State-Dependent Systematic Monetary Policy

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Abstract

This work estimates the time-varying Taylor Rule the systematic monetary policy.
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1 Introduction

The conduct of monetary policy can be divided via two axis (see table 1), the systematicality of a policy and the expectations of the market from the actions of monetary authority. The examples of monetary policy cells along the main diagonal of table 1 are the most frequent uses of systematic and unsystematic monetary policies, but note that the off diagonal elements are not empty.

Table 1. Monetary Policy Taxonomy

	Systematic	Unsystematic
Anticipated	Known monetary policy function	Credible announcement of a transitory policy
Unanticipated	Changes to monetary policy function	Monetary shocks

Notes: Idea of the distinction is from Jorda and Hoover (2000), who use it with regards to central bank's policy of money supply.

1.1 Related literature

Carvalho et al. (2021) argues for estimation of Taylor rule using the OLS because the monetary policy shocks tend to explain only a small fraction of the overall variation of monetary instruments (i.e. Fed Funds rate, FFR).

This work contribute to. Additionally we this work is one of the first, that uses newly developed way of identification of systematic monetary policy by , which allows us to estimate the aforementioned

*Email: avlasov(at)nes.ru. For supplementary materials, code and datasets, see the repository github.com/alvlsv/CheckingHank. I thank Valery Charnavoki and Konstantin Styrin for helpful comments.

overall effect of the monetary shock, without controlling for any income related covariates – without possible .

The remainder of the paper proceeds as follows: the next section thoroughly discloses the empirical strategy for estimating time-varying (or FOMC preference dependent) Taylor rule. Than I describe and the results and conclude.

2 Empirical Strategy

2.1 Systematic Monetary Policy Identification

Further I follow Hack et al. (2023) approach to systematic monetary policy identification that is based on the use of Hawk-Dove balance as a measure of systematic monetary policy variation. That is, I assume that the monetary policy rule is

$$r_t - r_t^* = \tilde{\phi}_t^{\pi} \mathbb{E}_t \pi_{t+1} + \tilde{\phi}_t^{x} \mathbb{E}_t x_t + \varepsilon_t, \tag{1}$$

where r_t is the real rate of interest, r_t^* is the natural rate of interest π_{t+1}^e and x_{t+1}^2 are the monetary authority's expectations over the inflation and output gap. As one can see Then $\tilde{\phi}_t^j = \phi^j + \phi_t^j$ is the systematic monetary policy – that is, the time-dependent response of the monetary authority to the expected change in inflation/output.

The assumed monetary policy rule is essentially a Taylor rule, but also it can be viewed as a simplified time-varying version of Romer and Romer (2004) regression rule.

I estimate the following state-dependent local projection model

$$\begin{aligned} r_{t+h} - r_{t+h}^* = \alpha^h &+ \delta^h \left(Hawk_t - \overline{Hawk}\right) \\ &+ \beta_\pi^h \pi_t^e + \gamma_\pi^h \pi_t^e \left(Hawk_t - \overline{Hawk}\right) + \beta_x^h x_t^e + \gamma_x^h x_t^e \left(Hawk_t - \overline{Hawk}\right) \\ &+ \zeta^h Z_t + e_{t+h}^h, \end{aligned} \tag{2}$$

where $h = 0, \ldots, H$ are the forecast horizons. r_{t+h} is federal funds rate (bridged with Wu and Xia (2016) for the ZLB period) and r_{t+h}^* is the Laubach and Williams (2003) natural interest rate.[1] π_t^e is the measure of the FED expectation of future inflation. I use the average of the one- and two-quarters tealbook inflation forecast following the approach by Coibion and Gorodnichenko (2011). $Hawk_t$ is the quarterly Hawk-Dove index of Hack et al. (2023), which is based on the Istrefi (2019) and Bordo and Istrefi (2023) estimation of individual policy preference of FOMC members expressed before each of the FOMC meeting in press; $\overline{Hawk}$ stand for the mean of this variable.

The vector of controls, Z_t, consists of the 4 lags of the dependent variable, $(r - r^*)_t$, 4 lags of the expected inflation, π_t^e, and 4 lags of expected gdp gap, x_t.

As Hack et al. (2023) suggest, the Hawk index, $Hawk_t$, can be potentially endogenous,[2] The proposed solution is to instrument $\left(Hawk_t - \overline{Hawk}\right)$ with the index of preferences of the rotating part of FOMC board[3] namely $\left(Hawk_t^{IV} - \overline{Hawk}^{IV}\right)$.

[1] I use Holston et al. (2023) updated version of the Laubach and Williams (2003) natural rate.

[2] The FOMC member's preferences, although persistent, can reflect the changes in economic environment or preference of a president who appoints new members, which also may depend on the business cycle state.

[3] Since 1940 each year 4/12 FOMC memberships rotate among 11 FRB presidents. Cleveland and Chicago get a seat

The instrument vector in this case is

$$\left[1 \quad \pi_t^e \quad x_t^e \quad \pi_t^e \times \left(Hawk_t^{IV} - \overline{Hawk}^{IV}\right) \quad x_t^e \times \left(Hawk_t^{IV} - \overline{Hawk}^{IV}\right)\right]$$

Note that the contemporaneous tealbook estimates of the GDP gap and CPI inflation are available only starting from 1987:Q3 and 1979:Q4, respectively. Also all Tealbook series are restricted 2018 Q4 due to 5 year publication lag, what leaves only 124 observations. In order to increase the time-span of the Taylor rule estimated in eq. (2) on the preceding page, I replace the projected CPI inflation with projected deflator inflation and projected GDP gap with projected unemployment gap.[4] Under the replaced measures of inflation and output gap (as unemployment gap) the sample size grows to 202 observations, starting from 1968:Q1.

