# Do the Voting Rights of Federal Reserve Bank Presidents Matter?

Finance Working Paper N° 856/2022
December 2023

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We would like to thank Shai Bernstein, Wei Jiang, and Jeremy Stein, and seminar and conference participants at Boston College, CUFE, Carnegie Mellon University, Columbia University, Lancaster Management School, Manchester Business School, New York Fed, Northeastern University, SUFE, Tsinghua University, University of Hong Kong, University of Massachusetts Amherst, Zhejiang University, 13th NYU-LawFin/SAFE-ESCPBS Law & Banking/Finance Conference, European Summer Symposium in Financial Markets, NFA, Stanford SITE, and UCLA Fink Center Finance Conference. We would also like to thank our exceptional research assistant team: Jianbo Bin, Paul Bo Cai, Nova Nuoer Chen, Ted Yufei Ma, Shuyi Niu, Jade Peng, Zimin Qiu, Anushka Shah, Tommaso Tamburelli, August Zhiao Yuan, and Yizhong Zhang. All errors are our own.

## Abstract

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Keywords: Federal Reserve System, monetary policy, FOMC, voting rights, Reserve Bank presidents, local economic conditions

JEL Classifications: E52, E58, D7, G1

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December 21, 2023

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# 1. Introduction

The Federal Reserve System (the Fed) is responsible for setting monetary policy in the United States, and the Federal Open Market Committee (FOMC) is the monetary policymaker body of the Fed. One of the key decisions made at FOMC meetings is whether to alter the Federal funds target rate (FFR), the interest rate at which depository institutions lend balances at the Federal Reserve to other depository institutions overnight. Because the FFR impacts tens of trillions of dollars, the importance of FOMC decisions to the U.S. and world economies cannot be overstated.

Janet Yellen, Chair of the Federal Reserve during 2014-2018, once described the FOMC decision-making process: "The Federal Open Market Committee is a group that has been charged with making decisions about the stance of policy, and it consists of the governors who serve on the Board of Governors and the twelve presidents of the Federal Reserve Banks, and of those twelve all attend but five vote at any particular time...My job is to try to find a consensus in the committee for what is an appropriate stance of policy for the day."[1] The goal is to find a common ground among all meeting participants—the governors and the twelve presidents—and identify a policy response that is in the best interests of the nation. Such a policy would take into account the interests of all Reserve Bank districts and be consistent with the Fed's stated mandate. An alternative hypothesis is that the committee prioritizes finding common ground between *voting* members of the FOMC—governors and presidents with voting rights. In this scenario, the FOMC adopts the policy that receives the broadest support from the voting members; the adopted policy is likely to under-weight the interests of non-voting districts.

We use detailed data on 472 FOMC meetings that took place between 1969 and 2019 and the predetermined rotations of Reserve Bank presidents' voting rights (since 1942) to show that the economic conditions in Reserve Bank presidents' districts

[1] See https://www.youtube.com/watch?v=SJ-AX6PSPXw&t=176s.

affect the FFR only when those presidents hold voting seats at FOMC meetings. In particular, a one standard deviation (SD) increase in voting districts' inflation rates predicts around a 0.2 SD or 13-15 basis point increase in the next FFR. The effect of voting districts' personal income (PI) growth on the FFR is around 0.11 SD or 6-8 basis points. In the same specification, the coefficients for inflation and PI growth in non-voting districts are indistinguishable from zero. This decomposition result survives a series of robustness tests, including tests that involve a wide range of alternative district-level inflation and PI growth measures. It should be noted that the rotating nature of Reserve Bank presidents' voting rights was determined in 1942, implying that the allocation of voting rights is exogenous to the economic conditions in Reserve Bank presidents' districts.[2]

To provide more direct support for the voting mechanism, we use hand-collected data to track the voting decisions of each voting participant in a meeting and show that voting presidents dissent based on local economic conditions in their districts. According to FOMC transcripts, voting districts are 20% more likely to be mentioned by governors and Reserve Bank presidents during FOMC meetings than are non-voting districts. Governors' attitudes towards voting presidents are also more positive than their attitudes towards non-voting presidents.

This mechanism has the potential to improve our understanding of how monetary policy decisions are made. First, we show that the FOMC voting structure is a systematic source of Romer and Romer (2004) monetary policy (MP) shocks, measured as the difference between the actual FFR decision and the intended FFR at the start of the meeting. We find that a one standard deviation increase in voting district inflation (real PI growth) leads to a 0.23 (0.13) SD increase in the MP shock, which is economically sizable because the Romer-Romer MP shock explains 45% of the variation in changes in the FFR. The results are robust after controlling for na-

[2] "An Act to Amend Sections 12A and 19 of the Federal Reserve Act, as Amended" July 7, 1942, 56 stat 648. https://fraser.stlouisfed.org/title/act-amend-sections-12a-19-federal-reserve-act-amended-6342

tional conditions. Second, we augment a state-of-the-art Taylor rule model with the economic conditions in voting and non-voting districts. We find that voting district inflation is a positive and significant determinant of changes in the FFR when we control for non-voting district inflation, national inflation, or the Greenbook inflation forecast. In the same specification, the effect of real PI growth in voting districts is also positive, but statistically insignificant. These findings indicate that the economic conditions in *voting* districts contribute to our understanding of monetary policy above and beyond *aggregate* economic conditions.

Next, we test whether economic conditions in voting districts affect asset prices. We find that inflation in voting districts has a robust positive effect on changes in long-term Treasury yields. A one SD increase in voting district inflation leads to a 6.8 bps or 0.2 SD increase in the yield change. The effect of real PI growth in voting districts is also positive and often significant. Conditions in non-voting districts do not affect changes in long-term Treasury yields. The results are robust after we control for national economic conditions.

The effects on Treasury yields begin to peak and become statistically significant one week before FOMC meetings, indicating that the market prices in voting district macro conditions prior to the meeting. Indeed, using Federal funds futures data from 1989 to 2019, we show that market participants understand and price the effect of local economic conditions on FOMC decisions. We find that both inflation and real PI growth for voting districts have robust, significant effects on changes in average FF futures rates from the end of the previous meeting to the end of the current meeting. We also follow Gürkaynak (2005) and construct an FFR forecast revision variable, which is conceptually closer to the rate setting decision analyzed in our paper as it fixes the FOMC meeting of interest. Using 1m/2m/3m contracts and a shorter sample from 2002 to 2019 (due to data availability), we find that voting district inflation is a positive predictor of the revision of the FFR forecast.

Finally, we show that distortions in the target rates are nontrivial and do not cancel out when aggregated over time. If voting rights had been allocated to *all* twelve districts (instead of the existing allocation of votes), the path of the target rate would have been different. Importantly, distortions to the target rate could take decades to correct. For instance, target rates would have been 36 basis points higher during the pre-Global Financial Crisis period (2000-2005) if economic conditions in all districts had been taken into account equally. Furthermore, if votes were allocated between districts according to their economic size, the distortion in the target rates due to the existing voting scheme would appear to be even more pronounced. This is consistent with the dramatic shift in the geographical allocation of economic activity across districts, such as the rise of the San Francisco District (covering Alaska, Arizona, California, Hawaii, Idaho, Nevada, Oregon, Utah, and Washington) since the mid 1980s.

We conclude the paper with a discussion of how to address these distortions. FOMC members could change their behavior and place greater emphasis on national economic conditions, rather than on economic conditions in voting districts. However, as long as regional presidents care about economic conditions in their districts and only some presidents vote, the power of incentives suggests that distortions in FOMC decisions are likely to persist. Alternatively, with Congressional approval, policymakers could change the voting structure of the FOMC either by giving voting rights to all reserve bank presidents or by removing those rights from all presidents so that only governors vote. Both approaches have shortcomings. Allocating (equal) voting rights to all presidents and governors could marginalize the role of governors (7 governors versus 12 reserve bank presidents). Allocating voting rights to governors only could reduce reserve bank presidents' interest in the FOMC because they would have no formal influence on FOMC decisions. Finally, policymakers could revise the Reserve Bank district boundaries. The current boundaries reflect economic activity at the time the district map was designed, i.e., about a century ago. Since the geographical allocation of economic activity in the U.S. has dramatically changed, the existing district maps lead to an unequal allocation of votes across units of economic activity.

Our paper contributes to several strands of the economics and finance literature. First, it contributes to the macroeconomics literature that studies the determinants of monetary policy decisions. In his seminal work, Taylor (1993) demonstrates that past monetary policy rules can be closely tracked by changes in the price level or real income. To date, to the best of our knowledge, there is no study that exploits the effects of differences in economic conditions across districts on the FOMC's monetary policy decisions.

While this study focuses on the real consequences of the FOMC voting structure, our research also relates to the literature that studies the voting behaviors of FOMC members and their background characteristics (e.g., Belden (1989), Havrilesky and Schweitzer (1990), Havrilesky and Gildea (1991), Chappell Jr, Havrilesky, and McGregor (1993), Chappell Jr and McGregor (2000), and Crowe and Meade (2008)). The standard empirical framework in this literature has individual-level interest rate preferences (as revealed in meeting transcripts or other documents) as the dependent variable of interest and individual-level characteristics (e.g., career, political party, education, gender, local economy, and so on) as explanatory variables. Existing studies acknowledge the importance of understanding the effect of personal biases on monetary policy decisions, but have not reached a consensus.[3] Our study differs from this literature in two major ways. First, and most importantly, while the literature focuses on examining the voting members' personal biases, our main goal is to compare voting and non-voting Reserve Bank presidents and their relative effects on FOMC decisions.[4] Second, our voting sample extends from 1/7/1958 to 12/11/2019, a much

[3]Among those of more relevance for our research, Tootell (1991) and Gildea (1992) use a 1965-1985 sample and a 1960-1987 sample, respectively, and find little evidence that regional economic conditions explain Reserve Bank presidents' votes. On the other hand, Meade and Sheets (2005) use a 1978-2000 sample and arrive at the opposite conclusion, supporting the role of regional developments in explaining presidents' interest rate preferences. Jung and Latsos (2014) represent a more recent update in this debate using a 1990-2008 sample but find mixed results. None of these studies examines the real effects on FOMC voting.

[4]In a different setting, Chen (2017) shows that local economic conditions have a significant effect on firm managers' macroeconomic expectations and consequently on firms' investment and employment

longer sample than, to the best of our knowledge, all existing papers in this personal bias literature, which increases the statistical power of our tests.

Second, our paper contributes to the political economy literature that studies the balance of power between various forms of government, including the federal government, states, and municipalities. This literature has analyzed the provision of a wide range of services, including welfare, legal services, health services, and housing (see, for example, Tiebout (1956), Fiss (1987), Merritt (1988), Boeckelman (1992), Weingast (1995), Inman and Rubinfeld (1997), Oates (1999), Besley and Coate (2003), Volden (2005), and Bulman-Pozen (2012)). Consistent with an insightful theoretical discussion of the FOMC governance structure by Faust (1996), our paper contributes to this literature by providing the first evidence on the effects of decision rights allocated to Federal Reserve Banks on macroeconomic policy. Specifically, we show how national and local economic conditions are aggregated into FOMC decisions and how the voting rights of FOMC members affect this aggregation process.

Finally, this study contributes to the literature that studies voting. The literature covers the role of voting in various settings, including political elections (e.g., Lee, Moretti, and Butler (2004) and Lee (2008)) and corporate governance (e.g., Manne (1962), Grossman and Hart (1988), Harris and Raviv (1988), Zingales (1995), Yermack (2010), and Fos and Tsoutsoura (2014)). In the context of political elections, Lee, Moretti, and Butler (2004) show that the degree of electoral strength does not affect a legislator's voting decisions. In the corporate governance setting, Manne (1962) was one of the first to propose that shareholder voting matters. Our paper contributes to this literature by showing that the way voting rights are allocated to Reserve Bank presidents has an important role in shaping FOMC decisions.

decisions.

# 2. Institutional Background

The Federal Reserve Act of 1913 created the Federal Reserve System (the Fed) and gave it responsibility for setting monetary policy to provide the nation with a safer, more flexible, and more stable monetary and financial system.[5] The Federal Open Market Committee (FOMC) is the monetary policymaking body of the Federal Reserve System and was created by the Banking Act of 1933. Voting rights in the 1933 FOMC were exclusive to the twelve Reserve Bank presidents; this was amended in 1935 and 1942 to extend voting rights to the Federal Reserve Board of Governors. This is the modern FOMC, which consists of twelve voting members—the seven members of the Board of Governors of the Federal Reserve System, the president of the Federal Reserve Bank of New York, and four of the remaining eleven Reserve Bank presidents, who serve one-year terms on a rotating basis.

Members of the Board of Governors are nominated by the President of the United States and confirmed by the Senate. Each governor can serve up to 14 years, and the terms are staggered such that one term expires every two years. If a governor leaves before her term is up, her successor completes this term. The Board's objective is to provide general guidance for the Federal Reserve System and to oversee the 12 Reserve Banks.

Subject to the approval of the Federal Reserve Board of Governors, the presidents of the twelve Reserve Banks are nominated by the Reserve Banks' Class B and C directors (those directors who are not affiliated with a supervised entity). The district presidents are elected to represent the interests of the public in their districts. The President of the United States and the Senate are not involved in the process of selecting the presidents of the twelve Reserve Banks.

The voting seats given to district presidents rotate on a yearly basis; this rotation

[5]Source: https://www.federalreserve.gov/aboutthefed/the-fed-explained.htm.

scheme was put in place in the 1942 amendment.[6] The rotating seats are filled from the following four groups of Banks, one Bank president from each group: (1) Boston, Philadelphia, and Richmond; (2) Cleveland and Chicago; (3) Atlanta, St. Louis, and Dallas; (4) Minneapolis, Kansas City, and San Francisco. Non-voting Reserve Bank presidents attend the meetings of the Committee, participate in the discussions, and contribute to the Committee's assessment of the economy and policy options. Figure 1 shows the maps of the twelve districts. Importantly, since the assignment of voting rights to presidents of Reserve Banks is specified in Section 12A of the Federal Reserve Act,[7] the public can be, and should be, fully informed about the allocation of voting rights amongst presidents of Reserve Banks.

[Insert Figure 1 here]

The FOMC holds eight regularly scheduled meetings per year.[8] At these meetings, the Committee reviews economic and financial conditions, determines the appropriate stance on monetary policy, and assesses risks to its long-term goals of price stability and sustainable economic growth. Using various tools of monetary policy, the Fed alters the Federal funds rate (FFR), the interest rate at which depository institutions lend balances at the Federal Reserve to other depository institutions overnight.

[6] To be specific, prior to 1990, the FOMC's Rules of Organization stated that the Reserve Bank representatives on the FOMC are elected by the boards of directors of the Reserve Banks in accordance with section 12A of the Federal Reserve Act for terms of one year commencing on March 1 of each year. At the November 1, 1988 FOMC meeting (meeting minutes: https://www.federalreserve.gov/monetarypolicy/files/fomcmoa19881101.pdf), the FOMC voted to amend the Rules of Organization to change the start of the annual terms of newly elected members and alternate members of Federal Reserve Banks from March 1 to January 1 of each year, effective January 1, 1990. The Federal Reserve Act also specifies the Alternate Member schedule, i.e., determines which Reserve Bank president can vote in the place of a Reserve Bank president who is supposed to vote but cannot. We show in Internet Appendix Table IB.1 that deviations from the assigned voting scheme are very rare.

[7] https://www.federalreserve.gov/aboutthefed/section12a.htm.

[8] https://www.federalreserve.gov/monetarypolicy/fomccalendars.htm.

# 3. Data

In this section, we describe several data sources, some of which have never been used in academic research prior to this paper, and then present descriptive statistics.

## 3.1. Data Sources

We begin by describing how we collect data on FOMC meetings and how we construct independent and outcome variables.

### 3.1.1. FOMC meetings

We focus on all FOMC events (meetings and conference calls) from January 1958 to December 2019 in which the committee discussed and made decisions about target rates, with voting decisions from each voting participant. This criterion informs our main outcome variable, the Federal funds rate ("FFR"), which is considered a standard measure of monetary policy. Among the 770 FOMC events between 1/7/1958 and 12/11/2019 that we hand-collected from the Federal Reserve website, 661 of them voted on target rate decisions.[9] 646 are FOMC meetings and 15 are conference calls. For simplicity, we refer to all of them as "FOMC meetings" in the remainder of the paper.[10]

For these 661 meetings, policy statements and meeting proceedings (transcripts or minutes) were released to the public. Statements are an important communication tool used by central banks. Transcripts or minutes are the most detailed records of FOMC meeting proceedings and feature precise dialogues between participants. Later in the paper, we focus on transcripts to shed light on how the voting rights of district

[9] There are 109 FOMC events that we do not study in this paper; they are all conference calls with relatively short meeting times, and 27 of them did not release policy statements, but they all posted transcripts or minutes. The topics discussed in these 109 events typically involved decisions on money supply and exchange rates.

[10] We run robustness tests of our main results dropping the 15 conference calls in the Internet Appendix.

presidents affect their voting and communication decisions. Transcripts are made available to the public with a five-year delay, and the first transcript record from the Federal Reserve archive is the 4/20/1976 meeting.

The black line in Figure 2 displays the time series of the number of actual votes in meetings from 1958 to 2019. While the total number of votes has been largely consistent at 12, we observe time-series variation and several major drops in recent history.[11] The blue solid line and the dashed orange line decompose the total number of actual votes into the number of voting presidents and governors, respectively, and show that the variation in the number of votes is primarily due to the variation in the number of governors, which is often below 7 due to vacancies.

[Insert Figure 2 here]

### 3.1.2. Local macro variables

Local macro variables refer to the economic conditions of the 12 Reserve Bank districts.[12] Given our research objective and data availability, we construct two district-level measures of economic activity: inflation rates and real growth rates. These variables are important determinants of monetary policy decisions.

**Local inflation.** Monthly aggregate U.S. CPI data are available from January 1947 (source: FRED). Because there are no readily available inflation or CPI data reported at the Reserve Bank district level or state level, we rely on data reported by the Bureau of Labor Statistics (BLS). Specifically, BLS reports the "Metropolitan Statistical Area" (MSA) CPI for all urban consumers. Table IA.1 in the Internet Appendix summarizes all data options downloadable from the BLS website at the metropolitan area level and evaluates how suitable they may be to proxy for district-level CPI data based on their time series properties (year coverage and frequency). Given that FOMC meetings

[11]The lowest point in Figure 2 corresponds to the 8/1/2018 meeting, https://www.federalreserve.gov/monetarypolicy/fomcminutes20180801.htm, in which only 8 members voted.

[12]Throughout the paper, we use "local" and "district" interchangeably.

happen every month or every other month, CPI data at the monthly frequency is preferred for our research objective as it captures the incremental information that becomes available to or known by FOMC members between two FOMC meetings. For those districts with multiple CPI data choices, we consider the MSA with the largest population according to the United States Census Bureau.

Most districts have consecutive CPI data at monthly, bimonthly, or quarterly frequency, and the sample frequency can vary over time within the same district. To impose consistency across districts, we construct monthly inflation rates. For monthly CPI series, monthly inflation is the percentage change in CPI. For other frequencies (bimonthly or quarterly), we compute the percentage changes between two consecutive CPI numbers, divide this by the number of months between them, and use the result to fill the months in between. For instance, for data at bimonthly frequency, if the percentage change between the available March and May CPI values is 0.4%, we assign the April and May inflation rates a value of 0.2%.[13]

We aggregate districts into two groups: districts with voting rights and districts without voting rights. Specifically, $Infl^{Vote}_{m,t-1}$ ($Infl^{NoVote}_{m,t-1}$) denotes the average monthly inflation rate among districts with (without) voting rights during the month prior to meeting $m$. The monthly or quarterly macro variable is time stamped with "$t$." Given our research objective, we are interested in tracking recent past macro conditions of districts with and without voting rights in meeting $m$, which we denote as $\{m, t-1\}$. The previous month's U.S. inflation rate is denoted as $Infl^{US}_{m,t-1}$. The inflation variables in this paper are all in units of monthly percent.

We report the results of several robustness tests concerning our inflation measure. We examine an array of alternative inflation variables in terms of granular-level data

[13]There are four districts with a long period of annual or (smoothed) semi-annual data only: Atlanta (1987-1997), St Louis (1998-2017), Minneapolis (1987-2017), and Kansas City (1987-2017). In these cases, we do not construct or "invent" monthly inflation rates, and consider these local inflation rates missing in our analysis; these can be observed in Table IB.2. We are able to obtain monthly inflation rates for most districts starting from the 1940s, with the exceptions of Cleveland (1966) and Kansas (1964).

sources (e.g., Hazell, Herreño, Nakamura, and Steinsson (2022)), horizons (e.g., 1 month vs. 3 months), frequencies (e.g., monthly vs. quarterly), and geographical coverage (e.g., MSA vs. state level). Internet Appendix Section IA.3 explains our efforts in detail. Compared to these alternative inflation variables, our MSA-based local inflation measure is the most suitable for our research objective given its monthly frequency and the lack of geographic overlap across district lines.

**Local real growth.** We use personal income (PI) growth as our main economic growth proxy. This variable is constructed by the U.S. Bureau of Economic Analysis (BEA) and is available at the state-quarterly level in a fully balanced way from as early as 1948 in some states.[14] The United States Regional Economic Analysis Project (US-REAP), `https://united-states.reaproject.org/data-tables/quarterly-earnings-sq5/`, also uses these personal income data to conduct economic growth analyses.

One challenge is how to aggregate a state-level variable into a *district-level* variable, given we know that 40% of the states are covered by two Fed districts. Following the objective of minimizing geographic overlapping to help with identification, we first obtain state-level quarterly PI growth rates and use the value of the main office's state as the proxy for the district-level value. Then, the real district PI growth rates are constructed by deducting the corresponding district's inflation at the quarterly frequency. $rgPI$ denotes real PI growth, which is available at the quarterly frequency, and $rgPI^{Vote}_{m,t-1}$, $rgPI^{NoVote}_{m,t-1}$, and $rgPI^{US}_{m,t-1}$ are defined analogously to inflation rates. Real growth variables are expressed as units of quarterly percent. Internet Appendix Section IA.3 discusses in detail the alternative real growth measures we consider in this paper, including various options to average across the covered states.

[14]State-level GDP data is available and downloadable starting in 2005 from the BEA website. However, we aim to use the longest possible sample for our variables and prefer data available at a frequency higher than annual.

#### 3.1.3. Outcome variables

**Target Federal funds rate data.** We use standard data sources to obtain information on FFRs. Romer and Romer (2004) provide data that cover FOMC meetings from the January 14, 1969 meeting through the December 17, 1996 meeting. Kenneth N. Kuttner's dataset covers FOMC meetings from the February 5, 1997 meeting to the June 19, 2019 meeting. Starting in 2008, the target rate becomes a range. Given that most studies are interested in changes in the target FFR, we follow Kuttner's choice of using the change in the lower range value to obtain the changes in the FFR for meetings after June 19, 2019.[15] This allows us to extend our sample through the end of 2019.[16]

**FOMC voting.** We collect voting results for each participant in an FOMC meeting – agree, dissent for a tighter monetary policy, dissent for an easier monetary policy, or dissent for other reasons – from various public FOMC documents that describe the proceedings of FOMC meetings: Record of Policy Actions (before 1967), Record of Policy Actions and Minutes of Actions (1967-1975), Transcript and Minutes (1976-2017),[17] and Minutes (2017-2019). We start with the existing effort made by Thornton and Wheelock (2014), whose dataset provides the last names of all dissenters in a meeting (i.e., 09/21/11, Fisher, Kocherlakota, Plosser). We then expand this dataset to include first, last, and full names, district/board affiliations, and the voting decisions of all voting participants in all FOMC meetings in our sample. This effort results in the most complete FOMC voting database at the meeting-participant level.

[15] We thank Kenneth Kuttner for offering this suggestion.

[16] In an earlier version of the paper, we used a sample period through the end of 2021. The main regression results held. However, from early 2020 to early 2021, real PI growth, like all other real economic variables, exhibited abnormally volatile behavior due to the COVID-19 crisis and various economic responses. Specifically, the U.S.'s real PI QoQ growth hit record values as low as -6% (i.e., -7.9 standard deviations from the average growth rate using the pre-2020 sample) in 2020Q3 or as high as 11% (i.e., +12 standard deviations) in 2021Q1. Given that, our main sample period ends in December 2019 in this draft. Nevertheless, we continue to collect the meeting voting data and will make it available.

[17] Transcripts are released on a 5-year delay. As of December 2023 (the time of the present draft), the last available transcript is the December 12-13, 2017 meeting.

**FOMC transcripts.** We download all transcripts available on the Federal Reserve website; the first available file with an interest rate decision is from 4/20/1976 and the last available file is from 12/13/2017. There are a total of 365 files (meetings). Transcripts show detailed conversations among all speakers, word for word. Transcripts of FOMC meetings can be 300 or more pages long, while transcripts of FOMC conference calls typically are 5 to 30 pages long. All transcripts end with a roll call of voting decisions. Transcripts record the entire conversation as it was spoken, including all contributions from governors, district presidents who have votes, district presidents who do not have votes, Fed economists, and other accompanying and meeting staff.

**Monetary policy shocks.** We focus on Romer and Romer (2004)'s monetary shocks, denoted by $DTARG$, that capture the difference between the actual FFR decision and the proposed or "initial intended" FFR entering the meeting, using a narrative and direct approach (i.e., manually collecting the intended and actual rates based on FOMC documents). This approach allows the sample to go back to 1969, whereas the high-frequency shocks in the literature typically start in the late 1990s and early 2000s. We obtain the 1969-1996 series from Romer and Romer (2004) and the 1997-2007 series from Wieland and Yang (2020).

**Federal funds futures.** We construct two outcome variables to capture changes in investors' expectations about policy actions (the Federal funds rate). Following the literature (e.g., Kuttner (2001), Bernanke and Kuttner (2005), Gürkaynak (2005)), we use the price of Federal funds futures contracts averaged over the settlement month.[18] Our first measure is the average implied rate of Federal funds contracts across 1- through 24-month terms, denoted by $\Delta f_m$, which is readily downloadable from Refinitiv DataStream starting in 1989. Moreover, we construct a forecast revision variable,

[18] The contracts are officially referred to as "30 Day Federal Funds Futures," and are traded on the Chicago Board of Trade (CBOT), a part of the Chicago Mercantile Exchange (CME) Group. By design, the implied rate is 100 - settlement price.

denoted by $E_{m+1}(FFR_{m+1}) - E_m(FFR_{m+1})$, to capture changes in market expectations of the same meeting FFR decision. This construct requires exact daily data for 1m/2m/3m contracts (source: Refinitiv DataStream), which limits the sample of this outcome variable; the data are available starting in 2002. Internet Appendix Section IA.5 offers more data details.

### 3.2. Descriptive Statistics

Appendix tables A1, A2, and A3 provide summary statistics for all variables. In this section, we briefly discuss variables used to establish the main decomposition result. In Table A1, we report summary statistics for changes in the FFR as well as inflation and real personal income growth variables. Panel A covers the 1969-2019 (full) sample period, and Panel B covers 1969-2019 excluding the zero lower bound (ZLB) period. The latter is the main sample of our paper, as during the ZLB period, the FFR is not the main tool of U.S. monetary policy.

Consider first the full sample period. The average (median) change in the FFR is -0.010% (0.000%). The average monthly U.S. inflation rate prior to FOMC meetings is 0.36% (or around 4% per annum), and the average voting and non-voting district inflation rates are 0.35% and 0.37%, respectively. The average quarterly real PI growth rate is 0.62%, with almost no difference between voting and non-voting districts. The summary statistics in Panel B are quite similar to those in Panel A. Finally, Panel C reports the summary statistics of other variables, including the Romer and Romer (2004) monetary shock, changes in the average FF futures rate, and forecast revisions.

