}$ of member j in the meeting at time t as falling into one of three categories, $V_{j,t} \in \{-1, 0, 1\}$, for dovish dissent, no dissent, and hawkish dissent, respectively. We express the probability of being in one of these three categories as a function of the desired interest rate from equation (11) via the following ordered probit model: For $k \in \{-1, 0\}$,

$$\begin{aligned} & P(V_{j,t} \leq k | \pi^e_{j,t+1|t}, x_{j,t}, \pi_t, y_t) \\ & = \Phi[\delta_{k,j,t} - a_t - \lambda_0 \omega \pi^e_{j,t+1|t} - \kappa' x_{j,t} - \pi_t x'_{j,t} \lambda_1 - (y_t - y^*) x'_{j,t} \gamma_1], \end{aligned} \tag{12}$$

where $\Phi(.)$ denotes the standard normal cumulative distribution. We normalize $a_1 = 0$, and we suitably scale all variables so that the latent residual has unit standard deviation.[27] The main variable of interest in estimating equation (12) is the experience-based forecast $\pi^e_{j,t+1|t}$.

The model in equation (12) generalizes the ordered-probit model because we allow the dissent thresholds $\delta_{k,j,t}$ to vary with the characteristics of the FOMC member and over time, especially across the transparency regime change in 1993. The most important concern motivating this generalization is that regional Fed presidents may have different dissent thresholds than Federal Reserve Board governors. As we il-

[27] These normalizations are of no consequence for the estimated partial effects, and so we do not explicitly write them out.

lustrated in Figure 2, this concern is particularly relevant since the November 1993 change in transparency. To accommodate the possibility of threshold-heterogeneity among FOMC members, we let the thresholds in equation (12) depend on the FOMC member characteristics $x_{j,t}$, including an interaction between indicators for the role of Fed President and for a meeting time after November 1993:

$$\delta_{k,j,t} = \delta_{0,k} + \delta'_{1,k} x_{j,t} \qquad \text{for } \ k \in \{-1, 0\}. \tag{13}$$

Note that coefficients of $\delta_{0,k}$ and $\delta_{1,k}$ are threshold-specific. With this threshold specification, we obtain a version of the generalized ordered probit model in Williams (2006). We estimate the model with maximum likelihood. As a robustness check, we also explore conventional fixed-threshold ordered probit specifications in Section 3.6.

3.4. Hyperinflation Experiences

One FOMC member in our data set, Henry Wallich, personally experienced hyperinflation.[28] Wallich was born in Germany in 1914 in a family of bankers, and lived through Germany's hyperinflation from 1921 to 1924. In the 1930s, he emigrated to the United States. He was Federal Reserve governor from 1974 to 1986. Mr. Wallich dissented 27 times during his tenure on the Federal Reserve Board, the highest number of dissents among all FOMC members in Federal Reserve history, according to Thornton and Wheelock (2014).[29]

[28] Henry Wallich is the only FOMC member with personal hyperinflation experiences that we could identify. H. Robert Heller, another German-born Federal Reserve Board member in the 1980s was born in 1940, after the hyperinflation. Stanley Fischer, who was born in Zambia in 1943, spent time in Israel, but not during its hyperinflation. He is not included in our sample because he started his tenure as vice chairman of the Federal Reserve Board in June 2014 while our sample ends in January 2014.

[29] In our sample, we identify only 26 dissents by Wallich, 24 of which were hawkish. The difference to Thornton and Wheelock's classification could be Wallich's vote on the 2/6/1979. In this meeting he

The presence of Wallich in our sample poses the question of how to include hyperinflation experiences into a parametric belief-updating scheme that is designed for (and works well in) a regime in which inflation rates are at most a few percent per quarter. How can we adjust it to properly describe expectation formation from data that include inflation rates around one million percent per quarter? Note that early life experiences are heavily downweighted in the calculation of the experience-based forecast, and it therefore makes virtually no difference whether we use inflation rates of the U.S. or another country, in which an individual might have grown up as a teenager, in low-inflation environments (with, say, single digit inflation rates). This is different with hyperinflation experiences. For example, if we naively plug German inflation rates from the 1920s into Wallich's experienced inflation history, the outliers are so big that three or four quarterly observations in 1923 would completely determine the autoregressive coefficients for the rest of Wallich's life. The post-1923 history would be rendered irrelevant, which is unlikely to be a plausible representation of how hyperinflation experiences influence inflation expectations.

We implement two approaches. First, we take a non-parametric approach and augment the inflation experience-based forecast (using U.S. data) with an indicator variable that we label "Wallich Dummy." With the caveat that this variable captures the voting behavior of just one individual member, the corresponding coefficient estimate provides at least tentative evidence on the effects of a "hyperinflation" treatment, i. e., how the extreme experience of hyperinflation may influence monetary policy views. Second, we also explore experience-based expectations formation with a mixed inflation process that includes a hyperinflation regime. This approach allows us to integrate hyperin-

dissented regarding the adopted growth rates of the monetary aggregates (M1-M3), but not regarding the open market transactions that were authorized. In our sample, this vote is not counted as dissent.

flation experiences within one parametric framework with qualitatively similar results, but at the cost of additional complexity. We show the corresponding estimation results in Appendix E.

3.5. Baseline Results

Table 3 presents the estimates of our baseline ordered probit specification (12) using data from 1951 to 2014. Our focus is on the coefficient estimate, and the corresponding marginal effect, of each member's experience-based inflation forecast $\pi^e_{j,t+1|t}$. The chairman's vote is excluded from the sample because he never dissented during our sample period.

Column (i) of Table 3 reports estimates for a specification where the dissent thresholds can vary with indicators for the type of FOMC member (governor versus regional president) and with an indicator for the post-November 1993 period, as well as their interaction. This allows the model to accommodate the dramatic shift towards fewer dissents among Federal Reserve Board members after November 1993 that we saw in Figure 2. The coefficient on the experience-based inflation forecast of 216.6 (s.e. 66.1) is significantly different from zero at conventional significance levels. The magnitude of the effect on the probability of dissent can be inferred from the average partial effects (APE) reported in the middle block of the table. An increase of 0.1 percentage points (pp) in the experience-based forecasts of an FOMC member—which, according to Figure 3b, is a typical within-meeting standard deviation of FOMC members experience-based inflation forecasts during much of the sample—translates into an increase in the probability of a hawkish dissent vote of 1.21 pp, which is a little less than a third of the unconditional probability of hawkish dissent (265/6707 $\approx$ 4.0%). The probability of a dovish dissent drops by 0.76 pp, which is approximately a third of the unconditional probability of dovish dissent (160/6707 $\approx$ 2.4%). Thus, the estimates imply an economically large impact of inflation experiences on voting behavior.

The APE of the Wallich dummy indicates that the "hyperinflation treatment" is associated with a very large reduction in the probability of dovish dissent, 5 pp, and increase in the probability of hawkish dissent, 8 pp. In other words, the effects associated with the Wallich dummy are roughly of the same magnitude as those associated with a 1.0 pp increase in an FOMC member's experience-based inflation forecast.

All results are virtually identical in column (ii) where we allow the dissent thresholds to also depend on the FOMC members' individual characteristics (age, gender, party of president at appointment indicator, and same party as current president indicator).

3.6. Robustness Checks

One potential concern with the estimates in columns (i) and (ii) in Table 3 is that the inclusion of meeting fixed effects in the ordered probit model might introduce an incidental parameters problem.[30] To address this concern, we estimate an alternative specification in which we omit the meeting fixed effects. Instead, we specify that the probabilities of dissent are driven directly by cross-sectional differences (against the incumbent chairperson) in inflation experiences and other personal characteristics. That is, we forgo the non-parametric controls for the time-specific determinants of voting behavior, but still remove some of their effect to the extent that it is captured by the time-varying values associated with the chairperson.