So, I end up estimating 2 specifications: the specification with projected CPI inflation and projected GDP gap, which I name *short specification*, and the specification with projected GDP price inflation and unemployment gap, named *long specification*. Both specifications, assuming stable Okun's law (linear relation between GDP gap and unemployment gap), essentially measure the same Taylor rule, but using different measures for inflation and gap in economic activity.

2.2 Endogeneity Bias

Note, that ideally in order to estimate eq. (2) on the previous page we want to instrument not only $Hawk_t$ but also the other main variables of interest, namely FOMC inflation and output gap projections. In order to find some orthogonal variation

Carvalho et al. (2021) argues that the monetary policy shocks tend to explain a small fraction[5] of the variance of regressors typically included in monetary policy rules, the endogeneity bias tends to be small.

3 Results

3.1 Response to expected Inflation and Output gap

3.1.1 Short Specification

The estimated coefficients of interest of the short regression can be found in fig. 1 and table 2 on the following page and on page 5. They are mean and differential response to a unit increase in tealbook projected CPI inflation and GDP gap. The differential responses is shown under the deviation of $Hawk_t$ from its mean equal to 2/12, which is slightly higher than one standard deviation. The coefficients for several selected quarters for the main regressors of interest can be seen in table 2 on page 5.

every second year and Philadelphia, Richmond, Boston, Dallas, Atlanta, St. Louis, Minneapolis, San Francisco, Kansas City – every third year. By construction this rotation is independent of the business cycle.

[4] I define projected unemployment gap as the difference between tealbook projection of unemployment and projection of NAIRU. As previously, following Coibion and Gorodnichenko (2011), the projection is an average between T+1 and T+2 projections.

[5] Also note that due to the increasing use of policies that rely on expectations management (i.e. forward guidance), central banks have become more opened, what leads to decrease in share of movement in rates due to monetary policy shocks.

The average response of the $(r - r^*)$ are larger than zero up on 95% confidence to 8th quarter. The impact of hawkishness of FOMC on the effect of a change in projected inflation becomes prominent after 3rd quarter and is negative, that is the additional 2 hawk members of FOMC reduce the response to inflation by 0.3 percentage points starting from the 3rd quarter. Note that the effect of hawks on response to inflation becomes not distinguishable from zero from the 7th quarter.

Figure 1. Policy Response to Inflation and FOMC Hawkishness. Short Specification

(a) Average Resp. to Projected CPI Inflation **(b)** Differential Resp. to Projected CPI Inflation

(c) Average Resp. to Projected GDP Gap **(d)** Differential Resp. to Projected GDP Gap

Notes: This figure reports the responses of the $(r - r^*)_t$ to an increase in the Tealbook CPI inflation forecast and GDP gap forecast of 1 p.p. The subfigure 1a reports the response of $(r - r^*)_t$ to projected CPI inflation for the *HAWK* index equal to the sample average; 1b is the addition to the response in case there are 2 (out of 12 in total) additional consistent hawks in the FOMC. Subfigures 1c and 1d report the same for the increase in projected GDP gap for 1p.p. The shaded areas correspond to 68%, 90% and 95% confidence bands calculated with HAC estimator with Andrews (1991) weighting.

3.1.2 Long Specification

Hack et al. (2023) (in appendix named "Validation Exercise") estimates the model similar to eq. (2) on page 2 under long specification, but under assumption that the systematic monetary policy responds only to inflation. My estimates in fig. 2 on page 6 and table 3 on the next page average and differential responses of $r_t - r_t^*$ to CPI inflation tend to be smaller compared to the estimations of Hack et al. (2023). The difference is due to the fact that Hack et al. (2023) 1) do not correct the fed funds rate for the natural rate of interest, i.e. estimate the response of r_t, and 2) assume that the monetary authority systematic policy respond only to inflation.

Table 2. Estimates of Short LP Taylor Rule

	Dependent variable: $(r - r^*)_{t+h}$						
	$h = 0$	$h = 2$	$h = 4$	$h = 6$	$h = 8$	$h = 10$	$h = 12$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Expected CPI Inflation,	0.175^{**}	0.570^{***}	0.923^{***}	0.856^{***}	0.791^{***}	0.738^{**}	0.596
ΔCPI_t^e	(0.073)	(0.157)	(0.263)	(0.308)	(0.281)	(0.342)	(0.448)
$\times \left(Hawk_t - \overline{Hawk}\right)$	0.170	−0.191	-1.600^{**}	-2.224^{**}	−1.741	-2.091^{*}	-2.070^{*}
	(0.186)	(0.530)	(0.749)	(1.094)	(1.122)	(1.193)	(1.193)
Expected GDP Gap, x_t^e	0.177^{***}	0.483^{***}	0.709^{***}	0.815^{***}	0.733^{***}	0.653^{**}	0.633^{*}
	(0.058)	(0.180)	(0.157)	(0.160)	(0.176)	(0.271)	(0.325)
$\times \left(Hawk_t - \overline{Hawk}\right)$	0.089^{*}	0.158	0.002	−0.122	−0.013	0.217	0.263
	(0.046)	(0.156)	(0.244)	(0.302)	(0.320)	(0.308)	(0.308)
$\left(Hawk_t - \overline{Hawk}\right)$	−0.146	0.875	3.991^{*}	6.539^{**}	7.241^{**}	8.725^{**}	7.998^{**}
	(0.446)	(1.321)	(2.151)	(3.167)	(3.432)	(3.640)	(3.928)
Observations	122	122	122	122	122	120	118
R^2	0.983	0.912	0.784	0.647	0.528	0.416	0.373
Adjusted R^2	0.981	0.898	0.749	0.590	0.451	0.318	0.266
Residual Std. Error	0.322	0.716	1.063	1.295	1.457	1.582	1.622
Wu-Hausman	0.395	0.352	0.718	1.891	6.496^{***}	15.97^{***}	15.05^{***}