Next, we turn to the time-series properties of district-level measures of inflation and real PI growth. The unconditional correlation between inflation rates (PI growth rates) for voting and non-voting districts is around 60% (55%) in both the full sample and the non-ZLB sample. Inflation and real PI growth variables have close-to-zero to weak correlations. Figure 3 shows that the time-varying correlation between inflation rates for voting and non-voting districts within a moving rolling window fluctuates substantially during the sample period, taking values mostly between -20% and 60%. The rolling correlation between PI growth rates for voting and non-voting districts (green dashed line) is typically slightly higher than that for inflation rates (black solid line).

[Insert Figure 3 here]

# 4. Main Results

In this section, we use the rotating structure of FOMC voting to decompose national inflation and PI growth into inflation and PI growth for voting and non-voting districts. We then provide the first evidence on the real consequences of the rotating structure of FOMC voting.

## 4.1. Exogenous Rotation of FOMC Voting

The predetermined, rather mechanical rotating structure of FOMC membership is a key factor in our empirical analysis. We briefly present two pieces of evidence in support of our empirical strategy.

First, we show that pre-specified voting rights determine which Reserve Bank presidents can vote at an FOMC meeting. That is, the intended voting scheme indeed closely tracks with the actual voting scheme (see Internet Appendix Table IB.3). The likelihood of a mismatch between the actual voting status and the pre-specified voting status of a district is 1%, indicating that the predetermined voting scheme is closely followed.[19] When we regress an indicator of a district's president voting during a meeting on her pre-specified voting status during that meeting, we find that the coefficients

[19] In the sample period, which runs from 1969-2019, there are 58 instances in which district presidents voted when they should not have according to the 1942 law and the Alternate Member schedule (58/5,664=1.0%, as displayed in the table).

exceed 0.91 and are highly statistically significant with large $F$-statistics.[20]

Second, we show that whether or not a district's president will be able to vote during next year's FOMC meetings is uncorrelated with the district's recent economic conditions (see Internet Appendix Table IB.1). We find no significant relationship between local economic conditions and whether a district's representative can vote in an FOMC meeting. Thus, the results of two tests support the assumption that we can treat the variation in district presidents' voting rights as exogenous to local economic conditions and to the outcome variables we consider.

### 4.2. The Effect of Local Economic Conditions on the FFR: The Role of FOMC Voting

In this section we present the main decomposition result of our paper—the effect of local economic conditions and the FOMC's voting structure on the FFR. The main outcome variable is the change in the Federal funds target rates between meetings. Specifically, we estimate the following specification:

$$\Delta FFR_m = \alpha + \beta_1 Infl^{Vote}_{m,t-1} + \beta_2 Infl^{NoVote}_{m,t-1} + \gamma_1 rgPI^{Vote}_{m,t-1} + \gamma_2 rgPI^{noVote}_{m,t-1} + \tau FFR_{m-1} + \varepsilon_m, \tag{1}$$

where $\Delta FFR_m$ is the change in the Federal funds target rate from meeting $m-1$ to meeting $m$. As explained in Section 3.1.2, $Infl^{Vote}_{m,t-1}$ is the last average monthly inflation rate for voting districts prior to meeting $m$, and $Infl^{NoVote}_{m,t-1}$ is the last average monthly inflation rate for non-voting districts. Similarly, $rgPI^{Vote}_{m,t-1}$ is the last aver-

[20]Small deviations are anticipated due to health issues or other reasons, such as a power transition (i.e., by law, district presidents are nominated by their district board, but they need to be confirmed by the Board of Governors, so there can be a transition gap). Depending on the nature of the absence, a vacancy can be declared without replacement, or the FOMC committee can ask other district presidents from the same group to vote (see Footnote 6). Substitution with an alternate member is typically what happens when the absent district has a voting right. In rare cases, the district vice president comes as a replacement (e.g., Sandra Pianalto, President of the Federal Reserve Bank of Cleveland, asked Greg Stefani, First Vice President of the Cleveland Fed, to attend the June 19, 2013 meeting; in this meeting, Cleveland was not a voting member).

age quarterly real personal income growth rate for voting districts, and $rgPI_{m,t-1}^{noVote}$ is the last average quarterly real personal income growth rate for non-voting districts. $FFR_{m-1}$ is the Fed funds target rate from meeting $m-1$. The unit of observation is one FOMC meeting.

The results are reported in Table 1. Panel A reports the results in the full sample. Column (1) shows that, as expected, higher national inflation and higher personal income growth rates are positive predictors of an increase in the FFR. Specifically, in terms of economic magnitude, a one standard deviation (SD) increase in national inflation (national real PI growth) in the preceding month, compared to the historical average, predicts a 0.13 (0.14) SD or 8.2 (8.9) basis point increase in the next FFR.

[Insert Table 1 here]

Columns (2) through (4) show the main result: the relationship between economic conditions and changes in the FFR is significant for voting districts only. In column (2), we retain the national real PI growth measure and decompose the national inflation measure into inflation averages in voting and non-voting districts. We find that there is a significant positive relationship between inflation in voting districts and changes in the FFR. In terms of economic magnitude, a one SD increase in a voting district's inflation in the last month predicts a 0.20 SD or 13 basis point increase in the next FFR, at the 1% significance level. In contrast, there is no such relationship for a non-voting district's inflation: the relationship between the inflation average of non-voting districts and changes in the FFR is indistinguishable from zero. Importantly, for non-voting districts, the economic magnitude of the estimated coefficient is seven times smaller than for voting districts. This finding is the first indication in the literature that the voting rights of FOMC members have a profound effect on how inflation rates in members' districts affect one of the FOMC's most important decisions.

In column (3), we retain the national inflation measure and decompose the national personal income growth measure into personal income growth averages in voting and non-voting districts. We find that there is a significant positive relationship between personal income growth in voting districts and changes in the FFR; a one SD increase in a voting district's real PI growth in the past quarter predicts a 0.09 SD or 6 basis point increase in the next FFR. In contrast, the coefficient for personal income growth in non-voting districts is insignificant and smaller in economic magnitude. In column (4), we decompose both inflation and personal income growth measures into measures for voting and non-voting districts. The main results remain unchanged: changes in the FFR are significantly associated with economic conditions in voting districts only.

Next, we repeat the analysis while dropping 57 FOMC meetings during the zero lower bound (ZLB) period (December 2008 to December 2015). We drop these observations because there is a limit on how FFRs can change during this period. Panel B in Table 1 reports the results. As expected, most of our key coefficients exhibit larger economic significance because we removed the FOMC meetings in which decisions were not focused on changing the FFR target rate. Based on the non-ZLB results, a one SD increase in a voting district's last period inflation (real PI growth) predicts a 0.22 SD or 15 basis point (0.12 SD or 8 basis point) increase in the next FFR. In the remaining part of the paper we use this sample of 415 non-ZLB FOMC meetings as our main sample of interest.

We perform several robustness tests. First, we show that the results are robust to using alternative constructions of district-level inflation, in terms of aggregation strategy (from granular to district), frequencies and horizons, and alternative data sources. Specifically on the last point, Hazell, Herreño, Nakamura, and Steinsson (2022)'s original dataset is a state-quarter YoY inflation measure, covering 21 states from 1978 to 2017 (with some missing 1987 and 1988) and 13 additional states from 1989 to 2017. In order to make it suitable for our research question (which is at the FOMC meeting frequency), we compute a quarterly QoQ inflation measure (see details in Internet Appendix Section IA.3). Table 2 summarizes the regression results. Our results are robust to (i) measuring inflation as the population-weighted average of all MSA-level inflation measures in a district (column (2)), (ii) measuring inflation at quarterly frequency (columns (3) and (4)), and (iii) using Hazell, Herreño, Nakamura, and Steinsson (2022)-based quarterly inflation (columns (5) and (6)). Moreover, the economic magnitudes are quite similar across alternative inflation measures. For instance, column (5) shows a significant relationship between FFR changes and voting district inflation and PI growth measures, which translates to a 0.26 SD increase in $\Delta FFR$ per unit SD in voting district inflation, compared to 0.22 SD using our main measure. The measure for non-voting districts remains insignificant. Moreover, in the Internet Appendix, Table IB.4 shows that when the regression includes further non-overlapping lags for inflation and PI growth measures for voting and non-voting districts (e.g., inflation rates for the last quarter, second to last quarter, third to last quarter, etc.), the largest and most significant positive coefficients are obtained for the most recent measures. This empirical finding indicates that changes in the FFR are plausibly most sensitive to recent developments in local economic conditions. Tables IB.5 and IB.6 show that the results are robust to making alternative inflation data choices for the San Francisco District and the Dallas district and to excluding conference calls, respectively.

[Insert Table 2 here]

Second, we show that the results are robust to using alternative constructions of district-level PI growth. Table 3 presents the results. We find that our results are robust to (i) using a population-weighted average of PI growth across all states covered in the same district (column (2)), (ii) using a population-weighted measure of PI growth calculated based on non-overlapping states only, and (iii) using an equally-weighted measure of PI growth calculated based on the all states within a district.[21]

[21] We have worked closely with the Quarterly Census of Employment and Wages (QCEW) dataset,

Overall, we find that our results are not particularly sensitive to any of these robustness tests based on alternative macro variables. Having said that, as we explain in the Data section, we believe our default measures of inflation and PI growth are the most suitable for addressing the research question at hand.

[Insert Table 3 here]

Third, we show that our results are not driven by one particular district. Figures 4 and 5 show that our main finding has little sensitivity to dropping a district or a group of districts. This is an important robustness test not only because it shows that the results are not driven by any particular district, but also because it shows that the results are not sensitive to dropping the New York district; that district's president's voting right is not rotating.

[Insert Figures 4 and 5 here]

Finally, we show that the results are robust to the inclusion of three lags of the FFR in the regression to allow for interest rate smoothing (following Coibion and Gorodnichenko (2012)). The results are reported in Internet Appendix Table IB.7. We find that national measures of inflation and PI growth exhibit a weaker correlation with changes in the FFR (column (1) in Internet Appendix Table IB.7). The reason is that the lagged values of the FFR are correlated with realized measures of inflation and PI growth. When we decompose national measures into measures for voting and non-voting districts, we find that whereas the coefficient of voting district PI growth loses statistical significance in one of the specifications, the coefficient of voting district inflation remains significant.

which provides county-quarter-level wage data, and attempted to construct another granular real growth measure from it. However, as we explain in Internet Appendix Section IA.3, QCEW-based real wage growth has a quite weak correlation with the Greenbook's governor forecast of real quarterly GDP growth, which dis-validates its use economically. In contrast, our real PI growth from the BEA has a much higher correlation.

## 4.3. The Economic Mechanism: The Governance Structure of the FOMC

In this section, we provide evidence supporting the role of Reserve Bank presidents' voting rights in shaping the FOMC's decisions. First, we consider voting decisions and evaluate the relationship between economic conditions in districts and voting decisions by districts' representatives at FOMC meetings. Second, we directly examine FOMC transcripts and test whether voting districts are more likely to be discussed during FOMC meetings than districts that do not have voting rights. Such relationships can shed light on how voting rights at FOMC meetings result in greater emphasis and attention on voting districts, giving those districts more weight in FOMC decisions.

### 4.3.1. FOMC Voting and Local Economic Conditions

We focus on voting dissent decisions at FOMC meetings because these are clearly observable deviations from the consensus opinion. In addition, voting dissent is informative about the second moment of decision making at an FOMC meeting, while Equation (1) focuses on the level effect.

Specifically, for each voting district president $i$ at FOMC meeting $m$, we construct the following variable: $Dissent_m^i$ equals one if FOMC voting president $i$ is a dissenter at meeting $m$ and zero otherwise. We then estimate the following regression:

$$\begin{aligned} Dissent_m^i &= \alpha_{g(i)} + \alpha_m + \alpha_i + \beta_1 Infl_{m,t-1}^i + \beta_2 rgPI_{m,t-1}^i \\ &+ \gamma_1 Infl_{m,t-1}^{US} + \gamma_2 rgPI_{m,t-1}^{US} + \varepsilon_m^i, \end{aligned} \tag{2}$$

where $\alpha_{g(i)}$ is district fixed effects, $\alpha_m$ is meeting fixed effects, and $\alpha_i$ is person fixed effects. All macro variables are as defined in Equation (1), except that here we use district-meeting-level measures rather than meeting-level voting and non-voting measures.

In addition to the $Dissent_m^i$ variable, we consider the direction of the dissent. Specifically, we replace $Dissent_m^i$ in Equation (2) with $Tighter_m^i$. This variable equals one if voting president $i$ is a dissenter and votes for a tighter monetary policy decision during the roll call at meeting $m$ (i.e., votes for a larger interest rate increase or a smaller interest rate cut) and zero otherwise. We also consider the $Easier_m^i$ variable, which equals one if voting president $i$ is a dissenter and votes for an easier monetary policy decision at meeting $m$ and zero otherwise.

Panel A in Table A2 reports summary statistics for voting decisions at the meeting-voting president level. The average likelihood of dissent is 8% for voting presidents. The likelihood of a dissent with tighter (easier) monetary policy goals is 6% (1%), indicating that presidents of Reserve Banks more often dissent with tighter monetary policy goals than with easier monetary policy goals.

Estimates of regression (2) are reported in Table 4. Columns (1) through (3) include district and voting member fixed effects and control for the national inflation and national personal income growth rates. Therefore, the coefficients on variables measuring local economic conditions in presidents' districts reflect the effect of *local* economic conditions in these districts on presidents' voting decisions.

[Insert Table 4 here]

The results show that a higher inflation rate in a voting president's district predicts a significantly higher likelihood of dissent in the direction of tighter monetary policy. In other words, presidents in districts with inflation rates that are higher than other districts or the national level are more likely to dissent and vote for a tighter policy. In economic magnitude, a one standard deviation (SD) increase in voting-district inflation in the preceding month predicts a 1.1% increase in the likelihood of a tighter dissent decision, which is sizable given that a tighter dissent decision from a Reserve Bank president only occurs at a 6% likelihood (see Table A2).

Next we consider the role of PI growth in shaping disagreement. The coefficient on local PI growth indicates that lower local PI growth leads to a higher likelihood of the president in that district dissenting from the consensus opinion at the end of the meeting. Thus, the results for both local inflation and local PI growth indicate that the likelihood that presidents will dissent increases as the local economic conditions in their district worsen relative to aggregate conditions, i.e. higher inflation and lower PI growth. When we consider dissent for an easier monetary policy decision, the coefficients are insignificant for both inflation and PI growth, likely because dissent for an easier policy decision is rare (see Table A2).

In columns (4) through (6), we report the results for a specification that replaces district fixed effects with meeting fixed effects, implying that we only use variation within a meeting. The inclusion of meeting fixed effects also implies that we do not need to control for the national inflation and personal income growth rates. We find that the results remain robust for local inflation when we use the variation in local economic conditions across the five voting presidents at a meeting. The coefficient for local PI growth remains negative, but becomes statistically insignificant.

#### 4.3.2. Textual Analysis

In this section, we present an analysis of FOMC transcripts to support more directly our conjecture that the voting rights of reserve bank presidents contribute to the effect economic conditions in those presidents' districts have on U.S. monetary policy. Under this hypothesis, one would expect establishments and organizations in districts with voting rights to be mentioned more often and "favored" more than those in districts without voting rights.

Summary statistics for the textual analysis sample are reported in Panel B of Table A2. The unit of observation is meeting-district. The average (median) number of times a keyword that can be linked to a district is mentioned by either governors or Reserve Bank presidents is 3.81 (2.00). Governors are less likely to refer to a specific district than presidents of Reserve Banks: the average number of times a keyword that can be linked to a district is mentioned by a governor (a Reserve Bank president) is 0.73 (3.09). This finding indicates that presidents of Reserve Banks are more likely than governors to speak about local economic activity. Besides the district mentions, we also study the Board of Governors' attitudes towards a district during each meeting, by constructing speech similarity scores and sentiment variables. Zeros in these variables meaningfully represent no similarity or neutral sentiment.

We begin the analysis by providing a specific example, in which John J. Balles, president and chief executive officer of the Federal Reserve Bank of San Francisco from 1972 to 1986, voted for a tighter policy on September 18, 1979. These words are from a single block of his speech, rather than an assembly of multiple blocks of his speech during the meeting that reveal his rationale.[22]

> *"Well, in addition to the Sunbelt,* ***the area west of the Rockies*** *is not feeling very much if any recession yet. Aerospace, electronics, and agriculture in general are all quite strong. One indication is that the [volume of] help wanted ads in the* ***Los Angeles Times*** *is almost unreal... In addition to the input that we bring to these meetings and the usual sources of our own research staff and directors, last Friday when* ***Vice Chairman Schultz*** *visited us in* ***San Francisco*** *we called in a special small group of bankers, businessmen, and academicians for a very frank exchange of views. We sounded them out about their feelings on the economy and on Fed policy, and I must say, Fred, that I thought the reactions were quite candid and somewhat humiliating in a way. The bankers generally expressed the view that as yet there's very little evidence that the high level of interest rates is having any significant total effect on cutting off credit demand... So I lean toward the view that we may have to use monetary policy as the principal weapon to break inflationary expectations and to get some deceleration in the actual rate of inflation.* ***Our directors*** *clearly voted to increase the discount*

[22]Here is the exact transcript link: https://www.federalreserve.gov/monetarypolicy/files/FOMC19790918meeting.pdf, pages 27-28.

*rate to reinforce what they thought should be a further snugging up in our efforts to get the rate of growth in the aggregates down somewhat."*

Next, we perform a descriptive analysis of the relationship between voting rights and mentions of districts' keywords by governors. A district's keywords include geographical features, federal agencies, universities, well-known businesses, and newspapers in that district.[23] Figure 6 shows that the average number of keywords spoken by governors can be linked to a district having a vote or not during our sample periods. Thick (with voting rights) and thin (without voting rights) lines indicate that, during most of the sample period, districts with voting rights are almost always more frequently mentioned in transcripts than districts without voting rights. This is the first indication of a positive relationship between whether a president of a Reserve Bank has voting rights at an FOMC meeting and the attention given to that district at the meeting.

[Insert Figure 6 here]

To formally test the hypothesis that voting districts are being mentioned and discussed more often during FOMC meetings, we estimate the relationship between a district president's voting rights (yes=1, no=0) and the number of the district's keywords found in the transcript and spoken by various types of participants (governors or presidents). Specifically, we estimate the following regression:

$$DistrictMentions^i_m = \alpha_m + \beta Vote^i_m + \varepsilon^i_m, \tag{3}$$

where $DistrictMentions^i_m$ is the word count of district $i$'s keywords in meeting $m$, $Vote^i_m$ equals 1 if district $i$'s president has a voting right in meeting $m$, and $\alpha_m$ is meeting fixed effects. The inclusion of meeting fixed effects implies that the estimates are based on within-meeting variation in how often voting and non-voting districts

[23]The full list is available upon request.

are mentioned. The sample covers transcripts for the 1976-2017 period. The unit of observation is meeting-district; that is, for each meeting, there are 12 data points.

The results are reported in Panel A of Table 5. Columns report estimates of the same specification but using different word samples to search for district keywords. In column (1), we count keywords associated with each of the twelve districts using word samples from governors and presidents. We find a positive and significant relationship between whether a district president has a voting right at the meeting and the number of times a keyword that is associated with that district is mentioned in the transcript by presidents or governors. Specifically, districts with voting rights have 0.766 more keywords mentioned than districts without voting rights. This is a sizable effect given that the average number of keywords used by governors and presidents is 3.81. That is, a district is 20% more likely to be mentioned if its president is a voting member of the meeting.

[Insert Table 5 here]

We next differentiate between district keywords mentioned by presidents and governors. The results in columns (2) and (5) indicate that both governors and presidents are more likely to use keywords that are associated with voting districts. For instance, districts with voting rights have about 0.3692 (0.3968) more keywords mentioned by governors (presidents) than districts without voting rights. This is an economically sizable result, indicating that districts with voting rights are 51% (13%) more likely to be mentioned by governors (presidents) than those without voting rights. The results for governors are particularly interesting, because governors' terms are relatively long (up to 14 years). This means that they actively change the content of their speech or comments during an FOMC meeting when a district's status changes from voting to non-voting. This pattern is also displayed in Figure 6.

Next, we consider presidents only and confirm that *voting* presidents use keywords that can be linked to voting districts. That is, we want to show that the results in column (5) cannot be attributed to non-voting presidents mentioning voting districts. To perform this test, we focus on transcript sections linked to voting and non-voting presidents and check which group is more likely to use keywords associated with voting districts. The results are reported in columns (6) and (7). We observe that voting (non-voting) presidents are more (less) likely to use keywords that can be linked to voting districts. This finding supports the idea that district presidents with voting rights talk about their districts and that governors respond to their arguments.

Panel B of Table 5 studies the attitude of governors toward districts. We use three measures of attitude towards an individual district: a measure of similarity between governors' speech and a district president's (column (1)), a categorical variable indicating positive/neutral/negative sentiment toward this district (column (2)), and a continuous measure of sentiment toward this district (column (3)). The results across all three measures indicate that governors express more positive sentiment and agreement towards voting districts than towards non-voting districts. For instance, column (1) indicates that governor agreement is 9.18% higher towards voting districts than towards non-voting districts. This is an economically sizable difference, given that the unconditional agreement score is 0.22.

# 5. Implications

In the previous section, we establish the main decomposition result: FFR decisions are more sensitive to economic conditions in voting districts than in non-voting districts. Since the allocation of voting rights among districts is predetermined and exogenous to districts' economic conditions, these findings imply that the effect on FOMC decisions is causal. In this section, we investigate whether these findings have significant implications for key academic research areas and policy questions. Importantly, we assess whether economic conditions in voting districts have incremental explanatory power above and beyond national economic conditions.

## 5.1. Implications for Monetary Policy Shocks

In this section, we explore the possibility that the FOMC voting structure may be a source of monetary policy shocks. To do so, we use a measure of monetary policy shocks as a dependent variable in regression (1). In particular, we focus on Romer and Romer (2004)'s monetary shocks because it precisely captures what policymakers do and believe, which is conceptually closer to our research objective thus far. As mentioned earlier, Romer-Romer monetary shocks calculate the difference between the actual FFR decision and the intended FFR entering the meeting. The sample goes back to 1969. Table 6 reports the results.

[Insert Table 6 here]

The results in column (1) show that when we consider national inflation and real PI growth, we find that national inflation is an insignificant predictor of monetary shocks and PI growth is a positive predictor of monetary shocks. Columns (2) through (4) show that when we decompose national economic conditions into economic conditions in voting and non-voting districts, both inflation and real PI growth in voting districts are significant determinants of monetary shocks. In contrast, the coefficients of economic conditions in non-voting districts are insignificant. For instance, a one SD increase in voting district inflation (real PI growth) leads to an 8.2 bps or 0.19 SD (6.4 bps or 0.15 SD) increase in Romer-Romer shocks. In addition, Romer-Romer shocks empirically account for almost 45% of the total variance of changes in the FFR from meeting $m-1$ to meeting $m$ during our sample period. As a result, the economic magnitudes of the two voting district variables are considered sizable.

In column (5), we show that even when we control for national economic conditions, inflation and real PI growth in voting districts remain significant determinants of monetary shocks. Since national economic conditions include the economic conditions in both voting and non-voting districts, this result is non-trivial and indicates an important role played by voting districts. Importantly, these findings imply that economic conditions in voting districts contribute to our understanding of sources of monetary shocks beyond national economic conditions. Thus, the interaction between district economic conditions and the FOMC voting structure account for a meaningful fraction of monetary shocks.

## 5.2. Implications for the Taylor Rule

We continue investigating whether our findings change the way we understand the determinants of monetary policy. Taylor (1993) demonstrates that past monetary policy rules can be closely tracked by changes in the price level or real income. Building on that, the literature has enhanced the reduced-form model by including lagged target rates and Greenbook forecasts.[24] In this section, we estimate the Taylor rule augmented with recent economic variables from districts with or without voting rights. Our approach builds on but differs from a general specification of the Taylor rule, as we accommodate local variables to reflect our research objective. The Taylor rule is forward looking, and therefore, in its empirical adaptation, the recent literature uses the Greenbook (currently known as the Tealbook) to obtain the Board of Governors' forecasts for the aggregate economy (typically a week) before each FOMC meeting. Each Greenbook is produced by the Board of Governors and has a five-year delay in its public release, suggesting that only ex-post analysis of the Taylor rule is empirically possible. Notably, our paper has a different objective, as we are interested in whether recent past local economic conditions in voting versus non-voting districts

[24]There exists an extensive body of literature that focuses on identifying other determinants to help improve the predictability of the reduced-form Taylor rule model. For instance, Clarida, Gali, and Gertler (2000) (and many papers around the same time, such as Rudebusch (2002)) document that current interest rate decisions can be closely predicted by recent lagged interest rate(s). Romer and Romer (2000) document that Greenbook (also known as the Tealbook) forecasts of changes in price level and real income or productivity at the aggregate level systematically outperform forecasts by professional forecasters. Coibion and Gorodnichenko (2012)'s empirical framework, which incorporates both aforementioned important findings, has been commonly used by researchers as the state-of-the-art empirical framework for testing the monetary policy consequences of new determinants, such as financial instability and stock market behaviors (see e.g. Cieslak and Vissing-Jorgensen (2021)).

affect FOMC decisions. Moreover, to the best of our knowledge, there is no local economic projection data reflecting each Federal Reserve president's beliefs, surveyed before each FOMC meeting, that is publicly available at the district level.

We estimate the following specification:

$$\Delta FFR_m = \alpha + \beta_1 Infl^{Vote}_{m,t-1} + \beta_2 Infl^{NoVote}_{m,t-1} + \gamma_1 rgPI^{Vote}_{m,t-1} + \gamma_2 rgPI^{noVote}_{m,t-1} + \sum_{k=1}^{K} \tau_k FFR_{m-k} + \boldsymbol{\delta X_m} + \varepsilon_m, \quad (4)$$

where as before $\Delta FFR_m$ is the change in the Federal funds target rate from meeting $m-1$ to meeting $m$. Most of the variables are as explained in Section 3.1.2. $\boldsymbol{X_m}$ denotes the set of control variables, including the U.S. inflation and real growth variables and Greenbook forecasts. We allow for interest rate smoothing (lagged FFR terms) up to the third order. The unit of observation is one FOMC meeting.

Table 7 reports the results. In column (1), we replicate the baseline aggregate framework using Greenbook variables as in Cieslak and Vissing-Jorgensen (2021).[25] In column (2), we replace Greenbook forecasts with recent national economic conditions and find that they are not significantly associated with changes in the FFR. Columns (3) and (4) show, however, that inflation in voting districts is a positive and significant determinant of changes in the FFR when we control for inflation in non-voting districts (column (3)) and national inflation (column (4)). In this specification, the effect of real PI growth in voting districts is also positive, but statistically insignificant.

[Insert Table 7 here]

[25] In our replication of Table 4, column (2) from Cieslak and Vissing-Jorgensen (2021), using the same 1994-2008 sample and our dataset, our coefficient estimate is 0.089*** (SE=0.011) for the Greenbook real GDP growth forecast (compared to 0.084 in their estimation), and 0.105*** (SE=0.021) for the Greenbook national inflation forecast (compared to 0.14 in their estimation). Both estimates are within 95% confidence intervals of the estimates in their paper.

## 5.3. Implications for Capital Markets

In this section, we test whether economic conditions in voting districts affect Treasury and futures markets. We begin by considering the changes in yields for 10-year maturity Treasury bonds. Specifically, we regress changes in 10-year Treasury bond yield rates on recent economic conditions in voting districts and non-voting districts. We consider the changes in yields around the week of the FOMC meeting (week 0). Specifically, $\Delta yield_{(-4,h)}$ denotes the yield difference from 4 weeks prior to the meeting to $h$ week, where yield (and hence the level difference) is in units of percent per annum.