The results are in columns (iii) and (iv) of Table 3. The coefficient estimates of the experience-effect forecast variable and the Wallich dummy decrease, but these changes largely reflect the altered econometric specification. As the APE calculations reveal,

[30] As T increases, the number of meeting fixed effects grows at the same rate as T. As a consequence, the probit estimator is inconsistent and standard formulas for the asymptotic distribution of the estimator may not provide a good approximation of its finite-sample properties.

the implied economic magnitudes remain similar to those in columns (i) and (ii). Both sets of estimates also remain statistically significant. We conclude that our findings are not generated by estimator inconsistencies due to the incidental parameter problem.

As a second robustness check, we test whether we still find experience effects if we employ a simple ordered probit model with fixed dissent thresholds and restrict the analysis to subsamples in which the fixed-threshold assumption is more likely to hold, i. e., prior to the decrease in dissents in November 1993 and for the votes of regional presidents.

Table 4 presents the results of this exercise. The specification in column (i) employs the voting records of all members prior to November 1993. The estimated results turn out to be very close to our benchmark case with characteristics-dependent dissent thresholds. We estimate slightly larger average partial effects of −9.5 pp for dovish dissents and +13.0 pp for hawkish dissents, again measured as the response to an increase of 1.0 pp in FOMC member's experience-based forecasts. The APE of the Wallich dummy also become slightly larger in both directions in this subsample.

In column (ii) we restrict the sample to regional Fed presidents, but use the full sample period. This subsample exploits the fact that the November 1993 transparency change did not have much effect on the voting behavior of regional presidents, as we showed in Figure 2. We find that the estimated effects are even stronger.[31] In this subsample, the proper comparison for the APEs is the unconditional probability of dovish or hawkish dissent by Federal Reserve presidents. The estimated average partial effects (APE) of changes in experience-based inflation forecast on the voting behavior of regional presidents suggests that an increase of 0.1% in the experience-based forecast

[31] Since Henry Wallich is not a regional Fed president, we cannot estimate the Wallich dummy coefficient in this case.

of regional Fed presidents translates into an increase in the probability of a hawkish dissent by roughly 2.6 pp, which is a bit less than one half of the unconditional probability of a hawkish dissent by regional Fed presidents ($191/3275 \approx 5.8\%$). Meanwhile, the probability of a dovish dissent drops by 0.6 pp, which is roughly half of the unconditional probability of dovish dissent by regional Fed presidents ($38/3275 \approx 1.2\%$). Comparing these numbers to our baseline case with all FOMC members, it appears that past inflation experience has a stronger effect on the votes of regional Fed presidents.

In column (iii), we further restrict the sample of regional presidents to include only the pre-November 1993 periods. The estimated APEs remain very similar.

Finally, in column (iv), we analyze the union of the column (i) and column (ii) subsamples, i. e., all members pre-November 1993 and only Fed presidents post-November 1993. The estimated effects are very similar to those in column (i), as well as to the benchmark case.

Appendix F contains an additional set of results with fixed thresholds where we use the full sample of all members and meetings. These results, shown in Table F.1, are again very similar. This simplified specification also allows a straightforward interpretation of the effects of the member characteristics, $x_{j,t}$. We report the coefficients associated with these variables in Table F.2.

As a last robustness check, we employ variations in the gain parameter θ of the learning algorithm. So far we fixed θ at the point estimate of 3.044 from Malmendier and Nagel (2016). Relying on a prior estimate has the advantage that we credibly tied our hands, rather than picking θ to fit the voting behavior of FOMC members. We now check how the fit and the estimated APE change if we vary θ. That is, we reestimate the learning rule for each FOMC member over a range of plausible values of θ. We then rerun the estimation from column (i) of Table 3 with the corresponding alternative experience-based forecasts of inflation.

For our first alternative value, we reestimate the gain parameter using MSC data based on the same procedure as in Malmendier and Nagel (2016), but with the sample restricted to college graduates. This sub-sample is more comparable to the FOMC members in terms of educational background. We estimate $\theta = 3.334$ (with s.e. of 0.347). That is, the θ estimate for college grads is less than one standard error from the full-sample estimate. As column (i) of Table 5 shows, employing $\theta = 3.334$ rather than $\theta = 3.044$ does not alter our findings. The results remain very similar to our baseline estimates in column (i) of Table 3.

Second, we employ a range of θ values between $\theta = 2$ to $\theta = 4$ (in steps of 0.5). As shown in columns (ii) to (v) of Table 5, all results are qualitatively similar to our baseline estimates as in column (i) of Table 3. We conclude that our results are robust to variations over a broad range of plausible θ values.

In summary, we find that lifetime inflation experiences have an economically large and robust effect on FOMC members' voting behavior. When an FOMC members' lifetime experience suggests higher inflation going forward than the experience of their peers, they are more likely to dissent in a hawkish direction. The opposite holds for inflation experiences suggesting lower future inflation; they induce dovish dissents.

4. Inflation Experiences and the Tone of FOMC Members' Speeches

The seeming reluctance of governors to dissent, especially since November 1993, indicates that FOMC members may not always fully reveal their disagreement in their voting behavior. They might voice their monetary policy views in discussions or speeches, but ultimately refrain from casting a dissenting vote.

In this section, we test whether FOMC members' attitude towards monetary policy can be detected in the language, or tone, they use in their speeches. To categorize language as hawkish or dovish, we employ an automated search-and-count approach that closely builds on the analysis of Apel and Grimaldi (2014). Apel and Grimaldi (2014) examine the Swedish Riksbank minutes and test whether the tone of an Executive Board member conveys a policy inclination toward loosening or tightening monetary policy. We apply their classification of tone to the speeches of FOMC members, with some adjustments to the different context and sample, as described in detail below.

Our data consists of all $6,353$ "Speeches and Statements" available from the Federal Reserve Archival System for Economic Research (FRASER), and additional 658 hand-collected speeches from the websites of the regional FRBs. To be consistent with the analysis of votes in the previous section, we focus on voting members and remove speeches delivered by the (rotating) non-voting regional Fed presidents. We also drop pdf files that could not be properly converted into text and for which the date of the speech cannot be determined. The final sample consists of $4,294$ speeches for 86 FOMC members from the meeting on March 8th, 1951, to June 2014, with an average of 50 speeches per member. A quarter of the members have 15 or fewer speeches in the sample, while long-serving FOMC members, especially chairmen, tend to have more than 100 speeches. For example, our sample includes 482 speeches by Alan Greenspan and 264 by Ben Bernanke. Appendix G details the construction of the data set.

Figure 4 shows the time series of the speeches in our sample. The total number increases over time. From 1965 onwards, the average number of speeches in a quarter is above 17, i.e., more than one speech per FOMC member per quarter. The share of speeches delivered by the chair increases only slightly over time and lies around 30%.

To classify the tone of these speeches, we follow Apel and Grimaldi (2014) and generate two-word combinations from two sets of words: nouns describing the *goals* of a central bank, and adjectives describing the *attitudes* of a central banker towards a goal. The list of goals in Apel and Grimaldi (2014) consists of "inflation," "cyclical position," "growth," "price," "wages," "oil price," and "development." In addition, we show estimation results after adapting the list to the FOMC context by adding "(un-)employment." Apel and Grimaldi had omitted this term because the Swedish Riksbank has price stability as a single goal, while the U.S. Federal Reserve System has a dual mandate. The list of attitudes consists of "decrease," "slow," "weak," and "low" on the dovish side, and "increase," "fast," "strong," and "high" for the hawkish counterpart. For unemployment, we swap the hawkish and the dovish adjectives.

For each mention of a *goal*, we check whether words from the *attitudes* list occur within a range (n-gram) of two words before and after the *goal*. While Apel and Grimaldi (2014) require the *attitude* word to appear directly before the *goal*, such two-word combinations do not generate sufficient variation between the speeches of FOMC members, possibly because the language is less formal and standardized than the Swedish central bank minutes, and the speeches of the FOMC members address a wider audience. We choose a range of two words before and after the goal (i.e., five-grams) in order to accommodate two-word goals such as "oil price," for which the *attitude* word is allowed to appear either one or two words before "oil" or one word after "price", as well as to accommodate different relative positions of the classification words. For example, an FOMC member might refer to "increasing prices" or mention that "prices are increasing." In addition, by centering the n-grams around the noun of interest, we avoid double-counting: Every word of the speech can occur in up to n n-grams but is at most once in the center of an n-gram.

