Sticky Information Meets Wealth in Utility: Implications for Monetary Policy

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ABSTRACT: This paper extends the New Keynesian model by incorporating Sticky Information and Wealth in Utility (the SIWUNK model), to address its implications for the design of monetary policy. This paper demonstrates that equilibrium determinacy can be achieved under a Taylor rule even with a passive monetary stance, while price-level rules require both information frictions and a discrete inflation response. The transmission of monetary policy is modified, since agents' preference for wealth and delayed information processing extend the effects of shocks, requiring prolonged periods of low interest rates. Welfare analysis reveals that inflation targeting becomes more desirable than price-level targeting when wealth enters utility, even when price-level targeting performs better in the New Keynesian model. Finally, despite the information frictions, optimal policy rules remain robust, though wealth in the utility function could shift the central bank preference towards output stabilization.

1. Introduction

Information in economics plays a crucial role in determining optimal outcomes. For decades, researchers in macroeconomics have developed powerful models to analyze macroeconomic fluctuations and their connection with monetary policy, with the New Keynesian (NK) model emerging as the workhorse for such purposes. These models are commonly categorized as Full Information Rational Expectations (FIRE) models, relying on two key assumptions. First, economic agents form rational expectations. Second, there is common knowledge of all relevant information and the structure of the economy. One criticism of these models concerns the second assumption, as acquiring and processing new information may be infeasible for economic agents due to the presence of private information or the cost associated with processing it.

In response to this limitation, extensive academic research has explored how imperfect information affects macroeconomic dynamics. According to Sims (2003), models incorporating rational inattention not only better reflect human behavior but also help to replicate the observed smoothness of aggregate variables, as demonstrated by Mankiw and Reis (2002) and Maćkowiak and Wiederholt (2015). However, micro-founded models that account for the cost of acquiring and processing new information have historically posed challenges due to their computational complexity. As a response, a more tractable approach to modeling imperfect information assumes that not all economic agents have access to the complete set of economic information. As proposed by Mankiw and Reis (2002) and expanded by Reis (2009), new information may flow only to a fraction of agents, whether due to private reasons or due to the high cost of processing new information. This framework creates a setting where some agents update their expectations based on new information while others rely on outdated information, a phenomenon known as Sticky Information/Expectations (SI).

On the other hand, the motivation for introducing Wealth in the Utility function is justified by several reasons. First, wealth may provide utility due to its role in social status, as argued by Michaillat and Saez (2021). Second, individuals may derive joy-of-giving utility from accumulating wealth to benefit future generations, as proposed by Straub (2019). Third, introducing wealth inside the utility function affects the Euler equation by incorporating a discounting mechanism,

as demonstrated by Michaillat and Saez (2021) and Zhao (2023). In this setting, individuals save more because they derive utility from holding wealth, making forward-looking behavior less attractive.

Therefore, the link between SI and Wealth in Utility is evident: economic agents who lack new information about the current state of the economy may find optimal to accumulate wealth as a protection mechanism against the uncertainty regarding future information flows. The intuition is straightforward: for agents relying on outdated information there is no strong incentive to postpone consumption today since they cannot anticipate the future state of the economy. As a result, holding wealth in the present period may serve as a protective mechanism against the uncertainty of when new information will become available. Consequently, if individuals base decisions on their current wealth and past trends, the frequency of expectations adjustments may slow, leading to sluggish responses in savings and consumption behavior when new information is received.

Consequently, incorporating wealth in the utility function under SI may amplify the incentive to look backward due to a lack of information or a strong preference for wealth over consumption when making future decisions, altering the transmission mechanism of monetary policy as previously known. The strong incentive to be "less forward-looking" implies that consumption may respond less to changes in the interest rate. Altogether, the consequent strong backward-looking motive described above remains unexplored in the literature of the design its monetary policy. Therefore, this paper extends the standard New Keynesian model to include the information structure proposed by Reis (2009) while accounting for the role of wealth in utility, proposing a SIWUNK model for this purpose. The key issues addressed include the implications of the model for determinacy, the transmission mechanism of monetary policy, the distributional welfare effects of imperfect information, and whether imperfect information influences the optimal interest rate coefficients in the central bank's policy rule. The analysis considers two monetary policy rules: the standard Taylor rule, which responds to inflation, and a Wicksellian rule, which reacts to the price level. This comparison may shed light on which monetary regime delivers better macroeconomic outcomes when information diffusion is slow.

The rationale for considering price level rules lies on the natural question of exploring how the welfare properties described by Svensson (1999) and Giannoni

(2014) interact with information frictions. Under a price-level monetary regime, after an inflationary shock the inflation expectations remain well anchored defined for the expected future deflation. This mechanism may mitigate in some dimensions the lack of information acquisition, since even when the agents cannot fully observe the shocks, they are certain that the central bank will accommodate its monetary policy according to bring back the price level to its former path. Therefore, under this monetary scheme, the central bank capacity to fully mitigate the inflationary shocks becomes more relevant to improving social welfare serving as an additional anchor for the inflation expectation of those who do not update their information set.

Finally, the results of the SIWUNK model can be summarized as follows. First, equilibrium determinacy can be obtained under a Taylor rule even with a passive monetary policy, while a price-level rule becomes attainable only when combined with information frictions and an small inflation response from the central bank. This situation highlights the relevant interaction between delayed information acquisition and the preference for wealth in affecting macroeconomic stability. Furthermore, the transmission mechanism of monetary policy is modified: the strong backward-looking motive due to inattention or for wealth accumulation, requires extended periods of low interest rates, particularly after expansionary monetary shocks. In terms of welfare, the introduction of wealth in utility favors the conventional idea that inflation targeting is preferable to price-level rules, despite price-level rules performs better in the NK model. Lastly, while optimal policy parameters remain robust to information frictions, the introduction of wealth expands the spectrum of effective policy responses, often favoring stronger output stabilization over inflation stabilization. Altogether, these findings reveal unconventional horizons that informational and behavioral frictions make emerge in determining and designing of monetary policy.

2. Literature Review

This paper lies at the intersection of the standard New Keynesian model, imperfect information, and models incorporating wealth in the utility function. Models with imperfect information have emerged as an alternative to full-information rational expectations models (FIRE) due to their more realistic assumptions about the

limitations individuals face when accessing, receiving, and processing new information. In this regard, the pioneering work of Sims (2003) has been influential, as it was the first to micro-found motives of why individuals may not change their behavior when they receive new information.

The paper emphasizes that agents experience inherent costs when re-optimizing and processing new information. Hence, even in the presence of tiny information costs, individuals may choose not to update their optimal behavior, a phenomenon called "Rational Inattention." Since then, the idea that economic agents optimize the amount of information they absorb has been incorporated into several DSGE models. One of the most notable examples is Maćkowiak and Wiederholt (2015), which highlights how rational inattention may explain the smoothness of certain aggregate variables in response to shocks.

A closely related approach, in which information frictions are taken as given (non-microfounded), was developed by Mankiw and Reis (2002) and Reis (2009). These papers emphasize that current economic decisions are not always based on currently available information but sometimes on outdated information. These models highlight the role of sticky information (SI) as the sole information friction. Under SI, only a fraction of the population updates their optimal behavior using new information about the real state of the economy, while the rest do not. This environment leads to a situation in which agents update their information at different times and frequencies.

Consequently, there is a gradual incorporation of information, delaying adjustments in economic variables. This scenario affects the optimal behavior of agents, as they now rely more on old information. As a result, the natural incentive to postpone consumption in the present weakens, since agents cannot anticipate the future state of the economy. Consequently, holding wealth in the present period may serve as a protective mechanism against the uncertainty of when new information will become available. This reasoning justify the assumption of introducing wealth in the utility function (WU), however, it has not been the standard motive in the fresh literature on it.

The influential work in Michaillat and Saez (2021) introduced a new approach to modifying the standard New Keynesian model to account for wealth utility (WU). This led to the Wealth-Utility New Keynesian (WUNK) model, which the

authors argue is capable of resolving most of the anomalies of the New Keynesian (NK) model in the presence of the Zero Lower Bound (ZLB). Most of the solutions that WU provides rely on the associated discounted Euler equation, which makes agents less forward-looking. This modification also has implications for determinacy, making the Taylor Principle less restrictive. Thus, according to the WUNK model, there is no need for a response to inflation greater than one in the Taylor rule, unlike in the standard NK model. This analysis is further expanded in Zhao (2023), confirming the need for a less aggressive interest rate response to inflation and highlighting the predominant role of the preference for wealth over consumption: the greater the preference for wealth over consumption, the larger the determinacy regions.

The ability of sticky expectations models to explain the observed smoothness of macroeconomic variables after shocks makes them appealing for use by central banks in understanding the transmission mechanism of monetary policy, particularly when there is a strong incentive to be "less forward-looking." In this regard, Bank of England Monetary Policy Committee member Mann (2023), highlighted the importance of the interaction between backward-looking and forward-looking agents in analyzing aggregate variables for the UK. These events become particularly significant in times when the inflation rate exceeds the inflation target, as agents rely more on past inflation experiences to forecast future inflation, namely on outdated information. This analysis is supported by the study of Cornea-Madeira and Madeira (2022), which found that, in the UK, 50% of agents are backward-looking and 50% are forward-looking under normal conditions. However, the proportion of backward-looking agents may rise to 80% after energy shocks. According to Mann, the degree of backward-looking price setters influences the transmission of monetary policy in the following way: after a cost-push shock, the output gap remains more negative for a longer period, followed by an extended increase in the inflation rate above the target. Consequently, monetary policy must become increasingly restrictive to return the inflation rate to its target when agents exhibit a higher degree of backward-looking behavior.