Table 8 reports the results. In Panel A, we use economic conditions in voting and non-voting districts as we do in demonstrating the main decomposition result. The results indicate a robust effect of inflation in voting districts on changes in long-term Treasury yields from 4 weeks prior to the FOMC meeting.[26] For instance, estimates in column (4) indicate that inflation in voting districts has a positive and significant affect on changes in yields. In terms of economic magnitude, a one SD increase in voting district inflation leads to a 6.8 bps or 0.2 SD increase in the yield change. When we consider various horizons across columns, it is interesting that the effect already begins to peak up and becomes statistically significant one week prior to the FOMC meetings. This is an indication that the market already seems to price voting district inflation in prior to the meeting. The effect of real PI growth in voting districts is also consistent, as shown in columns (3) through (6). Across all columns, inflation and real PI growth in non-voting districts is unrelated to changes in Treasury yields.

[Insert Table 8 here]

In Panel B, we use national economic conditions and economic conditions in voting districts. That is, we assess whether economic conditions in voting districts

[26] The results below are not sensitive to the starting week choice in terms of week -4, -3, or -2.

have explanatory power above and beyond national economic conditions. While the economic magnitude of the coefficient for real PI growth in voting districts does not change, only one coefficient (column (6)) remains positive and significant. In contrast, coefficients for inflation in voting districts are similar to the coefficients in Panel A and remain positive and significant. Overall, the results in Table 8 provide clear evidence that the interaction of local economic conditions with the FOMC voting structure has a significant effect on Treasury yields.

We also see evidence from Table 8, column (3) that is potentially consistent with market participants predicting this effect, which raises the possibility that market participants realize that inflation rates in voting districts have a significant effect on the FFR and have been gradually pricing them into the Treasury market. Next, we formally test this hypothesis using futures market data. If market participants understand that the decisions of FOMC members depend partly on economic conditions in voting districts, the relationship between FF futures rates and districts' economic conditions should be stronger for voting districts than for non-voting districts. A similar prediction applies if market participants follow comments about local economic conditions made by voting FOMC members. To perform this test, we replace changes in Federal funds rates from last meeting $m-1$ to this meeting $m$ in our regression (1) with changes in the average Federal funds futures rate, $\Delta f_m$. As mentioned earlier, the sample of this variable runs from 1989 to 2019 (see detailed descriptions in Section 3 and Internet Appendix Section IA.5). We are interested in including the ZLB period in this analysis because (unlike the FFR) Federal funds futures rates, reflecting time-varying market expectations, could fluctuate freely during the ZLB period. In fact, the standard deviation of $\Delta f_m$ is 19 bps during the ZLB period, which is comparable to that during the full sample (32 bps).

The results are reported in Table 9. Column (1) shows that the previous month's national inflation rate is a positive and significant predictor of an increase in FF futures rates and the real PI growth rate is a positive but insignificant predictor of changes in

FF futures rates. When we decompose the national inflation rate and real PI growth rate into those for voting and non-voting districts in column (2), we find that only measures for voting districts have significant effects on FF futures rates. A one SD increase in a voting district's inflation rate (real PI growth rate) in the last month leads to a 0.21 SD or 6.7 basis point (0.16 SD or 5.1 basis point) increase in $\Delta f_m$, significant at the 5% level. In contrast, the relationship between the inflation and PI growth rates for non-voting districts and changes in FF futures rates is economically small and statistically indistinguishable from zero. From column (3), the voting effect in market expectations of the FFR remains positive and significant after controlling for national economic conditions.

[Insert Table 9 here]

In columns (4) to (6), we follow Gürkaynak (2005) and construct an FFR forecast revision variable, which is conceptually closer to the rate setting decision analyzed in our paper, as it fixes the FOMC meeting of interest. Using 1m/2m/3m contracts and a shorter sample from 2002 to 2019 (due to data availability), we find that voting district inflation is a positive predictor of FFR forecast revision.

Overall, our results indicate that voting districts' economic conditions have a profound effect on Treasury markets and that investors realize the importance of disaggregating national economic conditions and taking into account the governance structure of the FOMC.

## 5.4. Policy Implications

Our empirical estimates of the voting variables give us a chance to quantify potential distortions in the conduct of monetary policy that are induced by the allocation of voting rights to five out of twelve Reserve Banks. In this section, we conduct two analyses to demonstrate the economic magnitude of the distortions in question and then to explore two specific counterfactuals.

We begin by investigating how large the potential distortion could be. Specifically, we consider two extreme counterfactual cases. The first counterfactual case, "Min(4)," creates an inflation series that uses the four lowest inflation values across the eleven Reserve Bank districts to generate a voting-group average (note that New York's president always votes). That is, in this exercise we reallocate the voting rights of the four rotating districts to the four districts with the lowest inflation rates. The second counterfactual case, "Max(4)," always uses the largest four inflation numbers. Similar counterfactual values are calculated for real PI growth. We consider the two macro variables one at a time here given that the purpose is to define magnitude.

The top (bottom) left panel of Figure 7 shows the difference between the counterfactual average inflation (real PI growth) rates and the actual voting districts' average inflation (real PI growth) rates, scaled by the standard deviation of the voting districts' inflation (real PI growth) rates. For demonstration purposes, we plot the yearly average. The top panel indicates that if the four votes are allocated to districts with the lowest (highest) inflation rates, the distortion in the inflation rate can exceed one standard deviation of the voting districts' inflation rates. A similar message comes from the bottom figure with real PI growth rates. Thus, the allocation of voting rights to only a few Reserve Banks can lead to potentially meaningful distortions in FFRs.

[Insert Figure 7 here]

The right panel of Figure 7 translates the distortions in inflation and real PI growth rates into distortions in FFRs for each period. Specifically, given the full-sample estimates in Table 1, column (4), we find that 1 SD in the voting district inflation (real PI growth) rate causes a 12.9 (6.7) basis point increase in $\Delta FFR$. We multiply the SDs in the left panel by 12.9 and 6.7 basis points, accordingly. The evidence in the right panel shows that these distortions can be economically meaningful. For instance, "10 bps" on the y-axis of the right panel implies that the $\Delta FFR$ would have gone higher by 10 basis points compared to the actual $\Delta FFR$ had this meeting used the largest four inflation rates to make the decision.

While the analysis in Figure 7 implies that a distortion to $\Delta FFR$ can be large, there is a possibility that these distortions could cancel out as one looks at the path of FFR targets. As a result, we study two specific counterfactual cases and trace out their implied FFR target rates. The most important counterfactual – with clear policy implications – would be an equal-weighted case that gives all districts an equal number of votes. In fact, the U.S. monetary policy decision committee in 1930 and 1933 imposed equal weights across all twelve districts.[27] The Banking Act of 1935 (amended again in 1942) superseded this arrangement by creating the FOMC's modern structure and introducing the rotation. We therefore analyze the counterfactual path of target rates under the assumption that voting rights are assigned to all Reserve Bank presidents *equally*. In that counterfactual, FOMC decisions are based on the equal-weighted inflation rates of all twelve districts. We fix the other coefficient estimates and other data inputs of the estimated regression, and replace the actual voting district macro variable series with the counterfactual series. The counterfactual path of $\Delta FFR$ can be computed, and as a result, the target rate can be computed. We also consider a second counterfactual case in which all districts have a voting right, but their voting power is proportional to the district's size (as measured by personal income levels).

Figure 8 presents the results. The time series in this plot are the difference between the counterfactual target rate series and the actual target rate series, expressed in basis points. The equal-weighted counterfactual series (solid green line) shows that the path of the target rate would have been different if all districts affected FOMC decisions equally. For instance, the results suggest that target rates would have been higher during the pre-Global Financial Crisis period (2000-2005) if economic conditions in all districts had been taken into account equally. Importantly, the results show that voting-related distortions to FOMC decisions do not cancel out after two or three years. The size-weighted counterfactual series (dashed blue line) indicates even larger

[27]See https://www.federalreservehistory.org/essays/banking-act-of-1935.

distortions to the target rate series, especially post-1985. This finding is consistent with the dramatic shift in the geographical allocation of economic activity across districts such as the rise of the San Francisco district, making the century-old district map outdated (Figure 1).

[Insert Figure 8 here]

There is a caveat in the counterfactual analysis. Specifically, the analysis does not incorporate the effect of changes in FOMC voting procedures on economic conditions and therefore the series of economic activity measures for voting and non-voting districts. Developing a model that incorporates these effects is a fruitful avenue for future research.

## 5.5. Revisiting the Voting Structure of the FOMC

There are two primary ways to shift monetary policy to better reflect national economic conditions. First, FOMC decision-makers could change their behavior and place a larger emphasis on national economic conditions, rather than economic conditions in voting districts. Since agents respond to incentives and this approach does not lead to a change in incentives, the likelihood that this would be effective is unclear. That is, as long as regional presidents care about economic conditions in their districts and only some presidents vote, distortions in FOMC decisions are likely to persist.

Alternatively, policymakers could change the voting structure of the FOMC, either by giving voting rights to all reserve bank presidents or by removing those rights from all presidents so that only governors vote. While both approaches reduce the likelihood that a small group of presidents has disproportionate voting power, they have shortcomings. Allocating (equal) voting rights to all presidents and governors could marginalize the role of governors (7 governors versus 12 reserve bank presidents). Allocating voting rights to governors only could reduce reserve bank presidents' interest in the FOMC because they will have no formal influence on FOMC decisions.

In addition to the question of how to allocate votes across districts, the results in this paper call into question whether district boundaries are up to date. Consider, for instance, the California and St. Louis districts. The large (small) geographical area covered by the California (St. Louis) district likely represents the extent of its economic activity at the time when the map was designed, i.e., about a century ago. Since the geographical allocation of economic activity in the U.S. has dramatically changed during that century, allocating votes equally across districts would lead to an unequal allocation of votes across units of economic activity. Indeed, the large difference between equal-weighted and size-weighted counterfactual values in Figure 8 suggests that that mismatch is non-trivial.

# 6. Conclusion

In this paper, we show that economic conditions in Reserve Bank districts affect the FFR only when those Banks' presidents hold voting seats at FOMC meetings. To provide more direct evidence of this voting mechanism, we use a hand-collected dataset that tracks the voting decisions of each FOMC member to show that voting presidents dissent based on economic conditions in their districts. Moreover, Reserve Bank presidents' districts are more likely to be mentioned and favored in discussions than are the districts of non-voting presidents according to FOMC transcripts. In terms of economic significance, the economic conditions in voting districts are a significant source of Romer-Romer monetary policy shocks, affect Taylor rule regressions, and have a profound effect on financial markets. In particular, market participants understand this and price the effect of local economic conditions on FOMC decisions accordingly. Our empirical strategy relies on the exogenous rotation of voting rights between Reserve Bank presidents. In a counterfactual analysis, we find that the path of the target rate would have been different if all districts affected FOMC decisions, and given our estimation, such voting-related distortions could take 15 to 20 years to absorb.

Our findings point to several important questions for future research. Is the existing decision-making mechanism adopted by the FOMC effective in achieving optimal macroeconomic policy? Is the balance of power between the Federal Reserve Board of Governors and Reserve Bank presidents effective in reflecting the heterogeneity in economic conditions and desired policy choices across districts? Should the standard Taylor rule equation include more granular-level economic activity measures, such as district-level measures, rather than national measures? Answers to these questions will not only contribute to academic research, but also be useful for policymakers.

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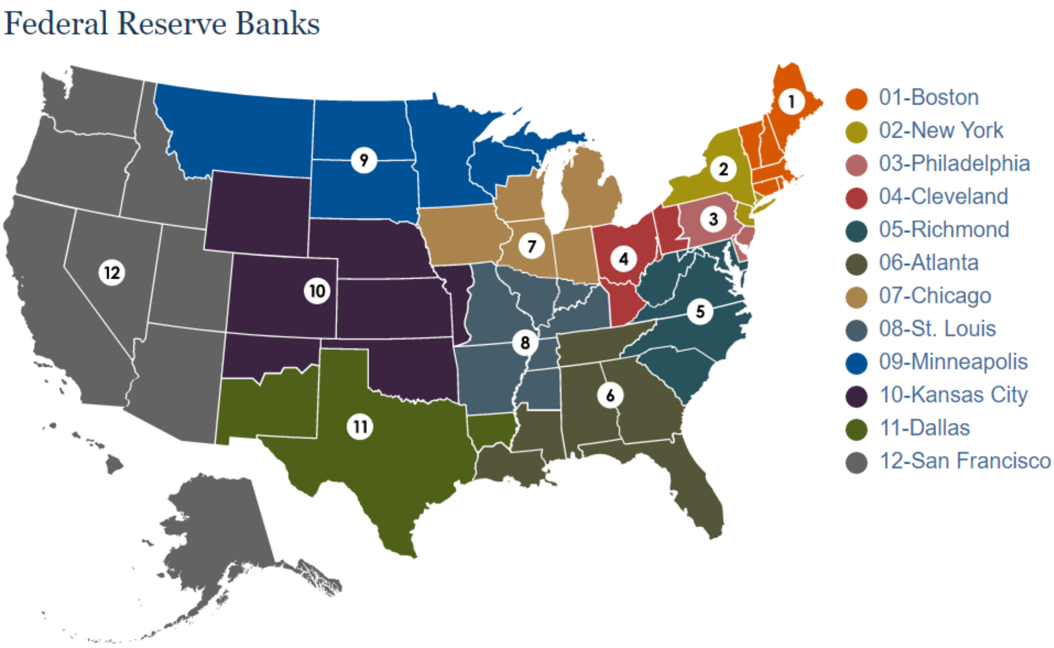



Figure 1: **Federal Reserve Banks.** Source: https://www.federalreserve.gov/aboutthefed/structure-federal-reserve-banks.htm

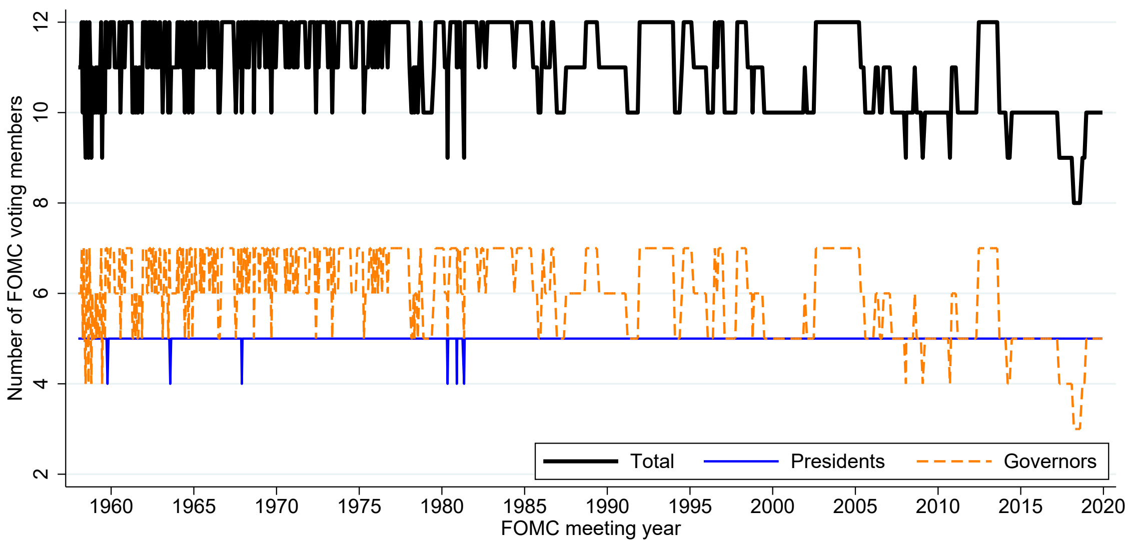



Figure 2: **Number of voting members at FOMC meetings from 1958 to 2019**

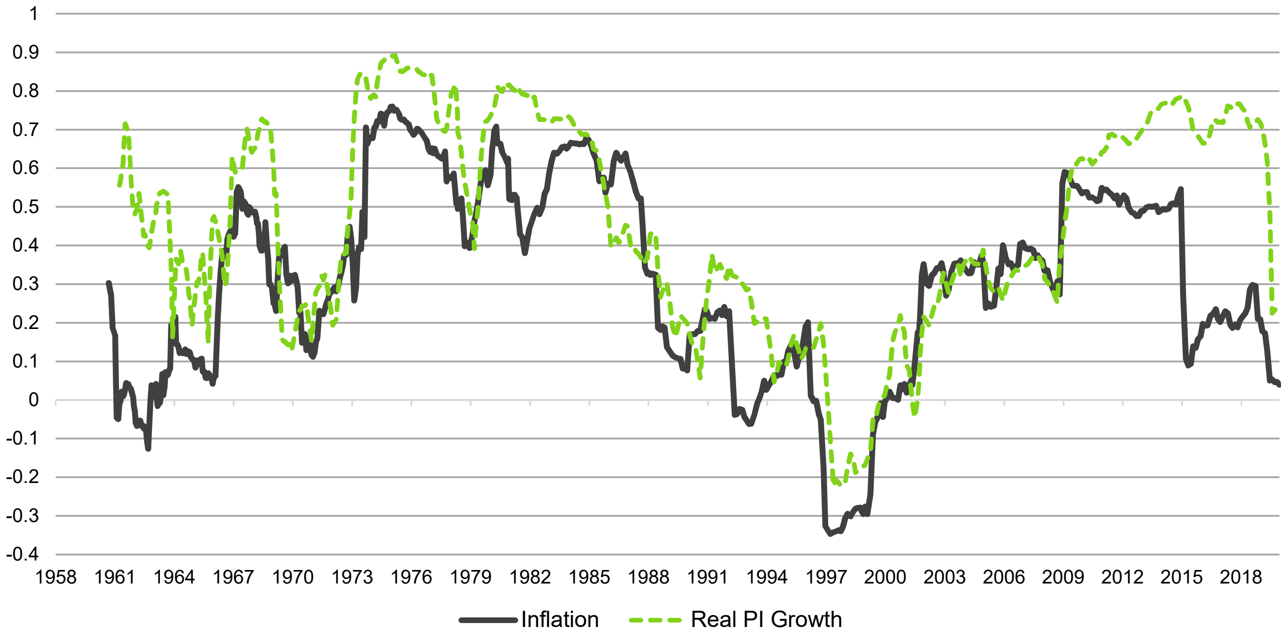
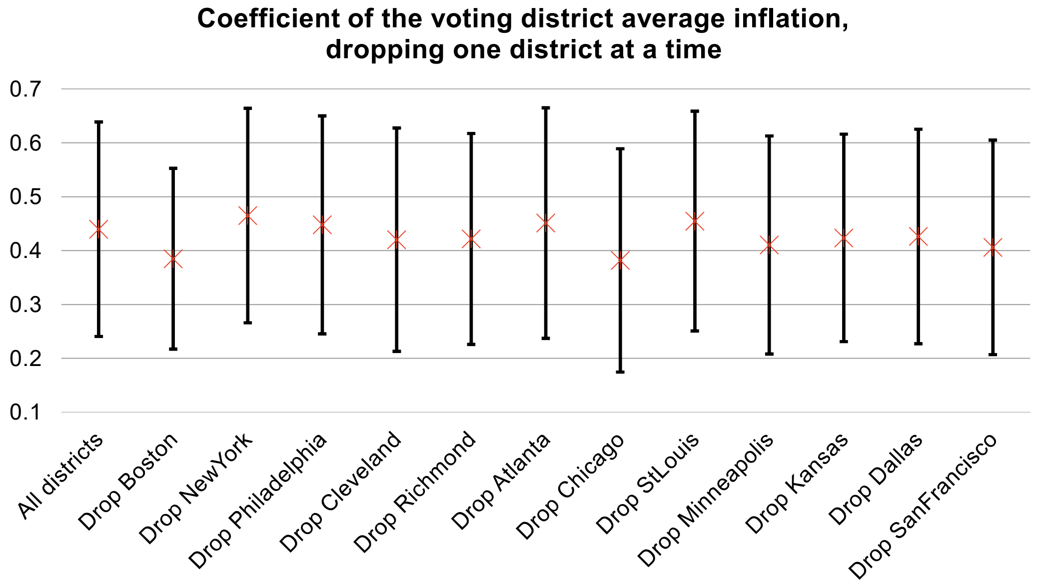



Figure 3: **Rolling correlation between voting and non-voting district macro variables.** In this figure we report the time series of rolling correlation between voting and non-voting district macro variables, inflation in black solid line and real PI growth in green dashed line. The rolling window sues 50 FOMC meeting, and the sample starts in 1/7/1958 and ends in 12/11/2019.



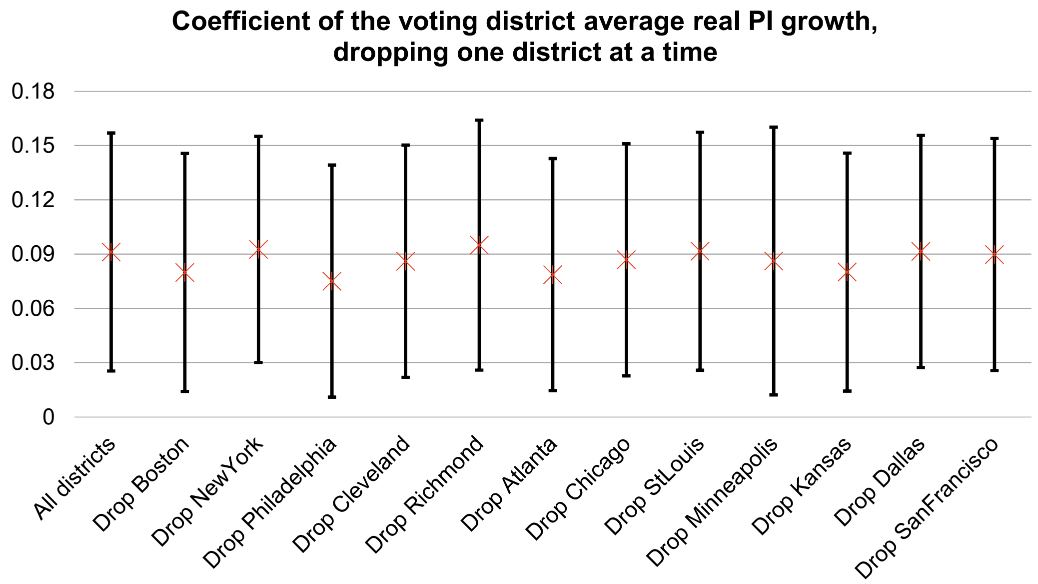




Figure 4: **Robustness test: The role of individual districts.** In this figure we report the coefficients of $Infl^{Vote}_{m,t-1}$ and $rgPI^{Vote}_{m,t-1}$ in the specification of column (4) in Table 1's Panel B (i.e., the main sample and main specification of interest) while dropping one district at a time when constructing voting and non-voting district macro variables. Coefficient estimates of $Infl^{Vote}_{m,t-1}$ are displayed in the top plot, and those of $rgPI^{Vote}_{m,t-1}$ are displayed in the bottom plot. The marker indicates the coefficient estimate and the bands indicate a 90% confidence interval.

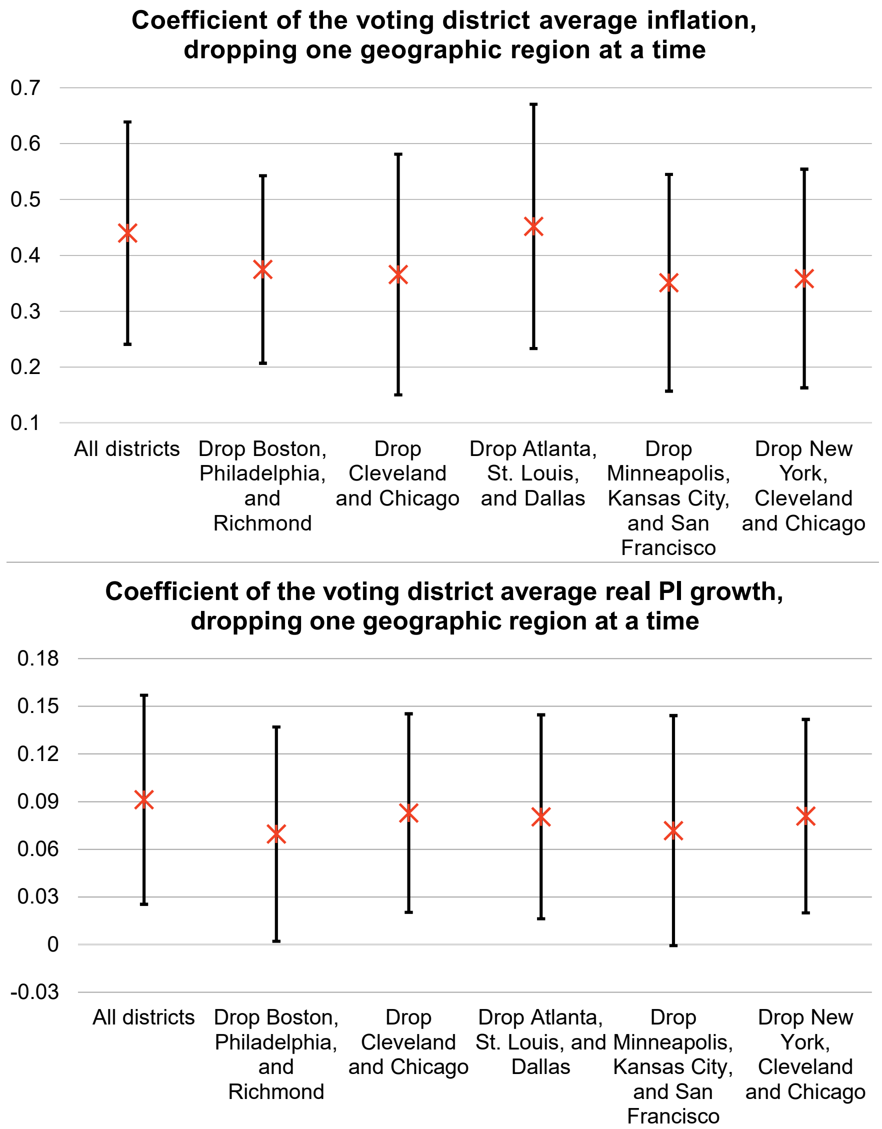



Figure 5: **Robustness test: The role of some district groups of interest.** In this figure we report the coefficients of $Infl^{Vote}_{m,t-1}$ and $rgPI^{Vote}_{m,t-1}$ in the specification of column (4) in Table 1's Panel B (i.e., the main sample and main specification of interest) while dropping one group of districts at a time when constructing voting and non-voting district macro variables. Coefficient estimates of $Infl^{Vote}_{m,t-1}$ are displayed in the top plot, and those of $rgPI^{Vote}_{m,t-1}$ are displayed in the bottom plot. The marker indicates the coefficient estimate and the bands indicate a 90% confidence interval.

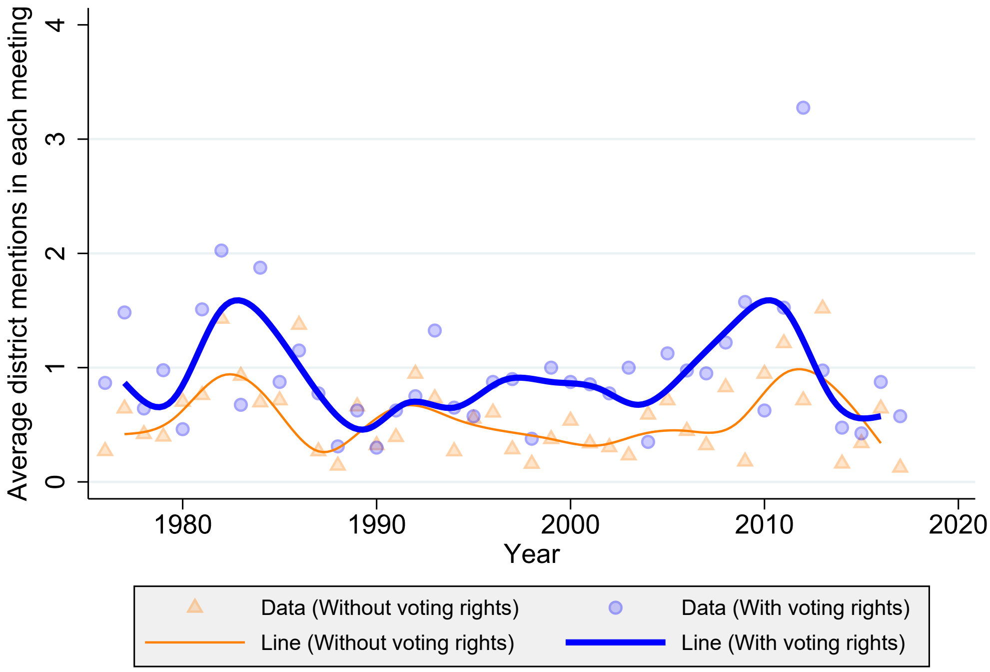



Figure 6: **Mentions of voting districts and non-voting districts by governors.** We search words spoken by governors for district keywords (i.e., "mentions"). Mentions of voting districts' keywords are significantly higher than those of non-voting districts' keywords, with a $p$-value of 0.0000 in a one-sided paired $t$-test. Regressions are presented in Table 5, Panel A, column (2).