We drop n-grams containing more than one "goal" or "attitude" with different connotations. For example, the sequence "... low growth and unemployment ..." generates a five-gram centered around the *goal* 'growth' combined with the *attitude* 'low;' but the same five-gram also features another *goal*, unemployment. Since these two goals generate a dovish combination ("low growth") as well a hawkish one ("low unemployment"), we drop the five-gram from our analysis.

As in Apel and Grimaldi (2014), we then collapse the number of hawkish and dovish combinations in each speech into a single index:

$$Net\ Index = \frac{Hawkish}{Hawkish + Dovish} - \frac{Dovish}{Hawkish + Dovish}. \quad (14)$$

The index ranges from -1 to $+1$, where -1 indicates that all of the tagged n-grams are dovish, and $+1$ that all tagged n-grams are hawkish. Hence, larger values of *Net Index* indicate greater hawkishness. If no hawkish or dovish n-grams can be found in the text, *Net Index* is set to zero.

Table 6 provides some summary statistics of *Net Index* and its components. On average, a speech contains 3,378 five-grams, but there is a large variation across speeches. A mean of 1.50 five-grams are tagged as hawkish, and 0.99 as dovish, when we use the original set of goals defined in Apel and Grimaldi (2014). By adding "employment/unemployment" to the goal list, we add an additional 0.29 hawkish and 0.22 dovish tags per speech. The average *Net Index* across speeches is about 0.10, irrespective of the specification of the goal list. The positive value indicates that the language used in our sample of speeches is slightly tilted towards a more hawkish wording, albeit with a large standard deviation of 0.55.

To develop our estimating equation, we assume that cross-sectional differences in *Net Index* between FOMC members map approximately linearly into differences in their desired interest rate according to equation (11). We obtain

$$Net\ Index_{j,t} = \alpha_t + \beta_1 \pi^e_{j,t+1|t} + \beta_2' x_{j,t} + \pi_t x_{j,t}' \beta_3 + (y_t - y^*) x_{j,t}' \beta_4, \tag{15}$$

where the coefficients are multiples (by the same factor) of the corresponding coefficients in equation (11). As before in the voting analysis, we relate the outcome during quarter t to $\pi^e_{j,t+1|t}$, which is constructed based on the inflation history leading up to the end of quarter $t-1$. We also continue to focus on cross-sectional heterogeneity by employing time-fixed effects, α_t, to absorb common time-variation in the use of hawkish and dovish expressions.[32] The vector of member characteristics $x_{j,t}$ is the same as in the voting analysis (age, gender, party of president at appointment indicator, and same party as current president indicator), and it can influence the level of hawkishness as well as the extent to which inflation or output gap increase or decrease hawkishness.

In addition, we also account for the fact that, differently from voting behavior, speech tone is likely subject to additional sources of heterogeneity. 'Speech style' and the choice of words can depend on other personal characteristics of the speaker, including education and prior professional experience. This heterogeneity adds noise and it could introduce correlated omitted variables. We use two approaches to account for these additional personal characteristics. First, we augment equation (15) with dummy variables that control for education and prior professional experience.[33] We generate indicator variables for having earned a PhD, a JD, an MBA, or a Master's degree as the highest degree. We also collect information on FOMC members' prior professional experience from the Fed's History Gateway and from the personal vitae of FOMC

[32] For example, in times of high unemployment, all FOMC members might be likely to employ the goal-attitude combination "high unemployment" in their five-grams.

[33] Details on the construction of both variables are at the end of Appendix G, including summary statistics in Table G.1.

members. Using those sources, we generate indicator variables for prior experience in the financial industry, in non-finance industries, in other government organizations and agencies besides the Fed, and as an academic (i. e., having worked full-time in an academic department at some point prior to becoming an FOMC member). As a second approach to addressing heterogeneity in speech style, we absorb any time-invariant personal characteristics with member fixed effects. Under this approach, the coefficient of interest, β_1, is identified from within-member variation of speech tone as their inflation experience changes. The inclusion of member fixed effects is, on the one hand, most comprehensive in accounting for unobserved person-specific determinants of language use. On the other hand, it removes a substantial amount of variation coming from the differences in average experience-based inflation forecasts between FOMC members.

Table 7 presents the results. In columns (i) to (iii), we use the original $NetIndex$ with the same list of goals as in Apel and Grimaldi (2014). In columns (iv) to (vi), we expand the index and add (un-)employment to the list of goals.

We estimate a significant effect of differences in inflation experiences on speech tone. In the baseline specification in column (i), the coefficient of 32.88 (s.e. 14.52) is significantly different from zero at the 5% level. An increase of 0.1 percentage points in the experience-based forecasts of an FOMC member—which is a typical within-meeting standard deviation—is associated with an increase of about 0.03 in the $NetIndex$, or about 1/16th of a standard deviation of $NetIndex$. This magnitude seems plausible for two reasons. First, the experience effects should be relatively subtle given the small age heterogeneity of FOMC members. Second, there is likely substantial measurement noise in $NetIndex$. This is apparent from the fact that the R^2 is only 4.4% despite the inclusion of time fixed effects, even though one would presumably expect substantial common time-variation in the *true* hawkishness of speeches.

The point estimate for the Wallich dummy suggests that hyperinflation experience predicts a 0.10 higher $NetIndex$ than that of other Fed governors with similar characteristics at the time; but given the standard error (0.08) it is not possible to rule out a zero effect at conventional significance levels in first specification. Nevertheless, it is noteworthy that the ratio of the point estimates for the experience-based forecasts and the Wallich dummy (about 200-300 here depending on the specification) is of the same order of magnitude as in the voting analysis in Table 3 (about 100-150).

In column (ii) we test the extent to which our estimation results are affected by the large number of speeches given by the chairperson. Speeches of the chair might systematically differ from the speeches of other FOMC member for at least two reasons. First, chairs might use a more balanced language for political reasons, especially given that they tend to attract more attention. Second, chairs might use the speeches to provide signals to financial markets, whereas the other FOMC member might primarily use the speeches to communicate their views between each other. When we drop the chair's speeches, we obtain a slightly larger coefficient of 39.15 (s.e. 18.50) which is also significant at the 5% level. In column (iii), we include both member fixed effects and speeches of the chair. The outcome remains almost unchanged.

In columns (iv) through (vi), we re-estimate the specifications from columns (i) through (iii) for the version of *Net Index* that includes (un-)employment as a goal. The results are very similar.

We conclude that the personal lifetime inflation experiences of FOMC members leave a significant imprint not only on their dissenting votes and the strong policy leanings expressed with those, but also on the more subtle expressions of attitudes towards monetary policy voiced in speeches.

5. Inflation Experiences and the Federal Funds Rate Target

Our analyses of cross-sectional differences in stated inflation expectations, voting decisions, and the tone of speeches all indicate that FOMC members rely, to a significant extent, on their own inflation experiences. We now test whether this partial reliance on personal experiences affects even the committee's ultimate decision about the Federal Funds target rate. That is, we test whether there is an incremental effect of FOMC members' experience-based inflation forecasts on the consensus decision, alongside conventional interest-rate determinants in a Taylor rule.

This last analysis has to overcome two additional difficulties. First, we aim to explain the time series of federal funds rates rather than cross-sectional differences in behavior. In the preceding analyses, we were able to identify the effects of inflation experiences from cross-sectional cohort-specific differences as well as from changes in those differences over time. Time dummies allowed us to absorb any potentially confounding time-series factors, including conventional determinants of monetary policy. Here, instead, we cannot absorb time-series factors but need to take a stand on a specific model of the time-series determinants of monetary policy decisions. We will focus on standard versions of the Taylor rule that have been proven successful in predicting the FOMC's federal funds rate policy in the recent empirical literature.

The second challenge is the limited data availability in the time-series dimension, relative to our earlier cross-sectional analyses. As we detail below, the need for output-gap forecast data and limitations of the forecast-based Taylor rule restrict our analysis to 1987Q3-2007Q2.

