Rule-Based Fiscal Stabilization with Consumption Taxes

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Abstract

Can consumption-tax rules substitute for interest-rate policy when nominal rates are fixed? I study this question in a two-agent New Keynesian model with savers and hand-to-mouth households. A rule that adjusts both consumption and labor taxes can replicate the output and inflation paths generated by a Taylor rule: the consumption tax reproduces the intertemporal wedge, while the labor tax neutralizes the induced marginal-cost distortion. When the instrument set is restricted to the consumption tax, this equivalence breaks down. The same tax wedge then affects both aggregate demand and marginal cost, changing determinacy conditions and forcing a trade-off between inflation and output stabilization. Quantitatively, the limited rule can match inflation closely but generates different output, debt, and redistribution dynamics. With capital accumulation, the consumption-tax rule remains a useful but partial substitute without additional instruments reproducing the dynamics from the capital Euler equation.

JEL Codes: E52, E62, E63, D31, C62.

Keywords: Consumption taxes; unconventional fiscal policy; monetary-fiscal policy; Taylor rules; heterogeneous households; determinacy.

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1 Introduction

The interaction between monetary and fiscal policy has long been central to macroeconomics. In normal times, short-term nominal interest rates are the standard stabilization instrument. When nominal rates are constrained by a lower bound, limited monetary autonomy, or institutional restrictions, policymakers need alternative instruments for stabilization purposes. One such alternative is unconventional fiscal policy: a combination of consumption taxes and other distortionary taxes reproduce the allocation associated with unconstrained monetary stabilization by effectively replicating the intertemporal effects generated by monetary policy (Correia et al. 2013). Consumption taxes are a natural candidate because changes in the expected path of the gross consumption-tax wedge enter the Euler equation in the same place as the real return. A consumption-tax rule can therefore, in principle, mimic the intertemporal substitution channel of an interest-rate rule.

This paper shows that this logic is incomplete once households are heterogeneous and fiscal instruments are limited. In a two-agent New Keynesian model with savers and hand-to-mouth households, a two-tax rule that adjusts both consumption and labor-income taxes can replicate the output and inflation paths generated by monetary policy. The consumption tax reproduces the Euler-equation wedge, while the labor tax offsets the induced marginal-cost distortion. If the consumption tax is the only active instrument, this equivalence breaks down: the same tax wedge affects both aggregate demand and marginal cost, altering determinacy and forcing a trade-off between inflation and output stabilization. I compare three environments: a standard monetary policy regime (MP), an aggregate-equivalent unconventional fiscal policy regime (UFPE) in which both consumption and labor-income taxes adjust, and a limited unconventional fiscal policy regime (LUFP) in which the only time-varying stabilization instrument is the consumption tax. The first result shows why a two-tax implementation can replicate aggregate output and inflation under monetary policy. A higher current consumption tax relative to future consumption taxes raises the effective real return faced by savers, reproducing the contractionary intertemporal wedge created by a Taylor-rule interest-rate increase. A matching movement in the labor-income tax keeps the household labor wedge, and hence marginal cost, unchanged. This set of policies, which I call the UFPE policy regime, replicates the output and inflation paths under MP. Its limitation is that it requires coordinated movements in consumption and labor-tax wedges; in the quantitative implementation below, this generates persistent tax-level shifts. This motivates LUFP, a more restrictive and empirically more plausible regime in which only the consumption tax adjusts. The restriction is consistent with policy experiments based on temporary VAT changes, such as the UK reform of 2008–09 and Germany's 2020 VAT reduction (Crossley, Low, and Sleeman 2014; Bachmann et al. 2023).

When the consumption tax is the only time-varying fiscal instrument, aggregate equivalence breaks down. In LUFP, the consumption tax does more than affect intertemporal substitution. Without a matching labor-income tax, consumption tax adjustments also feed directly into marginal cost and therefore act as a cost-push term in the New Keynesian Phillips curve. This dual role introduces an additional wedge in the aggregate Euler equation, whose magnitude depends on the degree of household heterogeneity. As a result, the mapping from policy coefficients to equilibrium determinacy differs from the monetary policy benchmark, and the standard Taylor principle is no longer sufficient to guarantee a unique equilibrium. I characterize the resulting determinacy region as a function of price stickiness and the share of hand-to-mouth households, building on the logic of Galí, López-Salido, and Vallés (2004) and Bilbiie (2008). With consumption taxes as the sole time-varying instrument, a policymaker facing dual stabilization objectives cannot, in general, replicate both output and inflation under monetary policy. The paper then derives the LUFP rule that replicates the inflation path under monetary policy and shows that a rule designed instead to replicate output would require commitment to an entire future path of tax adjustments, making it unattractive as a simple operational policy rule.

The numerical results shed light on how these two alternative policy regimes affect redistribution while preserving the stabilization effects under monetary policy. Under UFPE, aggregate equivalence fixes output and inflation but leaves the cross-sectional allocation undetermined. In the quantitative implementation, the equivalent tax rule raises revenue relative to MP and rebates it through identical transfers across households. Since hand-to-mouth households cannot smooth through asset markets and have a higher marginal propensity to consume out of transitory income, this transfer scheme tilts the net benefits of the policy toward them relative to savers while aggregate output and inflation remain unchanged relative to MP. Under LUFP, the same transfer channel cushions hand-to-mouth households relative to savers, but it operates alongside a less favorable aggregate allocation. A transition-based consumption-equivalent calculation show, under the benchmark calibration, the measured consumption-equivalent differences under these two UFP policies are small relative to MP, where the difference in aggregate welfare is below one basis point. This shows that the rule-based consumption-tax policies replicates similar quantitative effects in stabilization, but in itself leaves redistribution muted under identical rebates.

This paper contributes to the literature on unconventional fiscal policy. Correia et al. (2013) show that distortionary tax instruments can replicate unconstrained monetary-policy allocations at the zero lower bound, and Farhi, Gopinath, and Itskhoki (2014) develop related equivalence results in open economies. In heterogeneous-agent settings, Wolf (2021) studies transfer-based implementations, while Seidl and Seyrich (2023) show that fiscal policy can replicate monetary allocations in a HANK model when the government has access to a sufficiently rich set of instruments. Relative to these contributions, I focus on rule-based rather than discretionary implementation and deliberately restrict the fiscal instrument set. The analysis also connects to the TANK literature on monetary transmission and determinacy, especially Galí, López-Salido, and Vallés (2004) and Bilbiie (2008), by showing how household heterogeneity changes the determinacy properties of tax-based stabilization rules.

The rest of the paper proceeds as follows. Section 2 presents the model. Section 3 derives the aggregate equivalence result, characterizes LUFP, and studies local determinacy. Section 4 discusses the calibration. Section 5 presents the numerical experiments. Section 6 extends the model to allow for capital accumulation. Section 7 concludes.

2 Model

2.1 Households

The economy is populated by a unit mass of households indexed by $i \in [0,1]$. A share $1-\lambda$ consists of saver households, denoted by S, who trade one-period nominal bonds and own firms. The remaining share λ consists of hand-to-mouth households, denoted by H, who do not participate in asset markets and consume their current disposable income each period. Both household types maximize

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t U(C_{i,t}, N_{i,t}) \tag{1}$$

where period utility is given by

$$U(C_{i,t}, N_{i,t}) = \frac{C_{i,t}^{1-\sigma}}{1-\sigma} - \nu \, \frac{N_{i,t}^{1+\varphi}}{1+\varphi} \tag{2}$$

Here $\beta \in (0,1)$ is the discount factor, $\sigma > 0$ is the inverse intertemporal elasticity of substitution, $\varphi > 0$ is the inverse Frisch elasticity of labor supply, and $\nu > 0$ scales the disutility of labor. In the quantitative exercises, ν is chosen to normalize steady-state hours; because it is constant, it drops out of the log-linear equations. Hand-to-mouth households satisfy the following budget constraint

$$(1+\tau_{c,t})P_t C_{H,t} = (1-\tau_{n,t})W_t N_{H,t} + T_{H,t} \tag{3}$$

where $\tau_{c,t}$ is the consumption tax, $\tau_{n,t}$ is the labor-income tax, W_t is the nominal wage, P_t is the aggregate price index, and $T_{H,t}$ denotes lump-sum transfers. Saver households satisfy

$$(1+\tau_{c,t})P_t C_{S,t} + \frac{B_t}{R_t} + s_{S,t+1}P_t^e \leq B_{t-1} + (1-\tau_{n,t})W_t N_{S,t} + s_{S,t}\big(P_t^e + (1-\tau_{d,t})\Pi_t\big) + T_{S,t} \tag{4}$$

where B_t denotes holdings of one-period nominal bonds purchased at gross nominal return R_t, $s_{S,t}$ denotes equity shares, P_t^e is the ex-dividend equity price, $\tau_{d,t}$ is the profit tax, and Π_t denotes aggregate nominal profits.

The intratemporal optimality condition is identical across household types:

$$\nu C_{i,t}^{\sigma} N_{i,t}^{\varphi} = \frac{1-\tau_{n,t}}{1+\tau_{c,t}} \frac{W_t}{P_t} \qquad i \in \{H, S\} \tag{5}$$

For savers, the Euler equation for nominal bonds is

$$1 = R_t \mathbb{E}_t \big[M_{t,t+1} \big] = \beta R_t \mathbb{E}_t \left[\left(\frac{C_{S,t+1}}{C_{S,t}} \right)^{-\sigma} \frac{1+\tau_{c,t}}{1+\tau_{c,t+1}} \frac{1}{\pi_{t+1}} \right] \tag{6}$$

where $\pi_{t+1} \equiv P_{t+1}/P_t$ denotes gross inflation. The associated nominal stochastic discount factor is

$$M_{t,t+k} \equiv \beta^k \left(\frac{C_{S,t+k}}{C_{S,t}} \right)^{-\sigma} \frac{1+\tau_{c,t}}{1+\tau_{c,t+k}} \frac{P_t}{P_{t+k}} \qquad k \geq 1 \tag{7}$$

It follows that the equity price satisfies

$$P_t^e = \mathbb{E}_t \left[M_{t,t+1} \big(P_{t+1}^e + (1-\tau_{d,t+1}) \Pi_{t+1} \big) \right] \tag{8}$$

2.2 Production

A competitive final good firm aggregates a continuum of intermediate varieties according to the CES technology

$$Y_t = \left(\int_0^1 Y_t(j)^{\frac{\epsilon-1}{\epsilon}} \, dj \right)^{\frac{\epsilon}{\epsilon-1}}$$

with associated price index

$$P_t = \left(\int_0^1 P_t(j)^{1-\epsilon} \, dj \right)^{\frac{1}{1-\epsilon}}$$

where $\epsilon > 1$ is the elasticity of substitution across varieties. Each intermediate good firm j produces according to

$$Y_t(j) = A_t N_t(j)^{\alpha} \qquad 0 < \alpha < 1 \tag{9}$$

where A_t denotes aggregate productivity. Nominal profits are

$$\Pi_t(j) = P_t(j)Y_t(j) - W_t N_t(j) \qquad \Pi_t = \int_0^1 \Pi_t(j)\,dj$$

Demand for variety j is given by

$$Y_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\epsilon} Y_t$$

Marginal cost for each firm j is given as

$$MC_{t+k|t}(j) = \frac{W_{t+k}}{\alpha A_{t+k} N_{t+k|t}(j)^{\alpha-1}}$$

Following Calvo (1983), in each period a fraction $1-\theta_p$ of firms can reset their price. A firm that reoptimizes in period t chooses $\bar{P}_t$ to maximize the expected discounted stream of profits,

$$\max_{\bar{P}_t} \; \mathbb{E}_t \sum_{k=0}^{\infty} \theta_p^k M_{t,t+k} \left[\bar{P}_t\, Y_{t+k|t}(j) - W_{t+k} N_{t+k|t}(j)\right]$$

subject to

$$Y_{t+k|t}(j) = \left(\frac{\bar{P}_t}{P_{t+k}}\right)^{-\epsilon} Y_{t+k} \qquad Y_{t+k|t}(j) = A_{t+k} N_{t+k|t}(j)^{\alpha}$$

The analysis below uses the log-linear approximation of the Calvo pricing block around the zero-inflation steady state, which yields the standard New Keynesian Phillips curve.

