Better on Average? Average Inflation Targeting with an Unclear Averaging Window

James Dean*
Western Carolina University

Abstract

Average inflation targeting (AIT) aims to stabilize inflation expectations by offsetting past deviations from target. However, ambiguity about the averaging window can complicate expectations formation and reduce policy effectiveness. This paper integrates AIT into a benchmark DSGE model, incorporating adaptive learning and a signal extraction problem to examine the trade-offs between policy clarity and ambiguity. Results indicate that inflation is most stable and central bank losses are minimized when the averaging window is 5 years. However, the policy's success depends on transparency about the averaging window, as imperfect information about the averaging window leads to consistently worse outcomes. These findings provide insights into the design of monetary policy frameworks, particularly as central banks revisit their strategies.

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* *Email:* jdean@wcu.edu

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1 Introduction

From 2008-2019, the Federal Reserve's preferred inflation metric, core PCE, averaged 1.6%, consistently below the Fed's stated 2% goal. This persistent undershooting, coupled with a decline in the natural rate of interest[1], raised concerns that interest rates would remain low well into the future. In response, the Fed shifted its framework in September 2020, adopting "flexible average inflation targeting" (AIT). Under this framework, the Fed committed to offset past undershooting of its inflation target with periods of modest overshooting, aiming for inflation to average 2% over time. This approach was intended to re-anchor inflation expectations closer to the Fed's 2% target, improving the likelihood of hitting that target while reducing the frequency of encounters with the lower bound. However, it did not commit to specific rules or an explicit averaging window.

Inflation accelerated in 2021 as the economy reopened and the pandemic subsided. Nevertheless, the Fed held rates near zero and continued quantitative easing until early 2022. When the Fed began raising rates, it did so quickly, raising rates at the fastest pace in decades. This sharp pivot highlights the challenges of operating under an unclear policy framework, where the public must infer policy goals based on observed actions. These events underscore the central question this paper examines—how ambiguity about the Fed's framework affects expectations and economic outcomes. Understanding these dynamics is particularly relevant as the Fed reevaluates its framework, offering an opportunity to refine its approach to balancing credibility and flexibility.

[Figure 1 here.]

The left panel of Figure 1 shows the rise in inflation following the pandemic, and the right panel compares the forecasted response of the fed funds rate under an inflation targeting Taylor Rule (blue dashes), a 5-year average inflation targeting Taylor Rule (pink dashes), and the actual Fed response (black line). Under standard inflation targeting, the Taylor Rule would prescribe a tighter policy faster, while the 5-year AIT Taylor Rule prescribes a slower

[1] See Laubach and Williams [2003], Del Negro et al. [2017], and Hirose and Sunakawa [2023]

response and more closely matched actual fed funds movements until mid-2022. However, through later 2022 and onward, the actual fed funds rate began to converge to the standard inflation targeting forecast.

This paper examines the effects of imperfect information about average inflation targeting, wherein agents must slowly learn the averaging window based on policy movements. To do this, I use a model based on Carlstrom et al. [2017] which allows the central bank to set policy based on an AIT-interest rate rule. Average inflation targeting works as a trade-off between slower policy in the short-term but longer-held policy responses into the future. The model maintains rational expectations but introduces imperfect information specifically about the AIT horizon: agents cannot observe the averaging window J and must infer it from policy innovations via a Kalman filter. This contrasts with Jia and Wu [2023], who analyze credibility and strategic ambiguity about J in a small-scale New Keynesian model with full information; Honkapohja and McClung [2024], who adopt an adaptive learning framework about the structure of the entire model and study when AIT equilibria are stable under such learning; and Wagner et al. [2023], who employ a behavioral New Keynesian model with myopia and show that bounded rationality shortens the optimal AIT window when constrained by the lower bound. This paper, in turn, serves as a benchmark case to evaluate the trade-offs between policy clarity vs. ambiguity in average inflation targeting frameworks. While the Federal Reserve has shown a more asymmetric response to inflation deviations, this paper abstracts from this to isolate the effects of commitment and transparency on expectations and welfare.

Results show that AIT is best conducted with full information about the averaging window and over a period of 5 years. The effectiveness of average inflation targeting depends on its influence on expectations: if it can raise expectations enough to compensate for slower policy responses, it will be more effective than standard inflation targeting. However, imperfect information about the averaging window makes it more difficult for agents to form consistent expectations of future policy, leading to greater instability. In turn, the gains from average inflation targeting disappear under imperfect information relative to a full-information policy.

Taken as a whole, these results are informative for the Fed's future policy framework reviews. Monetary policy faces new obstacles in a post-pandemic world, and as results here would indicate, commitment and clarity about the future of average inflation targeting will be key to the policy's success.

2 Literature

Nessén and Vestin [2005] are the first to consider how average inflation targeting can differ from traditional inflation targeting. They find a price level target strictly dominates both average inflation targeting and standard inflation targeting in a pure forward-looking model. However, when backward-looking elements are introduced, average inflation targeting can improve outcomes compared to price level targeting and standard inflation targeting. Amano et al. [2020] and Budianto et al. [2023] extend this specification by incorporating the zero-lower bound into their analysis. Both find that average inflation targeting improves policy, even with a zero-lower bound, and the degree of history dependence is key to the policy's effectiveness. Importantly, neither Amano et al. [2020] nor Budianto et al. [2023] consider the effect of financial frictions when evaluating average inflation targeting. Jia and Wu [2023] incorporate the time inconsistency of the policy, finding that AIT shifts the Phillips Curve and incentivizes the central bank to deviate from its stated policy, so that uncertainty can help stabilize inflation and output. Honkapohja and McClung [2024] instead use an adaptive learning framework about the structure of the entire model, and as a result, they find that long averaging windows can undermine stability. Wagner et al. [2023] analyze alternative regimes in a New Keynesian model with bounded rationality, showing that the optimal AIT horizon shortens to about 1–3 years when agents are sufficiently myopic. Finally, Bhatnagar [2023] finds that the share of non-Ricardian households impacts the optimal monetary policy rule.

As part of the Federal Reserve's 2020 framework review, which culminated in the adoption of average inflation targeting, several Federal Reserve Finance and Economics Discussion Series (FEDS) papers examined alternative strategies. Arias et al. [2020] show that makeup strategies, including AIT, can improve outcomes at the lower bound, with gains depending on expectations. Chung et al. [2020] use stochastic simulations to demonstrate that AIT and PLT deliver better stabilization than flexible inflation targeting, especially with strong forward guidance and balance sheet tools. Duarte et al. [2020] argue that the lower bound will bind in most future recessions and stress the time-inconsistency risks of overshooting policies such as AIT. Finally, Hebden et al. [2020] find that AIT remains beneficial under imperfect information, but its effectiveness weakens if expectations become unanchored.

Eggertsson et al. [2021] consider two similar policies: nominal GDP targeting and symmetric dual objective targeting, finding both outperform standard inflation targeting. Choi and Foerster [2021] consider an alternative approach wherein the central bank can endogenously change its monetary policy rule, finding that raising the inflation target in response to low interest rates improves policy effectiveness. Empirical research has shown mixed effects of the introduction average inflation targeting. Coibion et al. [2023] showed that most of the public had not known about the shift in the Fed's policy strategy, and Candia et al. [2021] found that, while many still had not known of the policy, their inflation expectations had begun to shift upwards.

Recent literature extensively examines the Federal Reserve's transition from a flexible inflation target (FIT) to flexible average inflation targeting (FAIT), initiated in August 2020. Beckworth and Horan [2022] highlight that FAIT was designed to compensate for periods when inflation fell below the 2% target, ensuring average inflation remains close to this benchmark over time. However, FAIT faced criticism for its asymmetric application—targeting inflation overshoots less aggressively—leading some analysts to suggest reforms that would introduce greater symmetry, effectively aligning FAIT closer to nominal GDP targeting. Similarly, Ireland [2024] emphasizes the re-emergence of outdated perspectives that suggest an exploitable Phillips curve trade-off between inflation and employment. Cutsinger and Luther [2025] argue that this asymmetry contributed directly to delayed policy responses and elevated inflation rates observed in 2021–2022. Conversely, White [2025] maintains skepticism towards proposals advocating for raising the inflation target above 2%, underscoring that higher inflation targets incur considerable economic costs that outweigh the proposed benefits of having additional monetary policy flexibility. Collectively, these studies illustrate ongoing debates regarding optimal monetary policy frameworks, highlighting concerns over asymmetry, inflationary credibility, and the economic trade-offs inherent to different targeting strategies.