Because of these additional challenges, the time-series tests in this section should be viewed in conjunction with our earlier evidence from inflation forecasts, voting decisions, and the tone in speeches. The analysis in this section evaluates whether the federal funds rate moves over time in a way that is consistent with the evidence above.

In order to test whether we can detect the influence of FOMC members' personal experience in the fed funds rate target they set, we first have to aggregate the lifetime experiences of all members present at a given meeting, and hence their corresponding desired interest rates. We start from the linear approximation of the subjective Taylor rule in (11) that represents the desired federal funds rates of the individual FOMC members present at the meeting. In our baseline specification, we assume that the federal funds rate target decided at an FOMC meeting represents the average of the members' desired rate levels. (Alternatively, we use the median or the chairperson's desired rates instead; see Appendix I for both robustness checks.) Averaging equation (11) across all FOMC members present at a meeting at time t, we obtain (as derived in Appendix C)

$$i_t^* = \beta_0 + \bar{z}_t + \beta_e \bar{\pi}^e_{t+1|t} + \beta_\pi \pi_t + \beta_y (y_t - y^*), \tag{16}$$

where $\bar{\pi}^e_{t+1|t}$ is the average of the FOMC members' experience-based inflation forecasts as of the meeting at time t, and $\bar{z}_t$ is the time-t average of

$$z_{j,t} = \kappa' x_{j,t} + \pi_t x'_{j,t} \lambda_1 + (y_t - y^*) x'_{j,t} \gamma_1. \tag{17}$$

With $\bar{z}_t = 0$ and $\beta_e = 0$ (the latter would follow from $\omega = 0$ in equation (11)), this reduces to the standard Taylor rule. Our earlier analyses suggest instead $\omega > 0$ and hence $\beta_e > 0$, i. e., that FOMC members rely to some extent on their experience-based inflation forecast, over and above the standard inflation- and output-gap components of the Taylor rule.

Turning to the empirical implementation, we aim to minimize the chance that $\bar{\pi}^e_{t+1|t}$ picks up the effects of measurement error in the objective macroeconomic information used by the FOMC. In order to do so, we need to use empirical measurements of π_t and $(y_t - y^*)$ that are as close as possible to the information used by the FOMC. We do so in three steps. First, we build on Orphanides (2001, 2003), who shows that forecast-based variants of the Taylor rule provide a better empirical fit to the actual decisions about the federal funds rate target than a rule based on realized macroeconomic data. We follow Orphanides (2003) and replace, for every meeting in quarter t, π_t and $(y_t - y^*)$ with the Federal Reserve staff's Greenbook forecasts of inflation from quarter $t-1$ to $t+3$ and forecasts of the output gap in quarter $t+3$.[34] Second, we use the inflation index that the FOMC relies on primarily. Following Mehra and Sawhney (2010) and Bernanke (2010), we construct the time series of the staff's "core inflation forecast" from Greenbook forecasts of the core CPI inflation before the year 2000 and of the core PCE inflation thereafter. Third, we follow Coibion and Gorodnichenko (2012) and use one FOMC meeting per quarter (the one that is closest to the middle of the quarter). This ensures that the CPI information leading up to the end of the previous quarter, which is embedded in $\bar{\pi}^e_{t+1|t}$, is available to the FOMC. Moreover, obtaining data points that are almost equally spaced in time is useful when we include lagged interest rates.

We start the sample in 1987Q3 when the Federal Reserve's staff forecast of the output gap become available. As shown in Orphanides (2001), the Taylor rule, and its forecast-based variant in particular, then provides a good description of actual Federal Reserve policy. We end the sample in 2007Q2, just before the start of the financial crisis. Mishkin (2010) argues that starting in the summer of 2007, the FOMC reacted to information from financial markets that did not yet show up in inflation and output

[34] In the earlier sample, the Greenbooks did not not explicitly include output gap forecasts, but the Board of Governors staff used them to construct wage and inflation forecasts. See www.philadelphiafed.org/research-and-data/real-time-center/greenbook-data/gap-and-financial-data-set.cfm for more details.

gap forecasts. As a result, the Taylor rule does not provide a good description of the FOMC's policy during this period.[35]

Column (i) of Table 8 provides a benchmark for the analysis. We replicate the standard Taylor rule findings without $\bar{z}_t$ and $\bar{\pi}^e_{t+1|t}$. The estimated coefficients on the output gap (0.67) and on the inflation variable (1.51) are consistent with typical findings in the literature. In column (ii), we include the average experience-based forecast, $\bar{\pi}^e_{t+1|t}$. We estimate a coefficient of 0.38 (s.e. 0.21) that is significantly different from zero at a 10% level. Hence, FOMC members' average experience-based inflation forecast has explanatory power for the federal funds rate target over and above the staff forecast of inflation and the output gap, albeit only marginally significant in this specification. Considering the coefficients on the two inflation variables together, the weight on the experience-based forecast in our experience-augmented Taylor rule (16) is about $0.38/(1.27 + 0.38) \approx 0.23$.

Column (iii) turns to the full specification (16) by including $\bar{z}_t$, which captures the effect of the changing characteristics of the FOMC members on interest-rate decisions. Through equation (17), $\bar{z}_t$ depends on parameters that we cannot credibly estimate purely from time-variation in the federal funds rate target. For this reason, we construct $\bar{z}_t$ from the estimates in our voting analysis. The fitted values of the latent desired interest rate of our ordered probit model (12) allow us to construct $z_{j,t}$ in equation (17) up to scaling by a constant. More precisely, we use the ordered probit specification with fixed thresholds, shown in the robustness tables in the Appendix in Table F.1. (With characteristics-dependent thresholds, we would not be able to separate the effect of characteristics on the thresholds from the effect on the latent desired interest rate.)

[35] Baxa et al. (2013) provide empirical evidence consistent with this description of FOMC policy. They show that adding financial market variables to the Taylor rule equation matters significantly in 2008-09, over and above inflation and output gap information.

Averaging the fitted $z_{j,t}$ across FOMC members each period yields $\bar{z}_t$. After adding $\bar{z}_t$ to the Taylor rule as an explanatory variable in column (iii) of Table 8, we find that the coefficient on the experience-based inflation forecast increases to 0.61 (s.e. 0.24), which is now statistically highly significant.

Finally, in columns (iv) to (v), we check whether the experience variable might be picking up the effect of a lagged federal funds rate. Existing evidence from the literature on monetary policy rules, e. g., Clarida et al. (2000) and more recently Coibion and Gorodnichenko (2012), indicates that the Federal Reserve's policy is best characterized by partial adjustment, where the actual federal funds rate target i_t is a weighted average of the desired federal funds rate i_t^* from equation (16) and the lagged actual federal funds rate target i_{t-1},

$$i_t = (1-\rho)i_t^* + \rho i_{t-1}. \tag{18}$$

To check whether accounting for partial adjustment of this form changes the conclusions regarding the experience effects, we combine the partial adjustment rule with equation (16):

$$i_t = c + (1-\rho)\left[\bar{z}_t + \beta_e \bar{\pi}^e_{t+1|t} + \beta_\pi \pi_t + \beta_y (y_t - y^*)\right] + \rho i_{t-1}. \tag{19}$$

Since the parameter of interest, β_e, is now interacted with $1-\rho$, we estimate (19) with non-linear least squares. We report the estimates of β_e, β_π, β_y, ρ, and c in columns (iv) and (v) for the specification without and with the $\bar{z}_t$ variable, respectively.

Column (iv) presents the version without the $\bar{z}_t$ variable. Consistent with the existing literature on federal funds rate inertia, the lagged target rate has a strong predictive power and absorbs a large portion of the residual. The coefficients on the inflation variables are not affected much, though. The estimate of β_e of 0.46 (s.e. 0.21) is now a bit higher than in column (ii), and significantly different from zero at the

5% level. The implied weight on experienced inflation relative to the staff forecast is now $0.46/(1.27 + 0.46) \approx 0.27$. Turning to the estimation with the $\bar{z}_t$ variable included in column (v), we find that adding $\bar{z}_t$ has very little effect on the estimates when the lagged federal funds rate target is included.