2.3 Government and policy blocks

The government issues one-period nominal debt, rebates transfers, and collects taxes on consumption, labor income, and profits. Its budget constraint is

$$T_t + B_{g,t-1} = TR_t + \frac{B_{g,t}}{R_t} \tag{10}$$

where $B_{g,t}$ denotes government debt. Aggregate transfers T_t are given as

$$T_t = (1-\lambda)T_{S,t} + \lambda T_{H,t}$$

Total tax revenue is

$$TR_t = \tau_{c,t}P_tC_t + \tau_{n,t}W_tN_t + \tau_{d,t}\Pi_t \tag{11}$$

To ensure fiscal solvency, transfers adjust automatically to lagged government debt

$$T_t - \bar{T} = -\gamma_g\left(B_{g,t-1} - \bar{B}_g\right) \qquad \gamma_g > 0 \tag{12}$$

The same passive transfer rule is imposed under both the monetary policy and unconventional fiscal policy regimes. Here the responsiveness $\gamma_g > 0$ is set sufficiently high such that the government remains solvent.

2.3.1 Policy block

I distinguish between two main policy environments: a monetary policy regime (**MP**), in which the nominal interest rate is the active stabilization instrument, and unconventional fiscal policy regimes (**UFP**), in which the nominal interest rate is fixed and stabilization is implemented through distortionary taxes.

Monetary Policy regime

Under the monetary policy regime, the central bank sets the nominal interest rate according to a Taylor rule, while tax rates remain fixed at their steady state levels $(\bar{\tau}_c, \bar{\tau}_n, \bar{\tau}_d)$

$$R_t = \bar{R}\left(\frac{\pi_t}{\bar{\pi}}\right)^{\theta_\pi}\left(\frac{Y_t}{\bar{Y}}\right)^{\theta_Y} exp(\mu_t) \tag{13}$$

Here $\bar{\pi}$ and $\bar{Y}$ denote steady-state gross inflation and output. I calibrate to a zero-inflation steady state, so $\bar{\pi} = 1$. The coefficients θ_π and θ_Y measure the responsiveness of policy to inflation and output, and μ_t is a monetary policy shock following

$$\mu_{t+1} = \rho_\mu \mu_t + \epsilon_{t+1} \tag{14}$$

The associated ex ante real interest rate is

$$R_{r,t} \equiv \frac{R_t}{\mathbb{E}_t \pi_{t+1}} \tag{15}$$

Unconventional Fiscal Policy Regimes

Under an unconventional fiscal policy regime, the nominal interest rate is fixed at its steady-state level, $R_t = \bar{R}$, and stabilization is implemented through distortionary taxes. The UFP rule is written in terms of the change in the gross consumption-tax wedge because this is the fiscal object that enters the saver Euler equation. Holding the nominal interest rate fixed, an increase in $(1 + \tau_{c,t})/(1 + \tau_{c,t+1})$ raises the effective real return faced by savers, in the same way that a contractionary monetary-policy shock raises the real return under a Taylor rule. The time-varying fiscal instrument is the consumption tax, which follows

$$\frac{1 + \tau_{c,t}}{1 + \tau_{c,t+1}} = \left(\frac{\pi_t}{\bar{\pi}}\right)^{\gamma_\pi} \left(\frac{Y_t}{\bar{Y}}\right)^{\gamma_Y} exp(\zeta_t) \tag{16}$$

where ζ_t follows

$$\zeta_{t+1} = \rho_\zeta \zeta_t + \omega_{t+1} \tag{17}$$

The rule reacts to deviations of inflation and output from their steady state values. The effective real return relevant for savers is therefore

$$R_{r,t} = \bar{R}\, \mathbb{E}_t \left[\frac{1}{\pi_{t+1}} \frac{1 + \tau_{c,t}}{1 + \tau_{c,t+1}}\right] \tag{18}$$

The remaining tax instruments distinguish the two UFP regimes. Under the aggregate equivalent unconventional fiscal policy regime (**UFPE**), labor-income taxes adjust so as to keep the household labor wedge unchanged

$$\frac{1-\tau_{n,t}}{1+\tau_{c,t}} = \frac{1-\bar{\tau}_n}{1+\bar{\tau}_c} \qquad \tau_{d,t} = \bar{\tau}_d \tag{19}$$

Under the limited unconventional fiscal policy regime (**LUFP**), consumption taxes are the only time-varying fiscal instrument

$$\tau_{n,t} = \bar{\tau}_n \qquad \tau_{d,t} = \bar{\tau}_d \tag{20}$$

In both cases, profit taxes are held fixed. This restriction isolates the core stabilization mechanism: varying $\tau_{d,t}$ would primarily redistribute monopoly profits between savers and the government, but would not change the central three-equation logic underlying the aggregate equivalence and LUFP results.

2.4 Market clearing

Goods-market clearing implies

$$Y_t = (1-\lambda)C_{S,t} + \lambda C_{H,t} \tag{21}$$

Labor-market clearing implies

$$N_t = (1-\lambda)N_{S,t} + \lambda N_{H,t} \tag{22}$$

Only savers hold assets. Since all savers are identical, their equity shares satisfy

$$s_{S,t+1} = s_{S,t} = s = \frac{1}{1-\lambda} \tag{23}$$

Aggregate profits are

$$\Pi_t = P_t Y_t - W_t N_t \tag{24}$$

Aggregate transfers are

$$T_t = (1-\lambda)T_{S,t} + \lambda T_{H,t} \tag{25}$$

and bond-market clearing implies

$$B_{g,t} = (1-\lambda)B_t \tag{26}$$

2.5 Equilibrium

Given initial conditions for public debt and private asset holdings, and given exogenous processes for policy shocks, an equilibrium is a sequence

$$\{C_{H,t}, C_{S,t}, N_{H,t}, N_{S,t}, Y_t, P_t, W_t, \Pi_t, P_t^e, s_{S,t}, B_t, B_{g,t}, T_t, TR_t, R_t, \tau_{c,t}, \tau_{n,t}, \tau_{d,t}\}_{t\geq 0}$$

such that, for all $t \geq 0$,

1. hand-to-mouth households solve their static problem and satisfy (3) and (5)
2. saver households solve their intertemporal problem and satisfy (4), (5), (6), and (8)
3. final good producers and intermediate good firms solve their optimization problems, and pricing is consistent with the Calvo structure described above
4. the government budget constraint (10), the tax revenue identity (11), aggregate transfers (25), and the passive transfer rule (12) hold
5. the goods, labor, bond, and equity market clearing conditions hold
6. policy is set according to one of the following regimes:

MP the nominal interest rate satisfies (13), and taxes are fixed at $\tau_{c,t} = \bar{\tau}_c$, $\tau_{n,t} = \bar{\tau}_n$, and $\tau_{d,t} = \bar{\tau}_d$

UFPE the nominal interest rate is fixed at $R_t = \bar{R}$, the consumption tax satisfies (16), labor taxes satisfy

$$\frac{1-\tau_{n,t}}{1+\tau_{c,t}} = \frac{1-\bar{\tau}_n}{1+\bar{\tau}_c}$$

and profit taxes satisfy $\tau_{d,t} = \bar{\tau}_d$

LUFP the nominal interest rate is fixed at $R_t = \bar{R}$, the consumption tax satisfies (16), and the remaining taxes are fixed at $\tau_{n,t} = \bar{\tau}_n$ and $\tau_{d,t} = \bar{\tau}_d$

3 Aggregate Equivalence and Limited Instruments

The existing unconventional fiscal policy literature shows that full individual-level equivalence generally requires a sufficiently rich set of tax instruments and, in heterogeneous-agent environments, a transfer or debt policy that neutralizes the induced distributional effects (Wolf 2021; Seidl and Seyrich 2023). Aggregate equivalence is weaker: it requires only that output and inflation coincide across regimes. That distinction matters in the present setting, because different transfer schemes can support the same aggregate allocation while implying different cross-sectional outcomes.

I study a first-order approximation around a unique non-stochastic steady state. To isolate the stabilization role of distortionary taxes and maintain analytical tractability, I impose two simplifying restrictions in this section. First, passive fiscal transfers are directed only to saver households, so that $T_{H,t} = 0$ and $T_{S,t} = T_t$. Second, I abstract from variation in profit taxes and set $\tau_{d,t} = \bar{\tau}_d$. Since savers are the only asset holders, this shuts down the additional transfer channel to hand-to-mouth households and keeps fiscal adjustments within the Ricardian block. These assumptions keep the analytical comparison focused on stabilization. In the numerical section that follows, I relax the saver-only transfer assumption and consider an equal-transfer scheme, showing that redistribution is possible while preserving the aggregate stabilization result derived analytically here. In the following section, variables with hats denote log deviations from the non-stochastic steady state. Superscript F denotes allocations under unconventional fiscal policy regimes, and superscript M denotes allocations under the monetary policy regime.

Combining the hand-to-mouth household's budget constraint, labor supply condition, and market clearing conditions yields a linear representation of saver consumption in terms of aggregate output and productivity

$$\hat{c}_{S,t}^F = \Lambda \hat{y}_t^F + \Xi \hat{A}_t^F \tag{27}$$

The coefficients Λ and Ξ are time-invariant objects implied by the model's structural parameters. In particular,

$$\Lambda \equiv 1 + \frac{\lambda}{1-\lambda}\varphi\left(\frac{\alpha-1}{\alpha}\eta - \frac{1}{\alpha}\right) \qquad \Xi \equiv \frac{1}{\alpha}\frac{\lambda}{1-\lambda}(1+\eta)\varphi \qquad \eta \equiv \frac{1-\sigma}{\sigma+\varphi} \tag{28}$$

The coefficient Λ summarizes how household heterogeneity alters the mapping from aggregate output into saver consumption, and Ξ captures the additional effect of productivity on saver consumption that arises through labor supply and market clearing in the presence of hand-to-mouth households. Both coefficients are constant under the first-order approximation and depend on heterogeneity through the share of hand-to-mouth households, λ. In the representative-agent benchmark, $\lambda = 0$, so $\Lambda = 1$ and $\Xi = 0$, implying $\hat{c}_{S,t} = \hat{y}_t$. Appendix 1 provides the derivation.