Innovations in the implementation of monetary policy have also presented new challenges for modelers. Indeed, the Fed's use of non-interest rate instruments and focus on financial frictions has necessitated modelers expand the transmission of policy in macroeconomic models. Gertler and Karadi [2011], Gertler and Karadi [2018], Carlstrom et al. [2017], and Sims and Wu [2021] incorporate segmented financial markets and financial frictions into the framework of a DSGE model. These financial frictions allow strain in the financial sector to have real economic effects.

While much has been made about the Fed's shift to average inflation targeting, commitment and transparency are key determinants to the success of a shift in policy strategy. Erceg and Levin [2003] showed that the dynamics of inflation during the Volcker disinflation could largely be accounted for with rational, optimizing agents by incorporating imperfect information surrounding the inflation target. Ireland [2007] extends this framework to estimate the Fed's true inflation target from the 1950's to early 2000's, finding the target increased as high as 8% in the 1970s before settling at roughly 2.5% in the 2000s. Finally, De Michelis and Iacoviello [2016] examine the interaction of imperfect information and the zero-lower bound, applied to the introduction of Abenomics in Japan. They find information availability plays an even larger role in policy effectiveness when the interest rate is constrained by the zero-lower bound, as inflation and output are only half as responsive to changes in the inflation target under imperfect information. Finally, Park [2023] incorporates a numerical measure of central bank credibility into a New Keynesian model, finding that increases in credibility increase macroeconomic stability.

3 Model

The model has an environment based on Carlstrom et al. [2017] containing both forward- and backward-looking elements with households, firms, financial intermediaries, and the central bank. Households consume, hold short-term deposits, and a fraction of households supply labor while the remainder are intermediaries. A labor union purchases differentiated labor from the household and sells it as final labor to firms. Intermediaries use net worth and deposits to purchase firms' investment bonds and long-term government bonds. There are 3 types of firms: final goods, intermediate goods, and capital producing firms which transform capital and labor into final output. Finally, the central bank sets monetary policy according to a Taylor-type rule augmented for average inflation targeting.

3.1 Households

There are two types of members within each household: workers and intermediaries. Households all have the same lifetime utility function and maximize:

$$\mathbb{E}_{\mathrm{t}} \sum_{j=0}^{\infty} \beta^j e^{rn_{t+s}} \left[ln(C_{t+j} - hC_{t+j-1}) - \frac{BH_{t+j}^{1+\eta}(j)}{1+\eta} \right] \tag{1}$$

where $\beta \in (0,1)$ is the discount factor, $e^{rn_{t+s}}$ is a shock to the discount factor, $h \in [0,1)$ is the habit formation parameter, η is the inverse Frisch elasticity, B is a scaling parameter, C_t is consumption. Households supply labor, $H_t(j)$, which is combined into a homogeneous labor input and sold to intermediate firms:

$$H_t = \left[\int_0^1 H_t(j)^{1/(1+\lambda_{w,t})dj} \right]^{1+\lambda_{w,t}} \tag{2}$$

where $\lambda_{w,t}$ is a wage markup over the households' marginal rate of substitution. In turn, the real wage is given by:

$$W_t = \left[\int_0^1 W_t(j)^{-1/\lambda_{w,t}} dj \right]^{-\lambda_{w,t}} \tag{3}$$

A fraction of households (θ_w) must index their real wage to inflation:

$$W_t(j) = \frac{\Pi_{t-1}^{\iota_w}}{\Pi_t} W_{t-1}(j)$$

while the remaining households choose an optimal wage by maximizing:

$$\mathbb{E}_t \left\{ \sum_{s=0}^{\infty} \theta_w^s \beta^s \left[-e^{rn_{t+s}} B \frac{H_{t+s}(j)^{1+\psi}}{1+\psi} + \Lambda_{t+s} W_t(j) H_{t+s}(j) \right] \right\} \tag{4}$$

where Λ_{t+s} is the marginal utility of consumption.

Households also face the following budget constraints when making their purchasing decisions:

$$C_t + \frac{D_t}{P_t} + P_t^k I_t + \frac{F_{t-1}}{P_t} \leq W_t H_t + R_t^k K_t - T_t + \frac{D_{t-1}}{P_t} R_{t-1} + \frac{Q_t(F_t - \kappa F_{t-1})}{P_t} + div_t \tag{5}$$

where P_t is the price level, D_{t-1} is the nominal level of deposits a household has entering period t, R_{t-1} is the interest rate paid on those deposits, and W_t is the compensation a household receives for their labor supplied. P^k is the real price of capital, I_t is investment, R_t^k is the real rental rate, F_t is the quantity of private bonds held, and Q_t is the time-t price of the bond. DIV_t are dividends received from ownership of nonfinancial firms and T_t are lump-sum taxes.

3.2 Long Term Bonds

The government and intermediate goods firm can finance their endeavors by issuing long-term bonds, denoted B_t for government bonds and F_t for private bonds. Similar to Woodford (2001), these bonds are modeled as perpetuities with a constant decaying coupon payment, where the decay parameter is given by $\kappa \in [0, 1]$. New nominal bond issuances for firms are given by CI_t. Total liability due in period t is based on previous issuances:

$$F_{t-1} = CI_{t-1} + \kappa CI_{t-2} + \kappa^2 CI_{t-3} + \dots \tag{6}$$

Iterating forward gives:

$$CI_t = F_t - \kappa F_{t-1} \tag{7}$$

New bond issuances are sold at the price Q_t. Taken as a whole, the value of outstanding bonds is given by

$$Q_t F_t = Q_t CI_{t-1} + \kappa Q_t CI_{t-2} + \kappa^2 Q_t CI_{t-3} + \dots \tag{8}$$

The interest rates on bonds, R_t^F, are the realized holding period returns:

$$R_t^L = \frac{1 + \kappa Q_t}{Q_{t-1}} \tag{9}$$

The term premium is then the difference between the realized interest rate, R_t^L, and the yield implied by the expectations hypothesis of the term structure as the sum of short rates over the life of the bond, R_t^{EH}. The price and yield of the hypothetical expectations hypothesis bond are:

$$R_t = \mathbb{E}_t \frac{\kappa Q_{t+1}^{EH}}{R_{ss}} - Q_t^{EH} \tag{10}$$

$$R_t^{EH} = \left(\frac{R_{ss} - \kappa}{R_{ss}}\right) Q_t^{EH} \tag{11}$$

In turn, the term premium is:

$$TP_t = R_t^L - R_t^{EH} \tag{12}$$

3.3 Financial Intermediaries

Financial intermediaries in this model finance their lending to firms and government by absorbing household savings. In doing so, intermediaries also engage in maturity transformation, holding short-term liabilities in the form of deposits while holding long-term assets in the form of government and corporate bonds. Intermediaries hold long-term bonds issued by both the government and wholesale firms. They finance these holdings through their net worth, N_t, and by issuing deposits, D_t:

$$\frac{B_t}{P_t} Q_t + \frac{F_t}{P_t} Q_t = \frac{D_t}{P_t} + N_t = L_t N_t \tag{13}$$

where L_t is the firm's leverage ratio. Profits for the financial institution are given by:

$$prof_t = \frac{P_{t-1}}{P_t} \left[(R_t^L - R_{t-1}^d) L_{t-1} + R_{t-1}) \right] N_{t-1} \tag{14}$$

The financial intermediary will split these profits between dividends (div_t) and changes in net worth. The financial intermediary chooses dividends and net worth to maximize:

$$V_t = \max_{N_t, div_t} \mathbb{E}_t \sum_{j=0}^{\infty} (\beta\zeta)^j \Lambda_{t+j} div_{t+j} \tag{15}$$

subject to a financing constraint:

$$div_t + N_t \left[1 + \frac{\psi_n}{2} \right] \leq \frac{P_{t-1}}{P_t} \left[(R_t^L - R_{t-1}^d) L_{t-1} + R_{t-1} \right] \tag{16}$$

where $\left(\frac{N_t - N_{ss}}{N_{ss}}\right)^2$ is an adjustment cost which dulls the intermediary's ability to adjust its portfolio in response to shocks. The intermediary faces a binding leverage constraint:

$$\mathbb{E}_t \frac{P_t}{P_{t+1}} \Lambda_{t+1} \left[\left(\frac{R^L_{t+1}}{R^d_t} - 1 \right) L_t + 1 \right] = \Phi_t L_t \, \mathbb{E}_t \, \Lambda_{t+1} \frac{P_t}{P_{t+1}} \frac{R^L_{t+1}}{R^d_t} \tag{17}$$

Φ_t is an exogenous stochastic credit shock. The optimal net worth accumulation decision is given by:

$$\Lambda_t [1 + N_t f'(N_t) f(N_t)] = \mathbb{E}_t \, \beta \zeta \Lambda_{t+1} \frac{P_t}{P_{t+1}} \left[(R^L_{t+1} - R^d_t) L_t + R^d_t \right] \tag{18}$$

3.4 Production Firms

There are three types of firms in the economy: final goods, intermediate goods, and capital producing. Final goods firms produce the consumption good, Y_t by combining intermediate goods according to CES technology:

$$Y_t = \left[\int_0^1 Y_t(i)^{1/(1+\epsilon_p)} di \right]^{1+\epsilon_p} \tag{19}$$

Final goods firms are perfectly competitive, so the final good price, P_t, is the aggregate of intermediate goods prices.

