# Systematic Monetary Policy Approach to Taylor Rule

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**Abstract**

This work estimates the time-varying Taylor rule using FOMC members' preferences. I show that the dovish FOMC board delays policy rate hikes in response to increase in inflation projection. The effect is less pronounced for changes in output gap.

**Keywords:** Systematic Monetary Policy, Taylor Rule, FOMC

**JEL Codes:** E21, E52, E12

## 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 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. Specifically, 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 $\pi_{t+1}^e$ 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 augmented with IV model (Jorda, 2005; Plagborg-Møller and Wolf, 2021)

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

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] $\pi_t^e$ 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, $\pi_t^e$, 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

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[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

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 $\left(Hawk_t^{IV} - \overline{Hawk}^{IV}\right)$.

The instrument vector in this case is

$$\begin{bmatrix} 1 & \pi_t^e & x_t^e & \pi_t^e \times \left(Hawk_t^{IV} - \overline{Hawk}^{IV}\right) & x_t^e \times \left(Hawk_t^{IV} - \overline{Hawk}^{IV}\right) \end{bmatrix}$$

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.

Note that the IRFs LP estimator, unlike IRFs calculated from AR(-DL) models, do not exhibit the mean reversion property (which is a direct consequence of being robust AR model misspecification), which mean that for large horizons, $H$, estimates will be highly inaccurate due to elevated finite sample variance of the estimator (i.e. LP is less efficient than correctly specified AR-DL). Additionally, the fact that LP is instrumented additionally increases the variance of the estimator.[5] For this reason I restrict the projection horizon to 20, $H = 20$ (5 years of quarterly observations), but note that the significance of the projections for larger horizons should be viewed skeptically. For example, if the effects of a change in FOMC's projections become significant only after 10th quarter we should attribute this result to an estimator variation caused by a small sample (which in the case of short specification is only 122 observation).

## 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 in projection of

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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 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]The premium of LP on bias over efficiency, not on minimizing meansquared error loss.

Carvalho et al. (2021) argues that the monetary policy shocks tend to explain a small fraction[6] 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 6. 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 6.

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 (at 10% significance level) starting from the 7th quarter.

Also, from table 2 on page 6 one can note that the

### 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 7 and table 3 on page 6 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.

## 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. 4 on page 8 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 12 quarters, which represent the

The predicted paths are hard to analyze, so one of the ways to look at them, which is inspired by the size-persistence tradeoff in heterogeneous agent new keynesian model (HANK) by Kaplan et al.

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[6]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.

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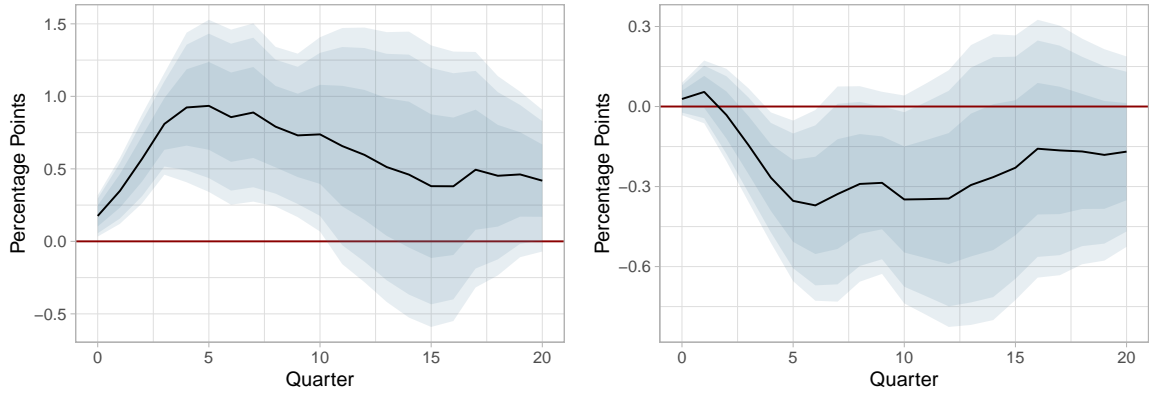
**(c)** Average Resp. to Projected GDP Gap