Throughout this section, $\hat{\tau}_{c,t}$ denotes the log deviation of the gross consumption tax wedge, $\hat{\tau}_{c,t} \equiv \log[(1 + \tau_{c,t})/(1 + \bar{\tau}_c)]$, and $\hat{\tau}_{n,t}$ denotes the log deviation of the net labor-tax wedge, $\hat{\tau}_{n,t} \equiv \log[(1 - \tau_{n,t})/(1 - \bar{\tau}_n)]$. Using (27), the log-linear equilibrium can be summarized by a standard three-equation system. Under UFP,

$$\hat{y}_t^F = \mathbb{E}_t \hat{y}_{t+1}^F - \frac{1}{\sigma\Lambda} \left[\hat{\tau}_{c,t} - \mathbb{E}_t \hat{\tau}_{c,t+1} - \mathbb{E}_t \hat{\pi}_{t+1}^F\right] + \frac{\Xi}{\Lambda} \left(\mathbb{E}_t \hat{A}_{t+1}^F - \hat{A}_t^F\right) \tag{29}$$

$$\hat{\pi}_t^F = \beta \mathbb{E}_t \hat{\pi}_{t+1}^F + \psi_{mc} \chi \hat{y}_t^F + \psi_{mc} z \hat{A}_t^F + \psi_{mc} \hat{\tau}_{c,t} - \psi_{mc} \hat{\tau}_{n,t} \tag{30}$$

$$\hat{\tau}_{c,t} - \mathbb{E}_t \hat{\tau}_{c,t+1} = \gamma_\pi \hat{\pi}_t^F + \gamma_Y \hat{y}_t^F + \zeta_t \tag{31}$$

Under MP,

$$\hat{y}_t^M = \mathbb{E}_t \hat{y}_{t+1}^M - \frac{1}{\sigma\Lambda} \left[\hat{R}_t - \mathbb{E}_t \hat{\pi}_{t+1}^M\right] + \frac{\Xi}{\Lambda} \left(\mathbb{E}_t \hat{A}_{t+1}^M - \hat{A}_t^M\right) \tag{32}$$

$$\hat{\pi}_t^M = \beta \mathbb{E}_t \hat{\pi}_{t+1}^M + \psi_{mc} \chi \hat{y}_t^M + \psi_{mc} z \hat{A}_t^M \tag{33}$$

$$\hat{R}_t = \theta_\pi \hat{\pi}_t^M + \theta_Y \hat{y}_t^M + \mu_t \tag{34}$$

Here χ, z, and ψ_{mc} are composite coefficients defined in Appendix 1, and r_t^* denotes the tax-distorted natural real rate implied by productivity growth. Household heterogeneity changes the slope of the IS relation through Λ. In the standard aggregate-demand-logic region studied here, $\Lambda > 0$, so higher effective real rates reduce output demand. The question is whether fiscal instruments can reproduce the monetary policy allocation.

Proposition 1 (Aggregate equivalence)**.** *Suppose the MP and UFP economies start from the same* *steady state, face the same non-policy shocks, and have determinate local equilibria. If the UFP instruments satisfy*

$$\hat{\tau}_{c,t} - \mathbb{E}_t \hat{\tau}_{c,t+1} = \theta_\pi \hat{\pi}_t^F + \theta_Y \hat{y}_t^F + \zeta_t \qquad \zeta_t = \mu_t \qquad \hat{\tau}_{n,t} = \hat{\tau}_{c,t} \tag{35}$$

then UFPE reproduces the MP paths of output and inflation.

Proof. The first condition in (35) makes the consumption-tax wedge in the UFP Euler equation identical to the nominal-interest-rate wedge in the MP Euler equation. The second condition keeps the labor wedge unchanged, so the tax-induced marginal-cost term in (30) is eliminated. The UFP IS equation and Phillips curve therefore coincide with the MP IS equation and Phillips curve. Since the policy innovations are mapped one-to-one and the local equilibrium is determinate, the two regimes generate the same paths for $(\hat{y}_t, \hat{\pi}_t)$. □

Two points deserve emphasis. First, aggregate equivalence does not automatically imply individual-level equivalence once transfers or asset positions differ across household groups. In the analytical system above, individual allocations coincide across MP and UFPE only under the saver-only transfer assumption, which shuts down the additional wealth effect from transfers to hand-to-mouth households. With equal transfers, or in a richer heterogeneous-agent environment, the same aggregate paths for output and inflation can be supported by different cross-sectional allocations. Full individual-level equivalence would require transfer or debt policies that neutralize household-specific wealth effects, as in Wolf (2021) and Seidl and Seyrich (2023).

Second, the implementation in Proposition 1 is institutionally demanding: it requires the consumption and labor-income tax wedges to move one-for-one, period by period. Given the slow-moving nature of labor-income taxes, this observation motivates the analysis of a more limited policy environment.

I now turn to LUFP. In this regime, the consumption tax is the only time-varying stabilization instrument:

$$\frac{1 + \tau_{c,t}}{1 + \tau_{c,t+1}} = \left(\frac{\pi_t}{\bar{\pi}}\right)^{\gamma_\pi} \left(\frac{Y_t}{\bar{Y}}\right)^{\gamma_Y} \zeta_t \tag{36}$$

while the nominal interest rate and the remaining tax instruments are fixed at $(\bar{R}, \bar{\tau}_n, \bar{\tau}_d)$. In this case aggregate equivalence is no longer attainable, because the consumption tax affects both intertemporal substitution and marginal cost, so a single fiscal instrument can no longer replicate both stabilization targets.

To see the implications of LUFP for equilibrium determinacy and stabilization, consider output under flexible prices:

$$\hat{y}_t^{F,\text{flex}} = -\chi^{-1}\hat{\tau}_{c,t} - \chi^{-1} z \hat{A}_t \tag{37}$$

where $\hat{y}_t^{F,\text{flex}}$ is the tax-distorted flexible-price allocation. Define the output gap by

$$\hat{y}_t^{F,\text{gap}} \equiv \hat{y}_t^F - \hat{y}_t^{F,\text{flex}}$$

Because the primitive consumption tax rule is specified in terms of output deviations rather than the output gap, the policy block must be transformed when the LUFP equilibrium is rewritten in gap form

$$\left(1 + \gamma_Y \chi^{-1}\right)\hat{\tau}_{c,t} - \mathbb{E}_t \hat{\tau}_{c,t+1} = \gamma_\pi \hat{\pi}_t^F + \gamma_Y \hat{y}_t^{F,\text{gap}} - \gamma_Y \chi^{-1} z \hat{A}_t^F + \zeta_t$$

Thus, rewriting the rule in output-gap form gives an equivalent representation of the same instrument rule. The LUFP economy can then be expressed as

$$\hat{y}_t^{F,\text{gap}} = \mathbb{E}_t \hat{y}_{t+1}^{F,\text{gap}} - \frac{1}{\sigma\Lambda}\left[\Omega_\tau\left(\hat{\tau}_{c,t} - \mathbb{E}_t \hat{\tau}_{c,t+1}\right) - \mathbb{E}_t \hat{\pi}_{t+1}^F - r_t^*\right] \tag{38}$$

$$\hat{\pi}_t^F = \beta \mathbb{E}_t \hat{\pi}_{t+1}^F + \kappa \hat{y}_t^{F,\text{gap}} \tag{39}$$

$$\left(1 + \gamma_Y \chi^{-1}\right)\hat{\tau}_{c,t} - \mathbb{E}_t \hat{\tau}_{c,t+1} = \gamma_\pi \hat{\pi}_t^F + \gamma_Y \hat{y}_t^{F,\text{gap}} - \gamma_Y \chi^{-1} z \hat{A}_t^F + \zeta_t \tag{40}$$

where

$$\Omega_\tau \equiv \frac{\chi - \sigma\Lambda}{\chi} \qquad \kappa \equiv \psi_{mc}\chi \qquad r_t^* \equiv \sigma\left(\Xi - \Lambda z \chi^{-1}\right)\left(\mathbb{E}_t \hat{A}_{t+1} - \hat{A}_t\right) \tag{41}$$

The term Ω_τ is the additional transmission wedge introduced by relying on consumption taxes alone. It depends on the degree of heterogeneity through Λ, and it is this term that changes the determinacy properties of the model relative to the monetary policy benchmark.

Figure 1 compares the local determinacy regions under MP and LUFP for the standard monetary policy responsiveness $\theta_\pi = \gamma_\pi = 1.5$ and $\theta_Y = \gamma_Y = 0.125$. A useful way to read Figure 1 is to

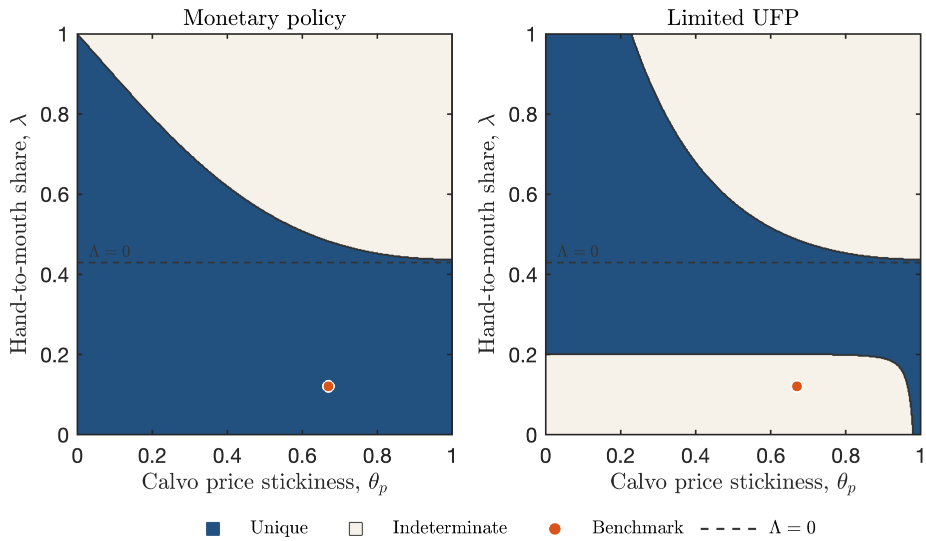

Figure 1: Local determinacy regions. The horizontal axis is the Calvo price-stickiness parameter θ_p and the vertical axis is the hand-to-mouth share λ. Blue regions denote locally unique rational-expectations equilibria; light regions denote indeterminacy. The orange marker denotes the benchmark calibration, $(\theta_p, \lambda) = (0.67, 0.121)$. The dashed line marks $\Lambda = 0$, above which the aggregate-demand mapping changes sign. Policy coefficients are $\theta_\pi = \gamma_\pi = 1.5$ and $\theta_Y = \gamma_Y = 0.125$.

compare how expected inflation is stabilized under MP and LUFP. Under MP, a rise in expected inflation is offset by the feedback of the Taylor rule into the nominal interest rate, so the real rate rises and demand falls. Under LUFP, the analogous adjustment comes from changes in the consumption tax. However, in (38), that adjustment is attenuated by Ω_τ, because the consumption tax affects aggregate demand only indirectly through savers' Euler equation and simultaneously distorts marginal cost. Thus, for a common policy coefficient, the induced increase in the effective real return is smaller under LUFP than under MP. When that attenuation is sufficiently strong, demand does not contract enough to offset the inflationary impulse, and self-fulfilling fluctuations are no longer ruled out.