Intermediate goods firms produce good i according to:

$$Y_t(i) = A_t K_t(i)^\alpha H_t(i)^{1-\alpha} \tag{20}$$

where $K_t(i)$ and $H_t(i)$ are capital and labor used by firm i. Total factor productivity, A_t evolves as:

$$lnA_t = \rho_A lnA_{t-1} + \varepsilon_{a,t} \tag{21}$$

Each period, θ_p of intermediate firms must index prices to inflation:

$$P_t(i) = P_{t-1}(i)\Pi_{t-1}^{\iota_p} \tag{22}$$

while the remaining firms can price optimally using the demand function from final goods producers, $Y_{t+s}(i)$, by maximizing:

$$\mathbb{E}_t\left\{\sum_{s=0}^{\infty}\theta_p^s\frac{\beta^s\Lambda_{t+s}/P_{t+s}}{\Lambda_t P_t}\left[P_t(i)\left(\prod_{k=1}^{s}\pi_{t+k-1}^{\iota_p}\right)Y_{t+s}(i) - W_{t+s}H_{t+s}(i) - P_{t+s}R_{t+s}^k K_{t+s}(i)\right]\right\} \tag{23}$$

New capital is produced from I_t investment goods and creates $\mu_t\left[1 - S\left(\frac{I_t}{I_{t-1}}\right)\right]I_t$ new capital goods. The firms finance capital purchases by issuing bonds through a "loan in advance" constraint:

$$P_t^k I_t \leq \frac{Q_t(F_t - \kappa F_{t-1})}{P_t} = \frac{Q_t C I_t}{P_t} \tag{24}$$

The profit for capital producing firms is:

$$P_t^k \mu_t\left[1 - S\left(\frac{I_t}{I_{t-1}}\right)\right]I_t \tag{25}$$

$S(\cdot)$ represents the investment adjustment cost function, similar to Christiano et al. (2005) where $S\left(\frac{I_t}{I_{t-1}}\right) = \frac{\psi_i}{2}\left(\frac{I_t}{I_{t-1}} - 1\right)$, and μ_t is an exogenous stochastic investment shock.

3.5 Monetary Policy

The central bank conducts policy according to a Taylor-type rule, responding to deviations of J-period average inflation from its stated inflation target, $\bar{\Pi}$, as well as to the growth rate in output.[2] This model uses a fixed and symmetric averaging window to serve as a

[2]The Taylor Rule in this model responds to output growth, rather than the output gap, for two reasons: first, because of the presence of both nominal and financial frictions, it is not clear what "potential" output should be, as most models only consider nominal frictions. Second, it is likely desirable for a central bank to focus on output growth, rather than an output gap, to resolve the imperfect knowledge problem discussed in Orphanides and Williams [2004]

benchmark for the framework and to isolate the effects of policy clarity versus ambiguity about the target. The $J-$period average of inflation is denoted by

$$\Pi_t^J = \frac{1}{J}\sum_{j=1}^{J}\Pi_{t-j+1}$$

Specifically, the central bank sets interest rates, constrained by the lower bound, according to:

$$R_t = \max\left[0, \rho_{TR}R_{t-1} + (1-\rho_{TR})\left[R_{SS} + \phi_\pi(\Pi_t^J - \bar{\Pi}) + \phi_Y(Y_t - Y_{t-1})\right] + e_{i,t}\right] \tag{26}$$

where ρ_{TR} is the smoothing parameter, ϕ_π is the inflation feedback parameter, and ϕ_Y is the output growth feedback parameter. Because fiscal policy is not central to this analysis, fiscal policy is passive and taxes change endogenously to pay interest on debt.

3.5.1 Average Inflation Targeting

In announcing the new framework in September 2020, Fed Chair Jerome Powell noted that inflation had run persistently below its stated target of 2%, and that inflation expectations had become anchored at this lower level. Therefore, the goal of average inflation targeting is not just to makeup for the past undershooting of inflation, but also to shift inflation expectations closer to the Fed's 2% target.[3] This, in turn, should push interest rates higher, away from the zero-lower bound. While the Federal Reserve has shown more asymmetric responses to inflation deviations, with greater emphasis on making up past undershooting than overshooting, this paper uses a symmetric averaging window to serve as a benchmark case and to isolate the effects of imperfect information. This simplification helps isolate how averaging and transparency affect expectations formation and policy effectiveness.

Expectations play a key role in average inflation targeting. Regardless of the size of the

[3] Coibion et al. [2023] and Naggert et al. [2021] discuss in greater detail how the announcement of AIT influenced inflation expectations

averaging window, average inflation targeting works as a trade-off between less responsive policy contemporaneously and more responsive policy over time. Specifically, when inflation is below target, longer averaging windows raise household, firm, and intermediary inflation expectations, as they incorporate the central bank's promise to "overshoot" in response to declines in inflation. These higher inflation expectations lead to comparatively higher wages and prices, higher long-term interest rates, and a greater overshoot in inflation and output over time. However, because policy is focused on longer-term goals, it is less responsive to current shocks.

For example, a one percentage point increase in current inflation causes the central bank to increase rates by $(1-\rho_{TR})\phi_\pi \frac{1}{J}$ percentage points under average inflation targeting, compared to $(1-\rho_{TR})\phi_\pi$ percentage points under standard inflation targeting. As such, one would expect this slower contemporaneous movement to lead to greater short-term increases in output and inflation from demand shocks, producing greater short-term movements in utility. However, policy is restrictive for longer under AIT, holding rates $(1-\rho_{TR})\phi_\pi \frac{1}{J}$ percentage points higher for $J-$periods after the change in inflation.[4] In this way, average inflation targeting acts similar to forward guidance as a promise to hold rates higher for longer. Observing this future path of interest rates, households shift their expectations accordingly. Thus, the effectiveness of average inflation targeting will depend on the relative effect of the shift in long-term expectations compared to the effect of smaller responses to current shocks. If re-set expectations play a larger role in determining the path of the economy, then AIT should improve policy-making compared to the baseline. However, if the dulled contemporaneous response of policy outweighs the effect of new expectations, standard inflation targeting should lead to better outcomes than average inflation targeting. The trade-off is likely to vary across averaging windows, as long averaging windows run the risk of over-averaging inflationary signals, leading to slow and sub-optimal policy.

[4] An alternative specification in the appendix considers how the effectiveness of the policy changes if the central bank responds more strongly to current inflation by targeting decaying inflation, rather than an arithmetic average.

3.5.2 Policy Information

When the Fed completed its review of its monetary policy framework, concluding that it would shift to targeting "flexible" average inflation, rather than its previous policy of single-period inflation. However, the Fed eschewed any mention of a specific averaging window or clarity on what "flexible" meant, instead allowing for discretion in their new framework. I incorporate this uncertainty surrounding their averaging window similar to Erceg and Levin [2003] strategy of incorporating a time varying inflation target. In the case of full information, the central bank commits to a specific averaging window, which agents can directly observe. However, in the case of imperfect information, agents in the model know the parameters of the policy rule $(\rho_{TR}, \phi_\pi, \phi_Y)$, but cannot directly observe the averaging window. Taking these observable components from 26, agents can predict movements in the interest rate according to:

$$R_t^{obs} = \rho_{TR} R_{t-1} + (1 - \rho_{TR}) \left[R_{SS} + \phi_Y (Y_t - Y_{t-1}) \right] \tag{27}$$