Overall, the evidence from the time-series of the target federal funds rate is consistent with the inflation experience effects that we identified in FOMC members' heterogeneous forecasts, voting decisions, and wording of speeches.

To assess the magnitude of this effect, we can compare these estimate to the those from the inflation forecast regressions in Table 1. There, we found that members put a weight of about 37-40% weight on their experience-based forecasts. It is reassuring that the weights obtained here, around 25%, are of very similar magnitude.

In Figure 5, we illustrate the magnitude of the effect by constructing a counterfactual federal funds rate target path that removes the estimated experience effects from the actual path. To construct the counterfactual path, we take the actual federal funds rate target and subtract the estimated β_e from column (ii) times the difference between FOMC members' average experience-based forecast and the Greenbook forecast of inflation. This counterfactual path represents the target that the FOMC would have chosen if its members had relied only on the staff forecast, not on their own inflation experiences—at least if we abstract from follow-on equilibrium effects.[36]

As the figure shows, the incremental effects of inflation experiences are substantial at times, but not unreasonably large. In the late 1980s and early 1990s, the effects were small. At the time, the average experience-based forecast remained very close to

[36] If the FOMC had chosen a different target rate path, macroeconomic performance would presumably have been different. As a consequence, the inputs to the Taylor rule would have been different, which would in turn have affected the federal funds rate target. Our simple counterfactual analysis does not consider these equilibrium effects, but allows us to get a sense of the magnitude of the experience effects relative to the other drivers of the federal funds rate target.

the staff's core inflation forecast. In contrast, in the 2000s the counterfactual federal funds rate target is often between 50 to 100 basis points lower than the actual federal funds rate.

6. Conclusion

We present novel evidence showing that personal lifetime experiences significantly affect the inflation forecasts, voting behavior, tone of speeches, and federal funds target rate decisions of FOMC members. Our findings suggest that heterogeneous inflation experiences generate heterogeneity in the desired policies and the macroeconomic outlook of FOMC members. Personal experiences exert this influence even though FOMC members are highly educated individuals and receive extensive decision-support from professional staff. In fact, experience effects help explain to a substantial extent why FOMC members deviate in their inflation forecasts from the forecasts prepared by Federal Reserve staff.

Our findings add to a growing literature on the role of experience-based heterogeneity in economic decisions and macroeconomic expectations. While existing studies focus on decisions and expectations of individual consumers and investors, this study is the first one to provide evidence of similar experience effects for policy makers.

The evidence in this paper also helps shed light on the behavioral origins of 'experience effects.' The overweighting of personal experiences by individual consumers documented in the earlier literature could perhaps be explained by informational frictions that restrict the availability of data they did not experience themselves. For sophisticated policy makers like the FOMC members in this study, such an explanation seems implausible. Presumably, FOMC members are extensively exposed to historical macroeconomic data. Thus, rational models of learning with informational frictions or rational inattention models fail to capture the empirical evidence. Instead, there seems to be a deeper behavioral reason for why personal experiences get a relatively high weight in belief formation, even if historical information is easily accessible.

In the same vein, the analysis and findings in this paper are also a step forward in the small but growing behavioral literature that aims to go beyond the traditional restriction of behavioral biases to small investors and consumers (cf. Malmendier (2019)). Even successful professionals and leaders make choices and form beliefs that is hard to reconcile with the traditional neo-classical model. Broadening the evidence from "behavioral CEOs" (Malmendier and Tate (2015)) to other professionals in leadership positions, such as the members of the FOMC, will help reinforce the notion of behavioral biases as reflecting how individuals are "wired" or, in the case of experience effects, "re-wired" due to prior life-time experiences (cf. Laudenbach et al. (2019)), rather than their cognitive abilities and intelligence.

On the policy side, our results add a twist to the practical notion that the choice of a policy maker can have a long-lasting impact on policy outcomes: To predict a policy maker's leanings, it is helpful to look at the person's prior lifetime experiences. For a given outcome variable of interest, here inflation, we can calculate their weighted average experience with (roughly) linearly declining weights, and obtain a directional and quantitative prediction about their future decision-making. It will be interesting to explore in future research the extent to which such a model of experience-based learning is helpful in predicting policy makers' behavior in other policy areas.

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Table 1

Influence of FOMC Members' Inflation Experiences on their Inflation Forecasts

Panel A presents summary statistics for the dependent and explanatory variables in the estimations shown in Panel B. MPR fcst. - staff fcst. is the difference between i) FOMC members' stated inflation projection from the MPR and ii) the most recent Fed Staff's inflation forecast from the Greenbook prior to the February or July FOMC meeting. In February, the horizon of the members' MPR forecasts is over the four quarters until the end of the current year. In July, two horizons are available: four quarters until the end of the current year and the four quarters during next year. From February 2000 on, we add the difference between CPI and PCE inflation rate to each FOMC member forecast. The sample period runs from the first half of 1992 to the second half of 2004. In Panel B, MPR fcst. - staff fcst. is the dependent variable. The explanatory variable is the difference between the i) experience-based forecast $\pi^e_{j,t+1|t}$ for each FOMC member at each meeting, and ii) the Fed staff's inflation forecast. We calculate $\pi^e_{j,t+1|t}$ for each member at each meeting by recursively estimating a mixed seasonal AR(1) model using the member's lifetime history of inflation, as described in Section 2.1 (with $\theta = 3.044$). In parentheses we report the standard error based on clustering as described in the table.

Panel A: Summary statistics

	Mean	S.D.	Within-Member S.D.	Within-Meeting S.D.
February MPR: Current-year forecast				
MPR fcst. - staff fcst.	0.26%	0.53%	0.44%	0.21%
Exp.-based fcst. - staff fcst.	0.66%	0.53%	0.43%	0.03%
July MPR: Current-year forecast				
MPR fcst. - staff fcst.	0.17%	0.44%	0.39%	0.18%
Exp.-based fcst. - staff fcst.	0.66%	1.09%	0.78%	0.03%
July MPR: Next-year forecast				
MPR fcst. - staff fcst.	0.32%	0.61%	0.50%	0.32%
Exp.-based fcst. - staff fcst.	1.16%	0.75%	0.61%	0.06%

Panel B: OLS regression

	(i)	(ii)	(iii)	(iv)
Exp.-based fcst. - staff fcst.	0.37	0.40	0.81	0.82
	(0.10)	(0.12)	(0.37)	(0.39)
Member × fcst. horizon FE	No	Yes	No	No
Member FE	No	No	No	Yes
Meeting × fcst. horizon FE	No	No	Yes	Yes
Clustered s.e.	Member and Meeting	Member and Meeting	Member	Member
Observations	383	383	383	383
Adjusted R^2	34.7%	41.0%	77.7%	81.5%

Table 2
Summary Statistics

The table shows statistics for all FOMC meetings from 3/8/1951 to 1/29/2014. Details of the data construction are in Appendix D. The first column in Panel A reports the statistics for all FOMC members; and columns 2 to 4 report separately those for members who dissent towards monetary easing (*Dovish Dissent*), who consent (*Consent*), and who dissent towards monetary tightening (*Hawkish Dissent*). Panel B reports the pairwise correlations between voting record, experience-based inflation forecast, and member characteristics. We code *Vote* as 1 for a hawkish dissent, as 0 for a consent, and as -1 for a dovish dissent; *Fed Role* as 1 for regional Fed presidents and 0 for board members; *Party* as 1 if the member was first appointed while a Republican was U.S. president and 0 otherwise; and *Same Party* as 1 if the party of the U.S. president at the time of the appointment is the same as the party of the current president and 0 otherwise.