Notes: This table reports the estimates of the coefficients of interest in model in eq. (2) on page 2 with projected inflation measured as a projected change in CPI. The Andrews (1991) HAC standard errors are in parenthesis. All of the coefficients can be seen in table B.1 on page 10. Weak Instrument F-statistics (for $h = 0$) are HAWK: 53.5***; interaction with CPI inflation: 42.2***, interaction with GDP gap: 51.4***. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

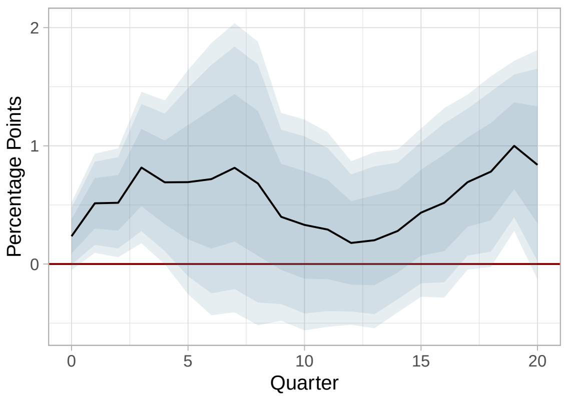
Table 3. Estimates of Long LP Taylor Rule

	Dependent variable: $(r - r^*)_{t+h}$						
	$h = 0$	$h = 2$	$h = 4$	$h = 6$	$h = 8$	$h = 10$	$h = 12$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Expected Deflator	0.235	0.518^{**}	0.691^{*}	0.718	0.681	0.331	0.178
Inflation, $\Delta Deflator_t^e$	(0.235)	(0.235)	(0.354)	(0.587)	(0.613)	(0.455)	(0.353)
$\times \left(Hawk_t - \overline{Hawk}\right)$	0.716	1.554^{**}	2.216^{***}	3.466^{***}	2.588^{**}	1.612	0.507
	(0.654)	(0.654)	(0.510)	(1.105)	(1.306)	(1.347)	(1.320)
Expected Unemployment	-1.192^{**}	-1.268^{**}	-1.908^{***}	-1.991^{***}	-1.267^{**}	-1.012^{*}	−0.871
Gap, $(u - u^*)_t^e$	(0.597)	(0.597)	(0.420)	(0.462)	(0.627)	(0.573)	(0.591)
$\times \left(Hawk_t - \overline{Hawk}\right)$	−0.168	-0.621^{*}	−0.541	−0.109	−0.074	−0.495	−0.345
	(0.338)	(0.338)	(0.430)	(0.615)	(0.716)	(0.746)	(0.808)
$\left(Hawk_t - \overline{Hawk}\right)$	−1.797	-3.636^{**}	-4.432^{***}	-6.435^{**}	−3.606	−1.688	0.305
	(1.477)	(1.477)	(1.431)	(2.614)	(3.186)	(3.162)	(2.740)
Observations	200	200	200	200	200	198	196
R^2	0.960	0.848	0.768	0.650	0.606	0.609	0.634
Adjusted R^2	0.956	0.833	0.746	0.618	0.569	0.572	0.600
Residual Std. Error	0.741	1.438	1.775	2.183	2.332	2.331	2.265
Wu-Hausman	2.268^{*}	6.267^{***}	6.322^{***}	16.09^{***}	9.765^{***}	5.584^{***}	2.04

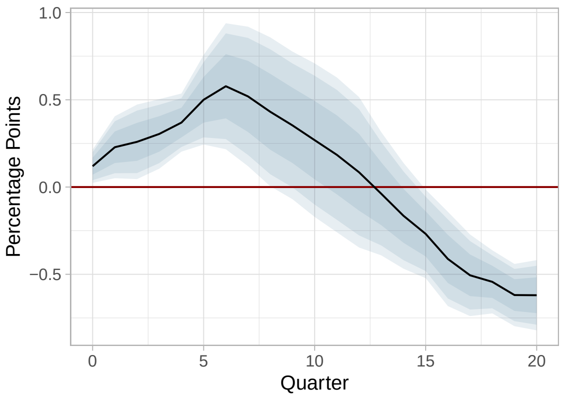
Notes: This table reports the estimates of the coefficients of interest in model in eq. (2) on page 2 with projected inflation measured as a projected change in GDP deflator and projected gap is the gap in unemployment. The Andrews (1991) HAC standard errors are in parenthesis. Weak Instrument statistics (for $h = 0$) are the following, hawk: 64.8; interaction with deflator inflation: 64.2, interaction with unemployment gap: 79.5. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Figure 2. Policy Response to Projected Deflator Inflation and Unemployment Gap and FOMC Hawkishness. (Long Specification)