The white region at low values of λ in the LUFP panel corresponds to parameter combinations in which the consumption-tax rule fails to generate a sufficiently strong effective response of aggregate demand to expected inflation. In that region, Ω_τ attenuates the tax-induced real-return movement, so the fiscal rule does not satisfy the analogue of the Taylor principle. The boundary also depends on price stickiness: when the Phillips curve is steeper, a given cost-push movement induced by the consumption tax requires a larger demand response to stabilize inflation.

The determinacy analysis of LUFP clarifies the environment in which the policy rule (40) operates. However, the policy objective under LUFP must still be specified. Since aggregate equivalence is impossible with only consumption taxes, the policymaker therefore faces a trade-off between replicating inflation and replicating output under monetary policy. Suppose first that the policymaker chooses to replicate the inflation path under MP. If $\hat{\pi}_t^F = \hat{\pi}_t^M$ and productivity is constant, the difference in output is

$$\hat{y}_t^M = \hat{y}_t^F + \frac{1}{\chi}\hat{\tau}_{c,t} \tag{42}$$

Combining the two IS equations yields the relation

$$\hat{R}_t = \Omega_\tau\big(\hat{\tau}_{c,t} - \mathbb{E}_t\hat{\tau}_{c,t+1}\big) \tag{43}$$

Hence the inflation-replicating LUFP rule is

$$\hat{\tau}_{c,t} - \mathbb{E}_t\hat{\tau}_{c,t+1} = \frac{\theta_\pi}{\Omega_\tau}\hat{\pi}_t^F + \frac{\theta_Y}{\Omega_\tau}\hat{y}_t^F + \frac{1}{\Omega_\tau}\mu_t \tag{44}$$

Relative to the monetary-policy benchmark, both the feedback coefficients and the policy innovation are scaled by Ω_τ^{-1}.

Now suppose instead that the policymaker attempts to replicate the output path under MP. Then the Phillips curves imply

$$\hat{\pi}_t^F - \beta\mathbb{E}_t\hat{\pi}_{t+1}^F - \psi_{mc}\hat{\tau}_{c,t} = \hat{\pi}_t^M - \beta\mathbb{E}_t\hat{\pi}_{t+1}^M \tag{45}$$

and the corresponding IS relation becomes

$$\hat{R}_t = \big(\hat{\tau}_{c,t} - \mathbb{E}_t\hat{\tau}_{c,t+1}\big) - \psi_{mc}\sum_{j=1}^{\infty}\beta^{j-1}\mathbb{E}_t\hat{\tau}_{c,t+j} \tag{46}$$

Equivalently,

$$\hat{\tau}_{c,t} - \gamma_{\text{output}} \mathbb{E}_t \hat{\tau}_{c,t+1} = \theta_\pi \hat{\pi}_t^F + \theta_Y \hat{y}_t^F \qquad \gamma_{\text{output}} \equiv 1 + \frac{\psi_{mc}}{1-\beta} \tag{47}$$

Since replicating the output path requires an infinite sequence of future tax expectations, it is not a useful simple policy rule in the way that (44) is. For that reason, the quantitative analysis below focuses on the inflation-replicating LUFP rule.

4 Calibration

The analytical results establish when a rule-based consumption tax policy can replicate monetary policy allocations and when limited instruments break aggregate equivalence. I now quantify these mechanisms under a benchmark calibration and evaluate how large the aggregate, fiscal, and distributional differences across MP, UFPE, and LUFP under empirically plausible parameter values. Calibration for preferences, production, and monetary policy rules follow standard values in the literature for comparison across regimes. These calibration values remain identical across all three regimes below unless explicitly mentioned.

I set $\beta = 0.99$, implying an annual real interest rate of approximately 4 percent, and set $\sigma = 2$. The labor-disutility scale ν is chosen to normalize steady-state hours. I set $\varphi = 1$, $\epsilon = 6$, and $\alpha = 2/3$. The depreciation rate is set to 0.025 per quarter, implying an annual depreciation rate of approximately 10 percent. The Calvo parameter $\theta_p = 0.67$ corresponds to an average price duration of three quarters. The monetary-policy coefficients are set to $\theta_\pi = 1.5$ and $\theta_Y = 0.125$.

The elasticity of investment with respect to Tobin's Q is set to one, following the standard real-business-cycle calibration tradition associated with King, Plosser, and Rebelo (1988). The shock persistence parameter is set to $\rho = 0.5$, and the transfer response to debt is set to $\gamma_g = 0.1$.

I calibrate steady-state tax wedges and debt using U.S. data following the fiscal-accounting approach in Leeper, Traum, and Walker (2017). The consumption-tax parameter should be interpreted as an effective aggregate consumption-tax wedge, constructed from sales and excise tax revenues relative to the consumption tax base. Since the United States does not have a federal VAT, this wedge largely reflects state and local consumption taxes rather than a federal statutory

Parameter	Interpretation	Value
β	Discount factor	0.99
σ	Coefficient of relative risk aversion	2
λ	Share of hand-to-mouth households	0.121
δ	Depreciation rate	0.025
φ	Inverse Frisch elasticity	1
ν	Labor-disutility scale	Hours normalization
ϵ	Elasticity of substitution across varieties	6
α	Labor share in production	0.67
θ_p	Calvo stickiness parameter	0.67
θ_π	Policy response to inflation	1.5
θ_Y	Policy response to output	0.125
ρ	Shock persistence	0.5
η_I	Investment elasticity with respect to Tobin's Q	1
γ_g	Transfer response to debt	0.1
$\tau_{c,ss}$	Steady-state consumption tax	0.019
$\tau_{n,ss}$	Steady-state labor-income tax	0.196
$\tau_{k,ss}$	Steady-state capital income tax	0.217
$\tau_{I,ss}$	Steady-state investment subsidy	0.217
$\tau_{d,ss}$	Steady-state profit tax	0.217
B_{ss}/Y_{ss}	Steady-state debt-to-output ratio	0.514

Table 1: Baseline calibration.

consumption tax. Using the 1955:Q1–2024:Q1 sample for taxes and government debt, the resulting values are 0.019 for consumption taxes, 0.196 for labor-income taxes, and 0.217 for capital-income taxes. The steady-state debt-to-output ratio is 0.514. I set the steady-state investment subsidy and profit tax equal to the capital-income tax so that the steady-state capital Euler equation is not distorted.

The hand-to-mouth share depends on the definition of hand-to-mouth behavior. Campbell and Mankiw (1989) motivate a broad rule-of-thumb interpretation in which a substantial fraction of households consumes current income. In the present model, hand-to-mouth households do not hold capital or illiquid assets. I therefore use the Kaplan, Violante, and Weidner (2014) estimate for poor hand-to-mouth households and set $\lambda = 0.121$. This value is lower than calibrations that interpret hand-to-mouth behavior more broadly.

5 Quantitative Analysis

I now compare the quantitative implications of the three policy regimes. I introduce equal per-household transfers, $T_{H,t} = T_{S,t}$, with zero transfers in steady state. The analytical section shuts down transfer-based redistribution in order to isolate the stabilization mechanism. The numerical exercise here shows how the same aggregate stabilization target can generate nontrivial cross-sectional effects once fiscal revenues are rebated equally across household types.

5.1 Stabilization and distributional effects

I compare the regimes using impulse responses to a common contractionary stabilization experiment. In the MP regime, the shock is a positive innovation to the Taylor-rule process in (34). In the UFP regimes, the shock is the corresponding innovation to the consumption-tax rule, normalized so that UFPE implements Proposition 1 and LUFP implements the inflation-replicating rule derived in Section 3. The impulse responses are computed for a one-standard-deviation contractionary policy-rule innovation. In the MP regime, the innovation has size 0.01 in the Taylor-rule disturbance and therefore corresponds approximately to a one percentage point increase in the gross quarterly policy-rate wedge, before endogenous feedback from inflation and output. Under UFPE, the fiscal innovation is normalized to generate the same 0.01 intertemporal policy wedge in the consumption-tax rule. Under LUFP, the innovation is scaled by Ω_τ^{-1}, so that the effective real-return wedge generated by the consumption-tax rule is comparable to the MP shock.

Figure 2 compares MP and UFPE at the aggregate level. As Proposition 1 implies, the two regimes generate identical paths for output and inflation. Under UFPE, the consumption tax rises and the labor-income tax adjusts so as to keep the labor wedge unchanged. Since the equivalence condition is stated in terms of changes in tax wedges rather than tax levels, the tax-level path must be pinned down by an implementation normalization. Under the initial-condition normalization used in the numerical exercise, the shock leaves a persistent level shift in the tax system even after inflation and output return to their initial paths. This has fiscal consequences: tax revenue remains persistently higher, public debt falls, and transfers rise. Figure 3 shows numerically that aggregate

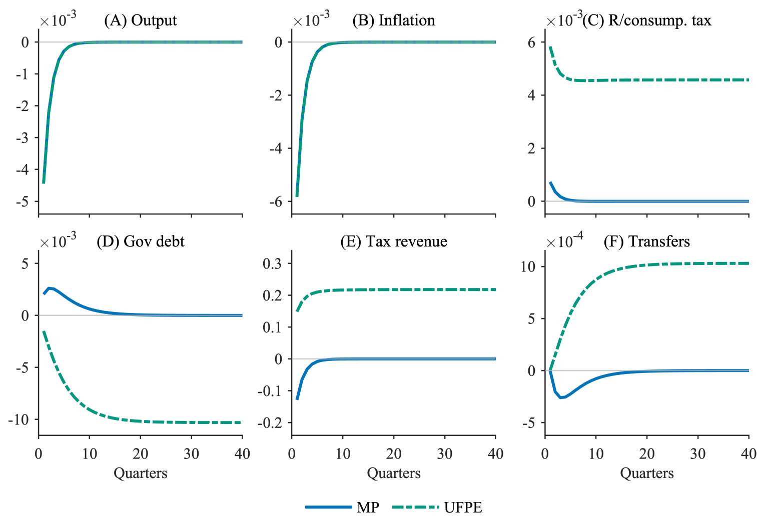

Figure 2: Aggregate impulse responses under MP and UFPE.

Notes: Figure 2 shows the impulse responses of selected aggregate variables to a contractionary policy innovation of 100 basis points. Responses are to a one-standard-deviation contractionary policy-rule innovation. MP is the Taylor-rule benchmark, UFPE is the aggregate-equivalent two-tax implementation. The horizon is 40 quarters. Vertical axes report deviations from steady state; for log-linear real variables, values are approximately percentage deviations after multiplying by 100. Inflation and policy variables are quarterly gross-rate wedge deviations.

equivalence does not imply identical household allocations once transfers are distributed equally across types. With equal transfers, UFPE modestly cushions hand-to-mouth consumption while shifting part of the fiscal adjustment onto savers. The cross-sectional effects remain quantitatively small, but they are economically informative: once transfers are allowed to move, the aggregate equivalent fiscal rule can be redistributive without undermining the goal of stabilization.