Panel A

	All	Dovish Dissent	Consent	Hawkish Dissent
#Meetings	659	109	659	178
#Votes	7,350	160	6,925	265
Avg. age	56.4	55.6	56.4	57.1
Avg. tenure (in days)	2,286	1,924	2,285	2,545
% w/ PhD	46.3	50.6	45.8	56.2
% studied Economics	67.5	70.6	67.0	78.9
% Male	93.9	83.1	93.9	100
% Regional Fed president	44.6	23.7	44.0	72.1
% Republicans	53.7	45.0	53.3	70.9
% Same party as current pres.	56.7	67.5	56.6	52.1
Expr.-based infl. fcst.: mean	3.4%	3.8%	3.4%	4.1%
std.dev.	1.8%	2.2%	1.8%	2.1%

Panel B: Pairwise Correlation

	Vote	Infl. fcst.	Male	Age	Fed role	Party	Same pty.
Vote	1.00	-	-	-	-	-	-
Exp.-based infl. fcst.	0.04	1.00	-	-	-	-	-
Male	0.08	-0.03	1.00	-	-	-	-
Age	0.02	-0.07	0.06	1.00	-	-	-
Fed role: Fed pres.	0.12	-0.01	0.10	-0.09	1.00	-	-
Party: Republican	0.07	0.15	-0.01	-0.02	0.10	1.00	-
Same Party	-0.03	0.05	-0.05	-0.18	0.03	0.12	1.00

Table 3

Experience-based Inflation Forecasts and FOMC Voting Behavior

The sample period is March 8, 1951 to January 29, 2014. The experience-based inflation forecast for each member at each meeting is calculated by recursively estimating a mixed seasonal AR(1) model using the member's lifetime history of inflation, as described in Section 2.1 (with $\theta = 3.044$). The *Wallich Dummy* equals one if the member is Henry Wallich; 0 otherwise. The average partial effects (APE) reported at the bottom of the table are calculated by taking the partial derivative of the probability of a given voting category with respect to the experience-based inflation forecast at each sample observation and then averaging these partial derivatives across the whole sample. Column (i) and (iii) report the results assuming that the thresholds depend on a) whether the member is a board member or regional president, and b) whether the meeting occurs after Nov. 1993 and the interaction of a) and b). Column (ii) and (iv) report the results assuming that the thresholds depends, in addition, on age, gender, party of president at appointment indicator, and same party as current president indicator. In parentheses we report the standard error based on two-way clustering by both member and meeting.

	Ordered Probit		Ordered Probit "de-chaired"	
	(i)	(ii)	(iii)	(iv)
Experienced-Based Forecast	216.6	214.4	97.2	98.5
	(66.1)	(67.8)	(39.5)	(39.0)
Wallich Dummy	1.43	1.39	1.05	1.05
	(0.36)	(0.36)	(0.17)	(0.17)
Meeting FE	Yes	Yes	No	No
Controls	Yes	Yes	Yes	Yes
Thresholds	Role × $I_{>93}$	All	Role × $I_{>93}$	All
Observations	6,707	6,707	6,707	6,707
Pseudo R^2	39.0%	39.1%	9.7%	10.0%
APE of Experienced-Based Forecast:				
Dovish Dissent	-7.6	-7.6	-5.1	-5.1
Consent	-4.4	-4.3	-2.5	-2.5
Hawkish Dissent	12.1	11.9	7.6	7.7
APE of Wallich Dummy:				
Dovish Dissent	-0.050	-0.050	-0.055	-0.055
Consent	-0.029	-0.028	-0.027	-0.027
Hawkish Dissent	0.080	0.077	0.082	0.082

Table 4
Experience-based Inflation Forecasts and FOMC voting behavior: Different Sample Periods with Fixed Ordered Probit Thresholds

The experience-based inflation forecast for each member at each meeting is calculated as in Table 3. The *Wallich Dummy* equals one if the member is Henry Wallich; 0 otherwise. The average partial effects (APE) reported at the bottom of the table are calculated by taking the partial derivative of the probability of a given voting category with respect to the experience-based inflation forecast at each sample observation and then averaging these partial derivatives across the whole sample. Column (i) reports the results with all FOMC members prior to November 1993. Column (ii) reports the results with regional Fed presidents only over the entire sample. Column (iii) reports the results with regional Fed presidents only prior to November 1993. Column (iv) reports the results with all FOMC members prior to November 1993 and regional Fed presidents only afterwards. In parentheses we report the standard error based on two-way clustering by both member and meeting.

	All Members pre-1993 (i)	Regional Pres. Only Full Sample (ii)	Regional Pres. Only pre-1993 (iii)	Mixed Members Full Sample (iv)
Expr.-Based Fcst.	230.0	379.2	495.5	230.9
	(80.0)	(103.9)	(155.9)	(68.9)
Wallich Dummy	1.49	-	-	1.51
	(0.37)	-	-	(0.37)
Meeting FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	5,123	3,275	2,467	5,931
Pseudo R^2	38.0%	45.3%	49.2%	38.3%
APE of Expr.-Based Fcst.:				
Dovish Dissent	-9.5	- 6.4	-8.0	-9.0
Consent	-3.5	-19.5	-21.0	-5.2
Hawkish Dissent	13.0	26.0	29.0	14.2
APE of Wallich Dummy:				
Dovish Dissent	-0.062	-	-	-0.059
Consent	-0.022	-	-	-0.034
Hawkish Dissent	0.084	-	-	0.093

Table 5
Experience-based Inflation Forecast and FOMC voting behavior: Varying Weights on Past Experience

The sample period is from March 8, 1951 to January 29, 2014. The ordered probit specification is the same as in column (i) of Table 3, but here with different values of the gain parameter θ in the calculation of the experience-based inflation forecast. The *Wallich Dummy* equals one if the member is Henry Wallich; 0 otherwise. The average partial effects (APE) reported at the bottom of the table are calculated by taking the partial derivative of the probability of a given voting category with respect to the experience-based inflation forecast at each sample observation and then averaging these partial derivatives across the whole sample. We assume that the ordered probit thresholds depend on a) whether the member is a board member or regional president, and b) whether the meeting occurs after Nov. 1993 and the interaction of a) and b). In parentheses we report the standard error based on two-way clustering by both member and meeting.

	$\theta = 3.334$ (i)	$\theta = 2$ (ii)	$\theta = 2.5$ (iii)	$\theta = 3.5$ (iv)	$\theta = 4$ (v)
Experience-Based Forecast	183.8	218.2	256.7	165.4	117.6
	(61.2)	(68.4)	(74.3)	(58.0)	(48.5)
Wallich Dummy	1.42	1.45	1.46	1.41	1.39
	(0.36)	(0.36)	(0.36)	(0.36)	(0.36)
Meeting FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Observations	6,707	6,707	6,707	6,707	6,707
Pseudo R^2	38.9%	38.9%	39.1%	38.8%	38.6%
APE of Experienced-Based Forecast					
Dovish Dissent	-6.5	-7.7	-9.1	-5.9	-4.2
Consent	-3.8	-4.5	-5.2	-3.4	-2.4
Hawkish Dissent	10.3	12.2	14.3	9.2	6.6
APE of Wallich Dummy					
Dovish Dissent	-0.050	-0.051	-0.052	-0.058	-0.050
Consent	-0.029	-0.030	-0.030	-0.029	-0.029
Hawkish Dissent	0.079	0.081	0.081	0.079	0.078

Table 6
Tone of Speeches: Summary Statistics

The sample includes voting FOMC members' speeches from March 1951 to June 2014. *Net Index* is an index of hawkishness calculated as described in equation (14). *Hawkish/Dovish Tags* is the average count of hawkish and dovish word combinations in a speech. *Hawkish/Dovish Tags for employment* counts the additional hawkish/dovish word combination per speech for the goal employment/unemployment.