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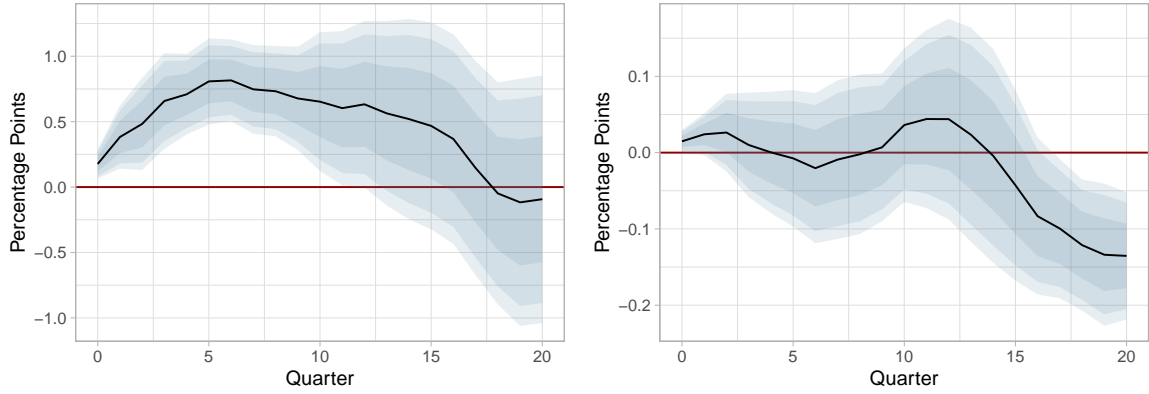


*Notes*: This figure reports the responses of the $(r - r^*)_t$ to an increase in the Tealbook CPI inflation forecast and GDP gap forecast of 1 p.p. The subfigure 1a reports the response of $(r - r^*)_t$ to projected CPI inflation for the *HAWK* index equal to the sample average; 1b is the addition to 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.

**Table 2.** Estimates of Short LP Taylor Rule(selected quarters)

| | 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, $\Delta CPI_t^e$ | 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) | (1.193) |
| 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 12. 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

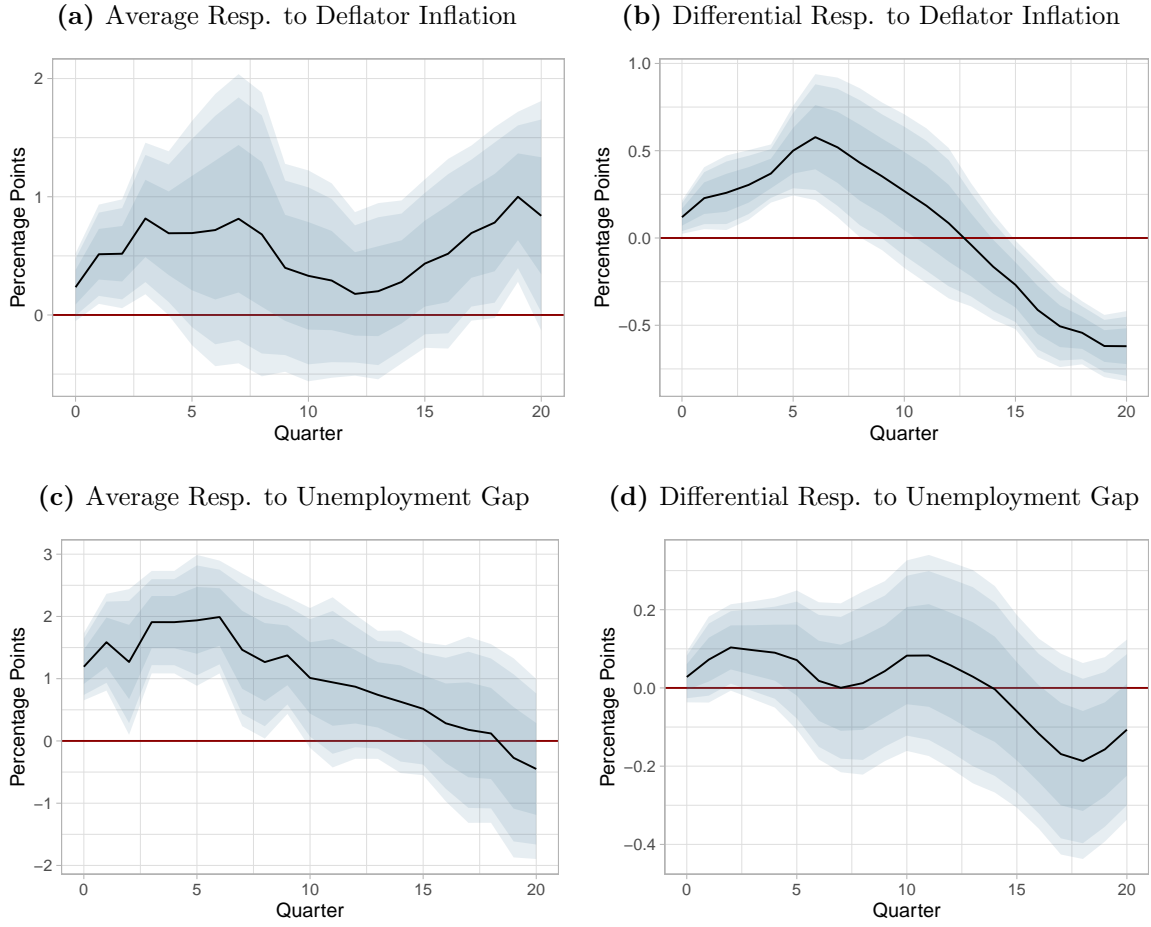| | Dependent variable: $(r - r^*)_{t+h}$ |
| | $h = 0$ | $h = 2$ | $h = 4$ | $h = 6$ | $h = 8$ | $h = 10$ | $h = 12$ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Expected Deflator Inflation, $\Delta Deflator_t^e$ | 0.235 | 0.518** | 0.691* | 0.718 | 0.681 | 0.331 | 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, $(u - u^*)_t^e$ | −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) |
| 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 of 1 p.p. 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.