About how central banks incorporate rational inattention when designing optimal policy, Bernstein and Kamdar (2023) provide an insightful modeling. In this context, the inability to know the true state of the economy creates a tradeoff for the central bank regarding which shock—demand or supply—requires more

attention. Thus, focusing more on one shock reduces attention to the other and optimal policy suggests that the central bank prioritizes demand shocks. The intuition is that highly persistent supply shocks have a smaller impact on expected consumption and expected output growth rates, making it preferable for the central bank to allocate more attention to demand shocks, which directly affect the natural interest rate.

Pioneering work on the design of optimal simple rules under sticky expectations was made by Reis (2009), who extended Mankiw and Reis (2002) into a DSGE framework, known as the Sticky Information General Equilibrium (SIGE) model. Interestingly, this paper finds that the optimal Taylor rule sets a greater emphasis on stabilizing real activity, in contrast to the traditional Taylor rule, which prioritizes stabilizing the inflation gap. Moreover, when firms have significant information stickiness, a version of price-level targeting may yield better results than the optimal Taylor rule. Furthermore, this paper provides evidence that the degree and type of inattention influence the effectiveness of monetary policies: inattentive firms make price-level targeting more attractive, whereas inattentive workers improve the performance of inflation-targeting rules.

Finally, the rationale for considering Wicksellian interest rate rules partially lies in appealing properties, as widely described by Giannoni (2014). First, the price level is trend-stationary. This implies that after any economic shock that causes the price level to deviate from its predetermined trend, the central bank must take the necessary actions to restore it. This response contrasts with the price-level dynamics implied by Taylor rules, where the price level follows a unit root. Second, a price-level rule introduces history dependence in monetary policy, as all past inflation rates influence the current evolution of the price level. Moreover, the determinacy regions under price-level rules are larger than those associated with Taylor rules, as confirmed by Bauducco and Caputo (2020) and McKnight (2018) for a model with capital. The stability mechanism under price-level rules operates through expected future deflation. Following an inflationary shock, firms do not raise their inflation expectations because they anticipate that the central bank will induce a deflationary process in the future to restore the price level to its predetermined trend. This mechanism differs from the standard Taylor principle, in which the real interest rate must increase to prevent the economy from entering an explosive output path. Additionally, price-level rules perform

better than Taylor rules in terms of welfare as shown by Svensson (1999) and, when learning dynamics are considered, they are more effective in ensuring determinacy and optimal policy as confirmed by Preston (2008).

3. A New Keynesian Model with Sticky Information and Wealth in Utility

This section presents Sticky information and wealth in the utility function New Keynesian Model, the SIWUNK model briefly. There is a continuum of households indexed by $i \in [0, 1]$, whose behavior follows a structure similar as in Zhao (2023). Specifically, each household derives utility from both consumption and wealth holdings. This assumption is closely related to the money in the utility framework but offers a different rationale: during the process of holding wealth, it is accumulated via the interest rate. Regarding how information is modeled in the economy, households are identical except for the date on which they receive new information, as in Reis (2009). This assumption helps to create an environment where well-informed and uninformed individuals coexist simultaneously.

As proposed by Zhao (2023), abstracting from subindex, the period t utility function of household k can be represented as:

$$U\left(C_t, L_t, \frac{B_t}{P_t}; \varepsilon_{bt}\right) = \frac{C_t^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}} - \frac{\kappa L_t^{1+\psi}}{1+\psi} + \varepsilon_{bt}\varphi_b \frac{\left(1+\frac{B_t}{P_t}\right)^{1-\eta}}{1-\eta} \tag{1}$$

The first two elements in Equation 1 are standard in the literature, stating that households derive positive utility from consumption C while they get dis-utility from labor L. The third element defines a broad measure of wealth, namely real bond holdings, $b_t = \frac{B_t}{P_t}$, and highlights the positive effect of wealth holdings on utility, which is subject to preference shocks, ε_{bt}.

The preference for wealth shock follows a log AR(1) process of the form

$$\varepsilon_{b,t} = \rho_{\varepsilon_b}\varepsilon_{b,t-1} + \epsilon_{\varepsilon_b,t}. \tag{2}$$

The household k maximization problem is:

$$\max_{\left\{C_t, L_t, \frac{B_t}{P_t}\right\}} \mathbb{E}_t \sum_{t=0}^{\infty} \beta^t \left\{ \frac{C_t^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}} - \frac{\kappa L_t^{1+\psi}}{1+\psi} + \varepsilon_{bt} \varphi_b \frac{\left(1+\frac{B_t}{P_t}\right)^{1-\eta}}{1-\eta} \right\} \tag{3}$$

subject to

$$\frac{C_t}{P_t} + b_t = \frac{W_t}{P_t} L_t + \frac{R_{t-1}}{\pi_t} b_{t-1} + \frac{\text{Profits}_t}{P_t} + \frac{\text{Transfers}_t}{P_t} - \frac{T_t}{P_t}$$

and the non-Ponzi condition. The first-order conditions for Equation 3 are:

$$C_t^{-\sigma} = \underbrace{\beta \mathbb{E}_t \left\{ C_{t+1}^{-\sigma} \frac{R_t}{\pi_{t+1}} \right\}}_{\text{Gain in utility from consumption in } t+1} + \underbrace{\varepsilon_{b,t} \varphi_b (1+b_t)^{-\eta}}_{\text{Gain in utility from holding wealth in } t} \tag{4}$$

$$\kappa L_t^{\psi} = w_t C_t^{-\sigma} \tag{5}$$

where $w_t = \frac{W_t}{P_t}$ is the real wage. While Equation 5 represents the standard intra-temporal consumption-labor condition, Equation 4 illustrates how introducing wealth modifies the Euler equation. The term $\varepsilon_{b,t} \varphi_b (1+b_t)^{-\eta}$ dampens the incentive to postpone present consumption since holding wealth through a higher b_t increases utility. Therefore, compared to the standard Euler equation, households have less incentive to postpone present consumption, reducing future consumption in the long run. Furthermore, expressing Equation 4 in terms of the output gap shows that wealth introduces a discounting effect in the IS curve, making households less forward-looking, as shown by Zhao (2023).

The introduction of information frictions on the household side closely follows the structure in Reis (2009). Agents are homogeneous and differ only in the date on which they receive and update their information set. Thus, we can group agents and let j represent the date on which they updated their information set. Denote $\delta \in [0,1]$ as the fraction of households that receive new information in each period. Therefore, in every period t, a fraction δ of households use new information

($j = 0$), while a fraction $\delta(1-\delta)$ has information that is one period old, etc. Next, suppose that the fraction of households with information that is j periods old form expectations according to:

$$\mathbb{E}_t^{(j)} = \mathbb{E}_{t-j} \tag{6}$$

If $j = 0$ is the fraction of households that form expectations rationally using up-to-date information, then Equation 6 imply $\mathbb{E}_t^{(0)} = \mathbb{E}_t$. Therefore, for the households who update their information set, Equation 4 becomes,

$$C_{t,0}^{-\sigma} = \beta \mathbb{E}_t \left\{ C_{t+1,0}^{-\sigma} \frac{R_t}{\pi_{t+1}} \right\} + \varepsilon_{bt,0} \phi_b (1 + b_{t,0})^{-\eta} \tag{7}$$

while Equation 5 turns into

$$w_{t,0} = \frac{\kappa L_{t,0}^{\psi}}{C_{t,0}^{-\sigma}} \tag{8}$$

It is assumed that agents who do not update their information set can freely observe Equation 7 and Equation 8 and set expectations accordingly. Thus for every $j > 0$:

$$C_{t,j} = \mathbb{E}_{t-j} \left(C_{t,0} \right) \tag{9}$$

$$w_{t,j} = \mathbb{E}_{t-j} \left(w_{t,0} \right) \tag{10}$$

Finally, provided that $\delta > 0$, aggregate consumption and wage are given by the following equations:

$$C_t = \delta \left(\sum_{j=0}^{\infty} (1-\delta)^j \mathbb{E}_{t-j} \left\{ C_{t,j} \right\} \right) \tag{11}$$

$$w_t = \delta \left(\sum_{j=0}^{\infty} (1-\delta)^j \mathbb{E}_{t-j} \left\{ w_{t,j} \right\} \right) \tag{12}$$

The rest of the model closely follows the structure of the standard New Keynesian (NK) model, as described in Galí (2015), Chapter 3. There is a continuum of firms, indexed by $i \in [0,1]$, that use a linear production function:

$$Y_t = A_t L_t \tag{13}$$

and face the same aggregate level of technology, A_t, which follows a log AR(1) process of the form:

$$a_t = \rho_a a_{t-1} + \epsilon_{a,t}. \tag{14}$$

Each intermediate good producer faces the optimality condition for labor given by:

$$mc_t = \frac{w_t}{A_t} \tag{15}$$

where mc_t is the marginal cost. The aggregate price dynamics follow the environment of Calvo (1983), in which each firm can reset its price with probability $1-\theta$, while the remaining fraction does not. As is standard in the NK literature, the Phillips curve can be represented as:

$$\pi_t = \beta \mathbb{E}_t \left\{ \pi_{t+1} \right\} + \lambda mc_t \tag{16}$$