	N	Mean	Std. Dev.	Min	Median	Max
5-grams per speech	4,294	3,378	2,098	10	3,058	23,891
Net Index excl. (un)empl.	4,294	0.10	0.55	-1	0	1
Net Index incl. (un)empl.	4,294	0.10	0.55	-1	0	1
Hawkish Tags excl. (un)empl.	4,294	1.50	3.05	0	0	68
Hawkish Tags for (un)empl.	4,294	0.29	0.85	0	0	16
Dovish Tags excl. (un)empl.	4,294	0.99	2.08	0	0	33
Dovish Tags for (un)empl.	4,294	0.22	0.72	0	0	12

Table 7

Experience-based Inflation Forecasts and FOMC Members' Tone of Speeches

OLS regressions with the $NetIndex$ measure of speech hawkishness from equation (15) as the dependent variable. The experience-based inflation forecast for each member at each meeting is calculated as in Table 3. All estimations include the same controls and interactions with recent CPI inflation and unemployment as in Table 3. In addition, we include the controls for education and professional background detailed in the text, except for columns (3) and (6) where we instead employ member fixed effects. In columns (2) and (5), we drop speeches of chairmen. Standard errors, shown in parentheses, are calculated allowing for two-way clustering by FOMC member and year-quarter.

	Net Index excluding (un)empl.			Net Index including (un)empl.		
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Experience-Based Fcst.	32.88	39.15	43.28	29.97	38.97	47.07
	(14.52)	(18.50)	(16.32)	(13.70)	(17.74)	(14.68)
Wallich Dummy	0.10	0.17	-	0.12	0.16	-
	(0.08)	(0.10)	-	(0.07)	(0.07)	-
Member FE	No	No	Yes	No	No	Yes
Year-quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Chair's speeches dropped	No	Yes	No	No	Yes	No
Industry expr. controls	Yes	Yes	No	Yes	Yes	No
Degree controls	Yes	Yes	No	Yes	Yes	No
Adjusted R^2	4.4%	4.7%	5.7%	3.9%	4.3%	5.1%
Observations	4294	3295	4294	4294	3295	4294

Table 8

Influence of FOMC Members' Inflation Experiences on the Target Federal Funds Rate

The sample period is from the 8/18/1987 to 6/28/2007. The dependent variable is the target federal funds rate set at the FOMC meeting closest to the middle of the quarter t. The experience-based forecast is the average of FOMC members' experienced-based 4-quarter forecast of inflation based on CPI data leading up to the end of quarter $t-1$, calculated as in Table 3. The staff's core inflation forecast is from end of quarter $t-1$ to end of quarter $t+3$ based on the core CPI before 2/1/2000 and the core PCE thereafter. The staff's output gap forecast at quarter t is the forecast for quarter $t+3$. The staff's forecasts of CPI/PCE and of the output gap are from the Philadelphia Fed Greenbook data set. Lagged fed funds rate target is the federal fund funds rate target from the previous quarter's meeting. Columns (i) to (iii) report the OLS estimates based on (16). Columns (iv) and (v) report the estimates of β_e, β_π, β_y, ρ, and c from non-linear least-squares regressions as specified in (19). Columns (iii) and (v) include a proxy for $\bar{z}_t$, the linear combination of five FOMC-member characteristics and their interaction with inflation and unemployment estimated from voting data as reported in the Appendix in Table F.1. In parentheses, we report Newey-West standard errors with six lags from column (i) to (iii), and zero lags in column (iv) and (v).

	(i)	(ii)	(iii)	(iv)	(v)
Experience-based inflation forecast	-	0.38	0.61	0.46	0.44
	-	(0.21)	(0.24)	(0.21)	(0.21)
Staff's core inflation forecast	1.51	1.27	1.44	1.27	1.25
	(0.13)	(0.23)	(0.23)	(0.17)	(0.20)
Staff's output gap forecast	0.67	0.69	0.46	0.98	1.00
	(0.06)	(0.06)	(0.10)	(0.08)	(0.15)
Lagged federal funds rate target	-	-	-	0.68	0.69
	-	-	-	(0.04)	(0.04)
Intercept	0.80	0.11	2.17	-0.03	-0.08
	(0.44)	(0.36)	(0.86)	(0.16)	(0.42)
Member characteristics	N	N	Y	N	Y
Method	OLS	OLS	OLS	NLS	NLS
Observations	80	80	80	80	80
Adjusted R^2	85.8%	86.5%	87.7%	97.6%	97.6%

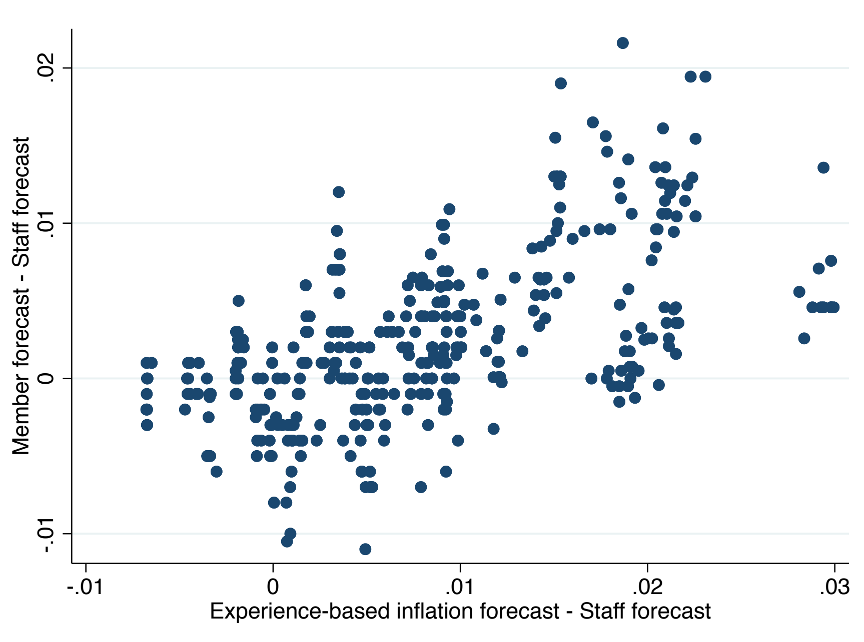
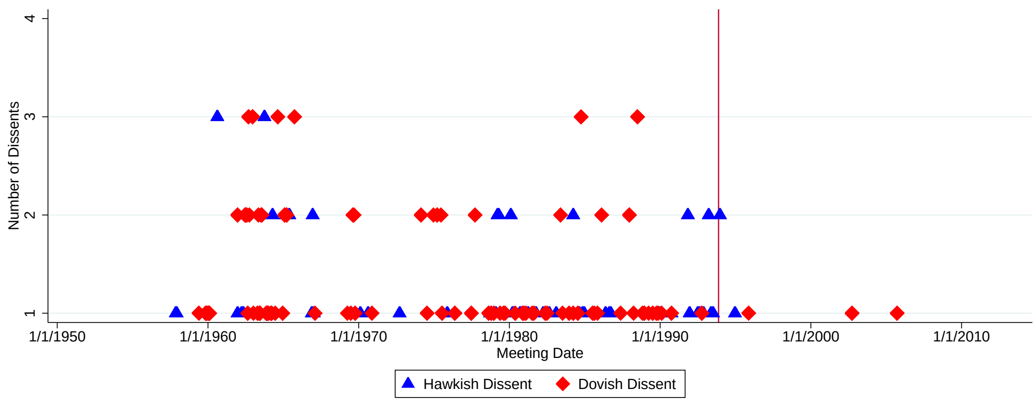
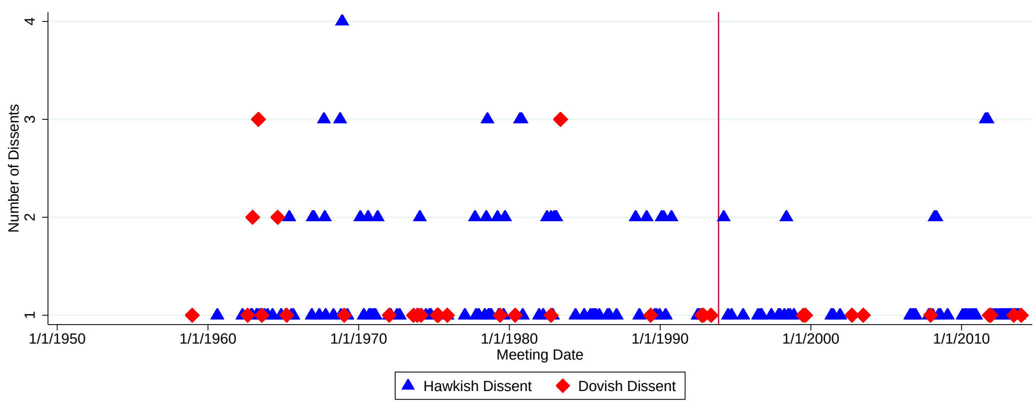


Figure 1
Relationship Between FOMC Member Inflation Forecasts in the MPR and their Experienced-Based Inflation Forecasts

Notes. Figure 1 compares individual members' actual inflation forecast $\tilde{\pi}_{j,t+1|t}$ with their experience-based forecast $\pi^e_{j,t+1|t}$.