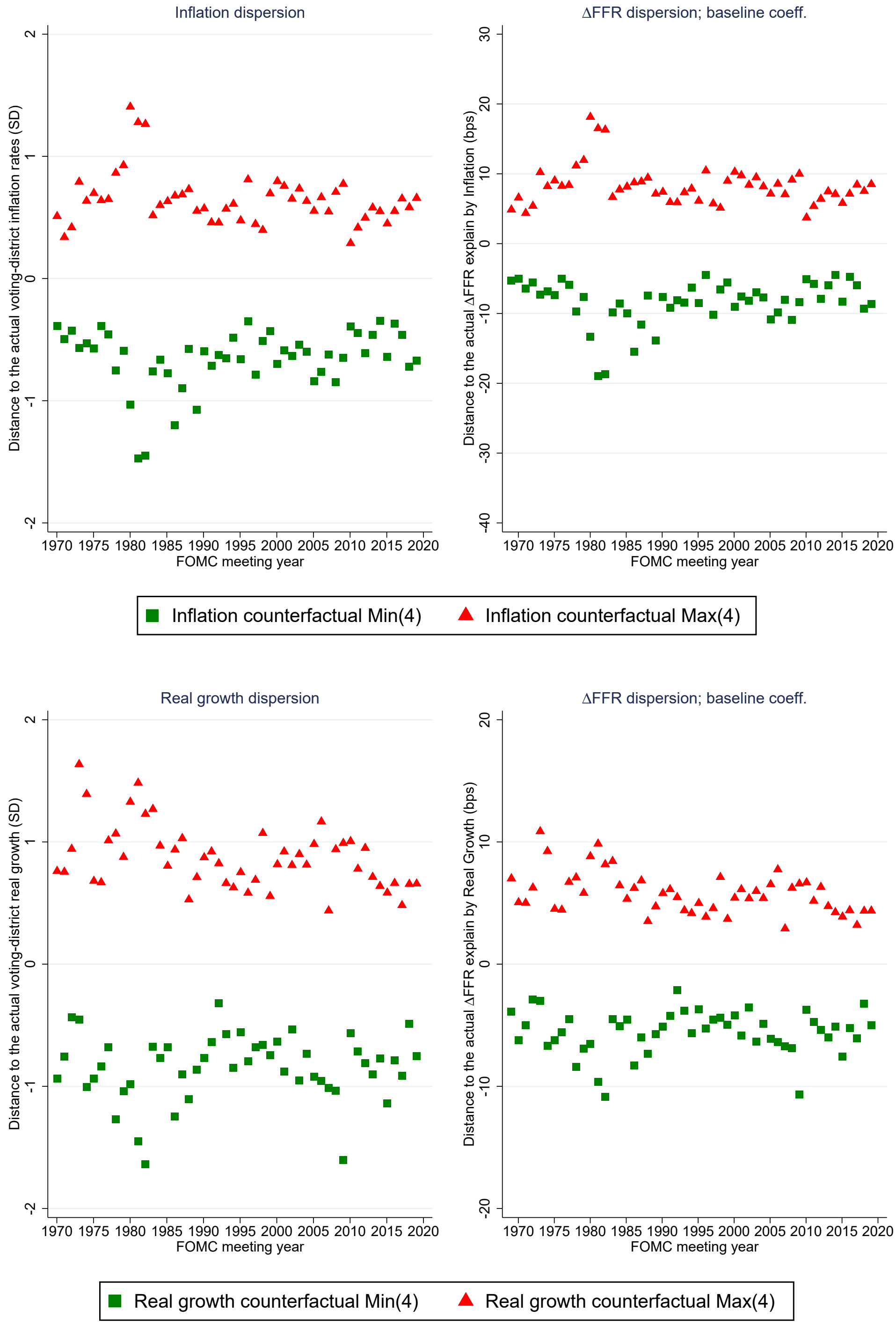



Figure 7: **Economic magnitude of extreme counterfactuals.** This figure demonstrates the economic magnitude of extreme counterfactual cases. The top panel uses inflation and the bottom panel uses real PI growth. In the top panel, we consider two extreme counterfactual cases. In the "Min(4)" ("Max(4)") case, we assume that votes are allocated to the four districts with the lowest (highest) inflation in the preceding month. The left plot shows the difference between the counterfactual inflation rates and the actual voting district's inflation rates divided by the standard deviation of the actual voting district's inflation rates, i.e., the SD of the counterfactual to the actual. In order to translate the difference between the actual and the counterfactual allocation of voting rights into the difference in FFR decisions, we rely on the estimates in column (4) of Table 1 and report in the right plot the implication on $\Delta FFR_m$ given the SD series on the left plot. For demonstration purposes, we plot the yearly average in the markers. The same procedure can be conducted for real PI growth, and the results are shown in the bottom panel.

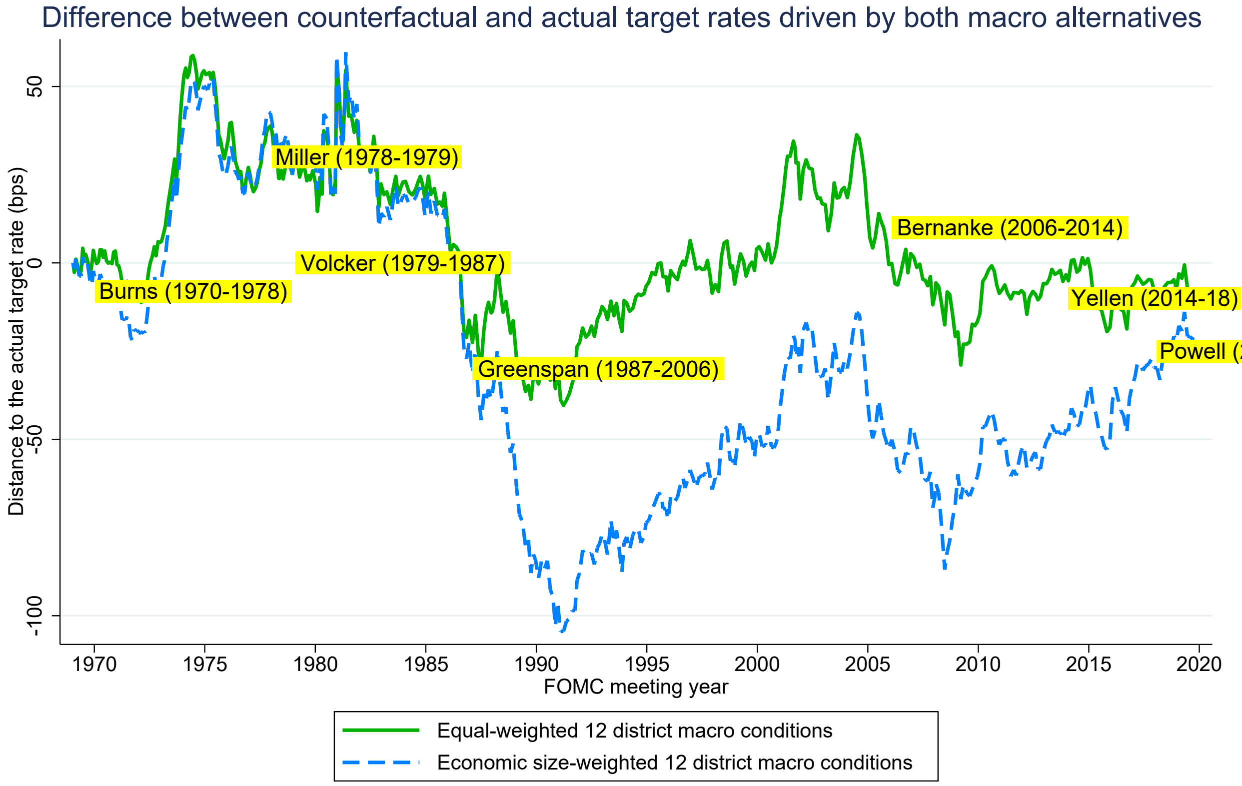



Figure 8: **Counterfactual minus actual paths of target rates.** This figure demonstrates what the path of the target rate would have looked like if decisions used alternative voting inflation rates: (1) the equal-weighted average of all twelve districts' inflation rates and (2) the economic size-weighted average of all twelve districts. The time series above displays the gap/difference between the counterfactual target rate series and the actual target rate series, expressed in basis points. Given the model estimates in column (4) of Table 1, we focus on the fitted part of $\Delta FFR_m$ that can be explained by the voting district inflation and PI growth variables. We feed the model with the counterfactual inflation and PI growth variables instead and then recompute a counterfactual path for $\Delta FFR_m$; hence the target rate can be implied.

Table 1: **Predicting changes in Federal funds rates.** This table presents estimates of regression (1), in which we regress changes in the FFR on recent macro variables of voting and non-voting districts. The unit of observation is one FOMC meeting. All the variables are defined in Table A1 and Section 3. Panel A reports the results for the full sample (1969-2019). Panel B reports the results for the sample that excludes the zero lower bound (ZLB) period, December 2008 to December 2015. Robust standard errors are reported in parentheses. ***, p-value <1%; **, <5%; *, <10%.

| Dependent variable: | $\Delta FFR_m$ | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| **Panel A:** Full sample | | | | |
| $Infl^{US}_{m,t-1}$ | 0.2408* | | 0.2482* | |
| | (0.127) | | (0.130) | |
| $Infl^{Vote}_{m,t-1}$ | | 0.3505*** | | 0.3573*** |
| | | (0.100) | | (0.101) |
| $Infl^{NoVote}_{m,t-1}$ | | -0.0465 | | -0.0438 |
| | | (0.115) | | (0.115) |
| $rgPI^{US}_{m,t-1}$ | 0.0970** | 0.1027** | | |
| | (0.042) | (0.042) | | |
| $rgPI^{Vote}_{m,t-1}$ | | | 0.0623* | 0.0686** |
| | | | (0.032) | (0.032) |
| $rgPI^{NoVote}_{m,t-1}$ | | | 0.0390 | 0.0392 |
| | | | (0.038) | (0.037) |
| $FFR_{m-1}$ | -0.0246 | -0.0279* | -0.0243 | -0.0277* |
| | (0.016) | (0.016) | (0.016) | (0.016) |
| Constant | -0.0202 | -0.0243 | -0.0249 | -0.0299 |
| | (0.054) | (0.055) | (0.054) | (0.054) |
| N | 471 | 471 | 471 | 471 |
| $R^2$ | 0.034 | 0.047 | 0.034 | 0.048 |
| **Panel B:** Exclude Zero Lower Bound | | | | |
| $Infl^{US}_{m,t-1}$ | 0.2721* | | 0.2863* | |
| | (0.159) | | (0.161) | |
| $Infl^{Vote}_{m,t-1}$ | | 0.4352*** | | 0.4397*** |
| | | (0.121) | | (0.121) |
| $Infl^{NoVote}_{m,t-1}$ | | -0.0723 | | -0.0634 |
| | | (0.136) | | (0.137) |
| $rgPI^{US}_{m,t-1}$ | 0.1245** | 0.1323** | | |
| | (0.055) | (0.054) | | |
| $rgPI^{Vote}_{m,t-1}$ | | | 0.0889** | 0.0912** |
| | | | (0.040) | (0.040) |
| $rgPI^{NoVote}_{m,t-1}$ | | | 0.0449 | 0.0501 |
| | | | (0.044) | (0.043) |
| $FFR_{m-1}$ | -0.0293 | -0.0342* | -0.0289 | -0.0339* |
| | (0.020) | (0.020) | (0.020) | (0.019) |
| Constant | -0.0136 | -0.0187 | -0.0230 | -0.0278 |
| | (0.082) | (0.083) | (0.081) | (0.082) |
| N | 414 | 414 | 414 | 414 |
| $R^2$ | 0.038 | 0.055 | 0.040 | 0.057 |

Table 2: **Alternative inflation measures.** This table presents estimates of regression (1), in which we regress changes in the FFR on recent macro variables of voting and non-voting districts. The unit of observation is one FOMC meeting. All the variables are defined in Table A1 and Section 3. In column (1), we report the results from the main specification. In column (2), we use a district inflation measure, calculated as the population-weighted average of all MSA-level inflation measures in the district. In column (3), we use a quarterly measure of inflation, calculated as the population-weighted average of all MSA-level inflation measures in main state of the district. In column (4), we use a quarterly measure of inflation, calculated as the population-weighted average of all state-level inflation measures in the district. In columns (5) and (6), we use Hazell, Herreño, Nakamura, and Steinsson (2022)'s inflation measures (for the main state and population-weighted average across states), adjusted to the quarterly QoQ level; detailed construction for these two variables is discussed in Internet Appendix IA.3. Robust standard errors are reported in parentheses. ***, p-value <1%; **, <5%; *, <10%.

| Dependent variable: | $\Delta FFR_m$ | | | | | |
|---|---|---|---|---|---|---|
| $Infl$ measure: | Main | Monthly, Population-weighted | Quarterly, Main state | Quarterly, Population-weighted | Hazell et al. (2022), Quarterly, Main state | Hazell et al. (2022), Quarterly, Population-weighted |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $Infl^{Vote}_{m,t-1}$ | 0.4397*** | 0.4613*** | 0.7540*** | 0.8566*** | 0.8813** | 0.7922** |
| | (0.121) | (0.131) | (0.241) | (0.274) | (0.361) | (0.375) |
| $Infl^{NoVote}_{m,t-1}$ | -0.0634 | -0.0760 | -0.1739 | -0.2638 | 0.2404 | 0.2763 |
| | (0.137) | (0.136) | (0.214) | (0.203) | (0.226) | (0.221) |
| $rgPI^{Vote}_{m,t-1}$ | 0.0912** | 0.1001** | 0.1220*** | 0.1190*** | 0.1565** | 0.1456** |
| | (0.040) | (0.040) | (0.041) | (0.040) | (0.061) | (0.060) |
| $rgPI^{NoVote}_{m,t-1}$ | 0.0501 | 0.0464 | 0.0394 | 0.0399 | 0.0691 | 0.0672 |
| | (0.043) | (0.043) | (0.041) | (0.041) | (0.071) | (0.071) |
| $FFR_{m-1}$ | -0.0339* | -0.0339* | -0.0415** | -0.0400** | -0.0604** | -0.0568** |
| | (0.019) | (0.019) | (0.019) | (0.020) | (0.026) | (0.026) |
| Constant | -0.0278 | -0.0417 | -0.0718 | -0.0803 | -0.1361 | -0.1450 |
| | (0.082) | (0.083) | (0.088) | (0.087) | (0.096) | (0.105) |
| N | 414 | 414 | 414 | 414 | 248 | 248 |
| $R^2$ | 0.057 | 0.058 | 0.059 | 0.069 | 0.086 | 0.080 |

Table 3: **Alternative real PI growth measures.** This table presents estimates of regression (1), in which we regress changes in the FFR on recent macro variables of voting and non-voting districts. The unit of observation is one FOMC meeting. All the variables are defined in Table A1 and Section 3. In column (1) we repeat the results for the main specification, in which we use PI growth for a district's main state. In column (2), we use a population-weighted measure of PI growth, calculated using all states within district. In column (3), we use a population-weighted measure of PI growth, calculated based on non-overlapping states only. In column (4), we use an equally-weighted measure of PI growth, calculated based on all states within that district. Robust standard errors are reported in parentheses. ***, p-value <1%; **, <5%; *, <10%.

| Dependent variable: | $\Delta FFR_m$ | | | |
|---|---|---|---|---|
| $rgPI$ measure: | Main state | Population-weighted | Non-overlapping states | Equal-weighted |
| | (1) | (2) | (3) | (4) |
| $Infl^{Vote}_{m,t-1}$ | 0.4397*** | 0.4357*** | 0.4355*** | 0.4343*** |
| | (0.121) | (0.121) | (0.121) | (0.121) |
| $Infl^{NoVote}_{m,t-1}$ | -0.0634 | -0.0718 | -0.0724 | -0.0715 |
| | (0.137) | (0.136) | (0.137) | (0.136) |
| $rgPI^{Vote}_{m,t-1}$ | 0.0912** | 0.1137** | 0.0600* | 0.0992** |
| | (0.040) | (0.046) | (0.034) | (0.044) |
| $rgPI^{NoVote}_{m,t-1}$ | 0.0501 | 0.0235 | 0.0722 | 0.0382 |
| | (0.043) | (0.060) | (0.047) | (0.061) |
| $FFR_{m-1}$ | -0.0339* | -0.0340* | -0.0342* | -0.0338* |
| | (0.019) | (0.019) | (0.020) | (0.019) |
| Constant | -0.0278 | -0.0260 | -0.0187 | -0.0242 |
| | (0.082) | (0.084) | (0.083) | (0.082) |
| N | 414 | 414 | 414 | 414 |
| $R^2$ | 0.057 | 0.058 | 0.055 | 0.056 |

Table 4: **Dissent decisions.** This table presents the results of regressing an indicator of voting dissent on a president's corresponding (local) macro variables, at the meeting-member level, using our largest sample (1958-2019). Voting dissent is a vote against the majority of FOMC members. We consider three dissent decision variables: (1) $Dissent_m^i$ is 1 if the voter dissented; (2) $Tighter_m^i$ is 1 if the voter dissented and proposed a tighter policy; (3) $Easier_m^i$ is 1 if the voter dissented and proposed an easier policy; all three variables are 0 otherwise. Other detailed variable definitions can be found in Table A2. Dissent data collection and local macro variable construction are explained in detail in Section 3 and Appendix IA. Robust standard errors are reported in parentheses. ***, p-value <1%; **, <5%; *, <10%.

| Dependent variable: | $Dissent_m^i$ | $Tighter_m^i$ | $Easier_m^i$ | $Dissent_m^i$ | $Tighter_m^i$ | $Easier_m^i$ |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $Infl_{m,t-1}^i$ | 0.0360** | 0.0267* | 0.0031 | 0.0398** | 0.0190 | 0.0104 |
| | (0.017) | (0.015) | (0.006) | (0.020) | (0.017) | (0.007) |
| $Infl_{m,t-1}^{US}$ | -0.0162 | 0.0019 | 0.0027 | | | |
| | (0.024) | (0.021) | (0.009) | | | |
| $rgPI_{m,t-1}^i$ | -0.0101** | -0.0049 | -0.0006 | -0.0060 | -0.0055 | 0.0005 |
| | (0.004) | (0.004) | (0.002) | (0.006) | (0.005) | (0.002) |
| $rgPI_{m,t-1}^{US}$ | 0.0010 | -0.0025 | -0.0030 | | | |
| | (0.007) | (0.006) | (0.003) | | | |
| Constant | 0.0796*** | 0.0531*** | 0.0138*** | 0.0710*** | 0.0546*** | 0.0092*** |
| | (0.009) | (0.007) | (0.004) | (0.009) | (0.008) | (0.004) |
| N | 2,879 | 2,879 | 2,879 | 2,879 | 2,879 | 2,879 |
| $R^2$ | 0.150 | 0.150 | 0.073 | 0.430 | 0.430 | 0.350 |
| District FE | Yes | Yes | Yes | No | No | No |
| Personal FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Meeting FE | No | No | No | Yes | Yes | Yes |

Table 5: **FOMC meeting attention.** Panel A presents the results of a regression of the number of district mentions in a meeting on whether the district has a vote ("$Vote_m^i$"). The sample period is from 4/20/1976 to 12/13/2017, a total of 365 meetings. For each meeting, there are 12 data points representing the 12 districts, bringing the total N to 4,380 (365×12). We construct seven word samples spoken by various FOMC members in which we search for district keywords: (1) governors and presidents; (2) governors only; (3) chair only; (4) non-chair governors only; (5) presidents only; (6) voting presidents; and (7) non-voting presidents. District mentions for each meeting-district are the word counts for district keywords, and these keywords include local geographical features, federal agencies, universities, (well-known) businesses, and newspapers in that district. All regressions include meeting fixed effects. In Panel B, $TextualSimilarity_m^i$ is the cosine similarity score calculated between speech blocks from all governors in the meeting and those from district $i$'s president during meeting $m$. $SentimentCat_m^i$ is a categorical variable that equals 1 if governor sentiment towards district $i$ is positive, -1 if negative, and 0 otherwise; $Sentiment_m^i$ gives the exact numerical sentiment value. More specifically, governor sentiment towards district $i$ is the text sentiment of all speech blocks that mention this district. Robust standard errors are reported in parentheses. ***, p-value <1%; **, <5%; *, <10%.

**Panel A:** Are voting districts more frequently mentioned in the meeting?

| Dependent variable: | $DistrictMentions_m^i$ | | | | | | |
|---|---|---|---|---|---|---|---|
| Speech sample: | Governors and Presidents | Governors (All) | Governors (Chair) | Governors (Non-Chair) | Presidents (All) | Presidents (Voting) | Presidents (Non-Voting) |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| $Vote_m^i$ | 0.7660*** | 0.3692*** | 0.1515*** | 0.2177*** | 0.3968*** | 1.9702*** | -1.5733*** |
| | (0.128) | (0.049) | (0.032) | (0.031) | (0.107) | (0.074) | (0.076) |
| Constant | 3.4948*** | 0.5745*** | 0.2840*** | 0.2905*** | 2.9203*** | 0.4448*** | 2.4755*** |
| | (0.075) | (0.024) | (0.017) | (0.015) | (0.067) | (0.026) | (0.060) |
| N | 4,380 | 4,380 | 4,380 | 4,380 | 4,380 | 4,380 | 4,380 |
| $R^2$ | 0.22 | 0.15 | 0.13 | 0.16 | 0.26 | 0.31 | 0.26 |
| Meeting FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

**Panel B:** Governor attitude toward voting districts.

| Dependent variable: | $TextSimilarity_m^i$ | $SentimentCat_m^i$ | $Sentiment_m^i$ |
|---|---|---|---|
| | (1) | (2) | (3) |
| $Vote_m^i$ | 0.0918*** | 0.0723*** | 0.0075*** |
| | (0.011) | (0.014) | (0.002) |
| Constant | 0.1830*** | 0.2389*** | 0.0282*** |
| | (0.006) | (0.009) | (0.002) |
| N | 4,380 | 4,380 | 4,380 |
| $R^2$ | 0.16 | 0.16 | 0.13 |
| Meeting FE | Yes | Yes | Yes |

Table 6: **Implications: Monetary policy shocks.** This table presents the regression results of predicting the difference between the actual FFR decision and the proposed FFR decision using recent macro variables for the U.S., voting districts, and non-voting districts. $DTARG$ is the difference between the actual FFR decision and the proposed FFR decision entering the meeting, which is a concept first raised and measured in Romer and Romer (2004). We obtain the 1969-1996 series from Romer and Romer (2004) and the 1997-2007 series from Wieland and Yang (2020) who publish their replication work and extended dataset at https://www.openicpsr.org/openicpsr/project/135741/version/V1/view. The unit of observation is one FOMC meeting. Other variables are defined in Tables A1 and 1 and Section 3. Robust standard errors are reported in parentheses. ***, p-value <1%; **, <5%; *, <10%.

| Dependent variable: | Romer-Romer MP Shocks, $DTARG_m$ | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| $Infl^{US}_{m,t-1}$ | 0.1011 | | 0.1171 | | -0.1237 |
| | (0.091) | | (0.092) | | (0.127) |
| $Infl^{Vote}_{m,t-1}$ | | 0.2431*** | | 0.2415*** | 0.2944*** |
| | | (0.072) | | (0.071) | (0.098) |
| $Infl^{NoVote}_{m,t-1}$ | | -0.0835 | | -0.0695 | |
| | | (0.073) | | (0.074) | |
| $rgPI^{US}_{m,t-1}$ | 0.0644* | 0.0723** | | | 0.0188 |
| | (0.037) | (0.036) | | | (0.053) |
| $rgPI^{Vote}_{m,t-1}$ | | | 0.0702*** | 0.0694*** | 0.0617* |
| | | | (0.023) | (0.023) | (0.034) |
| $rgPI^{NoVote}_{m,t-1}$ | | | 0.0037 | 0.0112 | |
| | | | (0.031) | (0.031) | |
| $FFR_{m-1}$ | -0.0218* | -0.0246** | -0.0215* | -0.0242** | -0.0242** |
| | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) |
| Constant | 0.0512 | 0.0428 | 0.0427 | 0.0353 | 0.0355 |
| | (0.073) | (0.073) | (0.073) | (0.073) | (0.073) |
| N | 373 | 373 | 373 | 373 | 373 |
| $R^2$ | 0.039 | 0.054 | 0.046 | 0.060 | 0.060 |

Table 7: **Implications: the Taylor rule.** This table estimates a variant of a generic Taylor rule (as in Cieslak and Vissing-Jorgensen (2021)) augmented by our voting and non-voting district macro variables. Given that Greenbooks are released to the public with a 5-year delay, our sample period for this analysis ends in 2017. $E_m(Infl_{q1})$ denotes GDP deflator inflation, one quarter ahead (q1). $E_m(gGDP_{q0})$ is the forecast for real GDP growth (current quarter, q0). Other variables are defined in Tables A1 and 1 and Section 3. Robust standard errors are reported in parentheses. ***, p-value <1%; **, <5%; *, <10%.

| Dependent variable: | $\Delta FFR_m$ | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $Infl^{US}_{m,t-1}$ | | 0.2115 | | -0.3529 |
| | | (0.156) | | (0.235) |
| $rgPI^{US}_{m,t-1}$ | | 0.0861 | | 0.0153 |
| | | (0.055) | | (0.071) |
| $E_m(Infl_{q1})$ | 0.0833*** | | 0.0892*** | 0.0898*** |
| | (0.024) | | (0.025) | (0.025) |
| $E_m(gGDP_{q0})$ | 0.0414** | | 0.0298 | 0.0297 |
| | (0.018) | | (0.018) | (0.018) |
| $Infl^{Vote}_{m,t-1}$ | | | 0.2183* | 0.3679** |
| | | | (0.123) | (0.186) |
| $Infl^{NoVote}_{m,t-1}$ | | | -0.1979 | |
| | | | (0.136) | |
| $rgPI^{Vote}_{m,t-1}$ | | | 0.0642 | 0.0577 |
| | | | (0.047) | (0.060) |
| $rgPI^{NoVote}_{m,t-1}$ | | | 0.0087 | |
| | | | (0.041) | |
| $FFR_{m-1}$ | 0.1560 | 0.2099* | 0.1500 | 0.1499 |
| | (0.117) | (0.119) | (0.116) | (0.116) |
| $FFR_{m-2}$ | -0.1816 | -0.1947 | -0.1730 | -0.1726 |
| | (0.185) | (0.191) | (0.185) | (0.184) |
| $FFR_{m-3}$ | -0.0313 | -0.0482 | -0.0386 | -0.0390 |
| | (0.120) | (0.117) | (0.119) | (0.119) |
| Constant | -0.0806 | 0.0635 | -0.0932 | -0.0928 |
| | (0.102) | (0.090) | (0.097) | (0.097) |
| N | 396 | 396 | 396 | 396 |
| $R^2$ | 0.14 | 0.10 | 0.16 | 0.16 |