**Figure 3.** In-sample Predictive Ability ($R^2$) of the Models
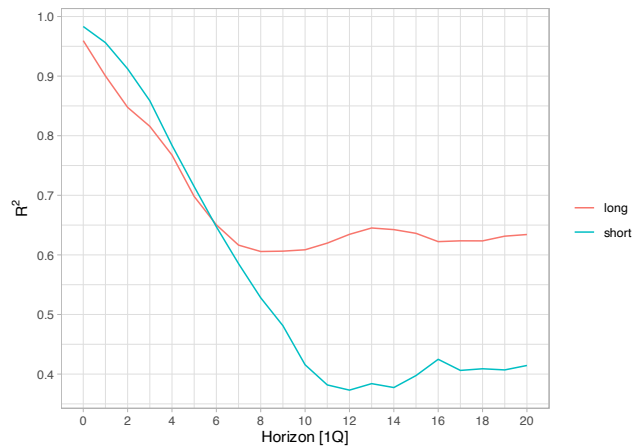
(2018), is to estimate the size and persistence of monetary policy. Contrary from Kaplan et al. (2018), I define the size is defined as a mean of predicted rate path.[7]

**Figure 4.** Predictions of FFR Paths Made in Each of the Period.

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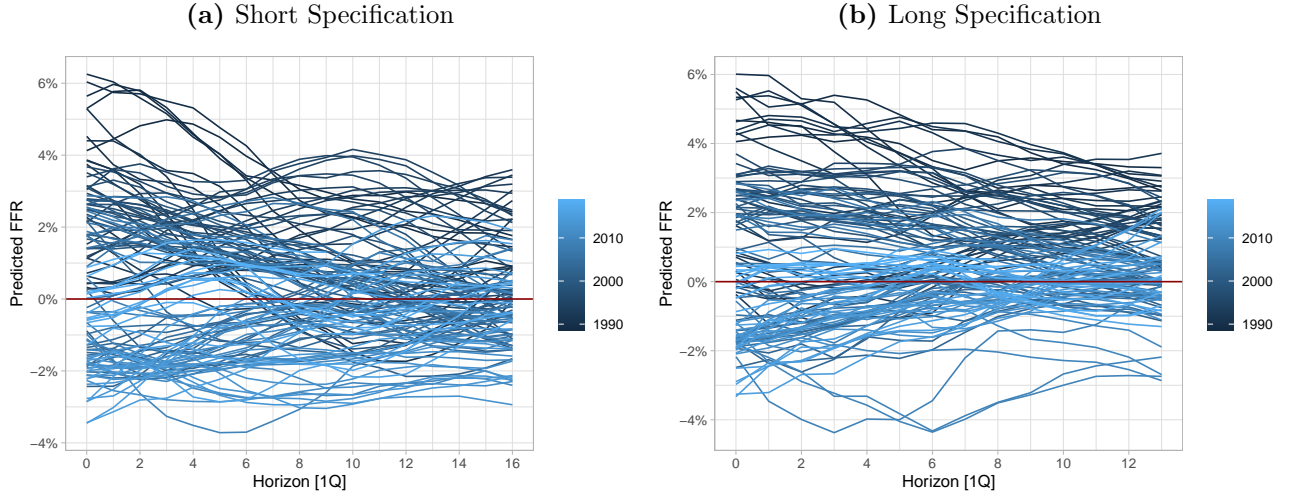


*Notes:* This figure shows the eq. (2) on page 2 model predictions of FFR rate paths made in each period of time for 2 specifications. The prediction period is restricted to start at 1988 Q3 for both specifications.