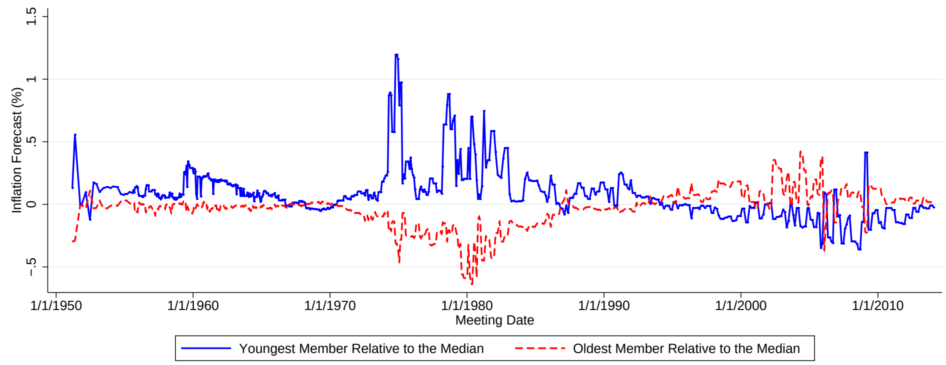
(a) Dissents by Federal Reserve Board Members



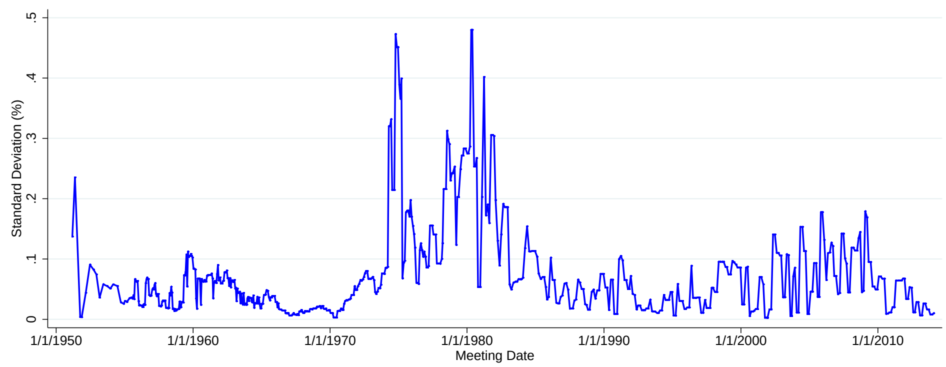
(b) Dissents by Regional Federal Reserve Presidents

Figure 2
Dissents in FOMC Meetings

Notes. Figure 2 shows the number of dissents in each FOMC meeting separately for Federal Reserve Board members (Panel a) and Regional Federal Reserve Presidents (Panel b). The red vertical line is the time-stamp for November 1993, after which the FOMC agreed to make public its lightly-edited transcripts with a five-year lag.



(a) Experience-based inflation forecasts of the youngest and the oldest FOMC member, relative to the median-age member's forecast



(b) Standard deviation of members' experience-based inflation forecasts

Figure 3
Dispersion of Experience-based Inflation Forecasts in each FOMC meeting

Notes. Panel (a) of Figure 3 shows the learning-from-experience forecasts $\pi^e_{j,t+1|t}$ of the youngest and oldest FOMC members at each meeting, both net of the forecast of the median-age member. Panel (b) plots the time-series of the within-meeting standard deviation of $\pi^e_{j,t+1|t}$.

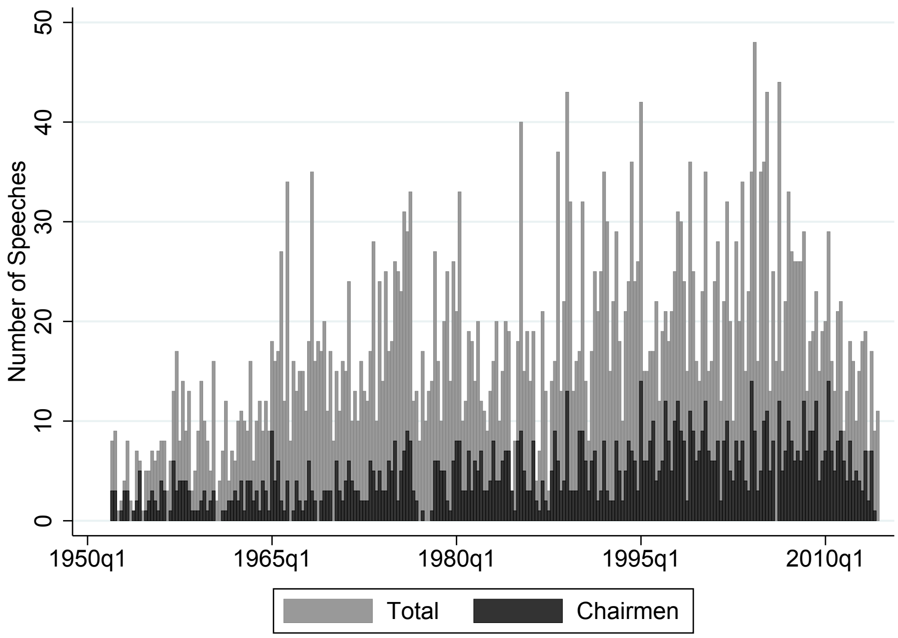


Figure 4
Number of FOMC Member Speeches Over Time

Notes. Figure 4 shows the time series of the number of speeches in our sample.

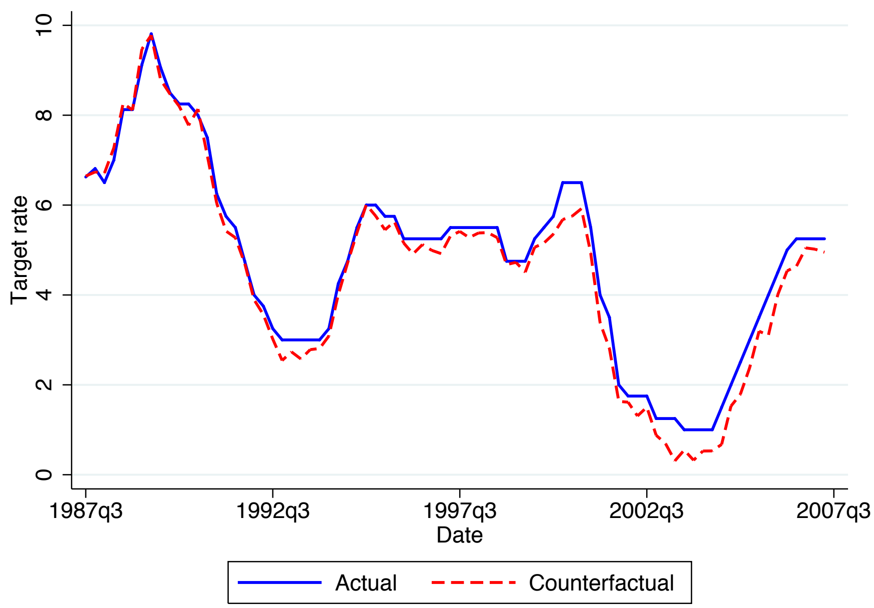


Figure 5
Counterfactual Federal Funds Rate Target (with experience effects removed)

Notes. Figure 5 plots the actual path of Federal Funds target rate and a counterfactual path that removes the estimated experience effects from the actual path.