Table 8: **Implications: Treasury yields.** This table presents the regression results of predicting changes in yields for 10-year maturity Treasury bonds using recent macro variables for the U.S., voting districts, and non-voting districts. Week 0 denotes the week of the FOMC meeting; $\Delta yield_{(-4,h)}$ denotes the yield difference from 4 weeks prior to the meeting to $h$ week, where yield (and hence the level difference) is in units of percent per annum. The unit of observation is the FOMC meeting. Other variables are defined in Tables A1 and 1 and Section 3. Robust standard errors are reported in parentheses. ***, p-value <1%; **, <5%; *, <10%.

| Dependent variable: | $\Delta yield_{(-4,h)}$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Horizon in weeks (-4,$h$) | (-4,-3) | (-4,-2) | (-4,-1) | (-4,0) | (-4,+1) | (-4,+2) | (-4,+3) | (-4,+4) |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A:** Voting and non-Voting measures | | | | | | | | |
| $Infl^{Vote}_{m,t-1}$ | 0.0049 | 0.0465 | 0.1400** | 0.2002*** | 0.2451*** | 0.3034*** | 0.3217*** | 0.3110*** |
| | (0.035) | (0.046) | (0.059) | (0.075) | (0.078) | (0.090) | (0.090) | (0.095) |
| $Infl^{NoVote}_{m,t-1}$ | -0.0215 | -0.0049 | -0.0336 | -0.0075 | 0.0008 | 0.0103 | -0.0360 | -0.0320 |
| | (0.030) | (0.041) | (0.051) | (0.065) | (0.077) | (0.089) | (0.092) | (0.097) |
| $rgPI^{Vote}_{m,t-1}$ | 0.0088 | 0.0190 | 0.0345* | 0.0357* | 0.0402* | 0.0536** | 0.0252 | 0.0443 |
| | (0.010) | (0.015) | (0.018) | (0.021) | (0.024) | (0.027) | (0.029) | (0.032) |
| $rgPI^{NoVote}_{m,t-1}$ | -0.0031 | -0.0099 | -0.0004 | -0.0024 | -0.0153 | -0.0244 | -0.0038 | -0.0059 |
| | (0.010) | (0.015) | (0.018) | (0.022) | (0.025) | (0.028) | (0.030) | (0.034) |
| $FFR_{m-1}$ | 0.0006 | 0.0012 | -0.0025 | -0.0094 | -0.0107 | -0.0133 | -0.0128 | -0.0144 |
| | (0.004) | (0.005) | (0.007) | (0.008) | (0.010) | (0.011) | (0.010) | (0.011) |
| Constant | 0.0170 | -0.0118 | -0.0341 | -0.0357 | -0.0306 | -0.0492 | -0.0368 | -0.0327 |
| | (0.018) | (0.027) | (0.034) | (0.036) | (0.044) | (0.050) | (0.051) | (0.058) |
| N | 414 | 414 | 414 | 414 | 414 | 414 | 414 | 414 |
| $R^2$ | 0.0036 | 0.0078 | 0.022 | 0.028 | 0.032 | 0.040 | 0.032 | 0.028 |
| **Panel B:** Voting and national measures | | | | | | | | |
| $Infl^{Vote}_{m,t-1}$ | 0.0220 | 0.0523 | 0.1679** | 0.2097** | 0.2485** | 0.3007** | 0.3513*** | 0.3389** |
| | (0.049) | (0.064) | (0.082) | (0.100) | (0.107) | (0.121) | (0.122) | (0.132) |
| $Infl^{US}_{m,t-1}$ | -0.0395 | -0.0116 | -0.0631 | -0.0187 | -0.0044 | 0.0109 | -0.0674 | -0.0622 |
| | (0.053) | (0.072) | (0.089) | (0.113) | (0.133) | (0.155) | (0.159) | (0.167) |
| $rgPI^{Vote}_{m,t-1}$ | 0.0109 | 0.0258 | 0.0344 | 0.0369 | 0.0506 | 0.0704* | 0.0275 | 0.0483 |
| | (0.014) | (0.022) | (0.026) | (0.030) | (0.034) | (0.039) | (0.043) | (0.046) |
| $rgPI^{US}_{m,t-1}$ | -0.0051 | -0.0166 | -0.0003 | -0.0035 | -0.0256 | -0.0411 | -0.0061 | -0.0100 |
| | (0.018) | (0.026) | (0.032) | (0.037) | (0.043) | (0.049) | (0.052) | (0.058) |
| $FFR_{m-1}$ | 0.0006 | 0.0012 | -0.0024 | -0.0093 | -0.0106 | -0.0132 | -0.0128 | -0.0143 |
| | (0.004) | (0.005) | (0.007) | (0.008) | (0.009) | (0.011) | (0.010) | (0.011) |
| Constant | 0.0170 | -0.0117 | -0.0340 | -0.0355 | -0.0305 | -0.0491 | -0.0366 | -0.0325 |
| | (0.018) | (0.027) | (0.034) | (0.036) | (0.044) | (0.050) | (0.051) | (0.058) |
| N | 414 | 414 | 414 | 414 | 414 | 414 | 414 | 414 |
| $R^2$ | 0.0037 | 0.0078 | 0.023 | 0.028 | 0.032 | 0.040 | 0.032 | 0.028 |

Table 9: **Implications: Market expectations.** This table presents the regression results of predicting changes in investor expectations using recent macro variables for the U.S., voting districts, and non-voting districts. We consider two dependent variables: in columns (1)-(3), changes in the average implied Federal funds futures rate across various terms; in columns (4)-(6), changes in Fed funds rate expectations from the end of the previous FOMC meeting date to the end of the current meeting date. The unit of observation is the FOMC meeting. Variables are defined in Tables A1 and 1 and Section 3. Appendix IA.5 provides construction details of $\Delta f_m$ and $E_{m+1}(FFR_{m+1}) - E_m(FFR_{m+1})$. We use the largest sample available, 1989-2019 for columns (1)-(3) and 2002-2019 for columns (4)-(6). Robust standard errors are reported in parentheses. ***, p-value <1%; **, <5%; *, <10%.

| Dependent variable: | Changes in average FFF rates $\Delta f_m$ | | | Forecast Revision: $E_{m+1}(FFR_{m+1}) - E_m(FFR_{m+1})$ | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $Infl^{US}_{m,t-1}$ | 0.1771** | | -0.0168 | 0.0816* | | 0.0163 |
| | (0.085) | | (0.133) | (0.048) | | (0.062) |
| $Infl^{Vote}_{m,t-1}$ | | 0.2247*** | 0.2317** | | 0.0768*** | 0.0700* |
| | | (0.078) | (0.107) | | (0.027) | (0.037) |
| $Infl^{NoVote}_{m,t-1}$ | | -0.0098 | | | 0.0095 | |
| | | (0.077) | | | (0.036) | |
| $rgPI^{US}_{m,t-1}$ | 0.0231 | | -0.0429 | 0.0130 | | 0.0338 |
| | (0.021) | | (0.045) | (0.011) | | (0.022) |
| $rgPI^{Vote}_{m,t-1}$ | | 0.0526** | 0.0705* | | -0.0081 | -0.0222 |
| | | (0.025) | (0.040) | | (0.010) | (0.018) |
| $rgPI^{NoVote}_{m,t-1}$ | | -0.0250 | | | 0.0197 | |
| | | (0.026) | | | (0.013) | |
| $FFR_{m-1}$ | -0.0182** | -0.0197** | -0.0197** | -0.0072 | -0.0068 | -0.0068 |
| | (0.009) | (0.008) | (0.008) | (0.005) | (0.005) | (0.005) |
| Constant | -0.0104 | -0.0141 | -0.0141 | -0.0279** | -0.0258** | -0.0258** |
| | (0.036) | (0.036) | (0.036) | (0.012) | (0.012) | (0.012) |
| N | 254 | 254 | 254 | 141 | 141 | 141 |
| $R^2$ | 0.035 | 0.069 | 0.069 | 0.10 | 0.16 | 0.16 |

Table A1: **Summary statistics of meeting-level variables.**

This table presents the summary statistics for the meeting-level variables used for Tables 1, 6, 7, and 9. We denote each meeting with time stamp "$m$" and the most recent (last) macro variable with time stamp "$m, t-1$." $\Delta FFR_m$ is the change in the Federal funds target rate from the last meeting $(m-1)$ to this meeting $(m)$. The unit for $\Delta FFR_m$ is percent per annum. $Infl^{US}_{m,t-1}$ is last month's U.S. inflation rate. $Infl^{Vote}_{m,t-1}$ ($Infl^{NoVote}_{m,t-1}$) is the average last month's inflation rate for districts with voting rights (without voting rights) during meeting $m$. Units are in monthly percent. $rgPI^{US}_{m,t-1}$ is the last quarter's U.S. real personal income (PI) growth. $rgPI^{Vote}_{m,t-1}$ ($rgPI^{NoVote}_{m,t-1}$) is the average last quarter's real PI growth for districts with voting rights (without voting rights) during meeting $m$. Units are in quarterly percent. Panel A considers 1969-2019. Panel B considers 1969-2019, excluding the zero lower bound (ZLB) period. Section 3 and Internet Appendix Sections IA.1 and IA.2 provide more details about the data and constructions of variables presented in Panels A and B. Panel C reports the summary statistics for the other aggregate variables in the meeting-level analysis. $DTARG$ is the Romer and Romer (2004) monetary policy shock, capturing the difference between the intended or proposed Federal funds target rate and the actual one as the meeting outcome. Romer and Romer (2004)'s original dataset ends in 1996; we then use published work and data by Wieland and Yang (2020) to obtain an extended series through the end of 2007. $\Delta f_m$ is the change in the average implied rates from Federal funds futures contracts. $E_{m+1}(FFR_{m+1}) - E_m(FFR_{m+1})$ is the change in Fed funds rate expectations from the end of the previous FOMC meeting date to the end of the current meeting date. Specifically, it is constructed as the current month's Fed funds futures (FFF) rate on the last day of a FOMC meeting minus the 1m/2m/3m FFF rate on the day after the previous meeting, where 1m/2m/3m uses the closest meeting gaps. Internet Appendix IA.5 provides more details about the data. Units of all three variables are percent per annum.

| Symbol, Variable | Mean (1) | SD (2) | Min (3) | Max (4) | 5th (5) | 25th (6) | 50th (7) | 75th (8) | 95th (9) |
|---|---|---|---|---|---|---|---|---|---|
| ***Panel A:*** *Sample 1969-2019 (N = 472)* | | | | | | | | | |
| $\Delta FFR_m$, FF Target Rate Change from $m-1$ to $m$ | -0.01 | 0.64 | -4.00 | 4.13 | -0.75 | -0.13 | 0.00 | 0.19 | 0.69 |
| $Infl^{US}_{m,t-1}$, Inflation, US | 0.36 | 0.34 | -1.77 | 1.81 | -0.08 | 0.18 | 0.30 | 0.52 | 1.00 |
| $Infl^{Vote}_{m,t-1}$, Inflation, Voting District Average | 0.35 | 0.36 | -1.42 | 1.54 | -0.18 | 0.14 | 0.32 | 0.54 | 0.99 |
| $Infl^{NoVote}_{m,t-1}$, Inflation, Non-voting District Average | 0.37 | 0.39 | -2.02 | 2.08 | -0.19 | 0.14 | 0.32 | 0.57 | 1.06 |
| $rgPI^{US}_{m,t-1}$, Real PI Growth, US | 0.62 | 0.92 | -2.77 | 3.88 | -0.85 | 0.24 | 0.67 | 1.18 | 1.88 |
| $rgPI^{Vote}_{m,t-1}$, Real PI Growth, Voting District Average | 0.56 | 0.97 | -3.30 | 3.80 | -1.07 | 0.04 | 0.62 | 1.09 | 1.91 |
| $rgPI^{NoVote}_{m,t-1}$, Real PI Growth, Non-voting District Average | 0.66 | 1.07 | -3.01 | 4.39 | -1.21 | 0.06 | 0.75 | 1.34 | 2.36 |
| ***Panel B:*** *Sample 1969-2019, excluding the ZLB period (N = 415)* | | | | | | | | | |
| $\Delta FFR_m$, FF Target Rate Change from $m-1$ to $m$ | -0.01 | 0.68 | -4.00 | 4.13 | -0.75 | -0.25 | 0.00 | 0.25 | 0.75 |
| $Infl^{US}_{m,t-1}$, Inflation, US | 0.40 | 0.32 | -0.55 | 1.81 | 0.00 | 0.19 | 0.33 | 0.53 | 1.02 |
| $Infl^{Vote}_{m,t-1}$, Inflation, Voting District Average | 0.38 | 0.34 | -0.49 | 1.54 | -0.14 | 0.17 | 0.35 | 0.57 | 1.02 |
| $Infl^{NoVote}_{m,t-1}$, Inflation, Non-voting District Average | 0.40 | 0.37 | -0.62 | 2.08 | -0.14 | 0.16 | 0.35 | 0.59 | 1.09 |
| $rgPI^{US}_{m,t-1}$, Real PI Growth, US | 0.65 | 0.85 | -2.14 | 3.88 | -0.75 | 0.27 | 0.69 | 1.17 | 1.83 |
| $rgPI^{Vote}_{m,t-1}$, Real PI Growth, Voting District Average | 0.57 | 0.89 | -2.32 | 3.80 | -1.05 | 0.02 | 0.61 | 1.10 | 1.88 |
| $rgPI^{NoVote}_{m,t-1}$, Real PI Growth, Non-voting District Average | 0.70 | 1.01 | -3.01 | 4.39 | -0.82 | 0.13 | 0.75 | 1.34 | 2.40 |
| ***Panel C:*** *Other meeting-level dependent variables* | | | | | | | | | |
| $DTARG$, Romer and Romer (2004) Monetary Policy Shock, 1969-2007 | -0.01 | 0.43 | -3.88 | 3.00 | -0.63 | -0.06 | 0.00 | 0.13 | 0.50 |
| $\Delta f_m$, FF Futures Change from $m-1$ to $m$, 1989-2019 | -0.02 | 0.32 | -2.13 | 1.03 | -0.61 | -0.15 | 0.00 | 0.14 | 0.48 |
| $E_{m+1}(FFR_{m+1}) - E_m(FFR_{m+1})$, Forecast revision, 2002-2019 | -0.02 | 0.09 | -0.49 | 0.24 | -0.19 | -0.03 | -0.00 | 0.01 | 0.10 |

Table A2: **Summary statistics for panel variables.**

This table presents the summary statistics for the panel variables used for Tables 4 and 5. Both panels use the longest sample. Panel A presents summary statistics for the panel variables in Table 4, where data are organized at the meeting-voting president level. $Dissent^i_m$ equals one if voting participant $i$ dissented in meeting $m$. $Tighter^i_m$ ($Easier^i_m$) equals one if voting participant $i$ dissented and proposed a tighter (easier) policy in meeting $m$ and zero otherwise. Panel B presents summary statistics for the panel variables in Table 5, where data are organized at the meeting-district level. Given that transcripts have a 5-year delay, the longest transcript sample we can obtain is from 4/20/1976 to 12/13/2017, a total of 365 meetings. For each meeting, there are 12 data points representing the 12 districts, bringing the total N to 4,380 (365×12). $DistrictMentions^i_m$ denotes the word counts of district $i$'s keywords (geographical features, federal banks, local businesses, universities, newspapers) during meeting $m$. Note that a transcript consists of words spoken by governors, words spoken by district presidents, and words spoken by others (staff). We focus on word samples from the first two groups, and construct $DistrictMentions^i_m$ measures of interest. Then, we construct three variables that capture governors' attitudes towards a district president. $TextualSimilarity^i_m$ is the cosine similarity score calculated between speech blocks from all governors and those from district $i$'s president during meeting $m$. $SentimentCat^i_m$ is a categorical variable that equals 1 if governor sentiment towards district $i$ is positive, -1 if negative, and 0 otherwise; $Sentiment^i_m$ gives the exact numerical sentiment value. More specifically, governor sentiment towards district $i$ is the text sentiment of all speech blocks that mention this district. $Vote^i_m$ equals one if district $i$ has voting rights during meeting $m$.

| Symbol, Variable | Mean<br>(1) | SD<br>(2) | Min<br>(3) | Max<br>(4) | 5th<br>(5) | 25th<br>(6) | 50th<br>(7) | 75th<br>(8) | 95th<br>(9) |
|---|---|---|---|---|---|---|---|---|---|
| ***Panel A:*** *Dissent regression sample at the Meeting-Voting President level (N = 2,883)* | | | | | | | | | |
| $Dissent^i_m$, Dummy: Dissent=1 | 0.08 | 0.27 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| $Tighter^i_m$, Dummy: Dissent and propose a tighter policy=1 | 0.06 | 0.23 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| $Easier^i_m$, Dummy: Dissent and propose an easier policy=1 | 0.01 | 0.11 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| ***Panel B:*** *Textual analysis sample at the Meeting-District level (N = 4,380)* | | | | | | | | | |
| $DistrictMentions^i_m$, District mentions, Governors and Presidents | 3.81 | 4.41 | 0 | 40 | 0 | 1 | 2 | 5 | 13 |
| $DistrictMentions^i_m$, District mentions, Governors | 0.73 | 1.56 | 0 | 23 | 0 | 0 | 0 | 1 | 4 |
| $DistrictMentions^i_m$, District mentions, Governors-Chair | 0.35 | 1.03 | 0 | 18 | 0 | 0 | 0 | 0 | 2 |
| $DistrictMentions^i_m$, District mentions, Governors-Non-Chair | 0.38 | 0.99 | 0 | 16 | 0 | 0 | 0 | 0 | 2 |
| $DistrictMentions^i_m$, District mentions, Presidents | 3.09 | 3.85 | 0 | 35 | 0 | 0 | 2 | 4 | 10 |
| $DistrictMentions^i_m$, District mentions, Voting Presidents | 1.26 | 2.48 | 0 | 30 | 0 | 0 | 0 | 1 | 6 |
| $DistrictMentions^i_m$, District mentions, Non-voting Presidents | 1.82 | 2.95 | -7 | 30 | 0 | 0 | 1 | 2 | 8 |
| $TextualSimilarity^i_m$, Governor speech similarity with District | 0.22 | 0.36 | 0.00 | 0.96 | 0.00 | 0.00 | 0.00 | 0.52 | 0.90 |
| $SentimentCat^i_m$, Category: =1 if Sentiment $>$ 0, =-1 if Sentiment $<$ 0, 0 otherwise | 0.27 | 0.48 | -1 | 1 | 0 | 0 | 0 | 1 | 1 |
| $Sentiment^i_m$, Governor sentiment towards District | 0.03 | 0.08 | -1.00 | 0.70 | 0.00 | 0.00 | 0.00 | 0.05 | 0.15 |
| $Vote^i_m$, Dummy: Voting=1 | 0.42 | 0.49 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |

Table A3: **Correlations of macro variables.**

This table presents several correlation results, all at the meeting level. Panels A and B present correlation matrices of U.S., voting, and non-voting district macro variables that enter our main specification. As mentioned in Table A1, "$Infl$" indicates inflation rates and "$rgPI$" indicates real PI growth. See detailed variable constructions in Appendix IA. A superscript "$US$" indicates that it is the U.S. aggregate value. A superscript "$Vote$" ("$NoVote$") indicates the average of voting districts' (non-voting districts') macro variables. See other notation details in Table A1. Panel A uses the 1969-2019 sample, and Panel B excludes the ZLB period.

| ***Panel A:*** *Sample 1969-2019 (N = 472)* | | | | | | |
|---|---|---|---|---|---|---|
| | $Infl^{US}_{m,t-1}$ | $Infl^{Vote}_{m,t-1}$ | $Infl^{NoVote}_{m,t-1}$ | $rgPI^{US}_{m,t-1}$ | $rgPI^{Vote}_{m,t-1}$ | $rgPI^{NoVote}_{m,t-1}$ |
| $Infl^{US}_{m,t-1}$ | 1 | | | | | |
| $Infl^{Vote}_{m,t-1}$ | 0.852*** | 1 | | | | |
| $Infl^{NoVote}_{m,t-1}$ | 0.937*** | 0.616*** | 1 | | | |
| $rgPI^{US}_{m,t-1}$ | -0.033 | -0.063 | -0.008 | 1 | | |
| $rgPI^{Vote}_{m,t-1}$ | -0.122*** | -0.148*** | -0.085* | 0.833*** | 1 | |
| $rgPI^{NoVote}_{m,t-1}$ | 0.030 | 0.003 | 0.043 | 0.934*** | 0.581*** | 1 |
| ***Panel B:*** *Sample 1969-2019, excluding the ZLB period (N = 415)* | | | | | | |
| | $Infl^{US}_{m,t-1}$ | $Infl^{Vote}_{m,t-1}$ | $Infl^{NoVote}_{m,t-1}$ | $rgPI^{US}_{m,t-1}$ | $rgPI^{Vote}_{m,t-1}$ | $rgPI^{NoVote}_{m,t-1}$ |
| $Infl^{US}_{m,t-1}$ | 1 | | | | | |
| $Infl^{Vote}_{m,t-1}$ | 0.843*** | 1 | | | | |
| $Infl^{NoVote}_{m,t-1}$ | 0.935*** | 0.599*** | 1 | | | |
| $rgPI^{US}_{m,t-1}$ | -0.116** | -0.133*** | -0.084* | 1 | | |
| $rgPI^{Vote}_{m,t-1}$ | -0.196*** | -0.194*** | -0.165*** | 0.804*** | 1 | |
| $rgPI^{NoVote}_{m,t-1}$ | -0.042 | -0.069 | -0.017 | 0.927*** | 0.523*** | 1 |

# Internet Appendices for "Do the Voting Rights of Federal Reserve Bank Presidents Matter?"

## IA. Data Appendix

This appendix section complements and provides more details on the material covered in Section 3.

### IA.1. Local Inflation Measure

**Sources.** We first investigate Reserve Banks' websites and data archives, and find no readily-available inflation rate or CPI time-series data for any of the 12 districts that are long enough for our research. Next we turn to the Bureau of Labor Statistics (BLS); while the CPI is not reported for each state, the BLS reports "metropolitan statistical area" (MSA) CPI data for all urban consumers. Table IA.1 in this section summarizes (1) state coverage as defined in each district – note that district boundaries do not always fall along state lines; (2) area CPI data from the BLS that are closely related to each state; (3) time-series coverage in terms of longitude and frequency. Our objective is to obtain an inflation measure for each district from a directly-reliable and easily-accessible source that has a long sample for all districts. MSA-based measures suit these criteria for our research. Specifically, we can find CPI data for at least one valid metropolitan statistical area that has a long sample for each district. We also prefer areas with as much monthly data as possible, given that the FOMC meets monthly or bimonthly, and as a result, annual inflation data are not useful for identification. For those districts with multiple metropolitan statistical areas, we primarily consider the area where the Head Office of the Federal Reserve Bank is located; this area also typically has the longest historical sample among these areas in the same district. If the MSA of the Head Office does not have a sample that is long or high-frequency enough, we use the next best MSA data in this district based on population data (`https://en.wikipedia.org/wiki/Metropolitan_statistical_area`).

The colored lines in Table IA.1 indicate our best choice for each district. Using their best choices, there are four districts with a long series of annual or (smoothed) semi-annual data: Atlanta (1987-1997), St Louis (1998-2017), Minneapolis (1987-2017), and Kansas City (1987-2017). Other districts have consecutive CPI data at monthly, bimonthly, or quarterly frequency for us to use to construct inflation data.

**Inflation construction.** The frequency of CPI data available for each district may be different: monthly, bimonthly, or quarterly. Given our research objective, we aim to construct monthly inflation. To achieve this, we address the data differently depending on its available frequency. For monthly CPI series, monthly inflation is the percentage change in CPI. For other frequencies, we compute the percentage change between two consecutive CPI numbers, divide the percentage change by the number of months in the gap, and then backfill. For instance, if data available at a bimonthly frequency has a percentage change between March and May CPI values of 0.4%, we will fill April and May inflation rates with values of 0.2%.

For the four districts with long periods of low-frequency data (i.e., Atlanta (1987-1997), St Louis (1998-2017), Minneapolis (1987-2017), and Kansas City (1987-2017), as mentioned above), we do not fill the missing months during these long gaps. Instead, we categorize these periods as missing because we cannot assume "true" high-frequency dynamics in their macro fundamentals with confidence. For example, when Atlanta is represented (voting) in an FOMC meeting but its inflation data is missing, the voting district average inflation rates prior to the meeting (as denoted by $Infl_{m,t-1}^{Vote}$) use the other four out of five districts with votes. This way, we do not introduce measurement uncertainty. Monthly aggregate U.S. CPI data for all urban consumers is available from January 1947 (source: FRED).

We conduct a wide range of robustness tests using population weighted averages (see Table 2 in the paper), alternative horizons (see Table 2), and alternative inflation measures in close cases, such as the San Francisco District and the Dallas District (see Table IB.5 at the end of this appendix).