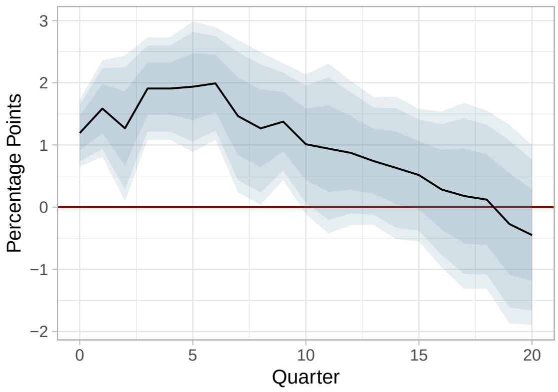
(a) Average Resp. to Deflator Inflation



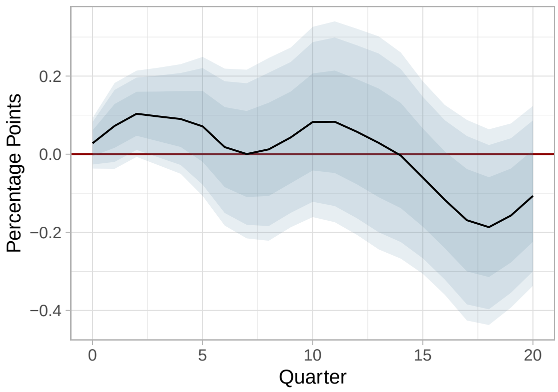
(b) Differential Resp. to Deflator Inflation



(c) Average Resp. to Unemployment Gap



(d) Differential Resp. to Unemployment Gap



Notes: This figure reports the responses of the $(r - r^*)_t$ to an increase in the Tealbook deflator inflation forecast and $(-)$ unemployment gap forecast of 1 p.p.. The subfigure 2a reports the response of $(r - r^*)_t$ to projected deflator inflation for the *HAWK* index equal to the sample average; 2b is the addition to the response in case there are 2 (out of 12 in total) additional consistent hawks in the FOMC. Subfigures 2c and 2d report the same for the increase in projected GDP gap for 1p.p. The shaded areas correspond to 68%, 90% and 95% confidence bands calculated with HAC estimator with Andrews (1991) weighting.

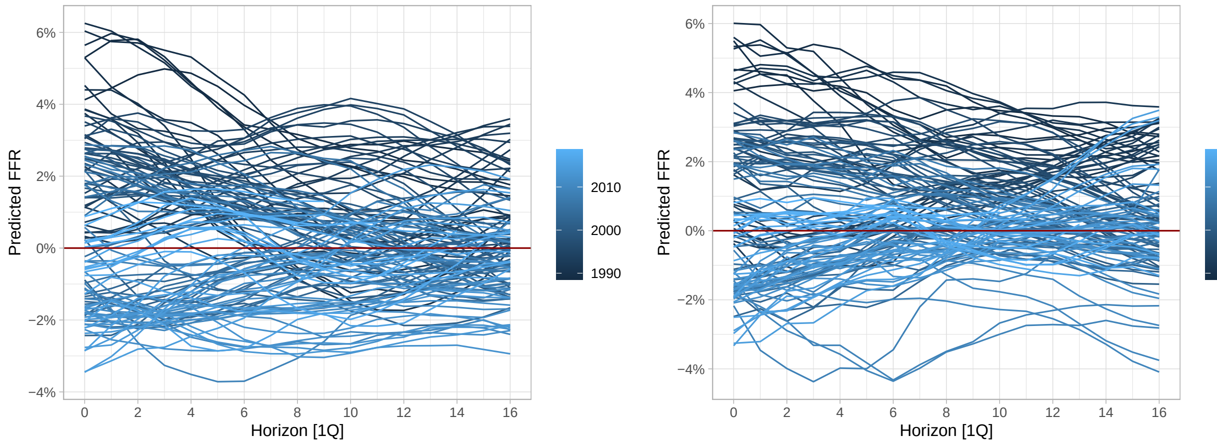
3.2 Historical Estimates of Size and Persistence

One of the advantages of using state-dependent local projection framework is that we can look at the fitted values as a predictions of FFR paths made in each period of time. The fig. 3 shows the point-predictions made using the model eq. (2) on page 2 based on the FOMC composition and tealbook projections of inflation and output gap. I restrict the prediction horizon to 16 quarters, which represent the

The predicted pathes are hard to analyze, so one of the ways to look at them[6] is to estimate the size and persistence of monetary policy. Deviating from Kaplan et al. (2018) the size is defined as a mean of predicted rate path

Figure 3. Predictions of FFR Paths Made in Each of the Period.

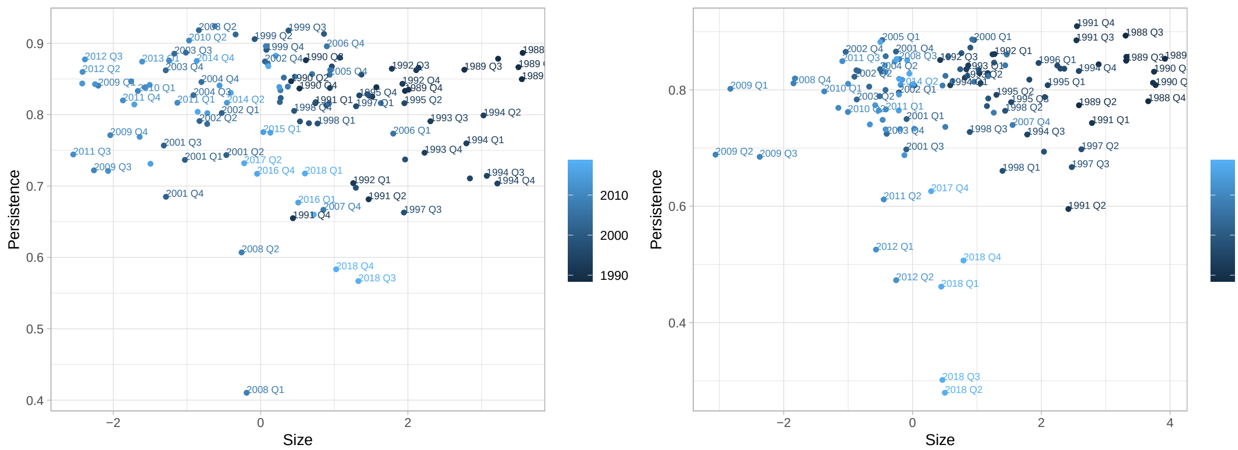
(a) Short Specification **(b)** Long Specification



Notes: This figure shows the eq. (2) on page 2 model predictions of FFR rate paths made in each period of time for 2 specifications. The prediction period is restricted to start at 1988 Q3 for both specifications.