Movements in the interest rate not explained by these observable components could be the result of a standard monetary shock, e_t, or a misperception of the averaging window, Π^J. The difference between the actual policy rate (26) and its observable components (27) is then:

$$Z_t = R_t - R_t^{obs}$$

$$Z_t = e_t + (1 - \rho_{TR})(\phi_\pi)(\Pi_t^J - \bar{\Pi}) \tag{28}$$

As a result, agents must figure out if there was a policy shock, e_t, or if they misunderstood the averaging window and, in turn, the central bank's measure of average inflation, Π_t^J. Formally, they must solve a signal extraction problem via the Kalman filter to form an expectation of the averaging window and the future path of interest rates based on policy innovations. In state space form, these components evolve according to the system:

$$\begin{bmatrix} \Pi_t^J - \bar{\Pi} \\ e_t \end{bmatrix} = \begin{bmatrix} \rho_{\Pi^J} & 0 \\ 0 & \rho_e \end{bmatrix} \begin{bmatrix} \Pi_{t-1}^J - \bar{\Pi} \\ e_{t-1} \end{bmatrix} + \begin{bmatrix} \epsilon_{\Pi^J,t} \\ \epsilon_{e,t} \end{bmatrix} \tag{29}$$

where $\epsilon_{\Pi,t}$ and $\epsilon_{e,t}$ are normal IID innovations with variances of $\sigma^2_{\Pi^J}, \sigma^2_e$, respectively. The averaging window has a high autoregressive root, while the monetary shock has an autoregressive root near zero. Intuitively, this means the central bank is committed to their unobserved policy rule, and they attempt to quickly correct for monetary shocks.[5]

To illustrate the signal extraction problem, consider an economy initially at steady state with inflation equal to the 2% target. Agents understand that the central bank responds to average inflation according to equation (26), but they do not observe the averaging window, J.

Now suppose that in period t, inflation rises one percentage point above target, so that $\Pi_t = 3\%$. Agents know the central bank will adjust the policy rate in response to this shock, but the magnitude of this adjustment depends on the unknown averaging window. If the central bank uses a short window ($J = 4$), the 1% inflation shock raises average inflation by 0.25 percentage points, warranting a $(1 - \rho_{TR})\phi_\pi \times 0.25$ percentage point increase in the policy rate. Conversely, if the central bank uses a longer window ($J = 20$), the same shock raises average inflation by only 0.05 percentage points, leading to a smaller adjustment in the interest rate.

When agents observe the actual policy rate movement, they use this to better understand the averaging window. Using the model's calibrated parameters $\rho_{TR} = 0.8$ and $\phi_\pi = 1.5$, suppose the central bank raises rates by 15 basis points from the steady state. If agents believed the central bank uses $J = 4$ quarters for averaging, the mechanical effect on average inflation (0.25 pp) would justify a $(1 - 0.8) \times 1.5 \times 0.25 = 7.5$ basis point increase. The remaining 7.5 basis points suggests either additional monetary tightening (i.e. a monetary

[5] A full discussion of the Kalman filter and Kalman gain can be found in Appendix 5.1

shock) or a misunderstanding of the Fed's averaging.

Agents interpret this uncertainty using the Kalman filter. The observed 15 basis point rate increase implies the central bank is responding as if average inflation were 2.5% (solving backward from the policy rule: $0.15\% = (1 - 0.8) \times 1.5 \times (2.5\% - 2\%)$). However, with $J = 4$ and current inflation of 3%, agents calculated that average inflation should be 2.25%. This 0.25 percentage point difference suggests agents might have misunderstood the Fed's averaging methodology.

Under the Kalman filter framework, agents decompose this surprise into its persistent and transitory components. With a Kalman gain $K_g \approx 0.3$ as calibrated in the model, agents update their belief about the Fed's measure of average inflation according to:

$$E_t(\Pi_t^J - 2\%) = 0.99 \times E_{t-1}(\Pi_{t-1}^J - 2\%) + 0.3 \times 0.25\% = 0 + 0.075\% = 0.075\%$$

where the 0.25% represents the difference between the Fed's implied assessment (2.5%) and agents' calculation based on $J = 4$ (2.25%). Agents now believe there is a 0.075 percentage point difference between their calculation of average inflation and the Fed's assessment, suggesting the Fed may be using a different averaging methodology than they initially assumed. The highly persistent component ($\rho_{\Pi^J} \approx 0.99$) reflects agents belief the Fed is consistent in its averaging, while the transitory component ($\rho_e \approx 0.01$) captures short-lived policy adjustments.

In turn, sustained policy rate movements that are inconsistent with agents' beliefs about the averaging window are attributed to misunderstanding the central bank's averaging window, while temporary fluctuations are attributed to monetary shocks. In the example above, if the central bank maintains this pattern of stronger-than-expected responses in subsequent periods, agents will gradually conclude they misunderstood the averaging window. Conversely, if rates quickly return to levels consistent with their original beliefs about the averaging window, agents will attribute the movement primarily to a policy transitory shock.

Because agents cannot immediately distinguish between different averaging methodologies and policy shocks, their expectations adjust gradually as they accumulate evidence about the central bank's true framework. The autoregressive structure in equation (29) provides a tractable way to model this learning, ensuring that agents' beliefs update gradually in response to persistent misperceptions about the unobserved averaging window.

It is useful to contrast this approach with other recent papers that incorporate imperfect information or non-rational expectations. In Jia and Wu [2023], ambiguity about the averaging horizon is modeled as a strategic communication device in a small-scale New Keynesian framework, rather than a signal-extraction problem for private agents. In Honkapohja and McClung [2024], agents adaptively learn about the structure of the entire model, so instability can arise if the averaging window is not communicated. Wagner et al. [2023] take yet another route, incorporating bounded rationality, which alters the transmission of shocks when constrained by the lower bound. By contrast, this paper keeps the model environment as close as possible to a standard rational-expectations model, introducing ambiguity only around the averaging window. As a result, any deviation from the full-information benchmark in this model is attributable solely to imperfect information about the policy horizon, providing a straightforward measure of the informational costs of not communicating J.

The assumption of imperfect information mirrors the reality that many households and firms lack detailed awareness of the Federal Reserve's AIT framework [Coibion et al., 2023]. Instead, agents form expectations based on observed policy actions, treating deviations from expected rates as signals about the averaging window. This highlights how public disengagement amplifies the need for clear communication strategies to improve policy effectiveness.

3.6 Calibration

The model incorporates an occasionally binding lower bound on the nominal interest rate, so the model is solved using the OccBin toolkit for Dynare described in Guerrieri and Iacoviello [2015]. This uses a piecewise linear approximation, computing separate first-order Taylor approximations for the constrained and unconstrained regimes. The algorithm endogenously determines when the economy switches between regimes based on state variables and forward-looking expectations, with agents anticipating when the ELB will bind and unbind.

Impulse response functions are computed by solving from the non-constrained steady-state given the initial shock. For simulations, the model is solved period-by-period, with each shock potentially triggering different lower bound durations. Under imperfect information, the Kalman filter is incorporated into both regimes, with agents updating beliefs about the averaging window based on observed policy actions.

Calibrated values of model parameters key to the analysis are described in Table 1 and the values are consistent with the original Carlstrom et al. [2017] specification. The bond decay parameter, κ, is calibrated so the average bond duration is 40 quarters; ψ, the proportion of new investment funded via debt, is taken to match the observed value of private debt to GDP. The steady state term spread, $i_t^L - i_t^{EH}$, is calibrated at 100 basis points, the average 10-year Treasury - fed funds spread over the same period. The leverage ratio is calibrated to $L_{ss} = 6$. The discount factor, β, is calibrated at a literature-standard 0.99. The Calvo parameters, ϕ_p and ϕ_w are calibrated to 0.75, and the indexation parameters, γ_p and γ_w, are calibrated to 0.5. Finally, the Taylor Rule parameters, ϕ_π, ϕ_Y, and ρ_{TR} are calibrated at the literature-standard $\phi_\pi = 1.5$, $\phi_Y = 0.5$, and $\rho_{TR} = 0.8$

[Table 1 here.]

4 Results

This paper examines monetary policy changes along two dimensions: varying average inflation targeting windows and information availability. To isolate the effects of average inflation targeting vs standard inflation targeting, I first look at AIT only in the case of full information in each section, both in response to individual shocks, as well as a combination of shocks in a simulation. Examining the policy through this lens shows the potential for average inflation targeting, provided the central bank transparently commits to a specific averaging window and households are attentive. Section 4.1 examines impulse response functions to individual shocks, while Section 4.2 examines how the dynamics of the model vary with different averaging windows under both full and imperfect information.

The model is simulated across 1,000 periods where the economy is hit by a combination of credit, technology, interest rate, and productivity shocks. The averaging window varies from standard average inflation targeting to a 10-year averaging window.[6]

4.1 Impulse Response Functions

In addition to the standard inflation targeting baseline ($J = 1$), I consider 2 different averaging windows under full information: $J = 12$ and $J = 20$. Impulse response functions for credit and interest rate shocks under full information can be seen in Figures 2 and 3. The model begins from its steady state. A consistent theme emerges across each IRF: longer averaging windows lead to greater contemporaneous responses in real variables (output and hours worked) from the shock, and greater overshooting of each variable later in the IRF.