To model the government, I follow the fiscal structure described in Zhao (2023), where the fiscal revenue comes from collecting lump-sum taxes and government spending arises from issuing government bonds. In this framework, real government spending, $g_t = \frac{G_t}{P_t}$, is:

$$g_t = \frac{\mathrm{T}_t}{P_t} + b_t - \frac{R_{t-1} b_{t-1}}{\pi_t} \tag{17}$$

and the government follows a tax rule for $\tau_t = \frac{T_t}{P_t}$, given by

$$\tau_t = \tau_b b_{t-1}. \tag{18}$$

On the other hand, the central bank may follow two interest rate rules to conduct its monetary policy:

$$i_t = \phi_\pi \pi_t + \phi_y y_t + \nu_t \tag{19}$$

or

$$i_t = \phi_\pi p_t + \phi_y y_t + \nu_t \tag{20}$$

where Equation 19 is the standard Taylor rule that responds to inflation and output and Equation 20 is a modified version of the Wicksellian rule proposed by Woodford (2003) that reacts to the price level and output. Both interest rate rules are exposed to monetary shocks of the form:

$$\nu_t = \rho_\nu \nu_{t-1} + \epsilon_{\nu,t}. \tag{21}$$

As usual, the connection between the nominal and the real interest rate is given by the Fisher equation,

$$R_t = i_t - \mathbb{E}_t \left\{ \pi_{t+1} \right\}. \tag{22}$$

The market clearing constraint requires,

$$Y_t = C_t + G_t \tag{23}$$

while the bond market clearing condition implies,

$$b_t = 0. \tag{24}$$

Finally, the equilibrium definition for this economy is the following.

DEFINITION 1. *Given the initial condition for B_0 and the exogenous sequence of technology shocks $\{a_t\}_{t=0}^{\infty}$ (Equation 14), wealth preference shocks $\{\varepsilon_{bt}\}_{t=0}^{\infty}$ (Equation 2) and monetary shocks $\{\nu_t\}_{t=0}^{\infty}$ (Equation 21), a sequential equilibrium is a sequence of prices $\left\{P_t, w_t, \left\{w_{t,j}\right\}_{k=0}^{\infty}, R_t, mc_t, i_t\right\}_{t=0}^{\infty}$ for quantities $\left\{C_t, \left\{C_{t,j}\right\}_{k=0}^{\infty}, \left\{L_{t,j}\right\}_{k=0}^{\infty}, B_t, T_t, Y_t, G_t\right\}_{t=0}^{\infty}$ such that:*

- *the household k optimal conditions for consumption (Equation 4) and labor (Equation 5) along with the transversality condition hold;*
- *given $\delta > 0$, the aggregate consumption (Equation 11) and wage (Equation 12) are satisfied;*
- *the aggregate production function for the representative firm (Equation 13), the real marginal cost (Equation 15) and the Phillips curve (Equation 16) hold;*
- *the government spending (Equation 17) and the fiscal rule (Equation 18) hold;*
- *the central bank set its interest rate according to a Taylor rule (Equation 19) or using a Wicksellian rule (Equation 20) and the Fisher equation (Equation 22) holds;*
- *goods market (Equation 23) and bond market (Equation 24) clear.*

TABLE 1. Calibration

Parameter	Description	Value	Reference
σ	Inverse of Inter-temporal Elasticity of Subs.	1	Galí (2015)
β	Discount Factor	0.98	Galí (2015)
φ	Inverse Frisch Elasticity	2	Galí (2015)
ϕ_π	Interest Rate Inflation/Price Response Coefficient	1.5	Galí (2015)
ϕ_y	Interest Rate Output Response Coefficient	0.5	Galí (2015)
θ	Calvo Parameter	$\frac{3}{4}$	Galí (2015)
ρ_ν	Monetary Shock Persistence	0.9	Galí (2015)
ρ_a	Technology Shock Persistence	0.9	Galí (2015)
ρ_{e_B}	Wealth Shock Persistence	0.9	Zhao (2023)
τ_b	Taxes response to Government Debt	0.05	Zhao (2023)
$\frac{B^{ss}}{Y^{ss}}$	Steady State Debt-to-Output Ratio	2.4	Zhao (2023)
$\frac{C^{ss}}{Y^{ss}}$	Steady-State Consumption-to-Output Ratio	0.8	Zhao (2023)
$\frac{G^{ss}}{Y^{ss}}$	Steady-State Government Spending-to-Output Ratio	0.2	Zhao (2023)
η_b	Curvature of Utility with Respect to Wealth	1	Zhao (2023)
Θ	Strength of Preference over Wealth	0.96	Zhao (2023)
δ	Fraction of Households that Update Information	0.25	Reis (2009)

4. Results

This section introduces the main monetary implications of the SIWUNK model and compares its results with the predictions of existing literature. For this purpose, it is important to note that the SIWUNK model can collapse into three alternative models under specific selections of δ and φ_b: i) NK for $\delta = 1$ and $\varphi_b = 0$; ii) SI for $\delta \in (0, 1)$ and $\varphi_b = 0$; iii) WUNK for $\delta = 1$ and $\varphi_b > 0$; iv) SIWUNK for $\delta \in (0, 1)$ and $\varphi_b > 0$.

4.1. Determinacy

The first result concerns the determinacy regions associated with each model. Figure 1A illustrates the necessity of the Taylor principle in ensuring determinacy for the NK model under a Taylor rule, as shown by Galí (2015). In contrast, when considering a Wicksellian rule in Figure 1E, the model does not require the Taylor principle to achieve determinacy, result consistent with Giannoni (2014). These two results serve as the baseline case, which will be compared against the predictions of introducing information frictions and wealth in utility separately, and finally

jointly.

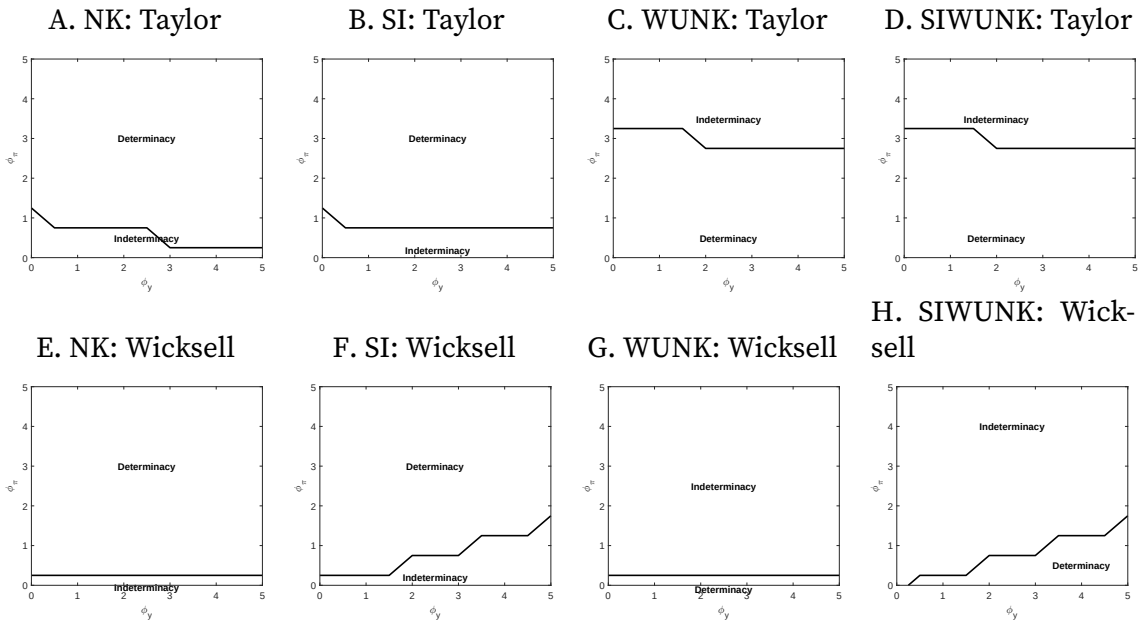
Introducing information frictions does not significantly alter the baseline results; however, it slightly reduces the determinacy regions for higher values of ϕ_y under a price-level rule, as shown in Figure 1F. Nonetheless, the introduction of wealth in utility considerably affects the determinacy results. As documented by Zhao (2023) and illustrated in Figure 1C, the WUNK model requires a passive response to ϕ_π to ensure determinacy under a Taylor rule. In this case, the Taylor principle is not necessary for determinacy. If $\phi_\pi < 1$ the real interest rate decreases and stimulate the economy without leading to an explosive output path, as it simultaneously increases household wealth accumulation that eventually will prevent output to explode.