Figure 4. Historical Estimates of Size and Persistence

(a) Short Specification **(b)** Long Specification



Notes: This figure shows the size and persistence calculated as in for 2 specifications. The prediction period is restricted to start at 1988 Q3 for both specifications.

[6]Which is inspired by the size-persistence tradeoff in heterogeneous agent new keynesian model (HANK) by Kaplan et al. (2018)

References

Andrews, Donald W K (1991) "Heteroskedasticity and Autocorrelation Consistent Covariance Matrix Estimation," *Econometrica*, 59 (3), 817–858, `http://www.jstor.org/stable/2938229`.

Bordo, Michael and Klodiana Istrefi (2023) "Perceived FOMC: The making of hawks, doves and swingers," *Journal of Monetary Economics*, 136, 125–143, https://doi.org/10.1016/j.jmoneco.2023.03.001.

Carvalho, Carlos, Fernanda Nechio, and Tiago Tristão (2021) "Taylor rule estimation by OLS," *Journal of Monetary Economics*, 124, 140–154, https://doi.org/10.1016/j.jmoneco.2021.10.010.

Coibion, Olivier and Yuriy Gorodnichenko (2011) "Monetary Policy, Trend Inflation, and the Great Moderation: An Alternative Interpretation," *The American Economic Review*, 101 (1), 341–370, `http://www.jstor.org/stable/41038791`.

Hack, Lukas, Klodiana Istrefi, and Matthias Meier (2023) "Identification of Systematic Monetary Policy," CEPR Discussion Paper 17999.

Holston, Kathryn, Thomas Laubach, and John C. Williams (2023) "Measuring the Natural Rate of Interest after COVID-19," Staff Reports 1063, Federal Reserve Bank of New York.

Istrefi, Klodiana (2019) "In Fed Watchers' Eyes: Hawks, Doves and Monetary Policy," Working papers 725, Banque de France, `https://ideas.repec.org/p/bfr/banfra/725.html`.

Jorda, Oscar and Kevin Hoover (2000) "Measuring Systematic Monetary Policy," Working Papers 203, University of California, Davis, Department of Economics, `https://ideas.repec.org/p/cda/wpaper/203.html`.

Kaplan, Greg, Benjamin Moll, and Giovanni L. Violante (2018) "Monetary Policy According to HANK," *American Economic Review*, 108 (3), 697–743, 10.1257/aer.20160042.

Laubach, Thomas and John C. Williams (2003) "Measuring the Natural Rate of Interest," *The Review of Economics and Statistics*, 85 (4), 1063–1070, `http://www.jstor.org/stable/3211826`.

Romer, Christina D. and David H. Romer (2004) "A New Measure of Monetary Shocks: Derivation and Implications," *American Economic Review*, 94 (4), 1055–1084, 10.1257/0002828042002651.

Wu, Jing Cynthia and Fan Dora Xia (2016) "Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound," *Journal of Money, Credit and Banking*, 48 (2-3), 253–291, https://doi.org/10.1111/jmcb.12300.

A Appendix. Data sources

HAWK and HAWK IV Indexes. Istrefi (2019) classifies each FOMC member as hawk or dove based on more than 20,000 historical media articles.Istrefi (2019) categorizes FOMC member for each FOMC meeting based on the news information available up to the meeting. Hawks are perceived to be more concerned about inflation, while doves are more concerned with employment and growth. Bordo and Istrefi (2023) show that educational background (Freshwater vs. Saltwater) and crises experience of FOMC member predict their policy preferences.

Hack et al. (2023) aggregate this classification as follows. First, they define the policy preferences of each FOMC member i at meeting τ, $Hawk_{i\tau}$, as

$$Hawk_{i\tau} = \begin{cases} +1 & \text{Consistent hawk} \\ +\frac{1}{2} & \text{Swinging hawk} \\ 0 & \text{Preference unknown} \\ -\frac{1}{2} & \text{Swinging dove} \\ -1 & \text{Consistent dove} \end{cases}.$$

A consistent hawk is a member that has not been categorized as a dove previously, in contrast a swinging hawk is a member that was a dove before. Then the hawkishness of the bord at meeting τ is the average of the members present, that is

$$Hawk_{\tau} = \frac{1}{|\mathcal{M}_{\tau}|} \sum_{i \in \mathcal{M}_{\tau}} Hawk_{i\tau}.$$

Then $Hawk_{\tau}$ is aggregated to the quarterly level into $Hawk_t$, which is used in this work.

$Hawk_t^{IV}$ is constructed the similar way but on the portion of the FOMC memberships that is rotated each year. Each year 4/12 FOMC memberships rotate among 11 FRB presidents (Cleveland and Chicago get a seat every second year and Philadelphia, Richmond, Boston, Dallas, Atlanta, St. Louis, Minneapolis, San Francisco, Kansas City – every third year) and this rotation is independent of cycle.