Table IA.1: **Availability of CPI data for all urban consumers from the Bureau of Labor Statistics (BLS).**

| District | State coverage | Best Area Data (BLS) | Coverage | |
|---|---|---|---|---|
| **01-Boston** | Maine | No | | |
| | Massachusetts | Boston-Cambridge-Newton | 1914-2022 | 1914-1940: Annual<br>1941-1952: Month<br>1953-1977: Quarter<br>1978-2022: Every other month |
| | | Boston-Brockton-Nashua | 2008-2012 | Annual |
| | New Hampshire | Boston-Brockton-Nashua | 2008-2012 | Annual |
| | Rhode Island | No | | |
| | Vermont | No | | |
| | Connecticut | No | | |
| **02-New York** | New Jersey (northern) | Philadelphia-Camden-Wilmington | 1914-2022 | 1914-1940: Annual<br>1941-1997: Month<br>1998-2022: Every other month |
| | | New York-Newark-Jersey City | 1914-2022 | 1914-1940: Annual<br>1941-2022: Month |
| | Connecticut (Fairfield County) | No | | |
| **03-Philadelphia** | Delaware | Philadelphia-Camden-Wilmington | 1914-2022 | 1914-1940: Annual<br>1941-1997: Month<br>1998-2022: Every other month |
| | New Jersey (Southern) | Philadelphia-Camden-Wilmington | 1914-2022 | 1914-1940: Annual<br>1941-1997: Month<br>1998-2022: Every other month |
| | Pennsylvania (Eastern) | Philadelphia-Camden-Wilmington | 1914-2022 | 1914-1940: Annual<br>1941-1997: Month<br>1998-2022: Every other month |
| **04-Cleveland** | Midwest urban | | 1966-2022 | 1966-1977: Quarter<br>1978-1986: Every other month<br>1987-2022: Month |
| | Kentucky (Eastern) | Cincinnati-Hamilton | 2016-2017 | Semi-Annual |
| | Ohio | Cincinnati-Hamilton | 2016-2018 | Semi-Annual |
| | | Cleveland-Akron | 2017 | Month |
| | Pennsylvania (Western) | Pittsburg | 1984-2017 | 1984-1997: Every other month<br>1998-2017: Annual |
| | West Virginia (Northern Panhandle) | No | | |
| **05-Richmond** | Maryland | Baltimore-Columbia-Towson | 1914-2022 | 1914-1940: Annual<br>1941-1947: Month<br>1948-1977: Quarter<br>1978-2022: Every other month |
| | | Washington-Arlington-Alexandria | 1914-2022 | 1914-1941: Annual<br>1942-1947: Month<br>1948-1977: Quarter<br>1978-2022: Every other month |
| | | Philadelphia-Camden-Wilmington | 1914-2022 | 1914-1940: Annual<br>1941-1997: Month<br>1998-2022: Every other month |
| | North Carolina | No | | |
| | South Carolina | No | | |
| | Virginia | Washington-Arlington-Alexandria | 1914-2022 | 1914-1941: Annual<br>1942-1947: Month<br>1948-1977: Quarter<br>1978-2022: Every other month |
| **06-Atlanta** | Alabama | No | | |
| | Florida | Miami-Fort Lauderdale-West Palm Beach | 1977-2022 | Every other month |
| | | Tampa-St. Petersburg-Clearwater | 2017-2022 | Every other month |
| | Georgia | Atlanta-Sandy Springs-Roswell | 1917-2022 | 1917-1934: Annual<br>1935-1977: Quarter<br>1978-1986: Every other month<br>1987-1997: Annual<br>1998-2022: Every other month |
| | Louisiana (Southern), | No | | |
| | Mississippi (Southern) | No | | |
| | Tennessee (Eastern Two-Thirds) | No | | |

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| District | State coverage | Best Area Data (BLS) | Coverage | |
|---|---|---|---|---|
| **07-Chicago** | Illinois (Northern) | Chicago-Naperville-Elgin | 1914-2022 | 1914-1934: Annual<br>1935-1940: Quarter<br>1941-2022: Month |
| | | St. Louis | 1917-2022 | 1917-1934: Annual<br>1935-1940: Quarter<br>1941-1947: Month<br>1948-1977: Quarter<br>1978-1997: Every other month<br>1998-2017: Annual<br>2018-2022: Quarter |
| | Indiana (Northern) | Chicago-Naperville-Elgin | 1914-2022 | 1914-1934: Annual<br>1935-1940: Quarter<br>1941-2022: Month |
| | Iowa | Midwest urban | 1966-2022 | 1966-1977: Quarter<br>1978-1986: Every other month<br>1987-2022: Month |
| | Michigan | Detroit-Warren-Dearborn | 1914-2022 | 1914-1934: Annual<br>1935-1940: Quarter<br>1941-1986: Month<br>1987-2022: Every other month |
| | Wisconsin (Southern) | Milwaukee-Racine | 2016-2017 | Semi-Annual |
| | | Minneapolis-St. Paul-Bloomington | 1917-2022 | 1917-1934: Annual<br>1935-1940: Quarter<br>1941-1947: Month<br>1948-1986: Quarter<br>1987-2017: Annual<br>2018-2022: Every other month |
| | | Chicago-Naperville-Elgin | 1914-2022 | 1914-1934: Annual<br>1935-1940: Quarter<br>1941-2022: Month |
| **08-St. Louis** | Arkansas | No | | |
| | Illinois (Southern) | No | | |
| | Indiana (Southern) | No | | |
| | Kentucky (Western) | Cincinnati-Hamilton | 2016-2017 | Semi-Annual |
| | Mississippi (Northern) | No | | |
| | Missouri (Eastern) | St. Louis | 1917-2022 | 1917-1934: Annual<br>1935-1940: Quarter<br>1941-1947: Month<br>1948-1977: Quarter<br>1978-1997: Every other month<br>1998-2017: Annual<br>2018-2022: Quarter |
| | Tennessee (Western One-Third) | No | | |
| **09-Minneapolis** | Michigan (Upper Peninsula) | No | | |
| | Minnesota | Minneapolis-St. Paul-Bloomington | 1917-2022 | 1917-1934: Annual<br>1935-1940: Quarter<br>1941-1947: Month<br>1948-1986: Quarter<br>1987-2017: Annual<br>2018-2022: Every other month |
| | Montana | No | | |
| | North Dakota; South Dakota | No | | |
| | Wisconsin (Northern) | No | | |
| **10-Kansas City** | Colorado | Denver-Aurora-Lakewood | 1964-2022 | 1964-1977: Quarter<br>1978-1986: Every other month<br>1987-2017: Annual<br>2018-2022: Every other month |
| | Kansas | Kansas City | 2014-2017 | Semi-Annual |
| | Missouri (Western) | Kansas City | 2014-2017 | Semi-Annual |
| | Nebraska | No | | |
| | New Mexico (Northern) | No | | |
| | Oklahoma | No | | |
| | Wyoming | No | | |

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| District | State coverage | Best Area Data (BLS) | Coverage | |
|---|---|---|---|---|
| **11-Dallas** | Louisiana (Northern) | No | | |
| | New Mexico (Southern) | No | | |
| | Texas | Houston-The Woodlands-Sugar Land | 1914-2022 | 1914-1940: Annual<br>1941-1952: Month<br>1953-1977: Quarter<br>1978-2022: Every other month |
| | | Dallas-Fort Worth-Arlington | 1963-2022 | 1963-1977: Quarter<br>1978-2022: Every other month |
| **12-San Francisco** | Alaska | Urban Alaska | 1960-2022 | 1960-1968: Annual<br>1969-1977: Quarter<br>1978-1986: Every other month<br>1987-2017: Annual<br>2018-2021: Every other month |
| | Arizona | Phoenix-Mesa-Scottsdale | 1914-2022 | 1914-1940: Annual<br>1941-1997: Month<br>1998-2022: Every other month |
| | California | Los Angeles-Long Beach-Anaheim | 1914-2022 | 1914-1940: Annual<br>1941-2022: Month |
| | | San Francisco-Oakland-Hayward | 1914-2022 | 1914-1940: Annual<br>1941-1947: Month<br>1948-1977: Quarter<br>1978-1986: Every other month<br>1987-1997: Month<br>1998-2022: Every other month |
| | | San Diego-Carlsbad | 1965-2022 | 1965-1977: Quarter<br>1978-1986: Every other month<br>1987-2017: Annual<br>2018-2022: Every other month |
| | | Riverside-San Bernardino-Ontario | 2017-2022 | Every other month |
| | Hawaii | Urban Hawaii | 1963-2022 | 1963-1977: Quarter<br>1978-1986: Every other month<br>1987-2017: Annual<br>2018-2022: Every other month |
| | Oregon | Portland | 2012-2017 | Semi-Annual |
| | Washington | Seattle-Tacoma-Bellevue | 1914-2022 | 1914-1934: Annual<br>1935-1940: Quarter<br>1941-1947: Month<br>1948-1977: Quarter<br>1978-1986: Every other month<br>1987-1997: Annual<br>1998-2022: Every other month |
| | Idaho; Nevada; Utah | No | | |

## IA.2. Local Real Growth Proxy

**Sources.** We first explore Reserve Banks' websites and the BEA to search for granular-level GDP data available in long samples and non-annual frequency. The BEA indeed produces MSA-level or state-level GDP data (http://www.bea.gov/newsreleases/regional/gdp_state/qgsp_newsrelease.htm); however, the earliest downloadable granular-level GDP data, both nominal and real, starts in 2001, which can be confirmed at this website https://apps.bea.gov/regional/downloadzip.cfm or from FRED.

We aim to obtain time series that are as long as possible, and therefore we use the other proxy for economic growth: personal income (PI). According to the BEA,[IA.2] data for quarterly personal income by state (seasonally adjusted) start as early as 1948 for some states and 1958 for others. The United States Regional Economic Analysis Project (US-REAP), https://united-states.reaproject.org/data-tables/quarterly-earnings-sq5/, also uses this personal income data source for regional economic growth analysis. The state-quarterly personal income datasets downloaded from both the BEA and REAP websites on personal income give the same numbers.

**Real growth construction.** This state-quarterly personal income (PI) dataset is fully balanced starting from 1958.[IA.3] We first obtain the state-quarterly PI growth rates, and use the main state value as our main PI growth measure for each district. The only exception is for the Federal Reserve Bank of Kansas City, where we use the state of Kansas as the proxy, mainly to differentiate it from Missouri's St Louis Fed. Table IA.2 shows the exact state composition in each district, and "*" indicates the main state choice. The real PI growth rates are then calculated by subtracting the corresponding district's inflation rates at the quarterly frequency (see above for the construction of district-level inflation rates).

We conduct a wide range of robustness tests using a population weighted average for all states covered in the district, a population weighted average for all non-overlapping states covered in the district, and an equal-weighted average (see Table 3 in the paper).

[IA.2] See https://apps.bea.gov/regional/downloadzip.cfm, zip folder "Personal Income by State," Table "SQINC1__ALL_AREAS_1948_2022.csv," rows "Personal income."

[IA.3] This is why our data collection efforts for FOMC meetings (see Section IA.4 later in this appendix) also start in 1958.

Table IA.2: **State growth rates used to calculate district growth rates.**
Gray indicates a state that is covered in two districts, and * indicates the main state choice.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Boston** | Connecticut | Maine | Massachusetts* | New Hampshire | Rhode Island | Vermont | | | |
| 2 | **New York** | New York* | Connecticut | New Jersey | | | | | | |
| 3 | **Philadelphia** | Delaware | New Jersey | Pennsylvania* | | | | | | |
| 4 | **Cleveland** | Kentucky | Ohio* | Pennsylvania | West Virginia | | | | | |
| 5 | **Richmond** | Maryland | North Carolina | South Carolina | Virginia* | West Virginia | | | | |
| 6 | **Atlanta** | Alabama | Florida | Georgia* | Louisiana | Mississippi | Tennessee | | | |
| 7 | **Chicago** | Illinois* | Indiana | Iowa | Michigan | Wisconsin | | | | |
| 8 | **St Louis** | Arkansas | Illinois | Indiana | Kentucky | Missouri* | Mississippi | Tennessee | | |
| 9 | **Minneapolis** | Michigan | Minnesota* | Montana | North Dakota | South Dakota | Wisconsin | | | |
| 10 | **Kansas** | Colorado | Kansas* | Missouri | Nebraska | New Mexico | Oklahoma | Wyoming | | |
| 11 | **Dallas** | Louisiana | New Mexico | Texas* | | | | | | |
| 12 | **San Francisco** | Alaska | Arizona | California* | Hawaii | Idaho | Nevada | Oregon | Utah | Washington |

## IA.3. Alternative Macro Variables

We also construct and examine an array of alternative inflation and real PI growth variables using different granular-level data sources, horizons, and frequencies. The performances of these alternative macro variables in our main specifications are shown in Table 2 and Table 3, whereas here we explain their construction details.

It is noteworthy that there is a large literature discussing differences among various U.S. / aggregate level inflation or real growth variables. However, in this paper, we focus on cross-district variation, and the data sources for granular-level macro variables that cover a long period of time are not ample. From our exhaustive search effort, we obtain the following two alternative data sources – one for inflation and one for growth. We carefully consider if and how these sources would be suitable to construct voting and non-voting macro variables to be used in our paper:

1. State-quarter-level YoY inflation rates from Hazell, Herreño, Nakamura, and Steinsson (2022).

2. County-quarter-level wage data from the Quarterly Census of Employment and Wages (QCEW) database.

Besides different data sources, we also construct alternative macro variables using our current data sources (i.e., BLS's MSA-based inflation and BEA's real personal income growth) but varying in terms of weighting schemes, horizons, and frequencies. At the end of this section, we also discuss unemployment rates.

**i. Understanding Hazell, Herreño, Nakamura, and Steinsson (2022)'s inflation data.** Hazell et al. (2022)'s data can be obtained from `https://eml.berkeley.edu/~enakamura/papers/statecpi_beta.csv` or other authors' websites. As mentioned before, the original Hazell et al. (2022) dataset is at the state-quarter-level and reports YoY (annual) inflation rates for the non-tradable sector, the tradable sector, and all sectors; this database does not include shelter. We focus on "all," denoted as "pi" in their dataset. The dataset covers 33 states and the District of Columbia, and below is a full summary of state coverage and data availability:

| | State | Start | Until | |
|---|---|---|---|---|
| 1 | Alabama | 1989 | 2017 | |
| 2 | Alaska | 1978 | 2017 | no 1987,1988 |
| 3 | Arkansas | 1989 | 2017 | |
| 4 | California | 1978 | 2017 | no 1987,1988 |
| 5 | Colorado | 1989 | 2017 | |
| 6 | Connecticut | 1989 | 2017 | |
| 7 | District of Columbia | 1978 | 2017 | no 1987,1988 |
| 8 | Florida | 1978 | 2017 | no 1987,1988 |
| 9 | Georgia | 1978 | 2017 | no 1987,1988 |
| 10 | Hawaii | 1978 | 2017 | no 1987,1988 |
| 11 | Illinois | 1978 | 2017 | no 1987,1988 |
| 12 | Indiana | 1989 | 2017 | |
| 13 | Kansas | 1989 | 2017 | |
| 14 | Louisiana | 1989 | 2017 | |
| 15 | Maryland | 1978 | 2017 | no 1987,1988 |
| 16 | Massachusetts | 1978 | 2017 | no 1987,1988 |
| 17 | Michigan | 1978 | 2017 | no 1987,1988 |
| 18 | Minnesota | 1978 | 2017 | no 1987,1988 |
| 19 | Mississippi | 1989 | 2017 | |
| 20 | Missouri | 1978 | 2017 | no 1987,1988 |
| 21 | New Jersey | 1978 | 2017 | no 1987,1988 |
| 22 | New York | 1978 | 2017 | no 1987,1988 |
| 23 | North Carolina | 1989 | 2017 | |
| 24 | Ohio | 1978 | 2017 | no 1987,1988 |
| 25 | Oklahoma | 1989 | 2017 | |
| 26 | Oregon | 1978 | 2017 | no 1987,1988 |
| 27 | Pennsylvania | 1978 | 2017 | no 1987,1988 |
| 28 | South Carolina | 1989 | 2017 | |
| 29 | Tennessee | 1978 | 2017 | no 1987,1988 |
| 30 | Texas | 1978 | 2017 | no 1987,1988 |
| 31 | Utah | 1989 | 2017 | |
| 32 | Virginia | 1989 | 2017 | |
| 33 | Washington | 1978 | 2017 | no 1987,1988 |
| 34 | Wisconsin | 1978 | 2017 | no 1987,1988 |

**ii. Evaluating Hazell et al. (2022)'s inflation data as an alternative variable in our research.** Overall, their measure is suitable for our particular research exercise, given its equally strong cross-section coverage. It also has several drawbacks. First, 40% of the state-level data starts in 1989, which is a much shorter sample than what MSA-based measures cover. Second, as our research focuses on meeting-level frequency (every 6-8 weeks or less in the earlier sample), the YoY frequency could introduce weaker variations in local macro variables, and hence are not ideal to capture the full effect.

While the first drawback is due to data limitations, we try to work on the second drawback. We produce two quarterly QoQ inflation measures using the given quarterly YoY values from Hazell, Herreño, Nakamura, and Steinsson (2022) for each state. We denote the implied QoQ total inflation at the end of quarter $q$ as $\Pi_{q,q-1}$. To initiate the series, we assume that, for all $q \leq 6$ ($\Pi_{1,0}$, $\Pi_{2,1}$, $\Pi_{3,2}$, $\Pi_{4,3}$, $\Pi_{5,4}$ and $\Pi_{6,5}$), $\Pi_{q,q-1}$ is equal to the average of the first six quarterly YoY inflation of the series divided by

4 (in order convert back to quarterly frequency). Next we denote the given YoY total inflation at the end of quarter $q$ $(q-1)$ as $\Pi_{q,q-4}$ $(\Pi_{q-1,q-5})$. The QoQ inflation at the end of quarter $q$ is $\Pi_{q,q-1}$, which can be written as $\frac{\Pi_{q,q-4}}{\Pi_{q,q-4}} \times \Pi_{q-4,q-5}$, where $\Pi_{q-4,q-5}$ is quarterly inflation computed from a previous data point. The rest of the series can be computed iteratively. Finally, given the implied state-quarterly inflation rates, we create two district-quarterly inflation rates using its main state measure and using a population-weighted average for all states within the district.

Summary statistics for these two variables are reported in Panel A of Internet Appendix Table IA.4 below. Correlations are reported in Panel A of Internet Appendix Table IA.5. Their performance in our main specification is reported in Table 2, columns (5) and (6). We are happy to share our quarterly series implied from Hazell et al. (2022) with future researchers.

Next, we evaluate the quarterly measure's correlation with the Greenbook inflation forecast. The reason is that we use recent past district-level inflation in our main specification to explain changes in the FFR, with the premise that recent past district-level inflation rates should be quite informative about expected future inflation and hence enter the forecasts. As a result, one statistical way to evaluate the informativeness of our measure and that of Hazell et al. (2022) – both converted into quarterly QoQ measures – is to calculate their correlations with the Greenbook forecast $E_m(Infl_{q1})$ (governors' forecast of one-quarter-ahead inflation). All correlations are calculated at the meeting level, using the longest sample.[IA.4] We find that in general, correlations are slightly higher using our measure, but not by much. Results are robust to considering the sample period without the ZLB period, where they are, if anything, a little stronger.

| Series (1): | Series (2): | Full sample: | No ZLB: |
|---|---|---|---|
| Greenbook, $E_m(Infl_{q1})$ | Last QoQ US inflation | 0.7965 | 0.8201 |
| Greenbook, $E_m(Infl_{q1})$ | Hazell et al. (2022), Last QoQ US inflation | 0.7351 | 0.7708 |
| Hazell et al. (2022), Last QoQ US inflation | Last QoQ US inflation | 0.8558 | 0.8337 |

***Note:*** *All correlations above are statistically significant at the 1% level.*

**iii. Understanding QCEW's wage data.** The Quarterly Census of Employment and Wages (QCEW) database provides the total wage dollar amount (non-seasonally adjusted) for each county during each quarter from 1975 to 2022 (as of our last download, which was May 20, 2023). The database is as large as 13 GB, and there are around 3,100 unique counties. Therefore, one obvious advantage of QCEW's wage data is that we can precisely create district-level total wages (and hence growth rates) given the shape files; one drawback is that wage data is not highly correlated with personal income or productivity growth, both conceptually and empirically; in addition, we need to deal with the strong seasonality in wages.

To give this measure the best chance, we first verify that 99.7% of the counties included in Fed districts can be found in the QCEW database, except for the San Francisco district, which only overlaps at 97.2%. Next, while QCEW does not provide

[IA.4] We have Greenbook data from 1976 to 2017; we have Hazell et al. (2022) data from 1978 to 2017.

seasonally adjusted (SA) measures, we compute our own seasonally-adjusted measures of wage growth. We first aggregate up and obtain a district-quarter-level total wage amount in dollars by summing up the precise county list. We then apply BEA's methodology to fix SA.[IA.5] We then subtract the quarterly district inflation from it to obtain real QCEW wage growth.

**iv. Evaluating QCEW's wage data as an alternative variable.** As with inflation, we want to understand how informative this QCEW-based US real wage growth is about the governors' forecast of the current real GDP growth, $E_m(gGDP_{q0})$, prepared for meeting $m$. We use lagged variables as before. We find a much weaker correlation (0.22; 0.26 in the non-ZLB sample) between QCEW-based real wage growth with $E_m(gGDP_{q0})$ than we do with our real PI growth measure (0.41; 0.48 in the non-ZLB sample). (We acknowledge that 0.41/0.48 is not as high as the correlation measure we see above with inflation. However, as explained earlier, historical GDP data at the granular level our research needs is simply not publicly available. What we capture in the paper regarding the effects through real growth is likely at its lower bound.)

Table IA.3 formalizes this result (dis-validation of the QCEW measure) in a regression framework, where we can also control for a lagged term of the Greenbook forecast. Our measure has a significant and positive coefficient, suggesting that it explains the incremental changes in the Greenbook forecast. On the other hand, the QCEW measure is mildly significant, and would become insignificant if we already control for our measure.

| Series (1): | Series (2): | Full sample: | No ZLB: |
|---|---|---|---|
| Greenbook, $E_m(gGDP_{q0})$ | Last QoQ US real PI growth | 0.4124 | 0.4781 |
| Greenbook, $E_m(gGDP_{q0})$ | Last QoQ US real wage growth, based on QCEW | 0.2153 | 0.2558 |
| Last QoQ US real PI growth | Last QoQ US real wage growth, based on QCEW | 0.3299 | 0.2885 |

***Note:*** *All correlations above are statistically significant at the 1% level.*

[IA.5]To validate our method, we validate BEA's SA method. The SA process involves the X13ARIMA software developed by the Census Bureau (x13as_ascii-v1-1-b60.zip). We download two wage series with both unadjusted and adjusted time series available from FRED's website. Using the code, we are able to confirm that FRED's seasonal adjustment method is the same as the default setting of the X13ARIMA method in the Python package "statsmodels." We apply this Python code to all unadjusted district-level data (aggregated up from county-level wage data). We are happy to share our codes.

Table IA.3: **Regression results with a lagged forecast.**
As mentioned in Table A1, the unit for Greenbook measure $E_m(gGDP_{q0})$ is percent per annum; units for both independent variables are quarterly percent.

| | (1) | (2) | (3) |
|---|---|---|---|
| | | $E_m(gGDP_{q0})$ | |
| Sample (no ZLB): | 1969-2017 | 1978-2017 | 1978-2017 |
| $rgPI^{US}_{m,t-1}$, Our measure | 0.3089*** | | 0.4758*** |
| | (0.119) | | (0.159) |
| $rgPI^{US}_{m,t-1}$, QCEW | | 0.0615* | 0.0239 |
| | | (0.033) | (0.033) |
| Lagged $E_m(gGDP_{q0})$ | 0.8020*** | 0.7823*** | 0.7160*** |
| | (0.057) | (0.051) | (0.060) |
| Constant | 0.2719* | 0.3900*** | 0.2963** |
| | (0.158) | (0.150) | (0.141) |
| N | 398 | 279 | 279 |
| $R^2$ | 0.72 | 0.65 | 0.67 |

**v. Constructing alternative macro variables using our current data sources.** Summary statistics for alternative variables based on our current data sources are reported in Panels B and C of Internet Appendix Table IA.4 below. Correlations are reported in Internet Appendix Table IA.5.

The first two are "MSA/MoM/Monthly/Main MSA," the district-level monthly MoM measure using the main MSA's values (i.e., our main measure), and "MSA/MoM/Monthly/Pop-weighted," the district-level monthly MoM measure using the population-weighted average of all available MSA inflation data. The next two are constructed to obtain the same data structure as Hazell, Herreño, Nakamura, and Steinsson (2022) at the state-quarterly frequency; state-level values are calculated using the population-weighted average of all available MSA inflation data within the state. "MSA/3m/Quarterly/Main state" is the district-level quarterly QoQ measure using the main state's values, and "MSA/3m/Quarterly/Pop-weighted" is the district-level quarterly QoQ measure using the population-weighted average of all states in the district (allowing overlapping).

Then our main measure "QoQ/Quarterly/Main state" takes the BEA's quarterly real PI growth at the state level and considers the main state within the district as the district-level measure. We also consider 3 alternative measures, reported in this order: the population-weighted average of all states within the district, the population-weighted average of all states within the district that do not overlap with other districts, and the equal-weighted average of all states within the district.

Table IA.4: **Summary statistics for alternative macro variables at the meeting level.**

This table presents summary statistics for our measures and alternative macro variable measures as discussed in Internet Appendix Section IA.3 and used in Tables 2 and 3. Panel A considers the two quarterly QoQ inflation measures constructed from Hazell, Herreño, Nakamura, and Steinsson (2022). Panels B and C use our data sources but vary from the main measures used in Table 1 in horizon, frequency of variation, or aggregation strategy (from granular to district-level). Units for all inflation measures are converted into monthly percent to be consistent with our main monthly MoM measure for comparison purposes. Similarly, units for all real growth measures are converted into quarterly percent.

| Variable | Mean (1) | SD (2) | Min (3) | Max (4) | 5th (5) | 25th (6) | 50th (7) | 75th (8) | 95th (9) |
|---|---|---|---|---|---|---|---|---|---|
| ***Panel A:*** *Alternative inflation measures using Hazell, Herreño, Nakamura, and Steinsson (2022) data (N = 248)* | | | | | | | | | |
| 3m/Quarterly/Main state, Voting District Average | 0.30 | 0.24 | -0.23 | 0.98 | -0.01 | 0.16 | 0.25 | 0.40 | 0.86 |
| 3m/Quarterly/Main state, Non-voting District Average | 0.36 | 0.41 | -0.49 | 1.77 | -0.13 | 0.14 | 0.26 | 0.44 | 1.22 |
| 3m/Quarterly/Pop-weighted, Voting District Average | 0.32 | 0.22 | -0.10 | 0.99 | 0.01 | 0.18 | 0.26 | 0.43 | 0.79 |
| 3m/Quarterly/Pop-weighted, Non-voting District Average | 0.35 | 0.42 | -0.51 | 1.77 | -0.10 | 0.11 | 0.26 | 0.42 | 1.20 |
| ***Panel B:*** *Alternative inflation measures using MSA data (N = 415)* | | | | | | | | | |
| MSA/MoM/Monthly/Main MSA, Voting District Average (main measure) | 0.38 | 0.34 | -0.49 | 1.54 | -0.14 | 0.17 | 0.35 | 0.57 | 1.02 |
| MSA/MoM/Monthly/Main MSA, Non-voting District Average (main measure) | 0.40 | 0.37 | -0.62 | 2.08 | -0.14 | 0.16 | 0.35 | 0.59 | 1.09 |
| MSA/MoM/Monthly/Pop-weighted, Voting District Average | 0.40 | 0.34 | -0.55 | 1.59 | -0.10 | 0.21 | 0.36 | 0.57 | 1.03 |
| MSA/MoM/Monthly/Pop-weighted, Non-voting District Average | 0.39 | 0.37 | -0.66 | 2.10 | -0.16 | 0.16 | 0.35 | 0.57 | 1.06 |
| MSA/3m/Quarterly/Main state, Voting District Average | 0.39 | 0.27 | -0.28 | 1.30 | 0.07 | 0.20 | 0.34 | 0.53 | 0.90 |
| MSA/3m/Quarterly/Main state, Non-voting District Average | 0.40 | 0.32 | -0.50 | 1.59 | 0.02 | 0.20 | 0.34 | 0.55 | 1.06 |
| MSA/3m/Quarterly/Pop-weighted, Voting District Average | 0.39 | 0.27 | -0.27 | 1.39 | 0.05 | 0.21 | 0.32 | 0.52 | 0.92 |
| MSA/3m/Quarterly/Pop-weighted, Non-voting District Average | 0.40 | 0.32 | -0.54 | 1.55 | 0.01 | 0.19 | 0.34 | 0.55 | 1.07 |
| ***Panel C:*** *Alternative real PI growth measures (N = 415)* | | | | | | | | | |
| QoQ/Quarterly/Main state, Voting District Average (main measure) | 0.57 | 0.89 | -2.32 | 3.80 | -1.05 | 0.02 | 0.61 | 1.10 | 1.88 |
| QoQ/Quarterly/Main state, Non-voting District Average (main measure) | 0.70 | 1.01 | -3.01 | 4.39 | -0.82 | 0.13 | 0.75 | 1.34 | 2.40 |
| QoQ/Quarterly/Pop-weighted, Voting District Average | 0.67 | 0.91 | -1.68 | 4.66 | -1.09 | 0.09 | 0.71 | 1.27 | 1.95 |
| QoQ/Quarterly/Pop-weighted, Non-voting District Average | 0.63 | 0.93 | -2.81 | 3.75 | -0.92 | 0.16 | 0.76 | 1.19 | 1.94 |
| QoQ/Quarterly/Non-overlapping states, Voting District Average | 0.66 | 0.97 | -1.88 | 5.01 | -1.02 | 0.04 | 0.69 | 1.28 | 2.15 |
| QoQ/Quarterly/Non-overlapping states, Non-voting District Average | 0.64 | 0.94 | -2.74 | 3.48 | -0.95 | 0.15 | 0.74 | 1.20 | 2.01 |
| QoQ/Quarterly/Equal-weighted, Voting District Average | 0.64 | 0.88 | -1.71 | 4.18 | -1.01 | 0.09 | 0.68 | 1.20 | 1.93 |
| QoQ/Quarterly/Equal-weighted, Non-voting District Average | 0.65 | 0.94 | -2.82 | 3.77 | -0.80 | 0.19 | 0.78 | 1.20 | 1.97 |

Table IA.5: **Correlation matrices of alternative macro variables at the meeting level.**

This table presents correlation matrices of our measure and alternative macro variable measures as discussed in Internet Appendix Section IA.3 and Table IA.4 and used in Tables 2 and 3. Both panels consider the paper's main sample of interest, which is 1969-2019 excluding the ZLB period. To conserve space, we drop "***" significance; all correlations in this table are statistically significant at the 1% level.