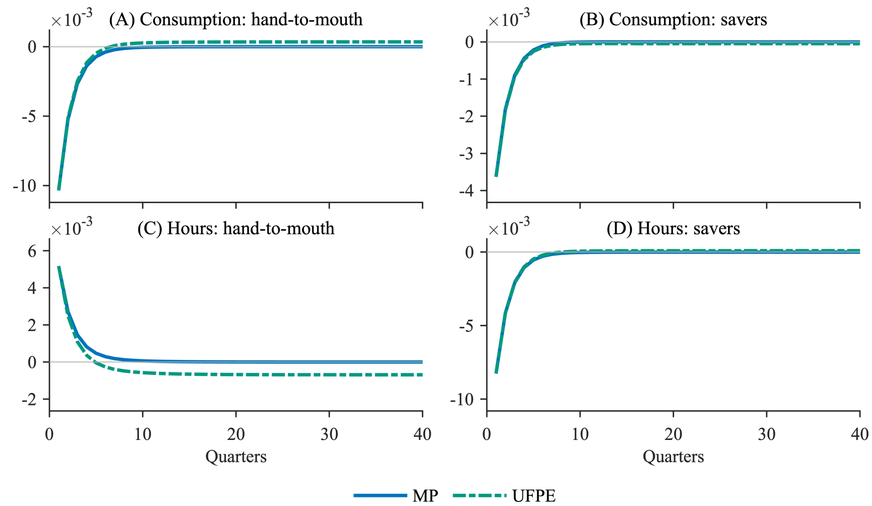

Figure 3: Household-level impulse responses under MP and UFPE.

Notes: Figure 3 shows the consumption and labor responses for hand-to-mouth and saver households. Responses are to the same contractionary policy innovation used for the aggregate MP-UFPE comparison.Vertical axes report percentage deviations from steady state.

Figure 4 adds LUFP to the comparison. As discussed above, with consumption taxes as the only time-varying instrument, the policymaker can no longer replicate both inflation and output. In the calibration here, LUFP tracks the inflation response under MP closely, but at the cost of a larger contraction in output. The reason is that the consumption tax now acts as a cost-push wedge that creates an additional trade-off between output and inflation stabilization. Unlike under UFPE, the level of the consumption tax matters under LUFP. With labor taxes fixed, a permanent increase in $\tau_{c,t}$ would remain as a permanent cost-push wedge and would also shift the tax-distorted flexible-price allocation. Hence, if inflation and output are to return to steady state after a transitory shock, the consumption tax itself must return to steady state rather than remain permanently displaced. Even so, LUFP raises tax revenue sharply on impact and produces a larger short-run decline in public debt than MP.

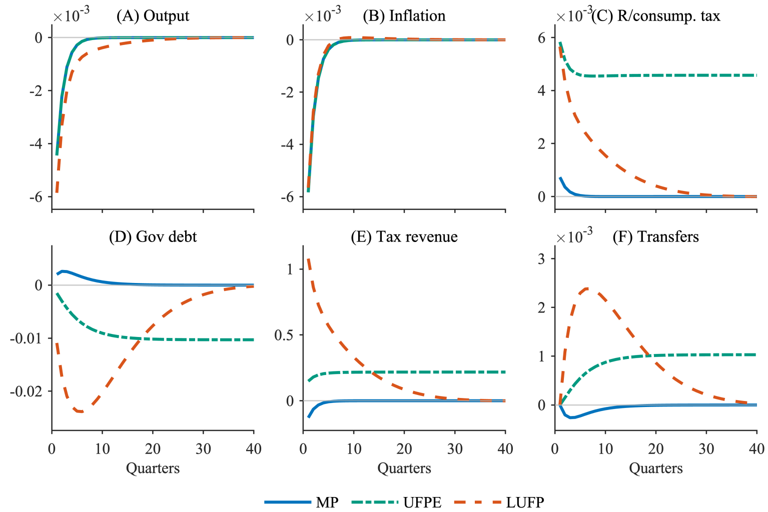

Figure 4: Aggregate impulse responses under MP, UFPE, and LUFP.

Notes: Figure 4 adds LUFP into comparison. Responses are to a one-standard-deviation contractionary policy-rule innovation, identical to that under Figure 2. MP is the Taylor-rule benchmark, UFPE is the aggregate-equivalent two-tax implementation, and LUFP is the consumption-tax-only rule calibrated to replicate the MP inflation response. Under LUFP, the policy innovation is scaled by Ω_τ^{-1}. The horizon is 40 quarters. Vertical axes report deviations from steady state; for log-linear real variables, values are approximately percentage deviations after multiplying by 100. Inflation and policy variables are quarterly gross-rate wedge deviations.

Figure 5 reports the corresponding household level allocations. Under LUFP, both household types experience a larger contraction than under MP, reflecting the stronger aggregate downturn. At the same time, the distributional effects remains uneven. Equal transfers partially cushion hand-to-mouth households, whose consumption continues to track the monetary policy benchmark more closely than saver consumption. Savers, by contrast, absorb a larger share of the adjustment through the combination of higher consumption tax distortions, asset income effects, and the temporary nature of transfers. Thus, even when LUFP is calibrated to match inflation, it does not replicate the cross-sectional allocation under monetary policy.

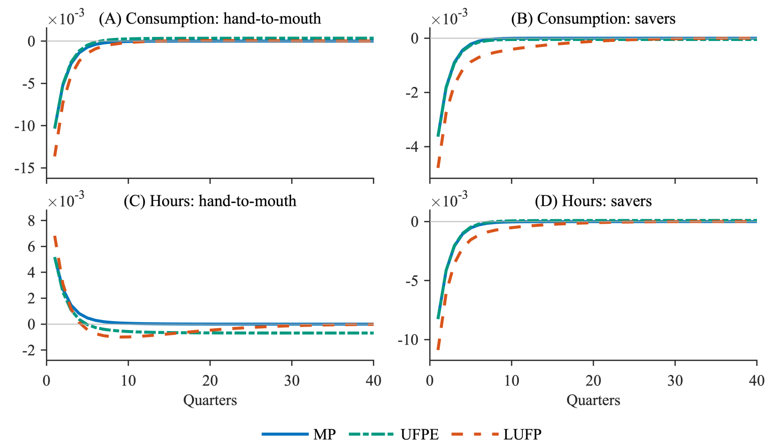

Figure 5: Household-level impulse responses under MP, UFPE, and LUFP.

Notes: Figure 5 shows the additional consumption and labor responses under LUFP for hand-to-mouth and saver households. Responses are to the same contractionary shock used for the aggregate variables' comparison. Vertical axes report percentage deviations from steady state.

5.2 Consumption-equivalent welfare

I report a simple consumption-equivalent calculation following Lucas (2003). The comparison is a first-order local approximation along the transition paths after the common shock. It act as a sanity check on whether the alternative rules generate large measured differences in household utility under the benchmark calibration. For household type $i \in \{S, H\}$ and regime r, let

$$W_i^r \equiv \sum_{t=0}^{\infty} \beta^t \left[\frac{(C_{i,t}^r)^{1-\sigma}}{1-\sigma} - \nu \frac{(N_{i,t}^r)^{1+\varphi}}{1+\varphi} \right] \tag{48}$$

Given a benchmark regime b, the consumption equivalent welfare change $\xi_i^{r|b}$ is defined implicitly by

$$W_i^r = \sum_{t=0}^{\infty} \beta^t \left[\frac{\left((1+\xi_i^{r|b})C_{i,t}^b\right)^{1-\sigma}}{1-\sigma} - \nu \frac{(N_{i,t}^b)^{1+\varphi}}{1+\varphi} \right] \tag{49}$$

Thus, $100\times\xi_i^{r|b}$ is the percentage increase in the benchmark consumption path that makes household type i indifferent between regime r and the benchmark. Aggregate welfare is computed as

$$W^r \equiv (1-\lambda)W_S^r + \lambda W_H^r \tag{50}$$

with the aggregate consumption equivalent welfare change defined analogously as a common percentage shift in the benchmark consumption paths of both household types.

Table 2: Consumption-equivalent differences relative to MP, basis points

	MP (benchmark)	UFPE	LUFP
Saver	0.00	-1.36	0.43
Hand-to-mouth	0.00	9.93	0.46
Aggregate	0.00	0.00	0.43

Notes: Entries are consumption-equivalent differences relative to MP, expressed in basis points of the benchmark consumption path. One basis point equals 0.01 percentage points. Values below one basis point should be interpreted as quantitatively negligible in this local transition exercise. Positive values indicate a higher value of the computed criterion under the transition path considered, not a robust welfare ranking across regimes. The aggregate row applies a common proportional consumption adjustment to both household types and uses welfare weights $1-\lambda$ for savers and λ for hand-to-mouth households.

Table 2 reports consumption-equivalent differences relative to MP, expressed in basis points. Under UFPE, the aggregate difference is zero to the precision reported, while the household-specific entries differ: the saver entry is -1.36 basis points and the hand-to-mouth entry is 9.93 basis points. This pattern is consistent with the transfer-channel interpretation of Figures 2 and 3: under the equal-transfer benchmark, UFPE can shift resources across household types even when aggregate output and inflation remain identical to those under MP. The magnitudes, however, are small, so the table should be read as a diagnostic of fiscal incidence rather than as welfare-ranking. For LUFP, the aggregate consumption-equivalent difference relative to MP is only 0.43 basis points. The household-specific entries are also very small: 0.43 basis points for savers and 0.46 basis points for hand-to-mouth households. Under the benchmark calibration and transition considered here, the consumption-equivalent comparison therefore does not reveal a quantitatively meaningful aggregate welfare difference between LUFP and MP.

One reason for the small magnitudes is the fiscal recycling mechanism. Given the government budget constraint in (10) and the passive transfer rule in (12), additional tax revenue generated by the alternative fiscal regimes is used primarily to adjust public debt rather than to finance large contemporaneous transfers. A different transfer rule, especially one that rebates tax revenue more aggressively or targets particular household groups, could generate larger distributional effects. The current exercise therefore does not imply that unconventional fiscal policy is inherently non-redistributive. Rather, it shows that under the equal-transfer and passive-debt rule considered here, the redistribution generated by the policy experiments is limited.

In short, UFPE remains an exact aggregate substitute for monetary policy in output and inflation, and equal transfers can generate cross-sectional reallocations without compromising that stabilization result. LUFP remains more limited as a stabilization device because it cannot simultaneously match both output and inflation under MP. The consumption-equivalent calculation suggests that the substantive quantitative distinction between the policy regimes lies primarily in stabilization and debt dynamics, rather than in a robust aggregate welfare ranking. I leave the design of optimal transfer rules under unconventional fiscal policy for future research.