This result changes dramatically under a price-level rule. In this scenario, determinacy becomes impossible, as depicted in Figure 1G. Regardless of whether the Taylor Principle is meet or not, the expected future deflationary process increases the real interest rate via Equation 22, making wealth accumulation more attractive than consumption. In the extreme case, unbounded wealth accumulation leads to a collapse in consumption and output, driving them toward zero where no stable equilibrium is achieved. Finally, when jointly considering information frictions and wealth in utility, the determinacy regions and mechanisms of the SIWUNK model under a Taylor rule remain essentially the same as those of the WUNK model. However, information frictions help ensure determinacy under a Wicksellian rule in the presence of wealth in utility, but only for small values of ϕ_π, as shown in Figure 1H. In this case, the presence of information frictions alleviates the indeterminacy problem for lower responses to ϕ_π, as households, limited by their imperfect information, may be uncertain about the future deflationary path the central bank would create.

4.2. Dynamics

The next step is to analyze the dynamics associated with the SIWUNK model. Similar to the determinacy analysis, I will compare the trajectories of the model's possible simplifications using the parameter values described in Table 1. The study examines the effects of two shocks: a technology shock, modeled as an increase in firms' total factor productivity, and a monetary shock, represented by a decrease

FIGURE 1. Interest Rate Rule Determinacy



in the nominal interest rate. Finally, the following considerations are assumed for the price-level rule scenario. First, since the WUNK model fails to achieve determinacy, this scenario is excluded from further analysis. Second, given the reduced determinacy region for the SIWUNK model, as discussed earlier, the analysis focuses on the specific case where $\phi_\pi = 0.1$.

Suppose the economy experiences a positive technology shock, and the central bank follows a Taylor rule to set its interest rate. As shown in Figure 2A, the NK model predicts that, on impact, output increases while marginal costs decline. This effect puts downward pressure on inflation through the Phillips curve, leading to a decrease in prices. Consequently, the real interest rate also declines due to a lower nominal interest rate caused by the dominant effect of inflation over output. Once the shock dissipates, the economy returns to its steady state, except for the price level, which remains positively affected. This serves as the baseline case for comparing the dynamics of the SIWUNK model. When incorporating wealth in utility, the WUNK model follows the same overall dynamics as the NK model, with only slight differences in magnitudes. The key distinction is that the real interest rate must turn positive relatively soon (around period 4) to make wealth accumulation attractive again, an adjustment not present in the NK model.

Introducing information frictions does not change the fundamental dynamics,

but it reveals a learning process as information gradually diffuses throughout the economy. In the SI model, output exhibits a hump-shaped response: on impact, uninformed agents remain unaware of the positive technology shock and do not adjust their optimal decisions, while informed agents do. As new information gradually spreads, uninformed agents receive and process it with a lag, causing output to peak later. Finally, adding wealth in utility to the sticky information model does not change the dynamics of inflation, the real interest rate, or the price level. However, it preserves the learning dynamics in output and, as in the WUNK model, requires a quick return to a positive interest rate to ensure that holding wealth remains attractive. Therefore, in the SIWUNK model with a Taylor rule, the overall dynamics closely resemble those of the NK model but incorporate both a learning process in output and a pronounced future response in the real interest rate by the central bank to maintain the attractiveness of wealth accumulation.

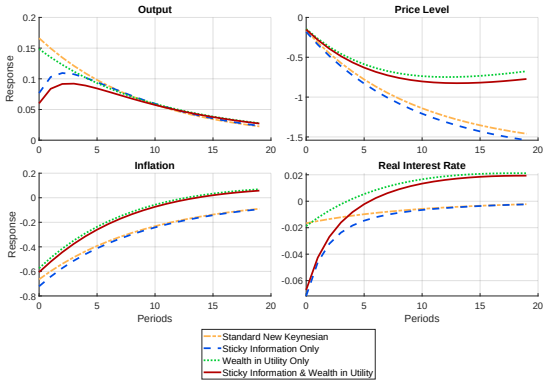
Next, consider the effect of a positive technology shock when the central bank follows a Wicksellian interest rate rule. It is important to first note that the dynamics of the WUNK model are not depicted due to the indeterminacy issue discussed in the previous section. As shown in Figure 2B, the NK model predicts that, on impact, output increases while inflation declines, though to a lesser extent than in the Taylor rule scenario. The underlying reason is that agents anticipate a future inflationary process driven by the central bank to restore the price level to its previous trend. Additionally, the nominal interest rate rises due to the dominant effect of output growth over inflation reduction. These results serve as the baseline case for analyzing the effects of a Wicksellian interest rate rule under a technology shock.

Introducing information frictions does not alter the overall dynamics described above but introduces the learning mechanism, similar to the Taylor rule case. Finally, when wealth in utility is incorporated into the SI model, the dynamics are similar but wider. The interest rate responds positively on impact, reinforcing the desirability of holding wealth in every period. This effect arises because the central bank's relatively weak response to inflation allows the increase in output to dominate the inflation component in the central bank's reaction function.

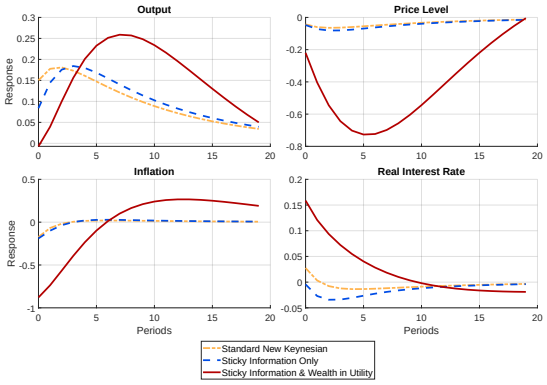
Now, consider the dynamics following an expansive monetary shock when

FIGURE 2. Dynamic Response to a Positive Technology Shock

A. Taylor Rule



B. Wicksellian Rule



the central bank follows a Taylor rule. As previously, the NK model serves as the reference case for comparison. As shown in Figure 3A, the dynamics operate through a lower real interest rate, which stimulates both output and inflation while allowing the price level to rise over time. Introducing wealth into utility does not drastically alter these dynamics; however, it requires a lower real interest rate for an extended period to offset the increased wealth accumulation resulting from higher output. Similarly, incorporating sticky information primarily affects output by introducing a learning component. Finally, the SIWUNK model jointly captures both of these properties.

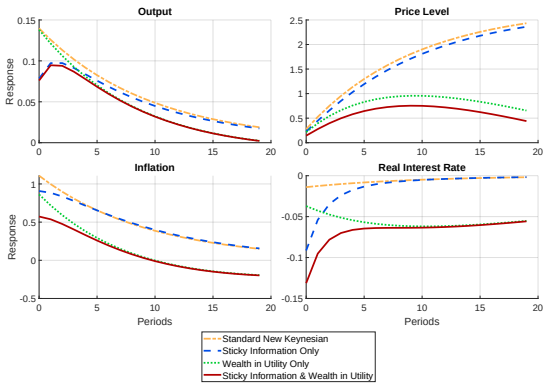
Figure 3B depicts that when the central bank instead follows a price-level rule, the baseline dynamics remain essentially unchanged, with the key distinction that the price level eventually returns to its previous path. Adding sticky information alone does not significantly alter the dynamics. However, its interaction with wealth in utility amplifies the model's responses, showing that the central bank can keep higher output for a longer period without an immediate return of the price level to its previous trend.

In summary, the analysis of the SIWUNK model's dynamics under different monetary policy rules highlights key distinctions introduced by wealth in utility and sticky information. First, the responses of output, inflation, and real interest rate are quite similar to the NK model, the introduction of information frictions introduce a gradual learning process, affecting the timing and magnitude of output responses. Second, wealth in utility requires a stronger central bank intervention to guarantee a continuous incentive for wealth accumulation. Under a Taylor

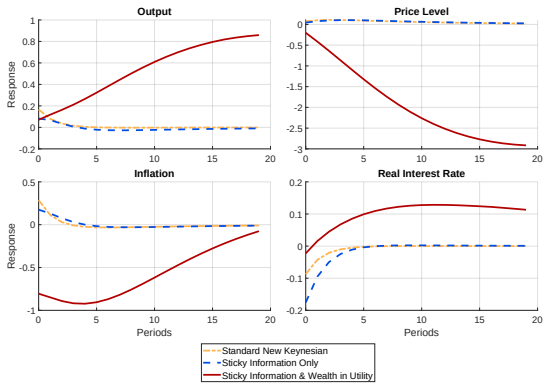
rule, the SIWUNK model captures both these mechanisms, whereas a Wicksellian interest rate rule results in a more muted inflation response due to expectations of future deflation yet dynamics more pronounced after a monetary shock.

FIGURE 3. Dynamic Response to an Expansive Monetary Shock

A. Taylor Rule



B. Wicksellian Rule



4.3. Welfare Analysis

The next important aspect is to evaluate how introducing wealth in utility and information frictions by documenting positive implications on the central banks actions on social welfare. The central bank's loss function proposed in this paper follows a simple quadratic structure as follows:

$$L_t = y_t^2 + \pi_t^2 \tag{25}$$

Equation 25 has the appeal of being simple to implement, an aspect particularly relevant when calculating the steady state of aggregate variables under information frictions. Moreover, this equation can be computed across all the models involved, allowing for a consistent welfare measurement across models. In all cases, the loss function is computed over the same range of ϕ_π and ϕ_y for which the respective model achieves determinacy. Finally, the cases where the central bank follows a Taylor rule and a Wicksellian rule after technology and monetary shocks are presented in what follows.