***Panel A:*** *Sample 1969-2019, excluding the ZLB period (N = 415); Inflation Measures*

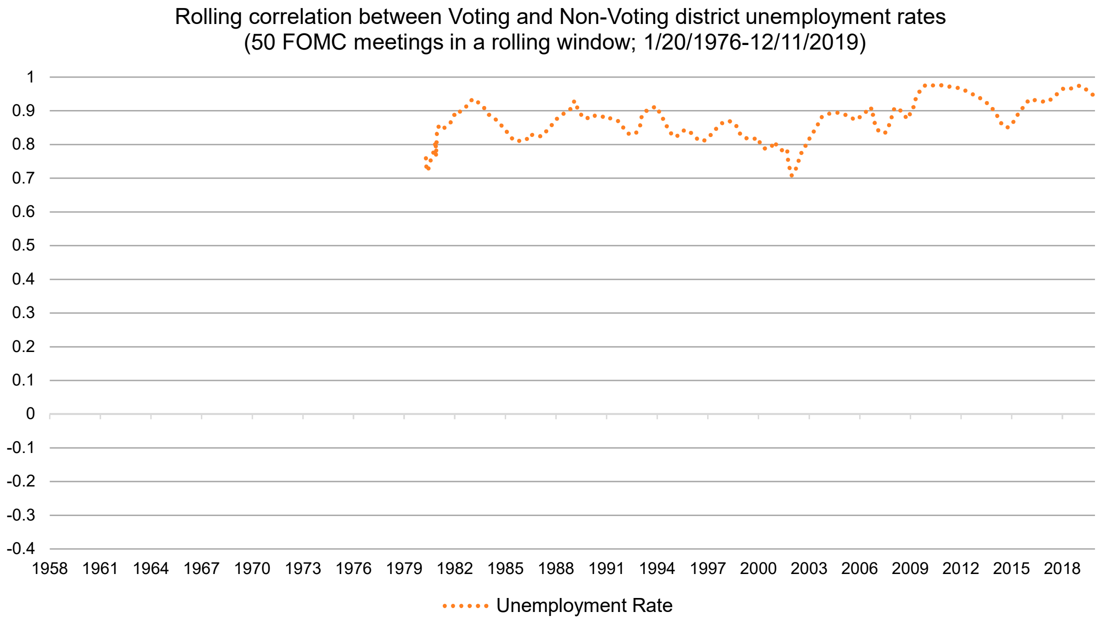
| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | MSA/MoM/Monthly/Main MSA, Voting (main measure) | 1 | | | | | | | | | | | |
| (2) | MSA/MoM/Monthly/Main MSA, Non-Voting (main measure) | 0.599 | 1 | | | | | | | | | | |
| (3) | MSA/MoM/Monthly/Pop-weighted, Voting | 0.972 | 0.625 | 1 | | | | | | | | | |
| (4) | MSA/MoM/Monthly/Pop-weighted, Non-Voting | 0.625 | 0.988 | 0.614 | 1 | | | | | | | | |
| (5) | MSA/3m/Quarterly/Main state, Voting | 0.816 | 0.630 | 0.830 | 0.627 | 1 | | | | | | | |
| (6) | MSA/3m/Quarterly/Main state, Non-Voting | 0.657 | 0.761 | 0.665 | 0.760 | 0.748 | 1 | | | | | | |
| (7) | MSA/3m/Quarterly/Pop-weighted, Voting | 0.806 | 0.648 | 0.825 | 0.641 | 0.983 | 0.759 | 1 | | | | | |
| (8) | MSA/3m/Quarterly/Pop-weighted, Non-Voting | 0.665 | 0.751 | 0.670 | 0.753 | 0.760 | 0.994 | 0.752 | 1 | | | | |
| (9) | Hazell et al. (2022)/3m/Quarterly/Main state, Voting | 0.625 | 0.615 | 0.628 | 0.612 | 0.842 | 0.693 | 0.842 | 0.691 | 1 | | | |
| (10) | Hazell et al. (2022)/3m/Quarterly/Main state, Non-Voting | 0.749 | 0.755 | 0.763 | 0.745 | 0.773 | 0.727 | 0.787 | 0.717 | 0.551 | 1 | | |
| (11) | Hazell et al. (2022)/3m/Quarterly/Pop-weighted, Voting | 0.616 | 0.595 | 0.617 | 0.594 | 0.818 | 0.676 | 0.821 | 0.673 | 0.948 | 0.554 | 1 | |
| (12) | Hazell et al. (2022)/3m/Quarterly/Pop-weighted, Non-Voting | 0.753 | 0.763 | 0.768 | 0.753 | 0.789 | 0.738 | 0.803 | 0.728 | 0.589 | 0.992 | 0.551 | 1 |

***Panel B:*** *Sample 1969-2019, excluding the ZLB period (N = 415); Real PI Growth Measures*

| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|---|
| (1) | QoQ/Quarterly/Main state, Voting (main measure) | 1 | | | | | | | |
| (2) | QoQ/Quarterly/Main state, Non-Voting (main measure) | 0.523 | 1 | | | | | | |
| (3) | QoQ/Quarterly/Pop-weighted, Voting | 0.936 | 0.669 | 1 | | | | | |
| (4) | QoQ/Quarterly/Pop-weighted, Non-Voting | 0.598 | 0.975 | 0.668 | 1 | | | | |
| (5) | QoQ/Quarterly/Non-overlapping states, Voting | 0.919 | 0.631 | 0.974 | 0.633 | 1 | | | |
| (6) | QoQ/Quarterly/Non-overlapping states, Non-Voting | 0.561 | 0.963 | 0.634 | 0.986 | 0.562 | 1 | | |
| (7) | QoQ/Quarterly/Equal-weighted, Voting | 0.934 | 0.675 | 0.991 | 0.680 | 0.957 | 0.652 | 1 | |
| (8) | QoQ/Quarterly/Equal-weighted, Non-Voting | 0.613 | 0.975 | 0.688 | 0.996 | 0.659 | 0.976 | 0.688 | 1 |

**vi. Evaluating unemployment rates (UR).** Another measure used in the literature to capture real economic activities is unemployment rates. The longest possible data for granular unemployment rates is a state-monthly level UR variable from the BLS, which is fully balanced starting from 1976. From this we can construct *district-level* UR using the UR measure of the main office's state.

Similar to Figure 3, the figure below depicts the rolling correlation between voting and non-voting district average UR levels using 50 past FOMC meetings. To make it comparable, both figures have the same scale on the y axis. Unemployment rates are always extremely highly correlated across districts. Correlation rates always stay around 0.9 and have even gone beyond 0.95 in recent years. This finding is a large part of why we do not choose unemployment rates as a main macro variable in our empirical strategy. We are interested in testing whether local economic conditions in voting and non-voting districts have profoundly different effects on FOMC decisions, so our measures of the economic conditions of voting and non-voting districts should exhibit enough dispersion between districts to test our hypothesis. Unemployment rates do not provide that, so we rely on real personal income growth.




## IA.4. Datasets Related to the FOMC

### IA.4.1. FOMC events.

In our research that involves examining target rate changes, voting decisions, and transcripts, we focus on all FOMC meetings from January 1958 to December 2019 that:

(1) *Discussed and made decisions about target rates.* This includes recording the voting decisions of each voting member. Note that while unconventional monetary policy is important in certain periods in U.S. history (typically as part of a domestic or

global crisis response), the present research examines a story that is not specific to any given period, and therefore we use a standard, consistent measure of monetary policy decision outcome, the Federal funds rate ("FFR"). The other advantage is that the FFR has a corresponding futures market, which allows us to examine investor perceptions in a dynamic way.

(2) *Released policy statements.* Note that releasing statements is an important part of central bank communications to the public and investors; when there is no decision being made or votes being cast, no statement is released. An example is the 1/9/2008 conference call, during which no voting happened and no decision was made.[IA.6] In contrast, the FOMC released a statement on the 10/7/2008 conference call at 7:00 AM EDT on October 8, 2008,[IA.7] which states that "the Board of Governors unanimously approved a 50-basis-point decrease in the discount rate to 1-3/4 percent." The 10/7/2008 meeting's votes can be found in its statement (or five years later in its meeting transcript).[IA.8] While the two examples above are conference calls, most of the FOMC events in our sample are scheduled meetings. We collect this data to validate Point (1) above.

(3) *Generated transcripts or minutes.* Our research also examines the speech patterns of Reserve Bank presidents and members of the Board of Governors at FOMC meetings. In addition, our research examines whether the market understands the role of Reserve Banks at FOMC meetings, and therefore public releases of these detailed records of FOMC meeting proceedings are important. Transcripts are the most detailed record of all and are made available to the public, with a five-year delay. The first transcript record for a meeting in which a vote occurred is the 4/20/1976 meeting, according to the archive page, https://www.federalreserve.gov/monetarypolicy/fomc_historical_year.htm. As of December 2023, we are able to download and retrieve 365 FOMC transcripts, corresponding to meetings from 4/20/1976 to 12/13/2017.

Overall, we focus on 661 FOMC events from 1/7/1958 to 12/11/2019 that have FFR decisions, public statements/announcements, and recorded transcripts/minutes. In terms of event formality, 646 are meetings and 15 are conference calls. Here are the 16 conference calls that satisfy our research objective:

[IA.6] https://www.federalreserve.gov/monetarypolicy/files/FOMC20080109confcall.pdf.
[IA.7] https://www.federalreserve.gov/newsevents/pressreleases/monetary20081008a.htm.
[IA.8] https://www.federalreserve.gov/monetarypolicy/files/FOMC20081007confcall.pdf.

| Conference Calls in our analysis | Chairman |
| --- | --- |
| 4/19/1968 | William McChesney Martin Jr. |
| 8/19/1968 | Alfred Hayes |
| 3/10/1978 | Arthur F. Burns |
| 5/5/1978 | G. William Miller |
| 3/7/1980 | Paul A. Volcker |
| 5/6/1980 | Paul A. Volcker |
| 11/26/1980 | Paul A. Volcker |
| 12/5/1980 | Paul A. Volcker |
| 12/12/1980 | Paul A. Volcker |
| 2/24/1981 | Paul A. Volcker |
| 5/6/1981 | Paul A. Volcker |
| 10/15/1998 | Alan Greenspan |
| 4/18/2001 | Alan Greenspan |
| 9/17/2001 | Alan Greenspan |
| 10/7/2008 | Ben S. Bernanke |

Therefore, most of the events we analyze are scheduled FOMC meetings. For simplicity, we refer to all of them as "FOMC meetings" in the paper.

### IA.4.2. FOMC dissenter data.

***Source Documents***

To collect our dissenter data, we recover the voting results for each member – agree, dissent for a tighter monetary policy, dissent for an easier monetary policy, or dissent for other reasons – from various publicly available documents that describe the *proceedings* of the FOMC. There are 12 votes, but that number does vary over time, especially during turnovers and transitions (see Figure 2 in the paper). We draw member-level voting results from multiple sources:

- Before 1967, we parse both the "**Record of Policy Actions**" and the "**Historical Minutes**."
- From 1967 to 1975, we parse both the "**Record of Policy Actions**" and the "**Minutes of Actions**." Before 1976, the writing of the minutes evolved a few times (see details in https://www.federalreserve.gov/monetarypolicy/fomc_historical.htm). This is fine for our purposes because all versions of the minutes show voting results.
- From 1976 to 2017, we parse both the "**Transcript**" and the "**Minutes**." Transcripts are the most detailed (verbatim records of the speech of each participant in the order of speaking), but they have a 5-year delay in their public releases; on the other hand, the minutes are high-level summaries of the FOMC's proceedings and have a timely release schedule. Both have voting results.
- From 2017-2019, there are no transcripts available because of the delay in release, so we parse only the "**Minutes**."

## *Examples*

We provide three examples of data sources and collection from three representative periods – before 1967, 1967-1975, and 1976-2019. The output data structure is at the meeting-participant level; that is, for each meeting, what is the voting decision for each participant?

**Example 1: January 7, 1958.** Record of Policy Actions: https://www.federalreserve.gov/monetarypolicy/files/fomcropa19580107.pdf; Historical Minutes: https://www.federalreserve.gov/monetarypolicy/files/fomchistmin19580107.pdf

- Participant list:

> A meeting of the Federal Open Market Committee was held in the offices of the Board of Governors of the Federal Reserve System in Washington on Tuesday, January 7, 1958, at 10:00 a.m.
>
> PRESENT: Mr. Martin, Chairman
> Mr. Hayes, Vice Chairman
> Mr. Allen
> Mr. Balderston
> Mr. Bryan
> Mr. Leedy
> Mr. Mills
> Mr. Robertson
> Mr. Shepardson
> Mr. Szymczak
> Mr. Williams

- Voting results and comments:

> Votes for this action: Messrs. Martin, Chairman, Hayes, Vice Chairman, Allen, Balderston, Bryan, Leedy, Mills, Robertson, Shepardson, Szymczak, and Williams. Votes against this action: none.

- Data collection: In this meeting, there are 11 voting participants (votes), including 5 district presidents and 6 governors from the Board. This meeting is recorded in our sample as follows:

| Last Name | Chair | President | Governor | Tag | Dissenters_Tighter | Dissenters_Easier | Dissenters_Other |
|---|---|---|---|---|---|---|---|
| Martin | 1 | 0 | 0 | Governor | 0 | 0 | 0 |
| Hayes | 0 | 1 | 0 | NewYork | 0 | 0 | 0 |
| Allen | 0 | 1 | 0 | Chicago | 0 | 0 | 0 |
| Balderston | 0 | 0 | 1 | Governor | 0 | 0 | 0 |
| Bryan | 0 | 1 | 0 | Atlanta | 0 | 0 | 0 |
| Leedy | 0 | 1 | 0 | Kansas | 0 | 0 | 0 |
| Mills | 0 | 0 | 1 | Governor | 0 | 0 | 0 |
| Robertson | 0 | 0 | 1 | Governor | 0 | 0 | 0 |
| Shepardson | 0 | 0 | 1 | Governor | 0 | 0 | 0 |
| Szymczak | 0 | 0 | 1 | Governor | 0 | 0 | 0 |
| Williams | 0 | 1 | 0 | Philadelphia | 0 | 0 | 0 |

**Example 2: February 20, 1974.** Record of Policy Actions: https://www.federalreserve.gov/monetarypolicy/files/fomcropa19740220.pdf; Historical Minutes: https://www.federalreserve.gov/monetarypolicy/files/fomcmoa19740220.pdf

- Participant list:

Meeting of Federal Open Market Committee

February 20, 1974

MINUTES OF ACTIONS

A meeting of the Federal Open Market Committee was held in the offices of the Board of Governors of the Federal Reserve System in Washington, D.C. on Wednesday, February 20, 1974, at 9:30 a.m.

PRESENT: Mr. Burns, Chairman
Mr. Hayes, Vice Chairman
Mr. Balles
Mr. Brimmer
Mr. Bucher
Mr. Daane
Mr. Francis
Mr. Holland
Mr. Mayo
Mr. Mitchell
Mr. Morris
Mr. Sheehan

- Voting results and comments:

2/20/74

-10-

To implement this policy, while taking account of international and domestic financial market developments, the Committee seeks to achieve bank reserve and money market conditions consistent with moderate growth in monetary aggregates over the months ahead.

Votes for this action: Messrs. Burns, Hayes, Balles, Brimmer, Daane, Holland, Mayo, and Mitchell. Votes against this action: Messrs. Bucher, Francis, Morris, and Sheehan.

The members dissenting from this action did so for different reasons. Messrs. Bucher, Morris, and Sheehan expressed concern about current and prospective weakness in aggregate economic demands. In order to encourage further declines in short- and long-term interest rates, including mortgage rates, they favored somewhat higher ranges of tolerance for the monetary aggregates and a lower range for the Federal funds rate than the Committee had agreed would be consistent with the directive. Mr. Francis expressed the view that the over-all economic situation was stronger than suggested by the staff projections and that inflation remained the major long-term economic problem. He dissented because he thought the policy adopted by the Committee would permit the money stock to grow at a faster rate than was consistent with progress in dealing with inflation.

- Data collection: In this meeting, there are 12 voting participants (votes), including 5 district presidents and 7 governors from the Board. Notice that from the record, there are 4 dissenters; the comments above state clearly that Bucher, Morris, and Sheehan viewed the current aggregate demand as still quite weak and favored a more lax policy; on the other hand, Francis saw the economy as strong and favored a tighter policy. As a result, these four are dissenters in this meeting. This meeting is recorded in our sample as follows:

| Last Name | Chair | President | Governor | Tag | Dissenters_Tighter | Dissenters_Easier | Dissenters_Other |
|---|---|---|---|---|---|---|---|
| Burns | 1 | 0 | 0 | Governor | 0 | 0 | 0 |
| Hayes | 0 | 1 | 0 | NewYork | 0 | 0 | 0 |
| Balles | 0 | 1 | 0 | SanFrancisco | 0 | 0 | 0 |
| Brimmer | 0 | 0 | 1 | Governor | 0 | 0 | 0 |
| Bucher | 0 | 0 | 1 | Governor | 0 | 1 | 0 |
| Daane | 0 | 0 | 1 | Governor | 0 | 0 | 0 |
| Francis | 0 | 1 | 0 | StLouis | 1 | 0 | 0 |
| Holland | 0 | 0 | 1 | Governor | 0 | 0 | 0 |
| Mayo | 0 | 1 | 0 | Chicago | 0 | 0 | 0 |
| Mitchell | 0 | 0 | 1 | Governor | 0 | 0 | 0 |
| Morris | 0 | 1 | 0 | Boston | 0 | 1 | 0 |
| Sheehan | 0 | 0 | 1 | Governor | 0 | 1 | 0 |

**Example 3: September 21, 2011.** Transcript: https://www.federalreserve.gov/monetarypolicy/files/FOMC20110921meeting.pdf; Minutes: https://www.federalreserve.gov/monetarypolicy/fomcminutes20110921.htm

- Participant list:

September 20–21, 2011 1 of 290

**Meeting of the Federal Open Market Committee on September 20–21, 2011**

A joint meeting of the Federal Open Market Committee and the Board of Governors of the Federal Reserve System was held in the offices of the Board of Governors in Washington, D.C., starting on Tuesday, September 20, 2011, at 10:30 a.m., and continuing on Wednesday, September 21, 2011, at 9:00 a.m.

Ben Bernanke, Chairman
William C. Dudley, Vice Chairman
Elizabeth Duke
Charles L. Evans
Richard W. Fisher
Narayana Kocherlakota
Charles I. Plosser
Sarah Bloom Raskin
Daniel K. Tarullo
Janet L. Yellen

- Voting results and comments:

**Voting for this action:** Ben Bernanke, William C. Dudley, Elizabeth Duke, Charles L. Evans, Sarah Bloom Raskin, Daniel K. Tarullo, and Janet L. Yellen.

**Voting against this action:** Richard W. Fisher, Narayana Kocherlakota, and Charles I. Plosser.

Messrs. Fisher, Kocherlakota, and Plosser dissented because they did not support additional policy accommodation at this time. Mr. Fisher saw a maturity extension program as providing few, if any, benefits in support of job creation or economic growth, while it could potentially constrain or complicate the timely removal of policy accommodation. In his view, any reduction in long-term Treasury rates resulting from this policy action would likely lead to further hoarding by savers, with counterproductive results on business and consumer confidence and spending behaviors. He felt that policymakers should instead focus their attention on improving the monetary policy transmission mechanism, particularly with regard to the activity of community banks, which are vital to small business lending and job creation. Mr. Kocherlakota's perspective on the policy decision was again shaped by his view that in November 2010, the Committee had chosen a level of accommodation that was well calibrated for the condition of the economy. Since November, inflation, and the one-year-ahead forecast for inflation, had risen, while unemployment, and the one-year-ahead forecast for unemployment, had fallen. He did not believe that providing more monetary accommodation was the appropriate response to those changes in the economy, given the current policy framework. Mr. Plosser felt that a maturity extension program would do little to improve near-term growth or employment, in light of the ongoing structural adjustments and fiscal challenges both in the United States and abroad. Moreover, in his view, with inflation continuing to run above earlier forecasts, such a program could risk adding unwanted inflationary pressures and complicate the eventual exit from the period of extraordinarily accommodative monetary policy.

- Data collection: In this meeting, there are 10 voting participants (votes), including 5 district presidents and 5 governors from the Board. Notice that according to the record, there are 3 dissenters, and they all favored a tighter policy. This meeting is recorded in our sample as follows:

| Last Name | Chair | President | Governor | Tag | Dissenters_Tighter | Dissenters_Easier | Dissenters_Other |
|---|---|---|---|---|---|---|---|
| Bernanke | 1 | 0 | 0 | Governor | 0 | 0 | 0 |
| Dudley | 0 | 1 | 0 | NewYork | 0 | 0 | 0 |
| Duke | 0 | 0 | 1 | Governor | 0 | 0 | 0 |
| Evans | 0 | 1 | 0 | Chicago | 0 | 0 | 0 |
| Fisher | 0 | 1 | 0 | Dallas | 1 | 0 | 0 |
| Kocherlakota | 0 | 1 | 0 | Minneapolis | 1 | 0 | 0 |
| Plosser | 0 | 1 | 0 | Philadelphia | 1 | 0 | 0 |
| Raskin | 0 | 0 | 1 | Governor | 0 | 0 | 0 |
| Tarullo | 0 | 0 | 1 | Governor | 0 | 0 | 0 |
| Yellen | 0 | 0 | 1 | Governor | 0 | 0 | 0 |

## *Summary of data collection*

The data collection effort for the voting results of these 661 FOMC meetings (1958-2019) has three steps. First, we use Python to parse down the full participant list of each meeting as listed on the first or second page of the various meeting records available on the Federal Reserve website. One major challenge during this process is that the formats of these documents have changed quite a few times over the past 62 years. Therefore, we also manually check the scraped results for accuracy. Another challenge is that in the early years, the minutes or transcripts only mention last names and titles, and their district or board affiliations are not mentioned at all, which can be observed in some examples above. Common last names such as "Johnson" or "Meyer" could refer to different people at different meetings or from different districts.[IA.9] The third challenge is that the same person could also serve both as a governor and a district president during their central banking career time. For instance, Janet L. Yellen was a governor from August 12, 1994 to February 17, 1997, the President of the Federal Reserve Bank of San Francisco from June 14, 2004 to October 4, 2010, the Vice Chair of the Board from October 4, 2010 to February 3, 2014, and the Chair of the Board from February 3, 2014 to February 3, 2018.

To circumvent these challenges (which could potentially lead to misalignment between district representation and a participant's name), we build from scratch a database of all current and past governors and district presidents and their in-office time periods since 1914. This way, we are able to determine precisely who was present at each meeting and what roles they held. This database primarily parses data from this website https://www.federalreserve.gov/aboutthefed/bios/board/boardmembership.htm for governor information and from various Reserve Bank websites for president information.[IA.10]

In the second step, we identify the voting outcomes. It is easy to identify dissenter(s), as public statements, minutes, transcripts, and other meeting records all summarize this information in one or two sentences. However, we are also interested in whether a dissenter was in favor of tighter or easier policy. In this step, we build on the existing effort by Thornton and Wheelock (2014);[IA.11] they provide *last names* of the voting members who dissented for tighter policy, easier policy, or other reasons in FOMC scheduled meetings from 1936 to present. We make several important necessary additions to their dataset, and we plan to release our dataset for other researchers to use. First, our research team manually checks this existing dataset and is able to validate most documented dissenter names. Then, we record voting results for the conference calls that we also examine in this paper. In addition, our dataset also expands and provides information on who *agreed* with the decision, so that we have a full record of voting decisions by every single member. Finally, we report full names and district and board affiliations. As a result, our dataset is at the meeting-member level, which makes it versatile for other research questions.

### IA.4.3. FOMC transcript data.

Our main dataset ranges from 1958 to 2019 and includes a total of 661 meetings or conference calls. To conduct the textual analysis discussed in Section 4.3, we need to

[IA.9] Starting with the January 26-27, 2010 meeting, transcripts and minutes dropped the titles and started to include full names.

[IA.10] All Reserve Banks have pages on their websites similar to this one from Boston: https://www.bostonfed.org/about-the-boston-fed/our-history/past-presidents.aspx.

[IA.11] Their dataset can be found here: https://www.stlouisfed.org/fomcspeak/history-fomc-dissents.

obtain transcripts that record all words spoken by meeting participants (voting and non-voting), word for word. Transcripts have a 5-year delay in public release and are only publicly available from 1976. Therefore, the longest transcript sample we can obtain is from 4/20/1976 to 12/13/2017 (which is the last transcript available at the time of the present draft, December 2023). Minutes do not provide the information that we extract from the transcripts (i.e., the exact words spoken by district presidents and governors). Therefore, we analyze a total of 365 transcripts from 4/20/1976 to 12/13/2017.

Transcripts of FOMC meetings can have 300 or more pages; those of FOMC conference calls are around 5 to 30 pages. Transcripts are organized in the order that words were spoken by people in the room, including governors and district presidents who have votes, district presidents who do not have votes, Fed economists, and other accompanying staff.

### IA.4.4. Target Federal funds rate data.

We use standard data choices to obtain the target Federal funds rate (FFR), given the existing literature. Romer and Romer (2004) collect and provide Federal funds target rates (or what the paper calls the "intended rate") from January 14, 1969 to December 17, 1996. To be specific, the original dataset provides "change in the intended funds rate decided at the meeting" and "level of the intended funds rate before the meeting," which makes the sum of these two numbers the new target rate at the end of the meeting.

From the February 5, 1997 meeting to the June 19, 2019 meeting, we use Kenneth N. Kuttner's target FFR collection.[IA.12] Kuttner's dataset starts in 1989. We use the Romer-Romer dataset as long as possible (until 1996), and then continue with Kuttner's dataset.

Finally, starting in 2008, the target rate becomes a range; given that most studies are interested in the change in the target FFR, we follow Kuttner's choice of using the lower range value to determine the changes in the FFR for meetings after June 19, 2019. This allows us to extend our sample until the last meeting in 2019.

The unit of change in the FFR is percentage points, as is standard practice in the literature.

## IA.5. Futures Data

To capture the market's expectations about policy actions (the Federal funds rate), we follow Kuttner (2001) and Bernanke and Kuttner (2005) (as well as many papers that follow) and use the price of Federal funds futures contracts to infer the market's expectations about the effective Federal funds rate, averaged over the settlement month. The contracts are officially referred to as "30-Day Federal Funds Futures," and are traded

[IA.12] The link to the dataset is in https://econ.williams.edu/faculty-pages/research/, and the exact dataset is in https://docs.google.com/spreadsheets/d/1Up04KzMYug9zyKWYFdrOgQD7S6n_Q7d7/edit#gid=696203667. At the time of writing, the last available update is the June 19, 2019 meeting.

on the Chicago Board of Trade (CBOT), a part of the Chicago Mercantile Exchange (CME) Group. These contracts start trading in late 1980s.

The CME's Federal Funds Futures are monthly contracts, extending 60 months out on the yield curve. That is, on August 1, 2022, a series of contracts with different settlement months were released to be settled at the end of August, the end of September, the end of October, etc. (see e.g. https://www.cmegroup.com/markets/interest-rates/stirs/30-day-federal-fund.quotes.html). These are active contracts with potential trading activities and price fluctuations. Importantly, at the end of the contract term, the value of a Federal funds futures contract is calculated using the arithmetic average of the daily effective Federal funds rates (FFR) during the contract's terminal month, and is reported by the Federal Reserve Bank of New York. If the effective FFR during the terminal month is 2.5%, then the settlement price of a Federal funds futures contract expiring that month would be 100-2.5 = 97.5. Intuitively, if one believes that in the future the target rate will increase, then one should choose to sell the Federal funds futures contract (expecting that its price will decrease in the future).