Federal Funds Rate. To measure r_t I take the minimum of the effective federal funds rate (DFF) and shadow federal funds rate by Wu and Xia (2016). This approach allows me to deal the zero lower bound episode and have a measure of the the estimate by Wu and Xia (2016) to periods earlier than (1990 Q1) zero lower bound episodes.

Natural Rate Estimates. Natural rate of interest used is estimated by Laubach and Williams (2003) and re-estimated by Holston et al. (2023) to bridge the Covid period.

Tealbook Projections.

B Appendix. Regression Tables

Table B.1. Estimates of Short LP Taylor Rule

	Dependent variable: $(r - r^*)_{t+h}$						
	$h = 0$	$h = 2$	$h = 4$	$h = 6$	$h = 8$	$h = 10$	$h = 12$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Expected CPI Inflation, ΔCPI_t^e	0.175**	0.570***	0.923***	0.856***	0.791***	0.738**	0.596
	(0.073)	(0.157)	(0.263)	(0.308)	(0.281)	(0.342)	(0.448)
$\times \left(Hawk_t - \overline{Hawk}\right)$	0.170	−0.191	−1.600**	−2.224**	−1.741	−2.091*	−2.070
	(0.186)	(0.530)	(0.749)	(1.094)	(1.122)	(1.193)	(1.473)
Expected GDP Gap, x_t^e	0.177***	0.483***	0.709***	0.815***	0.733***	0.653**	0.633*
	(0.058)	(0.180)	(0.157)	(0.160)	(0.176)	(0.271)	(0.325)
$\times \left(HAWK - \overline{HAWK}\right)_t$	0.089*	0.158	0.002	−0.122	−0.013	0.217	0.263
	(0.046)	(0.156)	(0.244)	(0.302)	(0.320)	(0.308)	(0.403)
$\left(HAWK - \overline{HAWK}\right)_t$	−0.146	0.875	3.991*	6.539**	7.241**	8.725**	7.998**
	(0.446)	(1.321)	(2.151)	(3.167)	(3.432)	(3.640)	(3.928)
$(r - r^*)_{t-1}$	1.308***	1.454***	0.962***	0.423	−0.050	−0.464	−0.938
	(0.143)	(0.302)	(0.351)	(0.415)	(0.443)	(0.551)	(0.685)
$(r - r^*)_{t-2}$	−0.274	−0.666***	−0.548	−0.050	0.336	0.220	0.263
	(0.207)	(0.231)	(0.342)	(0.391)	(0.394)	(0.520)	(0.580)
$(r - r^*)_{t-3}$	−0.244	−0.458***	−0.059	0.030	−0.036	0.148	0.328
	(0.156)	(0.177)	(0.306)	(0.365)	(0.377)	(0.376)	(0.385)
$(r - r^*)_{t-4}$	0.031	0.145	−0.172	−0.612	−0.990***	−1.140***	−1.076**
	(0.098)	(0.236)	(0.346)	(0.376)	(0.358)	(0.441)	(0.503)
ΔCPI_{t-1}^e	0.005	0.093	−0.005	0.076	0.089	0.170	0.290
	(0.071)	(0.101)	(0.137)	(0.172)	(0.163)	(0.228)	(0.241)
ΔCPI_{t-2}^e	0.057	0.184	0.030	−0.062	0.005	0.177	0.340
	(0.084)	(0.188)	(0.287)	(0.320)	(0.351)	(0.357)	(0.355)
ΔCPI_{t-3}^e	0.134*	0.084	0.181	0.249	0.270	0.433	0.459*
	(0.069)	(0.128)	(0.187)	(0.255)	(0.274)	(0.277)	(0.236)
ΔCPI_{t-4}^e	−0.077	−0.127	−0.007	0.200	0.575***	0.901***	1.183***
	(0.056)	(0.121)	(0.184)	(0.168)	(0.173)	(0.248)	(0.273)
x_{t-1}^e	−0.057	−0.208	−0.340*	−0.567***	−0.529**	−0.494**	−0.412*
	(0.089)	(0.166)	(0.183)	(0.181)	(0.231)	(0.238)	(0.243)
x_{t-2}^e	−0.102	−0.064	0.107	0.268	0.251	0.417**	0.371*
	(0.074)	(0.127)	(0.194)	(0.229)	(0.212)	(0.202)	(0.224)
x_{t-3}^e	0.044	−0.023	−0.427**	−0.644**	−0.669*	−0.715	−0.704
	(0.099)	(0.118)	(0.191)	(0.286)	(0.354)	(0.449)	(0.488)
x_{t-4}^e	0.022	−0.010	0.072	0.182	0.326	0.378	0.427
	(0.062)	(0.112)	(0.202)	(0.240)	(0.240)	(0.275)	(0.311)
Constant	−0.546**	−1.428**	−1.829	−1.944	−2.587	−3.800**	−4.825**
	(0.219)	(0.666)	(1.174)	(1.614)	(1.801)	(1.907)	(2.002)
Observations	122	122	122	122	122	120	118
R^2	0.983	0.912	0.784	0.647	0.528	0.416	0.373
Adjusted R^2	0.981	0.898	0.749	0.590	0.451	0.318	0.266
Residual Std. Error	0.322	0.716	1.063	1.295	1.457	1.582	1.622
Wu-Hausman	0.395	0.352	0.718	1.891	6.496***	15.97***	15.05***