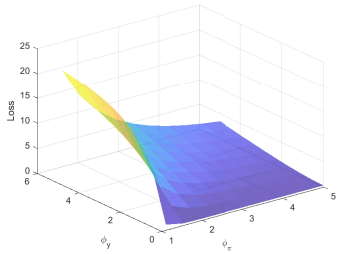
Consider first the associated loss behavior after a restrictive monetary shock. Figure 4A reveals that in the baseline case, the central bank assures a lower loss when it reacts strongly to inflation while setting a lower response to output. This result supports the idea that higher response to inflation is desirable because it helps to prevent indeterminacy while achieving a lower social welfare loss. This fact is also obtained in the WUNK model as Figure 4G shows for the case of a Taylor rule. Compared with Figure 4B, the aforementioned result still holds; however, it now highlights that price-level rules deliver a lower welfare loss, a finding previously proved by Svensson (1999). On the other hand, Figure 4C and Figure 4D show that, when information frictions are considered, the welfare loss associated to a Taylor rule decreases, while the loss under a price-level rule increases, relative to the NK baseline case. Nevertheless, a strong response to inflation relative to output remains desirable under a price-level rule. The results shift when wealth in utility is introduced altogether with information frictions. As shown in Figure 4E and Figure 4F, smaller responses to both inflation and output are preferred, regardless of the central bank's interest rate rule. Strikingly, following a price level rule results in a higher welfare loss, not surprisingly given the wide dynamics illustrated in Figure 2B.

The welfare implications of an expansive monetary shock are broadly similar to the previous case, though with some nuanced differences. As shown in Figure 5A and Figure 5B, price-level targeting continues to dominate inflation targeting in terms of welfare in the NK model. Even when an strong response to inflation combined with a moderate response to output remains a desirable policy stance, a strong response to both inflation and output also emerges as a potential alternative. Introducing information frictions does not significantly change these findings, however, when wealth in utility is introduced, the role of output becomes more relevant. In this case, it becomes optimal to respond less aggressively to inflation, and the preferred monetary framework shifts towards inflation targeting, as shown in Figure 5E and Figure 5F.

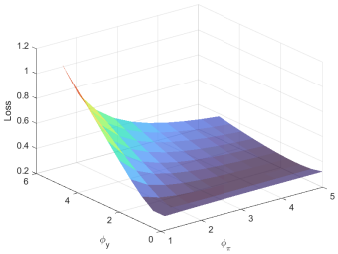
When the central bank follows a Wicksellian rule, onthe other hand, output increases over an extended period while prices continue to fall. Consequently, the central bank must maintain a restrictive monetary policy for longer than expected to stabilize output. This prolonged restriction raises the uncertainty surrounding future interest rate path, increasing the variances of both inflation and output, and

FIGURE 4. Loss Region given a Positive Technology Shock

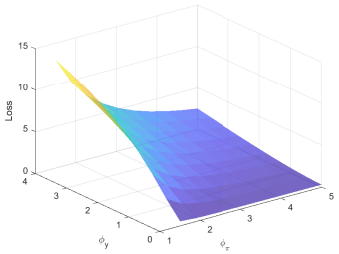
A. NK: Taylor



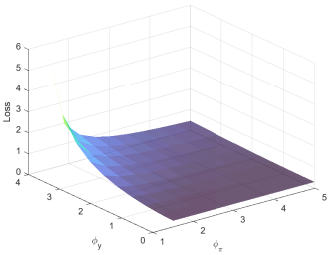
B. NK: Wicksell



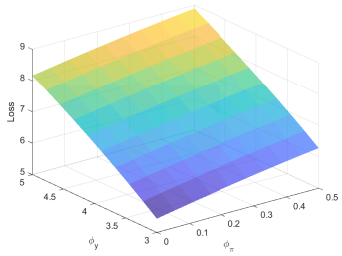
C. Sticky I.: Taylor



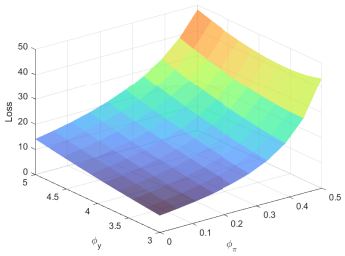
D. Sticky I.: Wicksell



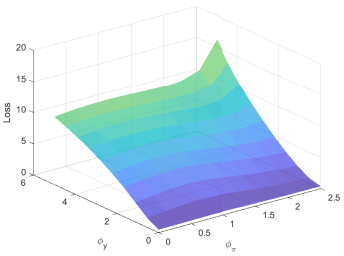
E. Sticky I. + Wealth U.: Taylor



F. Sticky I. + Wealth U.: Wicksell



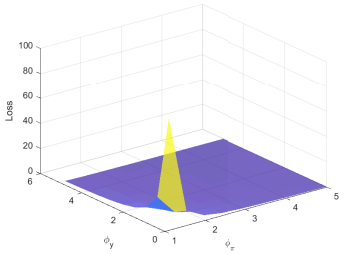
G. Wealth U.: Taylor



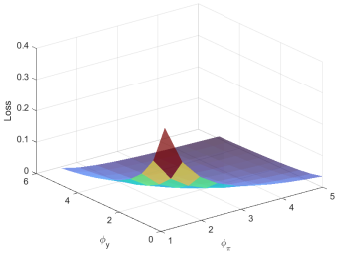
at the end leading to higher social loss. It is important to note that this mechanism does not occur under a Taylor rule, though. In that case, output returns to its steady state, while the price-level returns to its previous path. Therefore, when wealth in utility is considered, the uncertainty associated with future interest rates under price-level targeting aligns with the main critiques of that framework, namely, the associated bigger volatility in output and inflation.

FIGURE 5. Loss Region given an Expansive Monetary Shock

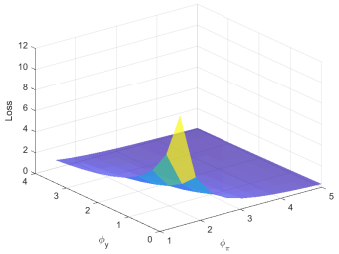
A. NK: Taylor



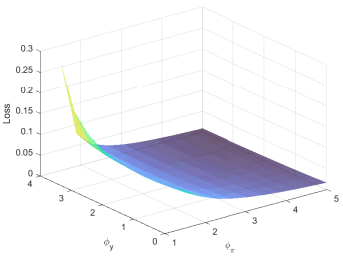
B. NK: Wicksell



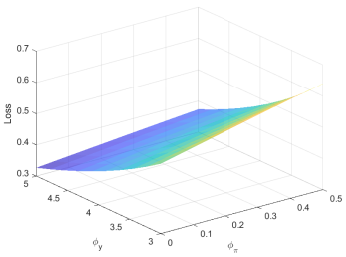
C. Sticky I.: Taylor



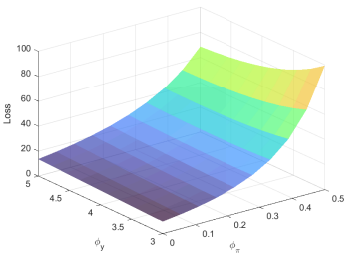
D. Sticky I.: Wicksell



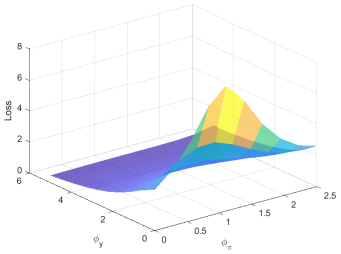
E. Sticky I. + Wealth U.: Taylor



F. Sticky I. + Wealth U.: Wicksell



G. Wealth U.: Taylor

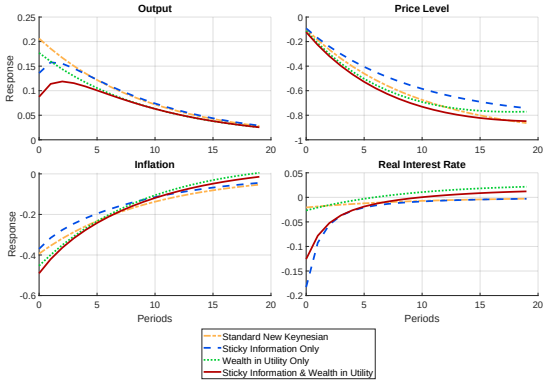


An interesting extension of the welfare analysis presented above involves studying the dynamics under optimal simple rules. In this context, the central bank optimizs the parameters of the interest rate rule, ϕ_π and ϕ_y, to minimize the social loss defined in Equation 25, as studied by Reis (2009). A key advantage of optimal simple rules is their ability to reduce uncertainty about the future monetary policy path, while still delivering outcomes that closely approximate the "First Best" in terms of welfare, as discussed by Williams (2003). In this line, Figure 6 illustrates the dynamic responses following a positive technology shock when the central bank implements optimal rules. Under the optimal Taylor rule in Figure 6A, the dynamics are quite similar but more pronounced: output reacts more strongly because the optimal policy prescribes a more aggressive response to inflation, while keeping real interest rates negative for a longer period.