6 A Model with Capital

I now extend the baseline model to allow saver households to accumulate capital. The purpose is to study the margin along which a consumption tax rule ceases to be a close substitute for monetary policy once the economy contains more than one intertemporal condition. In the presence of capital, exact aggregate equivalence generally requires additional fiscal instruments, such as capital income taxes or investment subsidies [1]. For that reason, the comparison in this section focuses on the monetary policy regime (MP) and the limited unconventional fiscal policy regime (LUFP).

Capital accumulates according to

$$K_t = (1-\delta)K_{t-1} + \phi\left(\frac{I_t}{K_{t-1}}\right)K_{t-1} \tag{51}$$

[1] See Correia et al. (2013).

where δ is the depreciation rate and $\phi(\cdot)$ satisfies

$$\phi' > 0 \qquad \phi'' \leq 0 \qquad \phi(\delta) = \delta \qquad \phi'(\delta) = 1$$

The saver household's budget constraint becomes

$$(1+\tau_{c,t})P_t C_{S,t} + \frac{B_t}{R_t} + s_{S,t+1}P_t^e + (1-\bar{\tau}_I)Q_t\big(K_{S,t} - (1-\delta)K_{S,t-1}\big) \leq \; B_{t-1} + (1-\bar{\tau}_n)W_t N_{S,t} + s_{S,t}\big(P_t^e + (1-\bar{\tau}_d)\Pi_t\big) + (1-\bar{\tau}_k)Z_t K_{S,t-1} + T_{S,t} \tag{52}$$

where Q_t denotes the nominal price of installed capital, Z_t the nominal rental rate of capital, and $\bar{\tau}_I$ and $\bar{\tau}_k$ denote the steady state investment subsidy and capital income tax. Hand-to-mouth households do not own capital, so their budget constraint is unchanged.

Optimality with respect to capital yields

$$(1-\bar{\tau}_I)Q_t = \mathbb{E}_t\left[M_{t,t+1}\Big((1-\bar{\tau}_k)Z_{t+1} + (1-\bar{\tau}_I)(1-\delta)Q_{t+1}\Big)\right] \tag{53}$$

Equation (53) highlights the central limitation of LUFP in this environment. A consumption tax rule can reproduce the wedge in the bond Euler equation, but it does not provide an independent instrument for the return relevant for capital accumulation. Once the economy contains multiple intertemporal margins, a single consumption tax rule is therefore no longer sufficient to replicate the full transmission of monetary policy.

On the production side, intermediate good firms now combine labor and capital according to

$$Y_t(j) = A_t N_t(j)^{\alpha} K_{t-1}(j)^{1-\alpha} \qquad 0 < \alpha < 1 \tag{54}$$

Marginal cost can be re-written as

$$MC_t = \frac{W_t}{\alpha Y_t/N_t} = \frac{Z_t}{(1-\alpha)Y_t/K_{t-1}} \tag{55}$$

There is a continuum of perfectly competitive capital goods producers. Let $q_t \equiv Q_t/P_t$ and $z_t \equiv Z_t/P_t$ denote the real price and rental rate of capital. A capital goods producer chooses investment to solve

$$\max_{I_t(j)} \; q_t \phi\left(\frac{I_t(j)}{K_{t-1}(j)}\right) K_{t-1}(j) - I_t(j) - z_t K_{t-1}(j) \tag{56}$$

The first-order condition for investment implies

$$q_t = \frac{1}{\phi'(I_t/K_{t-1})} \tag{57}$$

which log-linearizes to the standard Q-theory relation

$$\hat{I}_t - \hat{K}_{t-1} = \eta_I \hat{q}_t \tag{58}$$

Tax revenue now includes capital income taxation and investment subsidies:

$$TR_t = \tau_{c,t} P_t C_t + \bar{\tau}_n W_t N_t + \bar{\tau}_d \Pi_t - \bar{\tau}_I Q_t \big(K_t - (1-\delta) K_{t-1}\big) + \bar{\tau}_k Z_t K_{t-1} \tag{59}$$

Capital-market clearing implies

$$K_t = (1-\lambda) K_{S,t} \tag{60}$$

and goods-market clearing becomes

$$Y_t = C_t + I_t \tag{61}$$

The presence of capital also changes the timing structure of the LUFP problem. Without capital, the tax rule can be written purely in terms of forward-looking variables. With capital, however, the economy contains an additional predetermined state, so the policy rule must pin down the current tax level period by period. In the capital simulations, I therefore implement LUFP with a predetermined consumption tax schedule:

$$\hat{\tau}_{c,t-1} - \hat{\tau}_{c,t} = \theta_\pi \hat{\pi}_t + \theta_Y \hat{y}_t + \zeta_t \tag{62}$$

This preserves the simple Taylor-type structure of the rule while avoiding the indeterminacy that arises when the tax rule is written exclusively in forward-looking form. The rule preserves the spirit of the LUFP feedback rule, but the timing change means that the comparison is no longer a mechanical extension of the no-capital equivalence result. Appendix 3 derives the corresponding linear system and discusses determinacy in more detail.

I next compare MP and LUFP under the calibration in section 4, retaining the same passive transfer rule and the identical-transfer benchmark used in Section 5, without explicitly targeting inflation dynamics as in the no-capital experiment. The shock is the same positive contractionary policy innovation used in the no-capital experiment. Figure 6 reports the aggregate responses. LUFP under rule 62 is able to track both output and inflation closely, though not exactly. Relative to MP, the fiscal adjustment is more front-loaded under LUFP: tax revenue rises more sharply on impact, public debt falls by more initially, and transfers respond more strongly. These responses then reverse gradually as the economy converges back to steady state, so the associated fiscal dynamics are more pronounced and less monotonic than under MP.

Figure 7 highlights the missing transmission channel. Capital declines under both regimes, but the contraction is smaller under LUFP, and the price of capital recovers more quickly and briefly overshoots its steady state. The reason is that the consumption tax can mimic the bond Euler equation only imperfectly once capital is present: with the nominal interest rate fixed, LUFP does not reproduce the increase in the return relevant for capital accumulation that arises under MP. As a consequence, LUFP delivers a smaller contraction in capital than monetary policy, but not full replication of the capital-accumulation margin.

Figure 8 shows that the cross-sectional implications remain qualitatively similar to those in the model without capital. Both household types reduce consumption and labor on impact, but saver consumption exhibits the more persistent shortfall, while equal transfers partly cushion hand-to-mouth households relative to savers. Thus, introducing capital does not overturn the basic distributional logic of LUFP, but it makes the asset market channel quantitatively more important for saver households.

The main conclusion from the capital extension is therefore twofold. First, LUFP remains a

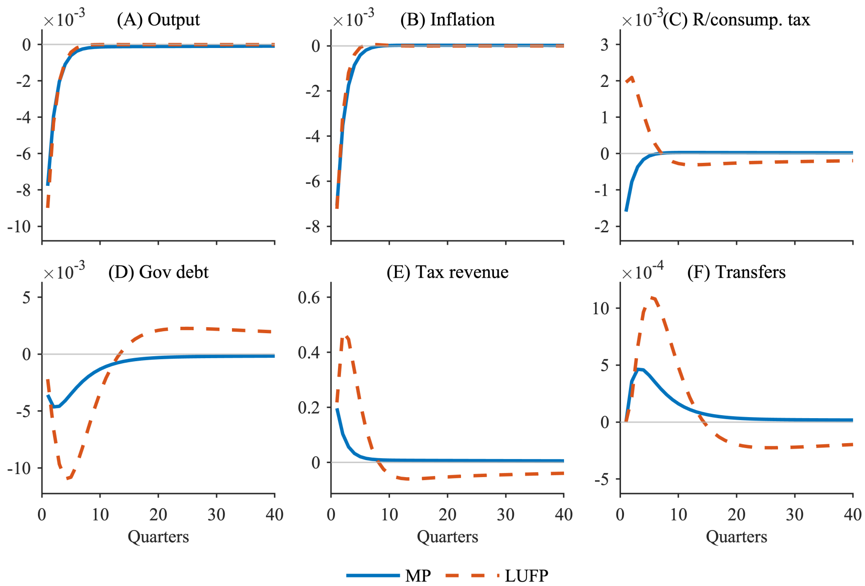

Figure 6: Aggregate impulse responses under MP and LUFP in the model with capital.

Notes: Figure 6 shows the impulse responses of selected aggregate variables to a contractionary policy innovation of 100 basis points in a model with capital. Responses are to a one-standard-deviation contractionary policy-rule innovation. MP is the Taylor-rule benchmark, LUFP is the consumption-tax rule implementation as in 62, with shocks identical to that under MP. The horizon is 40 quarters. Vertical axes report deviations from steady state; for log-linear real variables, values are approximately percentage deviations after multiplying by 100. Inflation and policy variables are quarterly gross-rate wedge deviations.

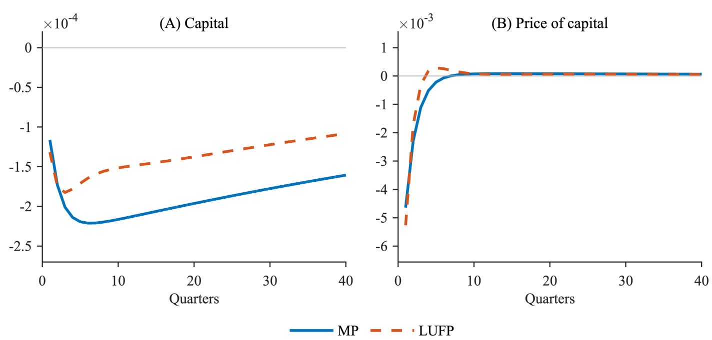

Figure 7: Capital and the price of capital under MP and LUFP.

Notes: Responses are to the same contractionary policy innovation used in the aggregate capital-model comparison. Capital and the real price of installed capital are reported as deviations from steady state over 40 quarters.

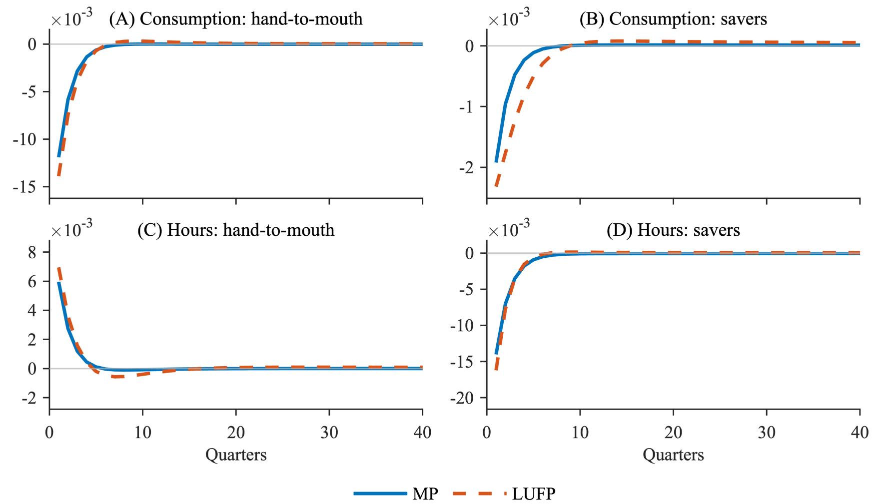

Figure 8: Household-level impulse responses under MP and LUFP in the model with capital.