Notes: This table reports the estimates of the coefficients of interest in model in eq. (2) on page 2 with projected inflation measured as a projected change in CPI. The Andrews (1991) HAC standard errors are in parenthesis. Weak Instrument statistics (for $h = 0$) are HAWK: 53.5; interaction with CPI inflation: 42.2, interaction with GDP gap: 51.4. $^*p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Table B.2. First Stage of the Short LP Model

	Dependent variable:		
	$\left(Hawk_t - \overline{Hawk}\right)$	$\times CPI_t^e$	$\times x_t$
	(1)	(2)	(3)
Expected CPI Inflation, ΔCPI_t^e	0.017	0.057	0.127**
	(0.034)	(0.084)	(0.055)
$\times \left(HAWK^{IV} - \overline{HAWK}^{IV}\right)_t$	−0.124***	0.144	−0.168**
	(0.044)	(0.109)	(0.071)
Expected GDP Gap, x_t^e	0.022	0.039	0.032
	(0.028)	(0.070)	(0.046)
$\times \left(HAWK^{IV} - \overline{HAWK}^{IV}\right)_t$	0.031**	0.030	−0.258***
	(0.016)	(0.038)	(0.025)
$\left(HAWK^{IV} - \overline{HAWK}^{IV}\right)_t$	0.776***	0.779***	0.408**
	(0.108)	(0.267)	(0.175)
$(r - r^*)_{t-1}$	0.041	−0.018	−0.125
	(0.052)	(0.128)	(0.084)
$(r - r^*)_{t-1}$	−0.013	0.003	0.030
	(0.082)	(0.203)	(0.133)
$(r - r^*)_{t-1}$	−0.041	0.081	−0.062
	(0.082)	(0.203)	(0.133)
$(r - r^*)_{t-1}$	0.090*	0.061	−0.021
	(0.048)	(0.118)	(0.077)
ΔCPI_{t-1}^e	−0.002	0.037	0.110*
	(0.038)	(0.093)	(0.061)
ΔCPI_{t-2}^e	0.047	0.052	0.140**
	(0.039)	(0.095)	(0.062)
ΔCPI_{t-3}^e	0.011	0.066	0.070
	(0.037)	(0.091)	(0.059)
ΔCPI_{t-4}^e	0.014	0.092	0.056
	(0.033)	(0.081)	(0.053)
x_{t-1}^e	−0.016	−0.051	−0.016
	(0.047)	(0.116)	(0.076)
x_{t-2}^e	−0.007	0.053	0.044
	(0.045)	(0.112)	(0.073)
x_{t-3}^e	0.002	−0.087	−0.042
	(0.043)	(0.107)	(0.070)
x_{t-4}^e	0.004	0.015	0.126***
	(0.030)	(0.073)	(0.048)
Constant	−0.340***	−0.843***	−1.058***
	(0.076)	(0.188)	(0.123)
Observations	122	122	122
R^2	0.857	0.814	0.866
Adjusted R^2	0.833	0.783	0.844
Residual Std. Error	0.162	0.399	0.261
F Statistic	36.591***	26.699***	39.550***
Weak instrument F	53.576	42.241	51.408

Notes: The Andrews (1991) HAC standard errors are in parenthesis. $^*p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Table B.3. Estimates of Long LP Taylor Rule

	Dependent variable: $(r - r^*)_{t+h}$						
	$h = 0$	$h = 2$	$h = 4$	$h = 6$	$h = 8$	$h = 10$	$h = 12$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Expected Deflator Inflation, $\Delta Deflator^e_t$	0.235	0.518**	0.691*	0.718	0.681	0.331	0.178
	(0.235)	(0.235)	(0.354)	(0.587)	(0.613)	(0.455)	(0.353)
$\times \left(Hawk_t - \overline{Hawk}\right)$	0.716	1.554**	2.216***	3.466***	2.588**	1.612	0.507
	(0.654)	(0.654)	(0.510)	(1.105)	(1.306)	(1.347)	(1.320)
Expected Unemployment Gap, $(u - u^*)_t$	−1.192**	−1.268**	−1.908***	−1.991***	−1.267**	−1.012*	−0.871
	(0.597)	(0.597)	(0.420)	(0.462)	(0.627)	(0.573)	(0.591)
$\times \left(Hawk_t - \overline{Hawk}\right)$	−0.168	−0.621*	−0.541	−0.109	−0.074	−0.495	−0.345
	(0.338)	(0.338)	(0.430)	(0.615)	(0.716)	(0.746)	(0.808)
$\left(Hawk_t - \overline{Hawk}\right)$	−1.797	−3.636**	−4.432***	−6.435**	−3.606	−1.688	0.305
	(1.477)	(1.477)	(1.431)	(2.614)	(3.186)	(3.162)	(2.740)
$(r - r^*)_{t-1}$	1.005***	0.485***	0.485**	−0.056	0.043	−0.355*	−0.416**
	(0.176)	(0.176)	(0.208)	(0.232)	(0.184)	(0.186)	(0.177)
$(r - r^*)_{t-2}$	−0.169	0.146	0.101	0.466***	0.261	0.198**	0.088
	(0.202)	(0.202)	(0.212)	(0.166)	(0.210)	(0.085)	(0.229)
$(r - r^*)_{t-3}$	0.147	0.411**	0.024	0.273*	−0.186	−0.071	−0.186
	(0.180)	(0.180)	(0.146)	(0.162)	(0.199)		(0.161)
$(r - r^*)_{t-4}$	0.054	−0.113	0.168	−0.030	0.171	0.195	0.208
	(0.160)	(0.160)	(0.216)	(0.259)	(0.291)	(0.311)	(0.281)
$\Delta Deflator^e_{t-1}$	0.038	0.157	−0.116	0.030	−0.367	−0.019	−0.0005
	(0.196)	(0.196)	(0.215)	(0.240)	(0.377)	(0.252)	(0.334)
$\Delta Deflator^e_{t-2}$	−0.138	−0.160	−0.052	−0.155	0.042	0.107	0.323**
	(0.367)	(0.367)	(0.221)	(0.256)	(0.311)	(0.216)	(0.161)
$\Delta Deflator^e_{t-3}$	0.109	−0.410	−0.237	−0.814**	−0.337	−0.176	0.150
	(0.262)	(0.262)	(0.277)	(0.358)	(0.306)	(0.262)	(0.104)
$\Delta Deflator^e_{t-4}$	−0.346	−0.143	−0.357	−0.112	0.194	0.708**	0.917***
	(0.247)	(0.247)	(0.413)	(0.419)	(0.371)	(0.344)	(0.354)
$(u - u^*)_{t-1}$	1.220	0.244	1.011**	0.763	0.088	−0.269	−0.244
	(0.799)	(0.799)	(0.441)	(0.639)	(1.096)	(1.009)	(0.780)
$(u - u^*)_{t-2}$	0.057	0.248	−0.074	0.589	0.779	0.289	0.029
	(0.178)	(0.178)	(0.320)	(0.572)	(0.882)	(0.569)	(0.491)
$(u - u^*)_{t-3}$	−0.615*	0.474	0.963*	0.847	0.088	0.190	0.180
	(0.320)	(0.320)	(0.510)	(0.722)	(0.728)	(0.523)	(0.620)
$(u - u^*)_{t-4}$	0.333	−0.138	−0.448	−0.626	0.045	0.396	0.558
	(0.298)	(0.298)	(0.569)	(0.676)	(0.582)	(0.484)	(0.597)
Constant	0.082	−0.111	0.051	0.663	−0.095	−1.352	−2.355**
	(0.555)	(0.555)	(0.656)	(0.968)	(1.074)	(1.174)	(1.090)
Observations	200	200	200	200	200	198	196
R^2	0.960	0.848	0.768	0.650	0.606	0.609	0.634
Adjusted R^2	0.956	0.833	0.746	0.618	0.569	0.572	0.600
Residual Std. Error	0.741	1.438	1.775	2.183	2.332	2.331	2.265
Wu-Hausman	2.268*	6.267***	6.322***	16.09***	9.765***	5.584***	2.04