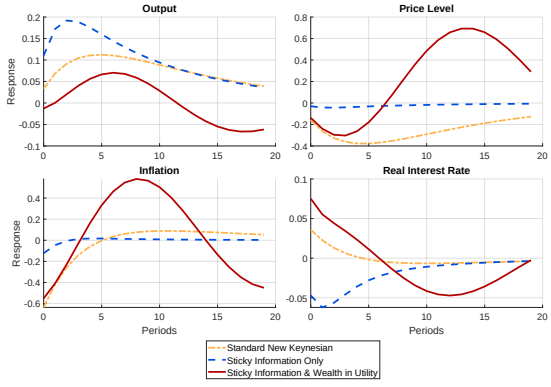
On the other hand, under an optimized Wicksellian rule, the impact on output is also stronger and is accompanied by expected future deflation, as expected but notoriously in higher magnitude for the NK model. However, in the SIWUNK model, the dynamics are more volatile: price level exhibit oscillations, and the real interest rate becomes more restrictive under the optimal policy. In this case, the output increase boosts consumption, but the higher interest rate also raises the incentive to accumulate wealth. These opposing forces generate a dramatically increase in volatility for aggregates, with the observed dynamic depending on which force dominates for a given period.

FIGURE 6. Dynamic Response to a Positive Technology Shock: Optimal Rule

A. Taylor Rule



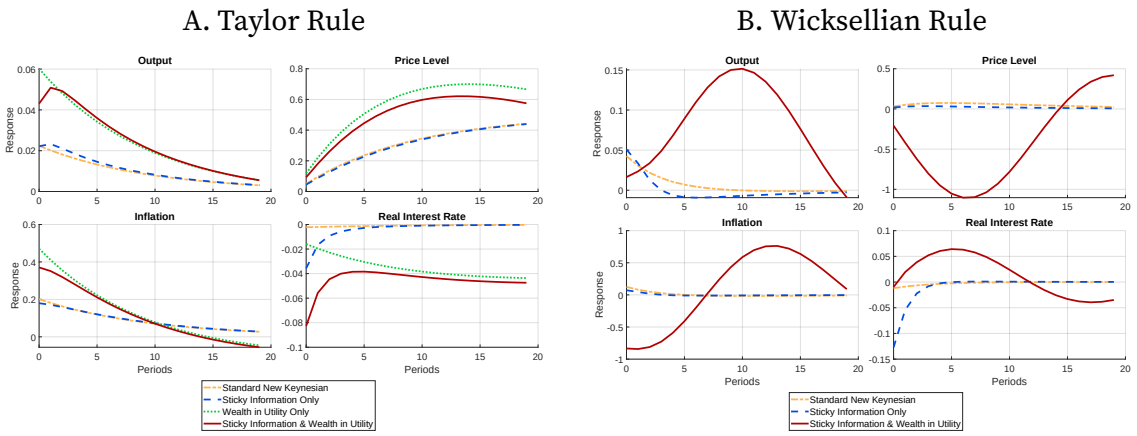
B. Wicksellian Rule



In contrast, Figure 7 shows the dynamic responses under an optimal Taylor

rule following an expansive monetary shock. The optimal policy calls for a less pronounced dynamics in both output and inflation, leading to a muted movement of the real interest rate. In this case, a strong central bank response to inflation and output that rapidly dissipates the shock yields the lowest loss. Analogously, these dynamics are similar when the central bank adopts an optimized Wicksellian rule, with the SIWUNK model still showing oscillatory dynamics. Therefore, this exercise highlights that under optimal simple rules, monetary policy shocks imply a weaker influence on the dynamics of macroeconomic aggregates.

FIGURE 7. Dynamic Response to an Expansive Monetary Shock: Optimal Rule



4.4. The Role of Sticky Information

This section extends the analysis by examining how variations in the fraction of households receiving new information influence the dynamics and welfare outcomes previously discussed. Recall that as $\delta \to 1$, the economy converges to the full-information benchmark, in which all agents instantly receive and process information, namely as in the baseline case for the NK model. It is important to mention that the analysis that follows focuses only on models where information frictions are relevant, namely, the Sticky Information (SI) and SIWUNK models. However, due to their similarity, this section only presents the results for the SIWUNK model, with the corresponding SI dynamics displayed in the Appendix.

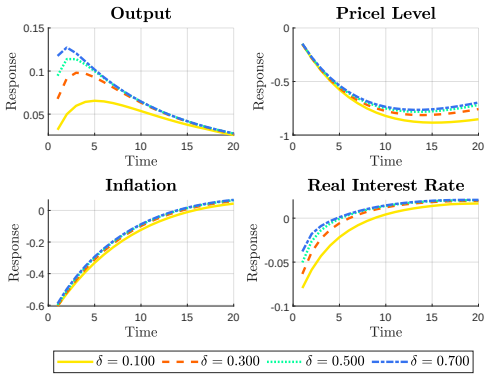
Under a Taylor rule and following a technology shock, Figure 8A illustrates how the hump-shaped response in output is governed by δ. A higher degree of information diffusion throughout the economy enhances social learning, thereby

amplifying the shock's aggregate effect. On the other hand, when a smaller fraction of agents perceives the shock and adjusts their behavior to the improved technology, the overall response is muted. Therefore, there is misallocation of resources derived from the delayed acquisition of information, which mute the response in output. Although the real interest rate adjusts more negatively, the effect in output is lower. Interestingly, the response of inflation is relatively unaffected by the degree of information frictions, showing similar dynamics across different values of δ.

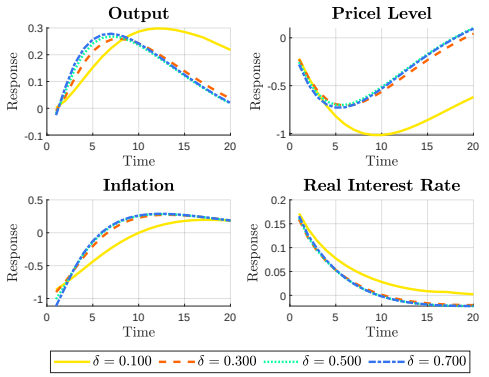
On the other hand, when the central bank follows a price level rule, as shown in Figure 8B, limited information diffusion does not negatively impact output dynamics as in the Taylor rule case. In fact, a Wicksellian rule appears to mitigate the dampening effects of higher information frictions on output by keeping a more positive real interest rate relative to the scenarios with more information diffusion. This implies that the positive effect of interest rates on wealth, mentioned in Section 4.2, is amplified, resulting in a delayed but strong positive response in output. It is important to emphasize that this channel arises from the inclusion of wealth in the utility function. When only information frictions are considered, as in the SI model, the response of output is considerably more subtle without a notorious delay, as illustrated in Figure A1B in the Appendix.

FIGURE 8. The Role of δ under an Expansive Technology Shock in the SIWUNK model

A. Taylor Rule



B. Wicksellian Rule



Next, consider how δ affects the dynamics following a monetary shock under

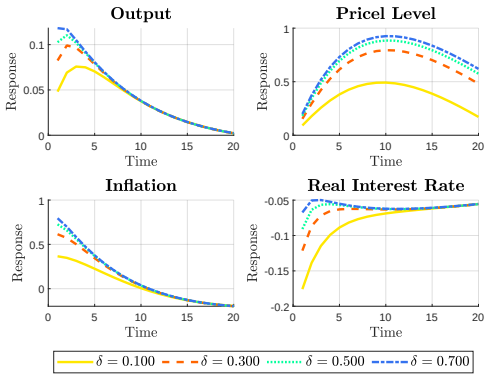
the SIWUNK model. Similar to the case of a technology shock, when a Taylor rule is in place, information frictions directly influence agents' ability to recognize and respond to the monetary shock. For example, when $\delta = 0.1$, a low share of agents internalizes the inflationary impact of the expansionary monetary policy, leading to a persistent lower inflation expectations compared to a more informed scenario. The Fisher equation (Equation 22) may help to understand the intuition. As the nominal rate falls while inflation expectations remain relatively unchanged, the real interest rate decreases close to one-to-one with the nominal shock, which explains the more pronounced response under stronger information frictions. This sluggishness dissipates as δ increases and agents become more capable of receiving and processing new information.

On the other hand, the dynamics are quite different under a Wicksellian rule. Here, the reduction in the nominal interest rate triggers a persistent deflationary process through a prolonged decline in the price level. In this case, information frictions impede not only the agents' ability to identify the monetary shock but also their understanding that the central bank is targeting the price level and that the central bank would compensate with future inflation. As a result, inflation expectations become excessively pessimistic, pushing the real interest rate into positive territory. A higher real interest rate increases incentives for wealth accumulation, which sustains output over a longer period. This process is reinforced by the persistent deflationary expectations. Thus, the duration and magnitude of the shock are amplified when information frictions are more severe. Finally, in this scenario, greater information diffusion appears to be beneficial, as it permits agents to better understand the nature and implications of the monetary shock.