Since the Federal Open Market Committee (FOMC) sets the Federal funds target rate and most FOMC meetings can *but do not always* occur exactly on Day 1 of a new month, the first Federal funds futures contract to be fully affected by an FOMC decision should be the next contract term, not the contract that expires during the month when the FOMC meeting occurs. As a result, to capture as much of the market's expectations about future Federal funds rates as possible, the literature typically focuses on terms longer than 1 (current) month. In a paper that represents the state-of-the-art choice, Jarociński and Karadi (2020) use primarily the 3-month contract term, and use two, three, and four quarters ahead for robustness, for the reasons mentioned above (or see their discussion on Page 6 of their published version). Figure IA.1 shows the day gaps between two consecutive meetings within a year in our sample from 1958 to 2021. Since the 1980s, the gaps seem to stabilize around 45 days, but also exhibit a wide range from 35 to 60 days. This makes 1, 2, and 3 months useful terms to look at, rather than focusing on any one given term.

Moreover, in terms of our research question, we are also interested in long-term Federal funds futures. The voting rotation changes at a low (yearly) frequency. Under our hypothesis that the macro conditions in districts with voting rights in an FOMC meeting might be over-weighted, investors could also believe that the voting district presidents could hold persistent views while in the voting chair. Therefore, from this perspective, we have no strong reasons to focus on one particular term. As a result, given that our paper does not have a high-frequency focus, we consider the average implied rate from Federal funds futures contracts across various terms in Section 5.3; the average implied rate at the end of meeting $m$ is denoted as $f_m$, and its between-meeting first difference is denoted as $\Delta f_m$ in the main paper (source: Refinitiv DataStream's composite series "CBOT-30 Day Federal Funds Composite Continuous Average"). We obtain the longest possible sample available from DataStream up to the end of the sample period studied in the present research, 1989-2019.

Finally, we construct and use forecast revision $E_{m+1}(FFR_{m+1}) - E_m(FFR_{m+1})$ as the dependent variable to examine whether changes in the Fed funds rate expecta-

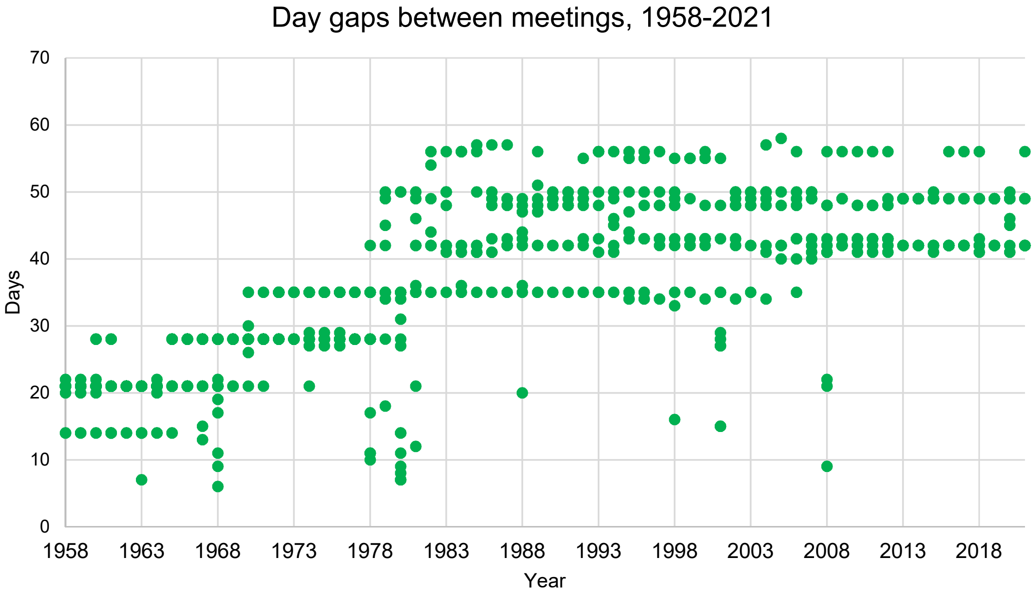



Figure IA.1: Number of days between two meetings. There are a few dots for each year; some years appear to have fewer dots due to overlaps.

tions of the same meeting can be explained by voting district variables as well. We follow Gürkaynak (2005) in the construction of forecast revision. It is noteworthy that the mathematical expression above is a conceptual construct, whereas in reality, as Gürkaynak (2005) points out, researchers should use the contracts expiring in the months of future FOMC meetings to measure market-based expectations for these meetings. This is due to the fact that FOMC meetings do not follow the month lines, whereas FFF contracts do. While this exercise has an advantage in that it anchors at the same meeting, it also requires exact daily data for 1m/2m/3m contracts. We obtain a shorter sample given Boston College's current subscriptions with Refinitiv DataStream (e.g.,"CBT-30 DAY FED FUNDS COMP TRc1 - SETT. PRICE," "CBT-30 DAY FED FUNDS COMP TRc2 - SETT. PRICE," and "CBT-30 DAY FED FUNDS COMP TRc3 - SETT. PRICE"). This sample is hence 2002-2019.

# IB. Supplementary Tables and Figures

Table IB.1: **Can districts' economic conditions predict the allocation of voting rights?** This table is a placebo test which projects whether a district's president voted (yes=1; no=0) in next year's meetings on its past economic conditions. We estimate the following regression: $Vote_{r,t} = \alpha + \beta_1 \text{Inf}_{r,t,q-1} + \beta_2 \text{rgPI}_{r,t,q-1} + \varepsilon_{r,t}$, where $Vote_{r,t}$ is an indicator of whether the representative of district $r$ votes during year $t$, $\text{Inf}_{r,t,q-1}$ is district $r$'s inflation rate during the fourth quarter that precedes year $t$, and $\text{rgPI}_{r,t,q-1}$ is district $r$'s personal income growth rate during the fourth quarter that precedes year $t$. In Panel A, we use last Q4 macro variables. In Panel B, we use last year macro variables. Units: quarterly percent or annual percent, respectively. The unit of observation is district-year, and therefore, N=612, 51 years × 12 districts. Robust standard errors are reported in parentheses. ***, $p$-value <1%; **, <5%; *, <10%.

| Dependent variable: | Voting Indicator | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| ***Panel A:*** *Using previous Q4's macro variables.* | | | |
| Q4 Inflation | 0.0055 | | 0.0164 |
| | (0.018) | | (0.021) |
| Q4 Real PI Growth | | 0.0151 | 0.0219 |
| | | (0.017) | (0.019) |
| Constant | 0.4669*** | 0.4508*** | 0.4364*** |
| | (0.021) | (0.028) | (0.034) |
| N | 612 | 612 | 612 |
| $R^2$ | 0.0002 | 0.0014 | 0.0024 |
| ***Panel B:*** *Using previous year's macro variables.* | | | |
| Last year Inflation | 0.0092 | | 0.0104 |
| | (0.006) | | (0.007) |
| Last year Real PI Growth | | 0.0018 | 0.0051 |
| | | (0.007) | (0.008) |
| Constant | 0.4357*** | 0.4647*** | 0.4196*** |
| | (0.030) | (0.027) | (0.039) |
| N | 612 | 612 | 612 |
| $R^2$ | 0.0035 | 0.0001 | 0.0041 |

Table IB.2: Summary statistics for district-meeting-level macro variables.

This table complements Table A1 and presents the summary statistics of our main macro variables at the district-meeting level. Note that some districts have missing data for local monthly inflation; we have explained this in the paper. Panels A and B consider the full sample; Panels C and D consider the sample that excludes the ZLB period, which is the main sample of the paper.

| ***Panel A:*** *Inflation* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Count | Missing | Mean | SD | Min | Max | 5th | 25th | 50th | 75th | 95th |
| Boston | 472 | | 0.37 | 0.39 | -1.29 | 1.53 | -0.18 | 0.11 | 0.34 | 0.58 | 1.04 |
| NewYork | 472 | | 0.36 | 0.40 | -1.64 | 2.13 | -0.24 | 0.12 | 0.31 | 0.60 | 1.02 |
| Philadelphia | 472 | | 0.34 | 0.47 | -1.54 | 1.78 | -0.42 | 0.02 | 0.33 | 0.61 | 1.14 |
| Cleveland | 472 | | 0.33 | 0.41 | -2.08 | 1.30 | -0.30 | 0.09 | 0.31 | 0.58 | 1.06 |
| Richmond | 472 | | 0.35 | 0.35 | -1.16 | 1.53 | -0.21 | 0.12 | 0.35 | 0.56 | 0.90 |
| Atlanta | 391 | 1987-1996 | 0.35 | 0.53 | -2.28 | 1.94 | -0.49 | 0.05 | 0.37 | 0.65 | 1.20 |
| Chicago | 472 | | 0.35 | 0.59 | -2.02 | 2.47 | -0.48 | 0.00 | 0.31 | 0.61 | 1.41 |
| StLouis | 314 | 1998-2016 | 0.42 | 0.44 | -0.84 | 1.66 | -0.32 | 0.18 | 0.44 | 0.66 | 1.21 |
| Minneapolis | 225 | 1987-2016 | 0.52 | 0.43 | -1.00 | 1.88 | -0.08 | 0.30 | 0.50 | 0.77 | 1.20 |
| Kansas | 225 | 1987-2016 | 0.57 | 0.42 | -1.19 | 1.79 | -0.01 | 0.31 | 0.54 | 0.85 | 1.18 |
| Dallas | 472 | | 0.35 | 0.42 | -1.05 | 1.62 | -0.26 | 0.06 | 0.33 | 0.60 | 1.11 |
| SanFrancisco | 472 | | 0.37 | 0.48 | -1.62 | 2.53 | -0.32 | 0.09 | 0.36 | 0.58 | 1.09 |
| US | 472 | | 0.36 | 0.34 | -1.77 | 1.81 | -0.08 | 0.18 | 0.30 | 0.52 | 1.00 |
| ***Panel B:*** *Real PI Growth* | | | | | | | | | | | |
| | Count | Missing | Mean | SD | Min | Max | 5th | 25th | 50th | 75th | 95th |
| Boston | 472 | | 0.54 | 1.17 | -3.49 | 3.52 | -1.39 | -0.20 | 0.56 | 1.24 | 2.56 |
| NewYork | 472 | | 0.40 | 1.42 | -4.44 | 4.40 | -2.15 | -0.25 | 0.47 | 1.30 | 2.54 |
| Philadelphia | 472 | | 0.45 | 1.31 | -4.15 | 5.41 | -2.01 | -0.27 | 0.51 | 1.15 | 2.50 |
| Cleveland | 472 | | 0.40 | 1.16 | -3.02 | 3.60 | -1.63 | -0.37 | 0.57 | 1.11 | 2.17 |
| Richmond | 472 | | 0.74 | 1.08 | -4.19 | 4.03 | -0.97 | 0.18 | 0.70 | 1.28 | 2.41 |
| Atlanta | 472 | | 0.82 | 1.31 | -3.97 | 4.80 | -1.49 | -0.01 | 0.87 | 1.76 | 2.70 |
| Chicago | 472 | | 0.47 | 1.33 | -5.08 | 4.05 | -1.57 | -0.21 | 0.56 | 1.20 | 2.58 |
| StLouis | 472 | | 0.51 | 1.23 | -2.74 | 4.56 | -1.68 | -0.15 | 0.45 | 1.18 | 2.82 |
| Minneapolis | 472 | | 0.57 | 1.35 | -3.81 | 6.18 | -1.68 | -0.15 | 0.51 | 1.43 | 2.47 |
| Kansas | 472 | | 0.45 | 1.58 | -5.13 | 5.39 | -2.06 | -0.31 | 0.51 | 1.23 | 3.04 |
| Dallas | 472 | | 0.92 | 1.22 | -3.84 | 4.16 | -1.07 | 0.15 | 0.97 | 1.60 | 3.05 |
| SanFrancisco | 472 | | 0.62 | 1.27 | -6.37 | 6.40 | -1.27 | -0.03 | 0.61 | 1.30 | 2.34 |
| US | 472 | | 0.59 | 0.90 | -3.07 | 3.37 | -1.06 | 0.22 | 0.67 | 1.07 | 1.80 |

| ***Panel C:*** *Excluding the ZLB period; Inflation* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Count | Missing | Mean | SD | Min | Max | 5th | 25th | 50th | 75th | 95th |
| Boston | 415 | | 0.40 | 0.39 | -0.80 | 1.53 | -0.18 | 0.16 | 0.37 | 0.62 | 1.07 |
| NewYork | 415 | | 0.39 | 0.39 | -0.60 | 2.13 | -0.21 | 0.15 | 0.35 | 0.63 | 1.07 |
| Philadelphia | 415 | | 0.38 | 0.46 | -1.11 | 1.78 | -0.37 | 0.07 | 0.36 | 0.63 | 1.19 |
| Cleveland | 415 | | 0.37 | 0.39 | -1.15 | 1.30 | -0.23 | 0.14 | 0.34 | 0.61 | 1.09 |
| Richmond | 415 | | 0.38 | 0.34 | -0.55 | 1.53 | -0.20 | 0.16 | 0.37 | 0.60 | 0.92 |
| Atlanta | 334 | 1987-1996 | 0.40 | 0.48 | -1.34 | 1.94 | -0.31 | 0.09 | 0.41 | 0.69 | 1.23 |
| Chicago | 415 | | 0.39 | 0.58 | -1.71 | 2.47 | -0.46 | 0.05 | 0.34 | 0.67 | 1.45 |
| StLouis | 314 | 1998-2016 | 0.42 | 0.44 | -0.84 | 1.66 | -0.32 | 0.18 | 0.44 | 0.66 | 1.21 |
| Minneapolis | 225 | 1987-2016 | 0.52 | 0.43 | -1.00 | 1.88 | -0.08 | 0.30 | 0.50 | 0.77 | 1.20 |
| Kansas | 225 | 1987-2016 | 0.57 | 0.42 | -1.19 | 1.79 | -0.01 | 0.31 | 0.54 | 0.85 | 1.18 |
| Dallas | 415 | | 0.38 | 0.42 | -1.05 | 1.62 | -0.22 | 0.07 | 0.35 | 0.67 | 1.11 |
| SanFrancisco | 415 | | 0.40 | 0.47 | -1.42 | 2.53 | -0.28 | 0.14 | 0.38 | 0.61 | 1.10 |
| US | 415 | | 0.40 | 0.32 | -0.55 | 1.81 | 0.00 | 0.19 | 0.33 | 0.53 | 1.02 |
| ***Panel C:*** *Excluding the ZLB period; Real PI Growth* | | | | | | | | | | | |
| | Count | Missing | Mean | SD | Min | Max | 5th | 25th | 50th | 75th | 95th |
| Boston | 415 | | 0.54 | 1.11 | -2.30 | 3.46 | -1.33 | -0.20 | 0.53 | 1.20 | 2.54 |
| NewYork | 415 | | 0.38 | 1.38 | -4.44 | 4.25 | -2.15 | -0.24 | 0.43 | 1.24 | 2.42 |
| Philadelphia | 415 | | 0.45 | 1.28 | -3.65 | 5.41 | -2.01 | -0.28 | 0.49 | 1.14 | 2.50 |
| Cleveland | 415 | | 0.40 | 1.09 | -2.73 | 3.23 | -1.37 | -0.36 | 0.57 | 1.09 | 2.05 |
| Richmond | 415 | | 0.79 | 1.01 | -2.39 | 4.03 | -0.83 | 0.20 | 0.70 | 1.31 | 2.44 |
| Atlanta | 415 | | 0.85 | 1.20 | -2.42 | 4.30 | -1.39 | 0.08 | 0.87 | 1.76 | 2.57 |
| Chicago | 415 | | 0.47 | 1.28 | -5.08 | 3.52 | -1.51 | -0.19 | 0.46 | 1.29 | 2.56 |
| StLouis | 415 | | 0.54 | 1.24 | -2.70 | 4.56 | -1.68 | -0.15 | 0.43 | 1.18 | 2.90 |
| Minneapolis | 415 | | 0.59 | 1.34 | -3.81 | 6.18 | -1.62 | -0.15 | 0.51 | 1.38 | 2.39 |
| Kansas | 415 | | 0.49 | 1.59 | -5.13 | 5.39 | -2.02 | -0.29 | 0.53 | 1.25 | 3.04 |
| Dallas | 415 | | 0.96 | 1.11 | -2.10 | 4.16 | -0.93 | 0.15 | 0.97 | 1.60 | 2.97 |
| SanFrancisco | 415 | | 0.63 | 1.10 | -2.75 | 4.67 | -1.06 | -0.02 | 0.61 | 1.30 | 2.34 |
| US | 415 | | 0.60 | 0.80 | -1.94 | 3.37 | -0.79 | 0.27 | 0.67 | 1.05 | 1.80 |

Table IB.3: **Actual vs. by law voting scheme.** This table reports estimates of a regression of a district's actual voting indicator (1 or 0) at an FOMC meeting ("$ActualVote_m^i$") on a federal-law-determined voting indicator (1 or 0) ("$ByLawVote_m^i$"). The by law rotation scheme was designed in 1942. The data structure is at the meeting-district level; that is, each meeting has 12 data points corresponding to 12 districts, and therefore the 1969-2019 sample in column (1) has N=5,664 (472×12). In column (2), we drop New York from each meeting, and therefore the numbers of observations are multiples of 11, instead of 12. The last two rows report the number of mismatches between actual voting and federal-law-determined voting. Robust standard errors are reported in parentheses. ***, $p$-value <1%; **, <5%; *, <10%.

| Dependent variable: | $ActualVote_m^i$ | |
|---|---|---|
| | (1) | (2) |
| $ByLawVote_m^i$ | 0.9278*** | 0.9147*** |
| | (0.005) | (0.006) |
| Constant | 0.0179*** | 0.0179*** |
| | (0.002) | (0.002) |
| N | 5,664 | 5,192 |
| $R^2$ | 0.87 | 0.85 |
| $F$-statistic | 32,380.6 | 22,285.3 |
| Drop NY District | No | Yes |
| % Mismatches with 1942 and alternate member schemes | 1.0% | 0.1% |

Table IB.4: **Cascading regression.** This table is to demonstrate the abilities of voting and non-voting macro variables from various non-overlapping quarters. Specifically, we include inflation rates and real PI growth rates of the last quarter, second to last quarter, third to last quarter, etc. The sample uses the main sample of the paper, which is 1969-2019 excluding the ZLB period. As before, all inflation variables in the paper (including appendices) have units of monthly percent and all growth variables quarterly percent. See other table details in Table 1. Robust standard errors are reported in parentheses. ***, p-value <1%; **, <5%; *, <10%.

| Dependent variable: | $\Delta FFR_m$ | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $Infl^{Vote}_{m,t-1}$, Last quarter | 0.7540*** | 0.6284** | 0.6734** | 0.8310*** |
| | (0.241) | (0.268) | (0.298) | (0.319) |
| $Infl^{NoVote}_{m,t-1}$, Last quarter | -0.1739 | -0.1931 | -0.3122 | -0.2767 |
| | (0.214) | (0.245) | (0.276) | (0.273) |
| $rgPI^{Vote}_{m,t-1}$, Last quarter | 0.1220*** | 0.1384*** | 0.1257*** | 0.1252** |
| | (0.041) | (0.048) | (0.048) | (0.052) |
| $rgPI^{NoVote}_{m,t-1}$, Last quarter | 0.0394 | 0.0349 | 0.0339 | 0.0446 |
| | (0.041) | (0.039) | (0.038) | (0.040) |
| $Infl^{Vote}_{m,t-2}$, Second to last quarter | | 0.2109 | 0.0267 | 0.0150 |
| | | (0.281) | (0.294) | (0.334) |
| $Infl^{NoVote}_{m,t-2}$, Second to last quarter | | 0.0588 | -0.0710 | -0.0513 |
| | | (0.245) | (0.241) | (0.259) |
| $rgPI^{Vote}_{m,t-2}$, Second to last quarter | | 0.0716 | 0.0912* | 0.0922* |
| | | (0.048) | (0.052) | (0.053) |
| $rgPI^{NoVote}_{m,t-2}$, Second to last quarter | | -0.0356 | -0.0275 | -0.0279 |
| | | (0.046) | (0.042) | (0.043) |
| $Infl^{Vote}_{m,t-3}$, Third to last quarter | | | 0.5171 | 0.7033* |
| | | | (0.356) | (0.388) |
| $Infl^{NoVote}_{m,t-3}$, Third to last quarter | | | 0.1605 | 0.1459 |
| | | | (0.204) | (0.225) |
| $rgPI^{Vote}_{m,t-3}$, Third to last quarter | | | 0.0117 | 0.0062 |
| | | | (0.043) | (0.049) |
| $rgPI^{NoVote}_{m,t-3}$, Third to last quarter | | | 0.0195 | 0.0045 |
| | | | (0.031) | (0.036) |
| $Infl^{Vote}_{m,t-4}$, Fourth to last quarter | | | | -0.2019 |
| | | | | (0.271) |
| $Infl^{NoVote}_{m,t-4}$, Fourth to last quarter | | | | -0.2564 |
| | | | | (0.195) |
| $rgPI^{Vote}_{m,t-4}$, Fourth to last quarter | | | | 0.0048 |
| | | | | (0.060) |
| $rgPI^{NoVote}_{m,t-4}$, Fourth to last quarter | | | | -0.0238 |
| | | | | (0.069) |
| $FFR_{m-1}$ | -0.0415** | -0.0462** | -0.0589*** | -0.0548** |
| | (0.019) | (0.021) | (0.021) | (0.023) |
| Constant | -0.0718 | -0.1100 | -0.1714** | -0.1431** |
| | (0.088) | (0.082) | (0.085) | (0.068) |
| N | 414 | 414 | 414 | 414 |
| $R^2$ | 0.059 | 0.066 | 0.085 | 0.095 |

Table IB.5: **Alternative inflation data choice for the San Francisco District and the Dallas District.** This table complements Table 1. Column (1) replicates column (4) in Panel B of Table 1. Column (2) uses an alternative inflation data choice for the San Francisco District. As motivated in Internet Appendix IA, we use CPI data from "San Francisco-Oakland-Hayward" to obtain our primary inflation rate for the San Francisco District, given that it is where the head office is located and has CPI data starting from 1914. For this FFR regression, we use CPI data from "Los Angeles-Long Beach-Anaheim" to obtain the next best alternative inflation rate for the San Francisco District, given that this MSA has the largest population among all other MSAs in this district (and in fact the second largest in the United States according to Census data). The two inflation rates (San Francisco-Oakland-Hayward, Los Angeles-Long Beach-Anaheim) are significantly correlated at 60.71% during our main sample period (1969-2019). Column (3) uses an alternative inflation data choice for the Dallas District. As motivated in Internet Appendix IA, we use CPI data from "Houston-The Woodlands-Sugar Land" to obtain our primary inflation rate for the Dallas District, given that the next best data choice, "Dallas-Fort Worth-Arlington," does not start until 1963. For this particular FFR regression, which starts from 1969, we therefore are able to use CPI data from Dallas-Fort Worth-Arlington to obtain the alternative inflation rate for the Dallas District. The two inflation rates (Houston-The Woodlands-Sugar Land and Dallas-Fort Worth-Arlington) are significantly correlated at 57.34% during 1969-2019. See other table details in Table 1. Robust standard errors are reported in parentheses. ***, p-value <1%; **, <5%; *, <10%.

| Dependent variable: | | $\Delta FFR_m$ | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Inflation Measures: | Main Measure | Alternative Measure for San Francisco | Alternative Measure for Dallas |
| $Infl^{Vote}_{m,t-1}$ | 0.4397*** | 0.4569*** | 0.4378*** |
| | (0.121) | (0.130) | (0.122) |
| $Infl^{NoVote}_{m,t-1}$ | -0.0634 | -0.0846 | -0.0622 |
| | (0.137) | (0.140) | (0.135) |
| $rgPI^{Vote}_{m,t-1}$ | 0.0912** | 0.0938** | 0.0933** |
| | (0.040) | (0.040) | (0.039) |
| $rgPI^{NoVote}_{m,t-1}$ | 0.0501 | 0.0456 | 0.0471 |
| | (0.043) | (0.043) | (0.043) |
| $FFR_{m-1}$ | -0.0339* | -0.0335* | -0.0337* |
| | (0.019) | (0.019) | (0.020) |
| Constant | -0.0278 | -0.0264 | -0.0277 |
| | (0.082) | (0.082) | (0.082) |
| N | 414 | 414 | 414 |
| $R^2$ | 0.057 | 0.058 | 0.057 |

Table IB.6: **Predicting changes in the FFR, excluding the ZLB period and excluding conference calls.**

This table complements Table 1, Panel B, and excludes the meetings that are conducted through conference calls. See other table details in Table 1. Robust standard errors are reported in parentheses. ***, p-value <1%; **, <5%; *, <10%.

| Dependent variable: | $\Delta FFR_m$ | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $Infl^{US}_{m,t-1}$ | 0.1931 | | 0.2046 | |
| | (0.144) | | (0.145) | |
| $Infl^{Vote}_{m,t-1}$ | | 0.3809*** | | 0.3841*** |
| | | (0.102) | | (0.102) |
| $Infl^{NoVote}_{m,t-1}$ | | -0.1097 | | -0.1025 |
| | | (0.123) | | (0.124) |
| $rgPI^{US}_{m,t-1}$ | 0.1015** | 0.1098** | | |
| | (0.049) | (0.049) | | |
| $rgPI^{Vote}_{m,t-1}$ | | | 0.0694* | 0.0711* |
| | | | (0.038) | (0.038) |
| $rgPI^{NoVote}_{m,t-1}$ | | | 0.0387 | 0.0449 |
| | | | (0.041) | (0.040) |
| $FFR_{m-1}$ | -0.0309 | -0.0360* | -0.0307 | -0.0358* |
| | (0.021) | (0.021) | (0.021) | (0.020) |
| Constant | 0.0383 | 0.0375 | 0.0314 | 0.0311 |
| | (0.088) | (0.089) | (0.087) | (0.087) |
| N | 401 | 401 | 401 | 401 |
| $R^2$ | 0.037 | 0.055 | 0.038 | 0.056 |

Table IB.7: **Predicting changes in Federal funds rates: FFR lags robustness.** This table presents estimates of regression (1), in which we regress changes in the FFR on recent macro variables for voting and non-voting districts. For robustness, we include three lags of the FFR. The unit of observation is the FOMC meeting. All the variables are defined in Table A1 and Section 3. Robust standard errors are reported in parentheses. ***, p-value <1%; **, <5%; *, <10%.

| Dependent variable: | $\Delta FFR_m$ | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $Infl^{US}_{m,t-1}$ | 0.2127 | | 0.2254 | |
| | (0.154) | | (0.159) | |
| $Infl^{Vote}_{m,t-1}$ | | 0.3803*** | | 0.3851*** |
| | | (0.113) | | (0.113) |
| $Infl^{NoVote}_{m,t-1}$ | | -0.0847 | | -0.0770 |
| | | (0.142) | | (0.144) |
| $rgPI^{US}_{m,t-1}$ | 0.0878 | 0.0957* | | |
| | (0.055) | (0.054) | | |
| $rgPI^{Vote}_{m,t-1}$ | | | 0.0706 | 0.0737* |
| | | | (0.043) | (0.044) |
| $rgPI^{NoVote}_{m,t-1}$ | | | 0.0257 | 0.0304 |
| | | | (0.043) | (0.043) |
| $FFR_{m-1}$ | 0.2095* | 0.1990* | 0.2085* | 0.1980* |
| | (0.119) | (0.117) | (0.119) | (0.117) |
| $FFR_{m-2}$ | -0.1931 | -0.1868 | -0.1897 | -0.1834 |
| | (0.191) | (0.190) | (0.192) | (0.191) |
| $FFR_{m-3}$ | -0.0486 | -0.0487 | -0.0506 | -0.0508 |
| | (0.117) | (0.117) | (0.118) | (0.118) |
| Constant | 0.0533 | 0.0477 | 0.0451 | 0.0396 |
| | (0.082) | (0.083) | (0.081) | (0.082) |
| N | 412 | 412 | 412 | 412 |
| $R^2$ | 0.10 | 0.12 | 0.10 | 0.12 |

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