Notes: The Andrews (1991) HAC standard errors are in parenthesis. Weak Instrument statistics (for $h = 0$) are HAWK: 64.8; interaction with deflator inflation: 64.2, interaction with unemployment gap: 79.5. $^*p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Table B.4. First-Stage of the Long LP Model

	Dependent variable:		
	$\left(Hawk_t - \overline{Hawk}\right)$	$\times\Delta Deflator_t^e$	$\times(u-u^*)_t$
	(1)	(2)	(3)
Expected Deflator Inflation, $\Delta Deflator_t^e$	−0.008	−0.024	−0.053
	(0.031)	(0.080)	(0.047)
$\times\left(Hawk_t^{IV} - \overline{Hawk}^{IV}\right)$	−0.081***	0.169***	−0.010
	(0.020)	(0.053)	(0.031)
$(u-u^*)_t$	−0.027	−0.091	−0.089
	(0.046)	(0.120)	(0.070)
$\times\left(Hawk_t^{IV} - \overline{HAWK}^{IV}\right)$	−0.094***	−0.160***	0.481***
	(0.021)	(0.054)	(0.031)
$\left(Hawk_t^{IV} - \overline{Hawk}^{IV}\right)$	0.703***	0.785***	−0.023
	(0.067)	(0.174)	(0.101)
$(r-r^*)_{t-1}$	−0.007	−0.040	−0.039
	(0.019)	(0.048)	(0.028)
$(r-r^*)_{t-2}$	−0.017	−0.077	0.007
	(0.027)	(0.069)	(0.040)
$(r-r^*)_{t-3}$	0.008	0.023	0.013
	(0.027)	(0.069)	(0.040)
$(r-r^*)_{t-4}$	0.040**	0.041	0.042
	(0.018)	(0.048)	(0.028)
$\Delta Deflator_{t-1}^e$	−0.006	−0.006	−0.022
	(0.043)	(0.112)	(0.065)
$\Delta Deflator_{t-2}^e$	0.026	0.084	0.021
	(0.043)	(0.111)	(0.064)
$\Delta Deflator_{t-3}^e$	−0.002	0.075	0.002
	(0.043)	(0.112)	(0.065)
$\Delta Deflator_{t-4}^e$	0.059*	0.271***	0.115**
	(0.032)	(0.084)	(0.049)
$(u-u^*)_{t-1}$	−0.019	0.070	0.045
	(0.083)	(0.214)	(0.124)
$(u-u^*)_{t-2}$	−0.074	−0.257	−0.082
	(0.088)	(0.228)	(0.133)
$(u-u^*)_{t-3}$	0.039	0.055	0.076
	(0.085)	(0.220)	(0.128)
$(u-u^*)_{t-4}$	0.003	0.102	−0.072
	(0.050)	(0.130)	(0.076)
Constant	−0.214***	−0.789***	−0.249***
	(0.035)	(0.091)	(0.053)
Observations	200	200	200
R^2	0.744	0.830	0.795
Adjusted R^2	0.720	0.814	0.776
Residual Std. Error	0.191	0.493	0.287
F Statistic	31.172***	52.315***	41.549***
Weak Instrument F	64.791	64.147	79.475

Notes: The Andrews (1991) HAC standard errors are in parenthesis. $^*p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.