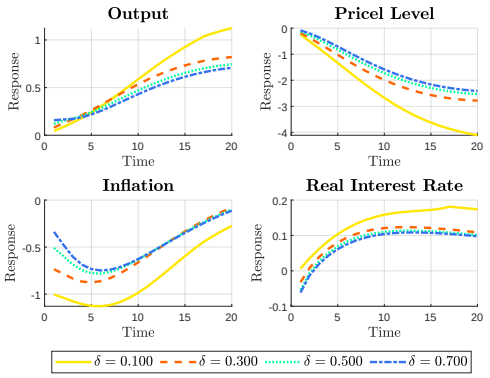
Another important dimension through which δ may affect the economy is its connection with welfare. To explore this link, I calculate the distribution of social loss when δ vary for the same ranges as in both Equation 4 and Equation 5. The analysis once again focuses exclusively on the SIWUNK model, with the corresponding results for the SI model offered in the Appendix B. A recurrent finding, shown in panels A, B, and C of Figure 10, is that greater information dispersion does not necessarily improve welfare. The reasoning is straightforward: a lower δ dampens the responses of output and inflation, as largely discussed, hence reducing their variances and therefore, lowering the aggregate social loss. As δ increases, more

FIGURE 9. The Role of δ under an Expansive Monetary Shock in the SIWUNK model

A. Taylor Rule



B. Wicksellian Rule



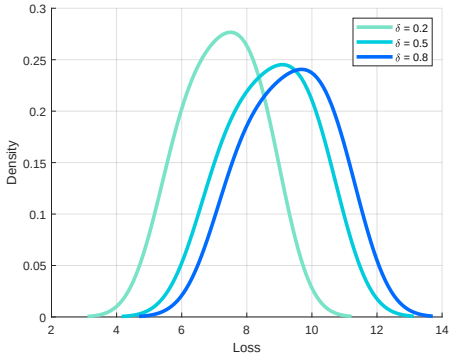
agents update their expectations, leading to stronger macroeconomic fluctuations and a rightward shift in the distribution of loss.

However, an important exception to this pattern emerges when the central bank follows a price level rule and the economy experiences an expansive monetary shock. As hypothesized in the discussion of Figure 9B, in this context, reduced information frictions (i.e., a higher δ) help lower the volatility of inflation and output, thereby decreasing social loss, as seen in Figure 10D. In this case, more information flow has a positive effect by improving agents' understanding of the central bank's policy framework. This may reduce the risk of deflationary expectation spirals, which otherwise would raise the real interest rate and consequently, constantly increase wealth accumulation. This result makes evident that, under specific conditions, better information diffusion can enhance welfare by stabilizing expectations and macroeconomic dynamics, while in other monetary frameworks, it do not.

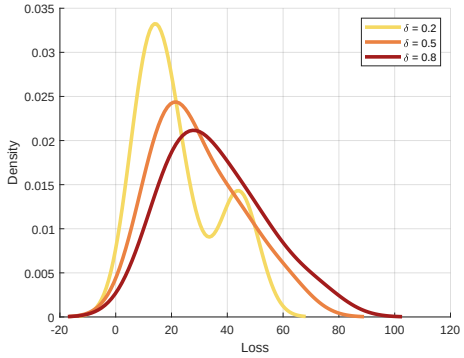
A final question to explore is whether the degree of information frictions affects how the central bank may optimally choose its interest rate rule parameters to minimize the social loss. The analysis builds on the Optimal Simple Rules exercise presented earlier, but now extends it by allowing that the information parameter δ vary. This extension is relevant only for the SI and SIWUNK models where δ plays a role, however, the results for the NK and WUNK models are also included

FIGURE 10. Effect of δ on the Loss Distribution in the SIWUNK Model

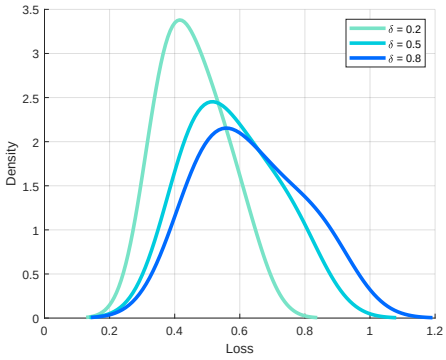
A. Tech. Shock & Taylor Rule



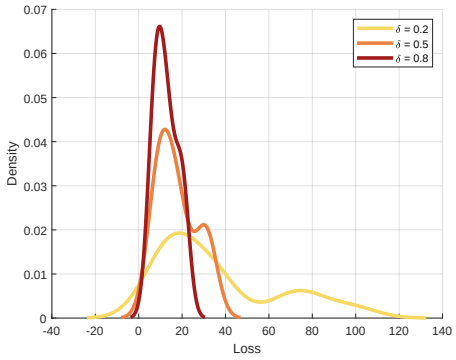
B. Tech. Shock & Wicksellian Rule



C. Mon. Shock & Taylor Rule



D. Mon. Shock & Wicksellian Rule



for comparison. The first evident result, consistent across all models, is that information frictions do not alter the optimal parameters in the interest rate rules. This implies that, although information frictions may affect the distribution of social loss, as shown in Figure 10, the central bank can be confident that its chosen policy parameters will remain optimal regardless of the value of δ.

On the other hand, there are subtle results regarding the optimal parameters magnitudes. Start by considering the case of a technology shock under a Taylor rule, as shown in Figure 11A. In the NK baseline, the optimal rule involves assigning a substantially stronger response to inflation than to output. The reason is the central bank latent need to stabilize the potentially inflationary dynamics

triggered by a positive technology shock. Although the central bank adheres to its dual mandate of stabilizing both inflation and output, the model favors a more aggressive stance toward inflation.

A similar intuition holds when information frictions are introduced, as in the SI model, although the optimal responses are less aggressive. Here, the presence of information frictions calls for a less aggressive policy since agents are slower to recognize and incorporate the shock into expectations. Therefore, despite the tendency of prioritize stabilizing inflation, the central bank moderates its response due to the delayed adjustment in expectations. On the other hand, in the WUNK and SIWUNK models, the optimal coefficients are essentially identical. In these frameworks, changes in the nominal interest rate directly impact the real rate r_t, and thus consumer utility via wealth accumulation. Preventing the destabilizing effects on output caused by excessive wealth accumulation, the central bank must avoid overreacting with interest rate movements. Nevertheless, the policy still assigns slightly more weight to inflation stabilization than to output.

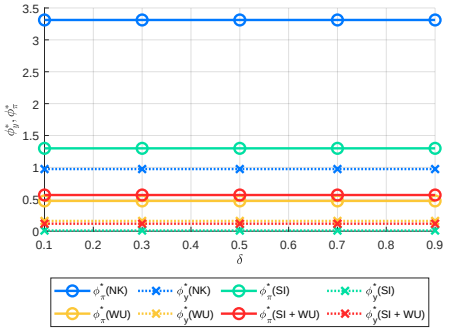
In contrast, when a price-level rule is implemented, the optimal policy calls for a stronger response to output relative to inflation. Under this monetary regime, agents anticipate future deflation in response to an inflationary shock, fully incorporating the central bank's commitment to the price level. As a result, there is no need for the central bank to overreact to inflation. Instead, the optimal policy shifts the central bank's preference toward stabilizing output in order to mitigate the increase in the output variance derived from the technological shock in order to reduce overall social loss.

Finally, consider the case where the central bank adheres to a Taylor rule and the economy experiences an expansionary monetary shock, as depicted in Figure 11C. In this case, a contrasting outcome appears since the shock requires an increased emphasis on output stabilization. In the baseline NK and SI models, the optimal coefficients reflect a balanced response to both inflation and output to minimize social loss. However, in the WUNK model, a stronger reaction to output is required. This shift is even more pronounced in the SIWUNK model, where the monetary shock require fully prioritizing output stabilization. Since r_t directly affects wealth accumulation, if the central bank overreacts to inflation this would amplify fluctuations in output and inflation via the wealth channel. Interestingly, these results remain consistent even under a price-level rule. Hence,

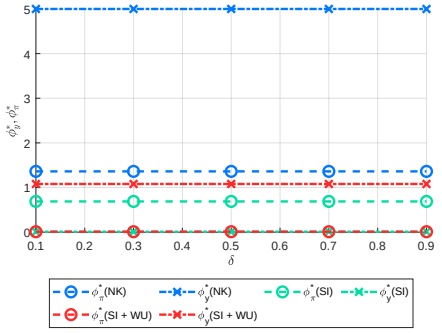
after a monetary shock, it becomes optimal for the central bank to shift toward a single mandate focused on output stabilization in order to achieve a lower social loss.