Figure 2 shows the response from a credit shock, or a sudden increase in Φ_t, illustrating the effect of financial frictions. In response, output, employment, and inflation decline with inflation declining slightly more under standard IT. This, in turn, causes the central bank to decrease its target interest rate, cutting rates more substantially under standard inflation targeting (0.35% vs 0.1%). The term premium rises similarly with each averaging window. Interestingly, output and hours worked recover more quickly with longer averaging windows, despite a smaller policy response. Moreover, the longer averaging windows lead inflation to rise toward steady state *faster*, as agents incorporate the central bank's promise to compensate for low inflation.

Figure 3 shows the response of the model to 100bp interest rate shock. Output and hours slightly decline more after a 100bp interest rate shock under AIT, while the inflation declines

[6]Hebden et al. [2020] indicates that, during the 2020 framework review, the Federal Reserve considered average windows up to at least 8-years.

more under standard IT. The term premium increases more initially under longer averaging windows, which can impact the production firm's financial decisions in (24). Following the shock, inflation rises more quickly toward steady state under AIT, moderately overshooting steady state. Output and hours also recover more quickly under AIT, as agents incorporate the central bank's promise to overshoot inflation. Responses are similar with $J = 12$ and $J = 20$.

[Figure 2 here.]

[Figure 3 here.]

Alternatively, to isolate the effect of information availability, Figures 4 and 5 hold the averaging window constant at $J = 12$ and compare the response of the model under full information and imperfect information. Figure 4 shows the response to a credit shock while Figure 5 shows the response to an interest rate shock.

Following a credit shock, output, hours worked, and inflation all fall, but the declines are larger under imperfect information as agents struggle to forecast how forcefully the central bank will respond. In both regimes, the central bank cuts interest rates, but policy remains lower for longer under imperfect information to offset the deeper downturn in inflation and output. The term premium rises sharply in both cases, with broadly similar dynamics afterwards. Overall, the responses show that even for a non-monetary, financial shock, imperfect information about the averaging window magnifies the contraction and slows the recovery relative to full information.

The model's response to an interest rate shock shows a larger divergence between full and imperfect information. Following a 100bp monetary shock, output and inflation decline more than twice as much under imperfect information (-0.2% vs -0.5%, and -0.03% vs -0.12%, respectively). These larger declines highlight how uncertainty about the averaging window dulls expectations of future policy overshooting. This uncertainty also causes the term premium to rise more under imperfect information. Under full information, the interest rate returns to steady state after 12 periods. However under imperfect information, the central bank decreases rates aggressively following the shock, with rates falling below steady state before converging back towards steady state after 20 periods.

[Figure 4 here.]

[Figure 5 here.]

4.2 Simulation Results

Variances of output, inflation, hours worked, the term premium, and the interest rate from the full information simulation can be seen as the black lines in Figure 6. Notably, most variables are best stabilized with at least a 5-year (20-quarter) averaging window. Specifically, output, interest rates, and the term premium are best stabilized under a very long average window (40 quarters). This greater stability in interest rates and the term premium can impact firm financing decisions via (24), helping stabilize investment and output. Meanwhile inflation and hours worked are best stabilized at a 5-year average average window, with variances rising modestly beyond this point. Short averaging windows and standard inflation targeting consistently lead to the highest variances for each variable.

In the New Keynesian framework, optimal monetary policy is typically defined as the policy that minimizes a quadratic loss function. As shown in Galí [2015], this function can be derived as a second-order approximation to household welfare around an efficient steady state, capturing the distortions generated by nominal rigidities. The loss penalizes variability in both output and inflation. Formally, the central bank minimizes:

$$\mathcal{L} = \frac{1}{2}\left[\left(\sigma + \frac{\eta+\alpha}{1-\alpha}\right)\mathrm{var}(Y_t) + \frac{\epsilon_p}{\lambda}\mathrm{var}(\Pi_t)\right] \tag{30}$$

where σ is the intertemporal elasticity of substitution, η is the inverse Frisch elasticity of labor supply, α is the capital share, and ε_p/λ is the relative weight on inflation stabilization.[7] Minimization of this loss amounts to balancing inflation stability with real economic stability,

[7] $\lambda = \left[\frac{(1-\theta_p)(1-\beta\theta_p)}{\theta_p}\right] \times \left[\frac{1-\alpha}{1-\alpha-+\alpha\epsilon_p}\right]$. Because this model uses a log utility function in (1), $\sigma = 1$.

consistent with the dual mandate of modern central banks. As such, the loss function provides a benchmark for evaluating alternative policy regimes, including average inflation targeting.

Results for the central bank's loss function under full information are shown by the black line in Figure 7. The loss function is highest under standard inflation targeting ($J = 1$), declining quickly as the averaging window increases. The improvement in policy tapers as the window lengthens, with the loss minimized at $J = 20$. Beyond this point, the loss remains relatively flat as the averaging window increases. In total, there are substantial gains from average inflation targeting compared to standard inflation targeting, with the combination of output and inflation most effectively stabilized targeting inflation over a 5-year window.

This pattern that AIT leads to better outcomes than standard IT echoes findings from smaller-scale models like Nessén and Vestin [2005] and Budianto et al. [2023]. However, findings here suggest there is little additional benefit to very long average windows, while smaller-scale models tend to prefer a price level target (essentially an infinite averaging window). This, in turn, suggests financial frictions in this model amplify monetary policy responses, and AIT at moderate horizons strikes a balance between responding to current inflationary signals and stabilizing long-term expectations.

[Figure 6 here.]

[Figure 7 here.]

While targeting average inflation over longer periods can lower the variability of output and inflation, these results assume households and firms have perfect information about the averaging window, and that the central bank will commit to the averaging. However, the Fed only said that they would target 2% inflation averaged "over time," and following periods of below-2% inflation, policy will target above-2% inflation for "some time."[8] Surveys done by Coibion et al. [2023] and Candia et al. [2021] show that most households did not know about the policy shift, and inflation expectations had become "unanchored" and began to drift

[8] See the Fed's 2020 Statement on Longer-Run Goals and Monetary Policy Strategy for the full statement.

upwards. In turn, there was a substantial amount of uncertainty about how high inflation would get, and how forcefully the Fed will respond as inflation rose.

The blue lines in Figure 6 show how the variance of inflation, output, and the interest rate change under imperfect information. Output and hours worked are most stable under a moderate AIT regime ($J = 10$). Moreover, inflation is most stable over a similar averaging window ($J = 12$ quarters) with the variance rising in longer averaging windows. In turn, interest rates and the term premium are also most stable under a 12-quarter averaging window and least stable under standard IT.

Results for the central bank's loss function under imperfect information are shown by the blue line in Figure 7. The loss is highest with short averaging windows and declines as the horizon extends, reaching a minimum at $J = 12$. Beyond this point, the loss rises again, as the weaker contemporaneous policy response outweighs the benefits of averaging, increasing the variability of both output and inflation.

The performance of the model under imperfect information is strictly dominated by full information: the variance of each variable is lower and the central bank's loss function is lower under full information. This illustrates the importance of information for a policy's effectiveness: when agents do not know the specifics around AIT, they must frequently update not only their expectations about the future, but also their expectations about the true policy rule. This additional uncertainty makes it more difficult for households to plan consumption and firms to make investment decisions, leading to higher variances in both output and inflation, both components of the central bank's loss function. In practice, limited public awareness of AIT reinforces the reliance on observable policy signals rather than stated intentions. The findings suggest that clear, consistent, and effective communication by central banks can help minimize uncertainty and anchor expectations more effectively. In short, AIT has benefits over standard inflation targeting, and the optimal averaging window is be $J = 20$ quarters if the central bank transparently and credibly commits to a specific rule.

5 Conclusion & Policy Implications

The Fed's flexible average inflation targeting framework was unveiled during the middle of the Covid-19 pandemic, so it is difficult to disentangle the effects of the new framework from the effects of the pandemic. Shortly after the framework began, many states began to relax pandemic-related restrictions, the US government passed a large fiscal policy, and inflation rose to its highest level in four decades. This paper uses a DSGE model to isolate average inflation targeting and the uncertainty surrounding it. Specifically, the model incorporates imperfect information about the central bank's policy framework. The model uses a fixed and symmetric averaging window to serve as a benchmark and to isolate the effects of imperfect information.