**Figure 5.** Historical Estimates of Size and Persistence

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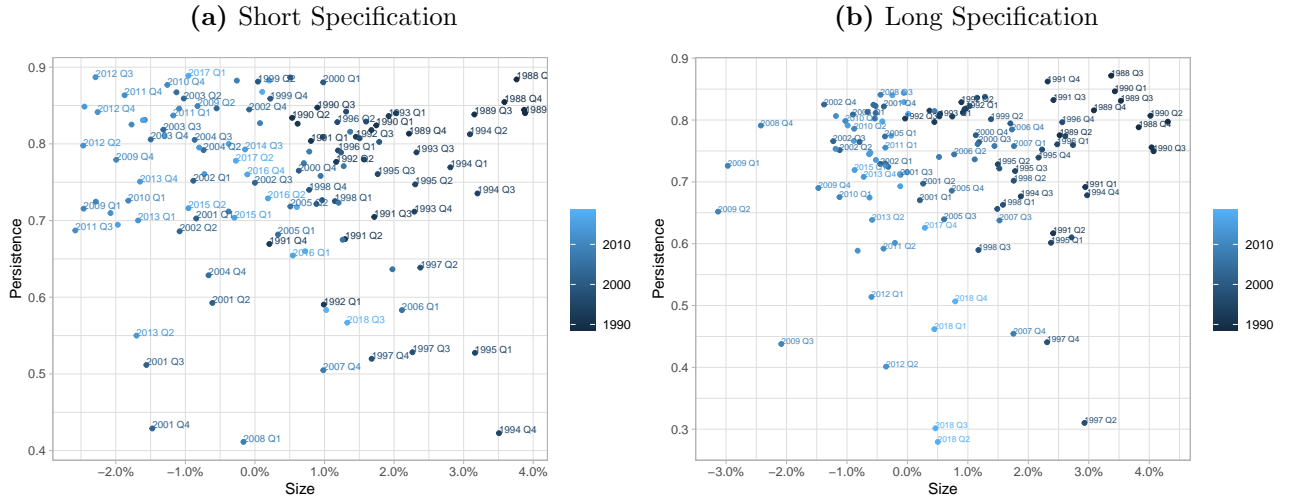


*Notes:* This figure shows the size and persistence calculated as in section 3.2 on page 4 for 2 specifications. The prediction period is restricted to start at 1988 Q3 for both specifications.

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[7]Kaplan et al. (2018) define size as a sum of deviation of rate of interest from natural rate for the whole duration of the policy, i.e. $\sum_{t=1}^{n} r_t - r^*$, the size in my definition is a Kaplan et al. (2018) defined scaled by 1/13.

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# 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 $\tau$, $Hawk_{i\tau}$, 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 $\tau$ 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, $\Delta CPI_t^e$ | 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) |
| $\Delta CPI_{t-1}^e$ | 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) |
| $\Delta CPI_{t-2}^e$ | 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) |
| $\Delta CPI_{t-3}^e$ | 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) |
| $\Delta CPI_{t-4}^e$ | −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

| | $\left(Hawk_t - \overline{Hawk}\right)$ | $\times CPI_t^e$ | $\times x_t$ |
|---|---|---|---|
| | *Dependent variable:* | | |
| | (1) | (2) | (3) |
| Expected CPI Inflation, $\Delta CPI_t^e$ | 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) |
| $\Delta CPI_{t-1}^e$ | −0.002 | 0.037 | 0.110* |
| | (0.038) | (0.093) | (0.061) |
| $\Delta CPI_{t-2}^e$ | 0.047 | 0.052 | 0.140** |
| | (0.039) | (0.095) | (0.062) |
| $\Delta CPI_{t-3}^e$ | 0.011 | 0.066 | 0.070 |
| | (0.037) | (0.091) | (0.059) |
| $\Delta CPI_{t-4}^e$ | 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, $\Delta Deflator_t^e$ | 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) |
| $\Delta Deflator_{t-1}^e$ | 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) |
| $\Delta Deflator_{t-2}^e$ | −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) |
| $\Delta Deflator_{t-3}^e$ | 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) |
| $\Delta Deflator_{t-4}^e$ | −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. $^*p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.