Notes: Responses are to the same contractionary policy innovation used in the aggregate capital-model comparison. Vertical axes report deviations from steady state.

useful stabilization device even when the economy contains capital accumulation: it still tracks the aggregate responses of output and inflation reasonably well. Second, once capital is present, a consumption tax rule is no longer a full substitute for monetary policy, because it does not span the additional Euler equation for capital. The remaining differences in capital, asset prices, and household allocations are the quantitative manifestation of that missing margin.

7 Conclusion

This paper studies whether a rule-based consumption tax can substitute for conventional monetary policy when the nominal interest rate is fixed. In a two-agent New Keynesian economy, I show that the answer depends on the fiscal instrument set. When policymakers can adjust both consumption and labor-income taxes, a consumption tax rule can replicate the aggregate output and inflation dynamics generated by a Taylor rule. When the policy instrument is restricted to the consumption tax alone, exact aggregate equivalence breaks down. In LUFP, the consumption tax affects both intertemporal substitution and marginal cost, so policymakers face a trade-off between inflation stabilization and output stabilization. The same mechanism alters equilibrium determinacy: the tax rule enters the aggregate Euler equation through an additional wedge that depends on household heterogeneity, implying that the standard Taylor principle is no longer sufficient in all parameter regions. A simple LUFP rule can nevertheless be constructed to match the inflation path under monetary policy, and the quantitative results show that it performs reasonably well along that dimension, albeit at the cost of a larger contraction in output.

The paper also discusses the distributional and welfare dimensions of tax-based stabilization, though these are not the central focus. Although not pursued in detail, the numerical results show that unconventional fiscal policy can deliver stabilization effects similar to those of conventional monetary policy while generating a different path for debt and fiscal revenues. The additional tax revenue, under a simple equal-transfer design, can be redistributive without hindering stabilization objectives. A local first-order consumption-equivalent exercise show the measured welfare differences are small in both policy regimes compare to monetary policy. The benchmark calculation does not support a quantitatively meaningful welfare gain. Redistribution under unconventional fiscal policy therefore reflects the joint operation of the active tax rule and the passive transfer rule.

The extension with capital explores the limits of tax-based stabilization. Once capital accumulation is introduced, a consumption tax rule no longer spans all intertemporal conditions: it can mimic the bond Euler equation, but not the Euler equation governing capital accumulation. LUFP therefore remains a useful stabilization device, but only as a partial substitute for monetary policy. More broadly, the results suggest that the stabilization, redistribution, and measured consumption-equivalent diagnostics associated with unconventional fiscal policy depend jointly on the available fiscal instruments, the determinacy properties of the equilibrium, and the transfer mechanism used to recycle the associated fiscal revenues.

Two directions for future work are especially natural. First, the paper treats the passive transfer rule as given. Studying the consequences of alternative transfer design would help separate what is inherent to tax-based stabilization from what is driven by fiscal recycling. Second, extending to a richer HANK setting with endogenous transitions across balance-sheet positions would permit a fuller analysis of the overall policy impact.

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Appendix 1. Three-equation representation without capital

This appendix derives the three-equation representation used in Section 3. Assume: (i) zero steady state transfers, (ii) identical steady state consumption and hours across the two household types, and (iii) fixed profit taxes. Variables are expressed in real terms.

For hand-to-mouth households,

$$(1+\tau_{c,t})C_{H,t} = (1-\tau_{n,t})w_t N_{H,t}$$

and the labor supply condition is

$$w_t C_{H,t}^{-\sigma} = \frac{1+\tau_{c,t}}{1-\tau_{n,t}} \nu N_{H,t}^{\varphi}$$

Because ν is constant, it drops out of the log-linear equations. Combining the two equations yields

$$N_{H,t} = \nu^{-\frac{1}{\sigma+\varphi}} \left(\frac{1+\tau_{c,t}}{1-\tau_{n,t}}\right)^{\frac{1-\sigma}{\sigma+\varphi}} w_t^{\frac{1-\sigma}{\sigma+\varphi}}$$

so that log-linearization gives

$$\hat{N}_{H,t} = -\eta\hat{\tau}_{c,t} + \eta\hat{\tau}_{n,t} + \eta\hat{w}_t \qquad \eta \equiv \frac{1-\sigma}{\sigma+\varphi}$$

Using the budget constraint implies

$$\hat{C}_{H,t} = -(1+\eta)\hat{\tau}_{c,t} + (1+\eta)\hat{\tau}_{n,t} + (1+\eta)\hat{w}_t$$

For savers, the labor supply condition is

$$\hat{w}_t = \varphi\hat{N}_{S,t} + \sigma\hat{C}_{S,t} + \hat{\tau}_{c,t} - \hat{\tau}_{n,t}$$

Substituting into the hand-to-mouth equations yields

$$\hat{N}_{H,t} = \eta\varphi\hat{N}_{S,t} + \eta\sigma\hat{C}_{S,t}$$
$$\hat{C}_{H,t} = (1+\eta)\varphi\hat{N}_{S,t} + (1+\eta)\sigma\hat{C}_{S,t}$$

Goods- and labor-market clearing imply

$$\hat{y}_t = (1-\lambda)\hat{C}_{S,t} + \lambda\hat{C}_{H,t}$$
$$\hat{N}_t = (1-\lambda)\hat{N}_{S,t} + \lambda\hat{N}_{H,t}$$

Using the second equation to eliminate $\hat{N}_{S,t}$ and substituting into the first yields

$$\hat{y}_t = \frac{(1-\lambda)^2 + \lambda(1-\lambda)}{(1-\lambda)+\lambda\eta\varphi}\hat{C}_{S,t} + \frac{\lambda(1+\eta)\varphi}{(1-\lambda)+\lambda\eta\varphi}\hat{N}_t$$

Since production satisfies $\hat{y}_t = \hat{A}_t + \alpha\hat{N}_t$, we obtain

$$\hat{C}_{S,t} = \Lambda\hat{y}_t + \Xi\hat{A}_t \tag{63}$$

where

$$\Lambda = 1 + \frac{\lambda}{1-\lambda}\varphi\left(\frac{\alpha-1}{\alpha}\eta - \frac{1}{\alpha}\right)$$
$$\Xi = \frac{1}{\alpha}\frac{\lambda}{1-\lambda}(1+\eta)\varphi$$

The saver Euler equation under UFP then implies

$$\hat{y}_t = \mathbb{E}_t\hat{y}_{t+1} + \frac{1}{\sigma\Lambda}\left[\mathbb{E}_t\hat{\pi}_{t+1} + \mathbb{E}_t\hat{\tau}_{c,t+1} - \hat{\tau}_{c,t}\right] + \frac{\Xi}{\Lambda}\left(\mathbb{E}_t\hat{A}_{t+1} - \hat{A}_t\right) \tag{64}$$

To derive the Phillips curve, write real marginal cost as

$$\hat{mc}_t = \hat{w}_t - \hat{A}_t - (\alpha - 1)\hat{N}_t$$

Substituting the saver labor supply condition and (63) gives

$$\hat{mc}_t = \chi \hat{y}_t + z\hat{A}_t + \hat{\tau}_{c,t} - \hat{\tau}_{n,t} \tag{65}$$

where

$$\begin{aligned}
\chi &= \frac{1}{\alpha}\left[\frac{\varphi}{(1-\lambda)+\lambda\eta\varphi} - (\alpha-1)\right] + \left[\sigma - \frac{\lambda\eta\sigma\varphi}{(1-\lambda)+\lambda\eta\varphi}\right]\Lambda \\
z &= -\frac{1}{\alpha}\left[\frac{\varphi}{(1-\lambda)+\lambda\eta\varphi} - (\alpha-1)\right] + \left[\sigma - \frac{\lambda\eta\sigma\varphi}{(1-\lambda)+\lambda\eta\varphi}\right]\Xi - 1
\end{aligned}$$

Using the Calvo Phillips curve then yields

$$\hat{\pi}_t = \beta \mathbb{E}_t \hat{\pi}_{t+1} + \psi_{mc}\chi \hat{y}_t + \psi_{mc} z \hat{A}_t + \psi_{mc}\hat{\tau}_{c,t} - \psi_{mc}\hat{\tau}_{n,t} \qquad \psi_{mc} \equiv (1-\theta_p\beta)\frac{1-\theta_p}{\theta_p} \tag{66}$$

Under flexible prices, real marginal cost is zero

$$\hat{y}_t^{\text{flex}} = -\chi^{-1}\hat{\tau}_{c,t} + \chi^{-1}\hat{\tau}_{n,t} - \chi^{-1} z \hat{A}_t \tag{67}$$

Hence the output gap is $\hat{y}_t^{\text{gap}} = \hat{y}_t - \hat{y}_t^{\text{flex}}$, and the LUFP system can be written as

$$\begin{aligned}
\hat{y}_t^{\text{gap}} &= \mathbb{E}_t \hat{y}_{t+1}^{\text{gap}} - \frac{1}{\sigma\Lambda}\left[\frac{\chi - \sigma\Lambda}{\chi}\left(\hat{\tau}_{c,t} - \mathbb{E}_t\hat{\tau}_{c,t+1}\right) - \mathbb{E}_t\hat{\pi}_{t+1} - r_t^*\right] \\
\hat{\pi}_t &= \beta\mathbb{E}_t\hat{\pi}_{t+1} + \kappa \hat{y}_t^{\text{gap}} \\
\left(1 + \gamma_Y \chi^{-1}\right)\hat{\tau}_{c,t} - \mathbb{E}_t\hat{\tau}_{c,t+1} &= \gamma_\pi \hat{\pi}_t + \gamma_Y \hat{y}_t^{\text{gap}} - \gamma_Y \chi^{-1} z \hat{A}_t + \zeta_t
\end{aligned}$$

with

$$\kappa = \psi_{mc}\chi \qquad r_t^* = \sigma\left(\Xi - \Lambda z \chi^{-1}\right)\left(\mathbb{E}_t\hat{A}_{t+1} - \hat{A}_t\right)$$

Appendix 2. LUFP rules under alternative policy objectives

This appendix derives the LUFP rules that replicate either inflation or output.