Targeting average inflation plays an important role in the formation of expectations, and the effectiveness of the policy depends on its ability to change expectations. Overall, the model shows that the framework has potential to lead to better outcomes when the Fed is clear about its averaging, more effectively stabilizing inflation compared to the standard inflation targeting baseline. In total, average inflation targeting is most effective when targeting a period of 5 years and using full information.

However, the Fed was not clear about its averaging window. When considering this imperfect information, the model shows that average inflation targeting leads to consistently *worse* outcomes than the full information baseline. Moreover, switching policy frameworks introduces uncertainty, as shown by Candia et al. [2021] and Coibion et al. [2023], and this uncertainty has an impact. Under imperfect information, households and firms have a harder time forming expectations, leading to less stability. In short, AIT can be beneficial, and credibility and transparency of the averaging window improve the effectiveness of the policy.

Tables and Figures

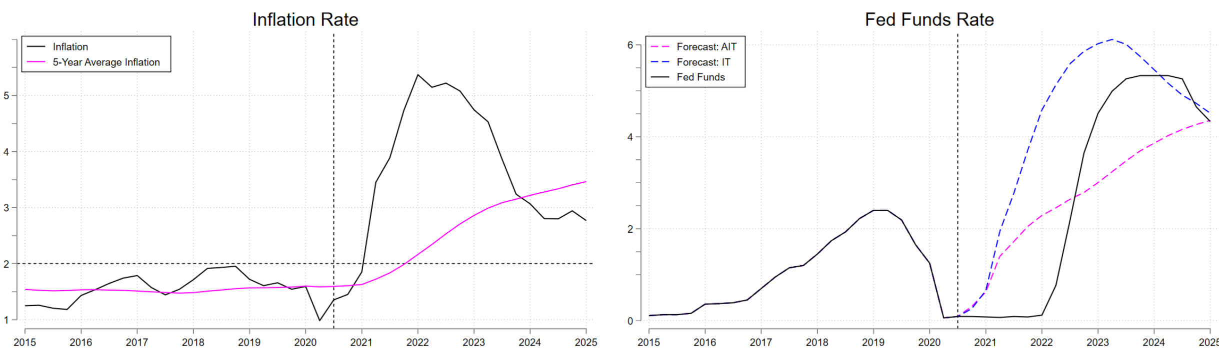

Figure 1: Left panel: U.S. core Personal Consumption Expenditures inflation from 2015 through 2025. Right panel: The fed funds rate. The IT forecast uses a standard inflation targeting Taylor Rule while the AIT forecast uses a 5-year average inflation targeting Taylor Rule.

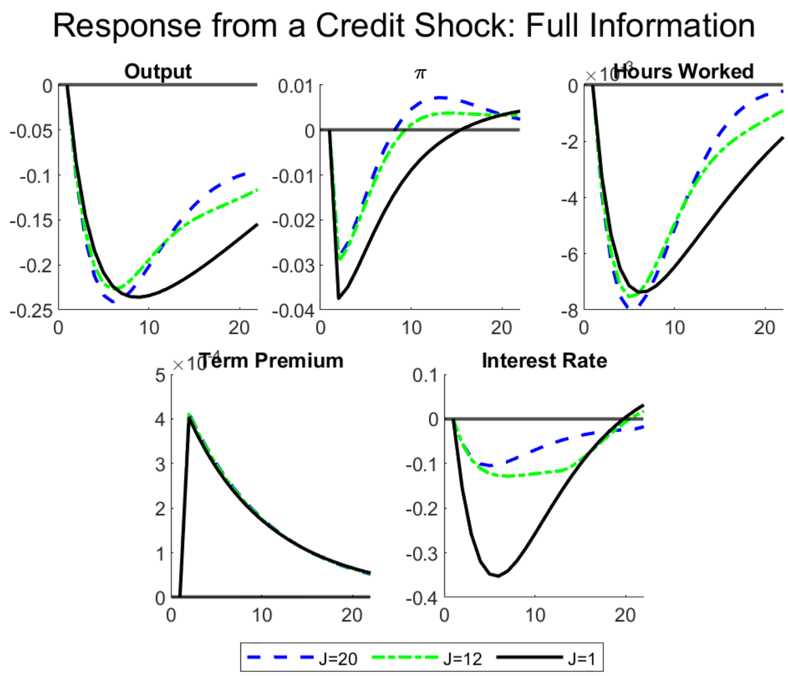

Figure 2: Response of the model to a credit shock

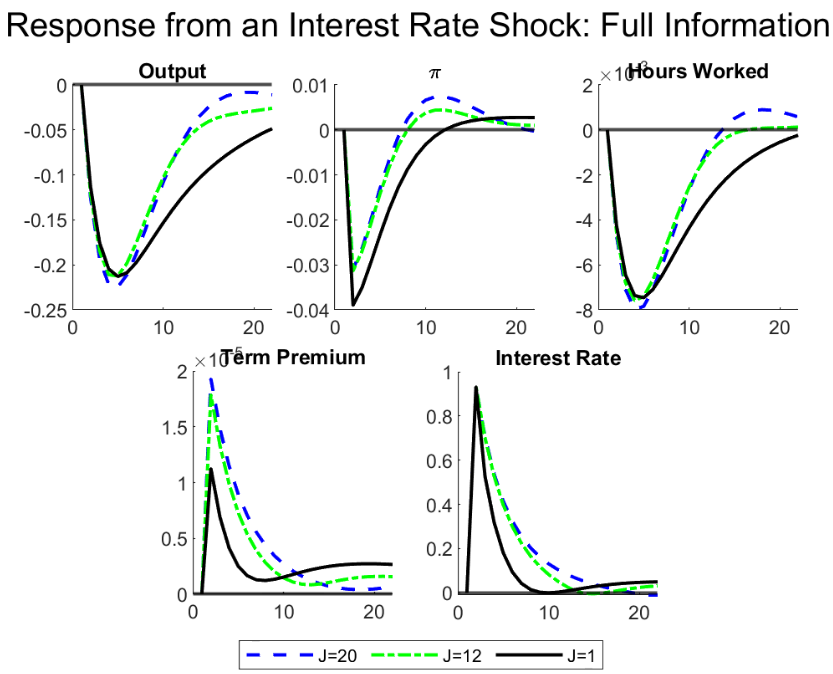

Figure 3: Response of the model to an interest rate shock

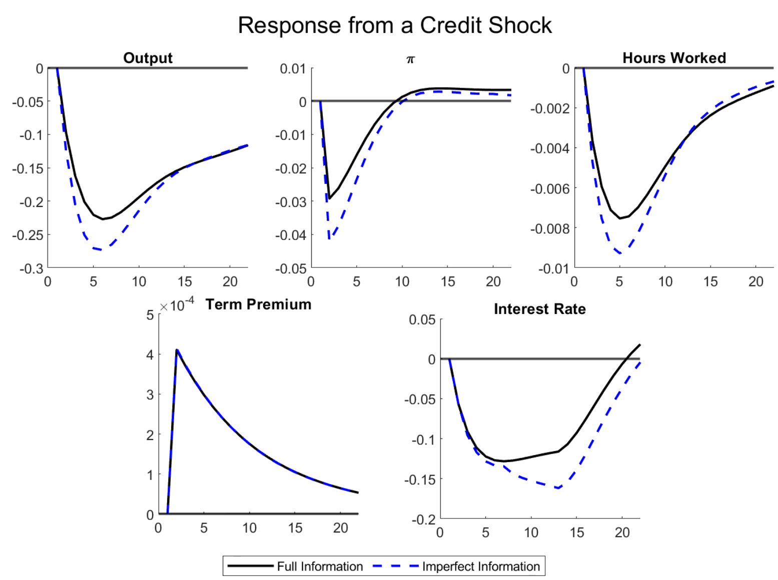

Figure 4: Response of the model to a credit shock holding the averaging window constant at $J = 12$