FIGURE 11. Optimal Interest Rate Coefficients

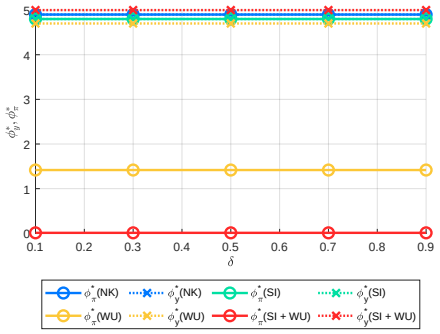
A. Tech. Shock: Taylor Rule



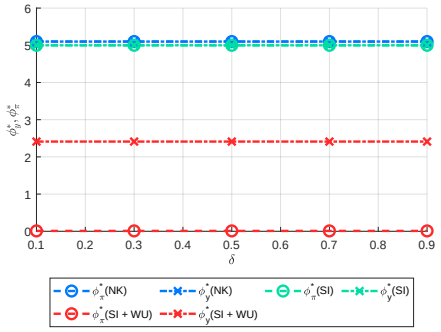
B. Tech. Shock:Wicksellian Rule



C. Mon. Shock: Taylor Rule



D. Mon. Shock: Wicksellian Rule



5. Conclusion

This paper has presented a novel theoretical framework that incorporates information frictions and wealth in the utility function into the standard New Keynesian model. The rationale behind this modification lies in the idea that, in the presence

of information frictions and uncertainty about future outcomes, agents may be more prone to accumulate wealth as a protection mechanism. Importantly, the analysis has provided insights into how the proposed SIWUNK model performs along key dimensions of monetary policy.

First, regarding determinacy, the SIWUNK model shows that a more passive monetary policy can sustain equilibrium stability under a Taylor rule, regardless of the degree of information frictions. In contrast, under a price-level rule and with wealth in utility alone, determinacy is not attainable, however, the introduction of information frictions opens small regions of determinacy when the central bank's interest rate response to inflation is sufficiently small. This result highlights the importance of the interaction between information frictions and the wealth motive for designing plausible monetary experiments.

Second, the transmission of monetary policy in the SIWUNK model differs from the standard knowledge provided by the NK model. The strong backward-looking motive, either due to information frictions or the wealth in utility, require the central bank to maintain lower interest rates for longer periods to preserve the attractiveness of wealth accumulation. However, the dynamics following a monetary shock under a price-level rule must be interpreted cautiously, as they tend to produce prolonged and somewhat unrealistic effects.

Regarding welfare, while price-level targeting performs better than inflation targeting in the NK and SI models, introducing wealth in utility reverses this outcome. Interestingly, greater information diffusion does not always guarantee a reduction in social loss under a Taylor rule, although it does under a price-level rule. Finally, in terms of optimal policy design, the presence of information frictions does not alter the optimal coefficients in the interest rate rules. This suggests that optimal simple rules remain robust in such settings, therefore reinforcing their appeal. Besides, when wealth in utility is considered, a broader range of desirable policy combinations emerges, sometimes with a stronger emphasis on stabilizing output rather than inflation.

Looking ahead, the SIWUNK model opens several avenues for future research. First, extending the model to a heterogeneous-agent framework could provide a richer understanding of how the wealth motive interacts with information frictions, particularly in relation to inequality and precautionary savings. Second,

since the model currently focuses only on monetary policy, and wealth is accumulated via bonds, studying the interaction between active fiscal policy and wealth dynamics would be an important extension. Finally, empirically validating the model's predictions using micro-level survey data, linking inflation expectations, savings motives, and wealth accumulation, would significantly boost its relevance for policy. Altogether, these extensions could improve our understanding of how monetary policy should be designed in complex environments where information is imperfect and individuals accumulate wealth as a safeguard, an agenda worth exploring in future research.

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Appendix A. Log-Linearized Model

This Appendix presents the log-linearized version of key non-linear equations obtained in the paper that constitutes the equilibrium. Equation 4 become:

$$\sigma c_{t,j} = \Theta\left(\sigma \mathbb{E}_t\left\{c_{t+1,j}\right\} - r_t + \mathbb{E}_t\left\{\pi_{t+1}\right\}\right) + (1-\Theta)\left(\varepsilon_{b,t,j} - \eta_b b_{t,j}\right) \tag{A1}$$

On the other hand, the linearized version of Equation 5 is:

$$w_{t,j} = \varphi l_{t,j} + \sigma c_{t,j}. \tag{A2}$$

Market clearing Equation 23 imply:

$$y_t = \frac{g^{ss}}{y^{ss}} g_t + \frac{c^{ss}}{y^{ss}}\left[\delta\left(\sum_{j=0}^{\infty}(1-\delta)^j \mathbb{E}_{t-j}\left\{c_{t,j}\right\}\right)\right] \tag{A3}$$

On the other hand, the linear version of the production function Equation 13 is:

$$y_t = a_t + l_t \tag{A4}$$

while marginal cost Equation 15 become:

$$mc_t = w_t - a_t. \tag{A5}$$

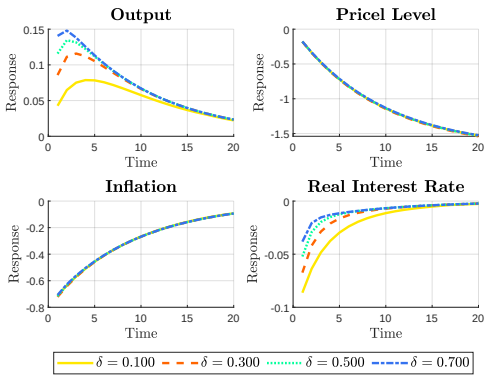
Finally, the government budged constraint Equation 17 turns into:

$$b_t = \frac{\Theta}{\beta}\left(r_{t-1} + b_{t-1} - \pi_t\right) + \left(1 - \frac{\Theta}{\beta}\right) g_t - \chi(\tau_t + y_t). \tag{A6}$$

Appendix B. Additional Figures

FIGURE A1. IRFs to Expansive Technology Shock in the SI model

A. Taylor Rule



B. Wicksellian Rule

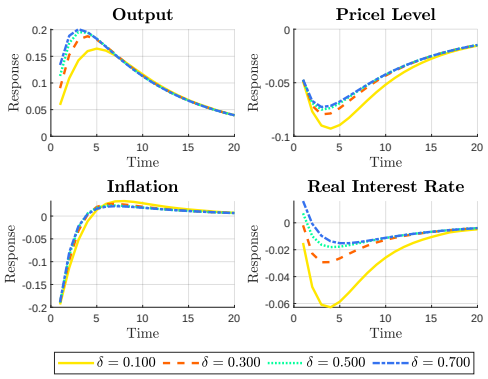
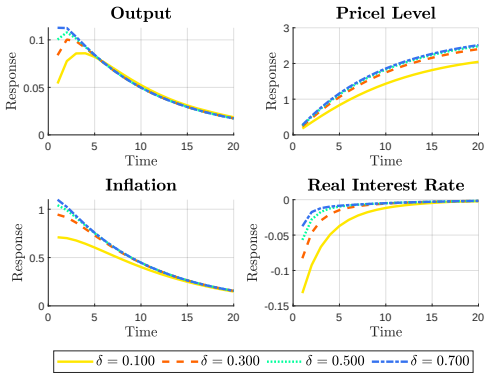


FIGURE A2. IRFs to an Expansive Monetary Shock in the SI model

A. Taylor Rule



B. Wicksellian Rule

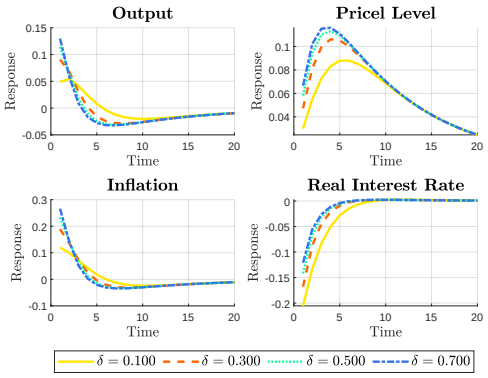
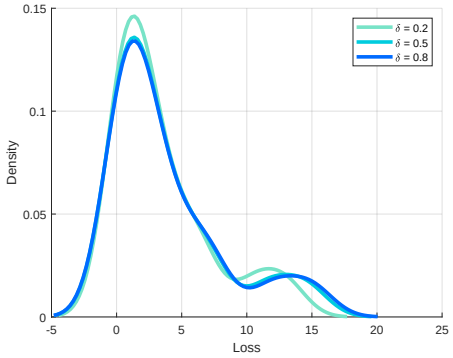
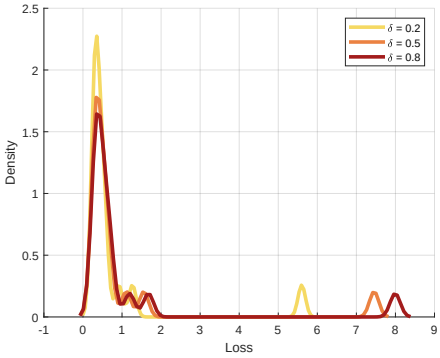


FIGURE A3. Effect of δ on the Loss Distribution in the SI Model

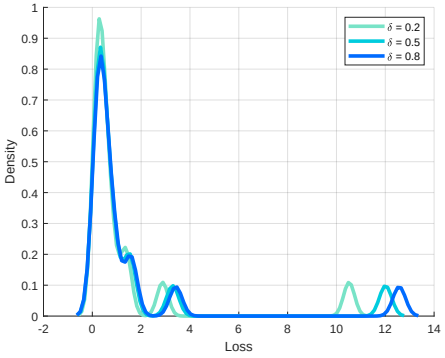
A. Tech. Shock & Taylor Rule



B. Tech. Shock & Wicksellian Rule



C. Mon. Shock & Taylor Rule



D. Mon. Shock & Wicksellian Rule