Start from the two three-equation systems, abstracting from productivity for simplicity:

$$\begin{aligned}
\hat{y}_t^F &= \mathbb{E}_t \hat{y}_{t+1}^F - \frac{1}{\sigma\Lambda}\left[\hat{\tau}_{c,t} - \mathbb{E}_t\hat{\tau}_{c,t+1} - \mathbb{E}_t\hat{\pi}_{t+1}^F\right] \\
\hat{\pi}_t^F &= \beta\mathbb{E}_t\hat{\pi}_{t+1}^F + \psi_{mc}\chi\hat{y}_t^F + \psi_{mc}\hat{\tau}_{c,t} \\
\hat{y}_t^M &= \mathbb{E}_t \hat{y}_{t+1}^M - \frac{1}{\sigma\Lambda}\left[\hat{R}_t - \mathbb{E}_t\hat{\pi}_{t+1}^M\right] \\
\hat{\pi}_t^M &= \beta\mathbb{E}_t\hat{\pi}_{t+1}^M + \psi_{mc}\chi\hat{y}_t^M
\end{aligned}$$

Equal inflation response

Assume $\hat{\pi}_t^F = \hat{\pi}_t^M$ for all t. The two Phillips curves imply

$$\hat{y}_t^M = \hat{y}_t^F + \frac{1}{\chi}\hat{\tau}_{c,t} \tag{68}$$

Substituting this relation into the two IS equations and simplifying yields

$$\hat{R}_t = \left(1 - \frac{\sigma\Lambda}{\chi}\right)(\hat{\tau}_{c,t} - \mathbb{E}_t\hat{\tau}_{c,t+1}) = \Omega_\tau\left(\hat{\tau}_{c,t} - \mathbb{E}_t\hat{\tau}_{c,t+1}\right) \tag{69}$$

which is equation (43) in the main text. For expositional simplicity, this derivation abstracts from policy shocks; adding the policy shock gives the rule in equation 44

Equal output response

Now assume instead that $\hat{y}_t^F = \hat{y}_t^M$ for all t. Then the two Phillips curves imply

$$\hat{\pi}_t^F - \beta\mathbb{E}_t\hat{\pi}_{t+1}^F - \psi_{mc}\hat{\tau}_{c,t} = \hat{\pi}_t^M - \beta\mathbb{E}_t\hat{\pi}_{t+1}^M \tag{70}$$

Subtracting the two IS equations gives

$$\hat{\tau}_{c,t} - \mathbb{E}_t \hat{\tau}_{c,t+1} = \hat{R}_t + \frac{1}{\beta}\left(\hat{\pi}_t^F - \hat{\pi}_t^M\right) - \frac{\psi_{mc}}{\beta}\hat{\tau}_{c,t} \tag{71}$$

Forward-iterating the Phillips curve for LUFP under the transversality condition

$$\lim_{j \to \infty} \beta^j \mathbb{E}_t \hat{\pi}_{t+j}^F = 0$$

yields

$$\hat{\pi}_t^F = \psi_{mc}\chi \sum_{j=0}^{\infty} \beta^j \mathbb{E}_t \hat{y}_{t+j}^F + \psi_{mc} \sum_{j=0}^{\infty} \beta^j \mathbb{E}_t \hat{\tau}_{c,t+j}$$

Since $\hat{y}_t^F = \hat{y}_t^M$ by assumption,

$$\hat{\pi}_t^F - \hat{\pi}_t^M = \psi_{mc} \sum_{j=0}^{\infty} \beta^j \mathbb{E}_t \hat{\tau}_{c,t+j}$$

Substituting back gives

$$\hat{R}_t = (\hat{\tau}_{c,t} - \mathbb{E}_t \hat{\tau}_{c,t+1}) - \psi_{mc} \sum_{j=1}^{\infty} \beta^{j-1} \mathbb{E}_t \hat{\tau}_{c,t+j} \tag{72}$$

which is equation (46) in the main text.

Appendix 3. Determinacy with capital

This appendix summarizes the linear system used to study local determinacy in the capital version of the model.

Monetary policy

Let $\gamma_c \equiv C/Y$ denote the steady state consumption-output ratio. Combining market clearing, the production function, and capital accumulation gives

$$\hat{K}_t = \left(1 - \delta + \frac{\delta(1-\alpha)}{1-\gamma_c}\right)\hat{K}_{t-1} + \frac{\delta\alpha}{1-\gamma_c}\hat{N}_t - \frac{\delta\gamma_c}{1-\gamma_c}\hat{C}_t \tag{73}$$

The Phillips curve becomes

$$\hat{\pi}_t = \beta\mathbb{E}_t\hat{\pi}_{t+1} + (1+\varphi-\alpha)\psi_{mc}\hat{N}_t + \sigma\psi_{mc}\hat{C}_t - (1-\alpha)\psi_{mc}\hat{K}_{t-1} \tag{74}$$

Define

$$\hat{C}_{S,t} = \Phi_c\hat{C}_t - \Phi_N\hat{N}_t \qquad \Phi_c \equiv 1 + \frac{\lambda}{1-\lambda}\eta\varphi \qquad \Phi_N \equiv \frac{\lambda}{1-\lambda}(1+\eta)\varphi$$

Then the aggregate Euler equation is

$$\Phi_c\hat{C}_t - \Phi_N\hat{N}_t = \mathbb{E}_t\left[\Phi_c\hat{C}_{t+1} - \Phi_N\hat{N}_{t+1}\right] - \frac{1}{\sigma}\left[\hat{R}_t - \mathbb{E}_t\hat{\pi}_{t+1}\right] \tag{75}$$

The Euler equation for capital, combined with investment adjustment costs, yields

$$\begin{aligned}\frac{\alpha}{1-\gamma_c}\hat{N}_t + \frac{\gamma_c-\alpha}{1-\gamma_c}\hat{K}_{t-1} - \frac{\gamma_c}{1-\gamma_c}\hat{C}_t + \eta_I\hat{R}_t = &\left[\beta(1-\delta)\frac{\alpha}{1-\gamma_c} + \omega(1+\varphi)\right]\mathbb{E}_t\hat{N}_{t+1} \\ &+ \left[\beta(1-\delta)\frac{\gamma_c-\alpha}{1-\gamma_c} - \omega\right]\hat{K}_t \\ &+ \left[-\beta(1-\delta)\frac{\gamma_c}{1-\gamma_c} + \omega\sigma\right]\mathbb{E}_t\hat{C}_{t+1} + \eta_I\mathbb{E}_t\hat{\pi}_{t+1}\end{aligned} \tag{76}$$

where $\omega \equiv \eta_I[1-\beta(1-\delta)]$. The policy rule is

$$\hat{R}_t - \theta_\pi \hat{\pi}_t - \theta_Y \alpha \hat{N}_t - \theta_Y (1-\alpha)\hat{K}_{t-1} - \mu_t = 0 \tag{77}$$

Collecting terms, the monetary policy system can be written as

$$\mathbb{A}X_t = \mathbb{B}\mathbb{E}_t X_{t+1} + \mathbb{C}e_t$$

where

$$X_t = \begin{bmatrix} \hat{C}_t \\ \hat{N}_t \\ \hat{K}_{t-1} \\ \hat{\pi}_t \\ \hat{R}_t \end{bmatrix}$$

Limited unconventional fiscal policy

Under LUFP, the first equation remains unchanged, while the Phillips curve becomes

$$\hat{\pi}_t = \beta \mathbb{E}_t \hat{\pi}_{t+1} + (1+\varphi-\alpha)\psi_{mc}\hat{N}_t + \sigma\psi_{mc}\hat{C}_t - (1-\alpha)\psi_{mc}\hat{K}_{t-1} + \psi_{mc}\hat{\tau}_{c,t-1} \tag{78}$$

The aggregate Euler equation is

$$\Phi_c \hat{C}_t - \Phi_N \hat{N}_t = \mathbb{E}_t\left[\Phi_c \hat{C}_{t+1} - \Phi_N \hat{N}_{t+1}\right] - \frac{1}{\sigma}\left[\hat{\tau}_{c,t-1} - \mathbb{E}_t\hat{\tau}_{c,t} - \mathbb{E}_t\hat{\pi}_{t+1}\right] \tag{79}$$

The capital Euler equation becomes

$$\frac{\alpha}{1-\gamma_c}\hat{N}_t + \frac{\gamma_c-\alpha}{1-\gamma_c}\hat{K}_{t-1} - \frac{\gamma_c}{1-\gamma_c}\hat{C}_t = \left[\beta(1-\delta)\frac{\alpha}{1-\gamma_c} + \omega(1+\varphi)\right]\mathbb{E}_t\hat{N}_{t+1}$$
$$+\left[\beta(1-\delta)\frac{\gamma_c-\alpha}{1-\gamma_c} - \omega\right]\hat{K}_t$$
$$+\left[-\beta(1-\delta)\frac{\gamma_c}{1-\gamma_c} + \omega\sigma\right]\mathbb{E}_t\hat{C}_{t+1} + \eta_I\mathbb{E}_t\hat{\pi}_{t+1} + \omega\mathbb{E}_t\hat{\tau}_{c,t} \tag{80}$$

Finally, the predetermined-tax policy rule used in the capital simulations is

$$\hat{\tau}_{c,t-1} - \hat{\tau}_{c,t} - \gamma_\pi\hat{\pi}_t - \gamma_Y\alpha\hat{N}_t - \gamma_Y(1-\alpha)\hat{K}_{t-1} - \zeta_t = 0 \tag{81}$$

The corresponding state vector is

$$Y_t = \begin{bmatrix} \hat{C}_t \\ \hat{N}_t \\ \hat{K}_{t-1} \\ \hat{\pi}_t \\ \hat{\tau}_{c,t-1} \end{bmatrix}$$

and the system can again be written as

$$\mathbb{A}_\tau Y_t = \mathbb{B}_\tau\mathbb{E}_t Y_{t+1} + \mathbb{C}_\tau e_t$$

The determinacy maps are shown in Figure 9.

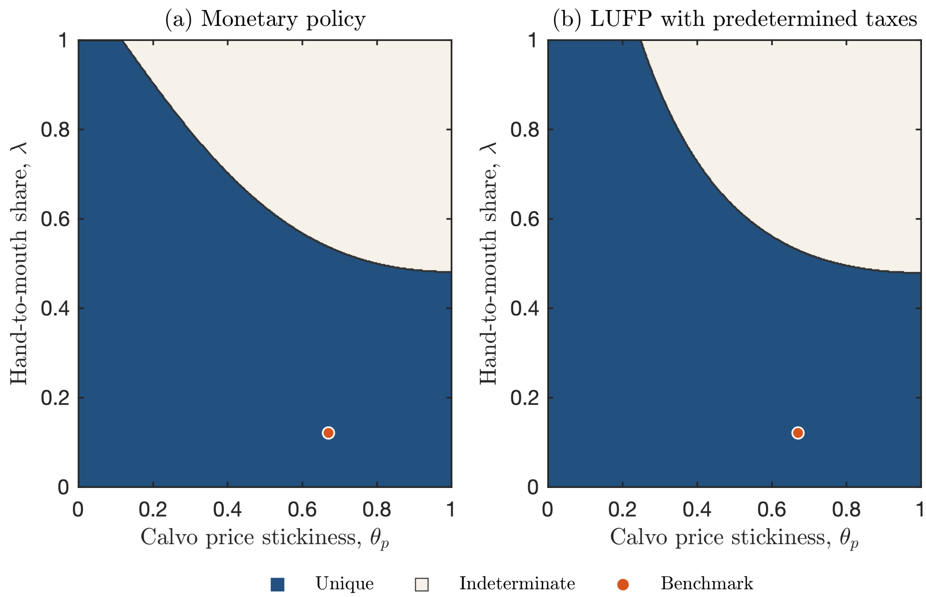

Figure 9: Local determinacy with capital. Blue regions denote locally unique equilibria, while white regions denote indeterminacy. The LUFP panel uses the predetermined-tax timing.