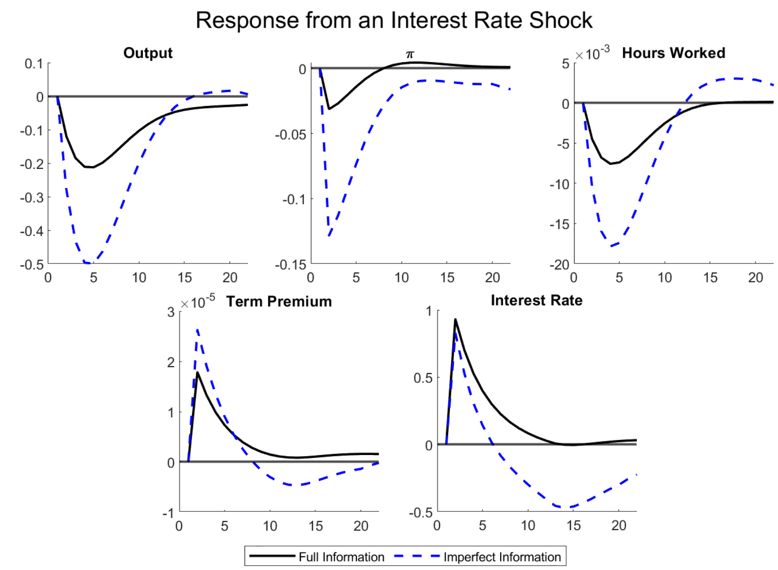

Figure 5: Response of the model to an interest rate shock holding the averaging window constant at $J = 12$

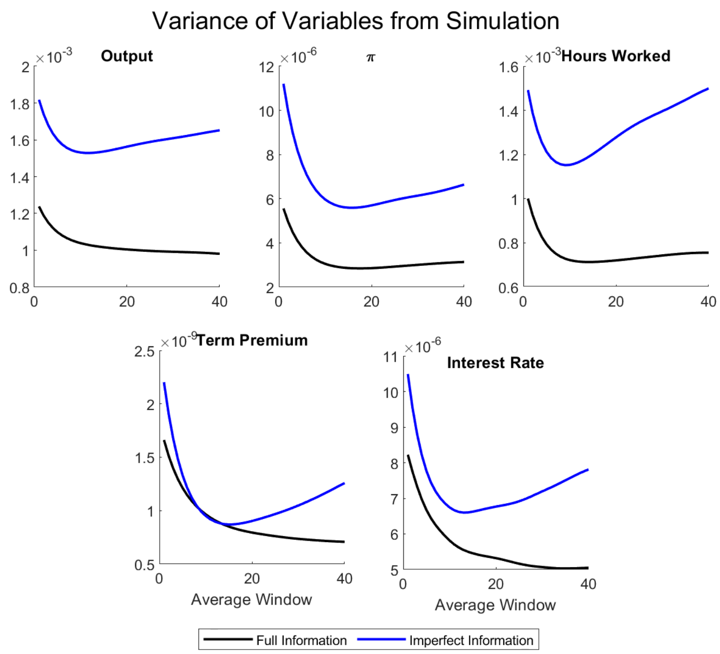

Figure 6: Variance of each variable from model simulation over 1,000 periods with random shocks to credit, productivity, investment, and the interest rate.

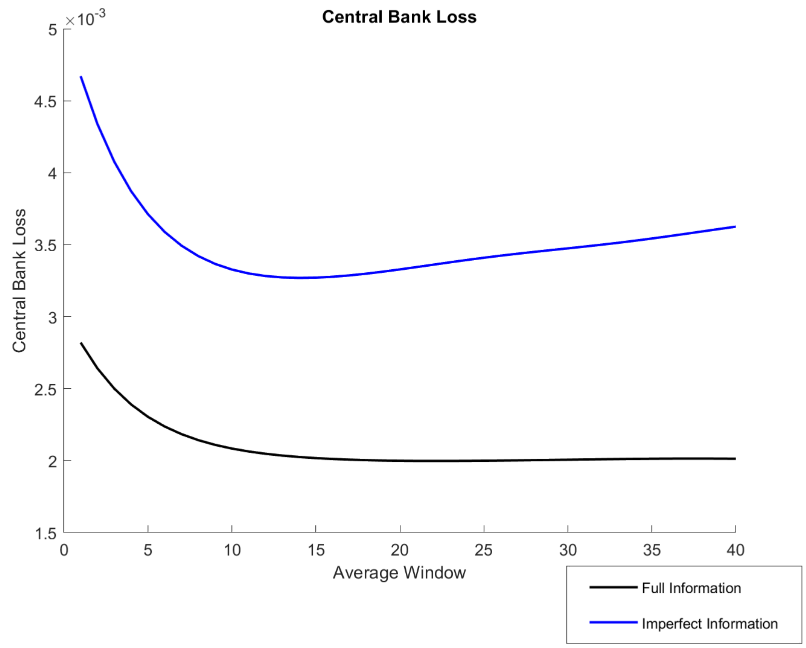

Figure 7: Central bank losses from model simulation over 1,000 periods with random shocks to credit, productivity, investment, and the interest rate.

Table 1: Key parameter calibration

Parameter	Value	Description
κ	0.975	Bond duration
ψ	0.81	Fraction of investment from debt
θ	3	Steady state spread
L	6	Steady state leverage
β	0.99	Discount factor
θ_p, θ_w	0.75	Price/wage rigidity
γ_p, γ_w	0.5	Price/wage indexation
ρ_{TR}	0.8	Taylor Rule: smoothing
ϕ_π	1.5	Taylor Rule: Inflation
ϕ_Y	0.5	Taylor Rule: Output growth
ρ_{π^J}	0.99	AR: Average misperception
ρ_e	0.01	AR: monetary shock

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Appendix

5.1 Kalman Filter

Households and firms use the Kalman filter to distinguish between movements in average inflation and monetary policy shocks. The signal extraction problem can be represented in state-space form, with the state equation (29) and observation equation (28). Under these assumptions, the Kalman filter gives the solution to the signal extraction problem. Let $X_t = [(\Pi_t^J - \bar{\Pi}), e_t]'$ denote the vector of unobserved state variables. The observation equation can be written as:

$$Z_t = HX_t$$

where $H = [(1 - \rho_{TR})\phi_\pi, 1]$. Given 29, estimates of the unobserved components can be obtained through:

$$E_t X_t = F E_{t-1} X_{t-1} + L_{gain}(Z_t - HFE_{t-1}X_{t-1})$$

where $F = \text{diag}(\rho_{\Pi^J}, \rho_e)$ and L_{gain} is the Kalman gain matrix. The term $Z_t - HFE^*_{t-1}X_{t-1}$ is the one-step-ahead forecast error in predicting the observed policy innovation, while the matrix L_{gain} determines how agents respond to this forecast error by updating their estimates of the underlying components.

In the special case where $\rho_e = 0.01 \approx 0$ and $\rho_{\Pi^J} = 0.99 \approx 1$, the perception of the averaging window evolves according to:

$$E_t^*(\Pi_t^J - \bar{\Pi}^J) = \rho_{\Pi^J} E^*_{t-1}(\Pi^J_{t-1} - \bar{\Pi}^J) + K_g \cdot (Z_t - E^*_{t-1}Z_t)$$

where the scalar Kalman gain parameter is:

$$K_g = \frac{\sigma^2_{\Pi^J}}{\sigma^2_{\Pi^J} + \sigma^2_e}$$

In turn, agents update their assessment of the averaging window by the product of the forecast error innovation and a constant coefficient.

Using $\sigma^2_{\Pi^J} = 0.00049$ and $\sigma^2_e = 0.001$, this gives a signal-to-noise ratio of 0.49 and a Kalman gain of $K_g = 0.33$, which are calibrated based on the estimated values in De Michelis and Iacoviello [2016]. This implies that agents incorporate approximately one-third of the forecast error into their estimate of the averaging window. The updating equation for agents' beliefs about average inflation becomes:

$$E_t \Pi^J_t = \rho_{\Pi^J} E_{t-1} \Pi^J_{t-1} + K_g \times Z_t$$

The calibrated Kalman gain of 0.33 reflects a moderate learning speed that balances two considerations. A higher gain would imply faster learning but greater volatility as agents overreact to transitory shocks, while a lower gain would reduce volatility but slow learning about the averaging window.

5.2 Additional Impulse Response Functions

A productivity shock, shown in Figure 8, presents a challenge for the central bank. Because output and inflation are moving in opposite directions, the weights in the Taylor Rule and the averaging window play an important role in the movement of the interest rate. Under standard inflation targeting, the central bank cuts rates to counteract the decline in inflation before quickly raising as inflation recovers. However, as longer averaging windows dull the sensitivity of the central bank to current inflation, the central bank actually raises rates modestly under AIT. As a result, the term premium responds differently under different averaging windows: under the standard IT baseline, the term premium declines initially, but under AIT, the term premium initially increases before quickly converging with the IT term premium. The dynamics of other variables are largely similar in each scenario.

Finally, while output and employment respond similarly to a investment shock (Figure 9), inflation increases more with standard inflation targeting. This, in turn, requires the central bank to increase interest rates more than in average inflation targeting, leading to future undershooting in inflation and the term premium.

[Figure 8 here.]

[Figure 9 here.]

5.3 Decaying AIT

Under standard average inflation targeting, the central bank responds equally as strongly to current and past inflation. Instead, AIT could be implemented by incorporating a decay parameter on past inflation. In this scenario, I replace the inflation averaging ($\frac{1}{J}\sum_{j=1}^{J}\Pi_{t-j+1}$) in equation (26) with:

$$\hat{\Pi}_t = \omega\Pi_t + (1-\omega)\hat{\Pi}_{t-1} \tag{31}$$

In this specification, agents can have imperfect information about the central bank's decay parameter, ω, rather than the averaging window.

Results for the simulations can be found in Figures 10 and 11. Similar to the specification discussed in section 5, imperfect information still leads to consistently higher variances in each variable, as well as higher central bank losses. Under this specification, inflation is most effectively stabilized when $\omega = .1$, so changes in inflation have a half-life of 7 quarters. However, central bank losses are minimized at $\omega = 0.05$, so inflation changes have a half-life of roughly 14 quarters.

Under imperfect information, a similar theme holds: output, inflation, and interest rates are stabilized by targeting modest average inflation ($\omega = .15$), and central bank losses are also minimized at $\omega = 0.05$. Importantly, similar to the earlier specification of AIT, full information policy still leads to consistently lower central bank losses than the most effective imperfect information policy, reiterating the importance of commitment and transparency to a policy by the central bank, and attentiveness to the policy by households and firms.

[Figure 10 here.]

[Figure 11 here.]

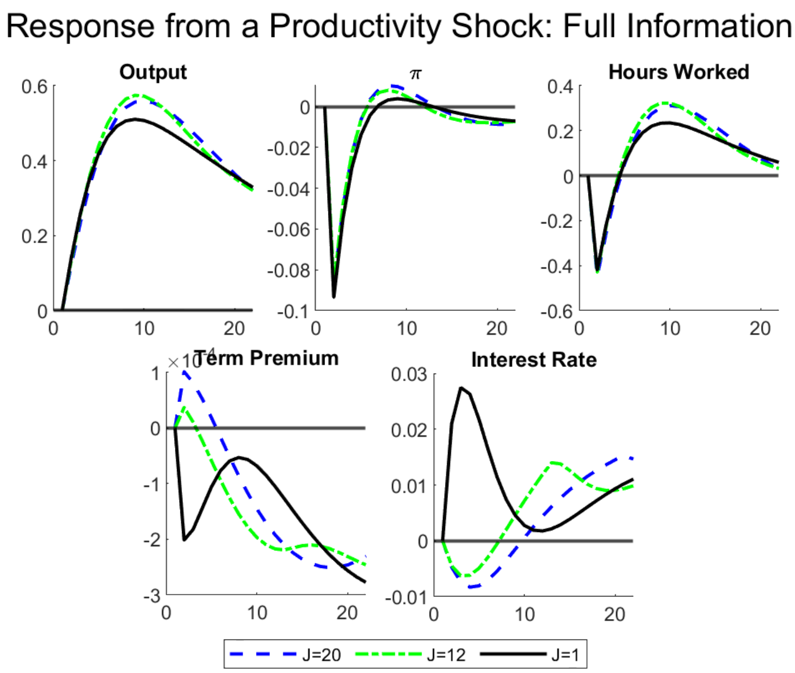

Figure 8: Response of the model to a productivity shock

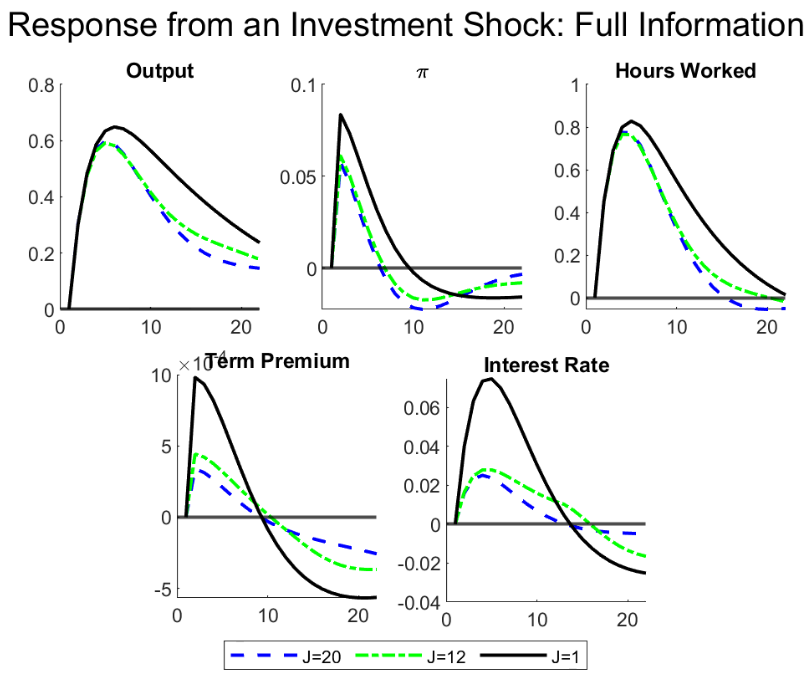

Figure 9: Response of the model to an investment shock

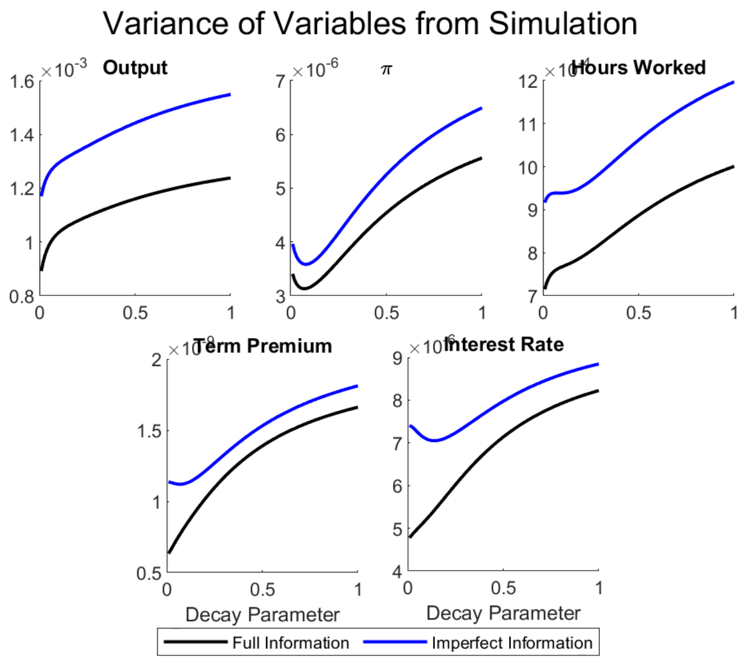

Figure 10: Variance of each variable from model simulation over 1,000 periods with random shocks to credit, productivity, investment, and the interest rate.

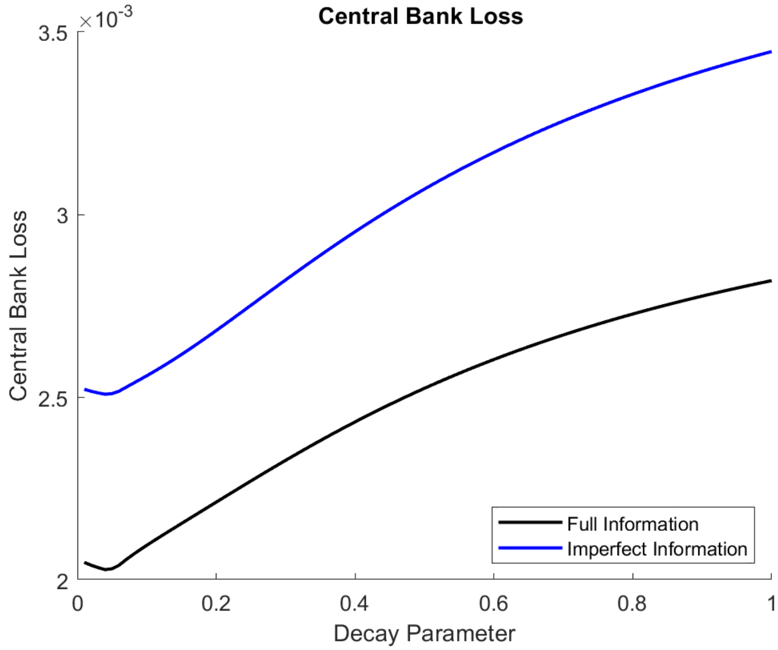

Figure 11: Central bank losses from simulations.