PS3 Solutions

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Q3. Baseline Estimation of SW2007 (1965Q1-2004Q4)

Table 1: Comparison of Estimated Parameter Posterior Modes

Parameter	Description	Dynare Name	Q3 Estimation	Smets & Wouters (2007)
Structural Parameters				
α	Capital share	`calfa`	0.2127	0.19
σ_c	Intertemporal substitution	`csigma`	1.4504	1.39
h	Habit formation	`chabb`	0.6857	0.71
ξ_w	Calvo prob. (wages)	`cprobw`	0.7329	0.73
σ_l	Labor supply elasticity	`csigl`	1.9554	1.92
ξ_p	Calvo prob. (prices)	`cprobp`	0.6931	0.65
ι_w	Indexation (wages)	`cindw`	0.6202	0.59
ι_p	Indexation (prices)	`cindp`	0.3253	0.22
ψ	Capital utilization cost	`czcap`	0.5731	0.54
ϕ	Investment adj. cost	`csadjcost`	5.5245	5.48
Φ	Fixed costs	`cfc`	1.6276	1.61
Monetary Policy Parameters (Taylor rule)				
r_π	Response to inflation	`crpi`	1.9760	2.03
ρ	Interest rate persistence	`crr`	0.8075	0.81
r_y	Response to output gap	`cry`	0.0754	0.08
$r_{\Delta y}$	Response to output growth	`crdy`	0.2266	0.22
Shock Process Parameters				
ρ_a	Persistence: productivity	`crhoa`	0.9573	0.95
ρ_b	Persistence: risk premium	`crhob`	0.2000	0.18
ρ_g	Persistence: gov. spending	`crhog`	0.9713	0.97
ρ_i	Persistence: invest. specific	`crhoqs`	0.7086	0.71
ρ_r	Persistence: MP shock	`crhoms`	0.1438	0.12
ρ_p	Persistence: price mark-up	`crhopinf`	0.8826	0.90
ρ_w	Persistence: wage mark-up	`crhow`	0.9632	0.97
μ_p	MA term: price mark-up	`cmap`	0.7228	0.74
μ_w	MA term: wage mark-up	`cmaw`	0.8721	0.88
ρ_{ga}	Feedback tech. on spending	`cgy`	0.5548	0.52

Notes: Q3 Estimation are posterior modes from our baseline run over 1965Q1-2004Q4. The monetary policy modes imply a strong inflation response and sizable interest-rate smoothing.
The rightmost column reproduces the canonical SW(2007) Table 1a values to facilitate visual comparison of magnitudes and notation.

Table 2: Variance Decomposition: Q3 vs. Original `usmodel`

Variable	Q3 Estimation (SW2007_PS3_2025)							Original (usmodel)						
	ea	eb	eg	eqs	em	ep	ew	ea	eb	eg	eqs	em	ep	ew
y	31.2	1.9	3.9	9.8	3.0	8.1	42.2	28.6	66.2	2.6	2.0	0.6	0.0	0.0
π	3.9	0.7	1.3	4.4	5.3	33.5	50.9	0.8	92.8	0.3	2.2	2.5	1.2	0.3
i	10.4	8.5	4.8	23.5	16.8	7.7	28.3	0.2	97.9	0.1	1.6	0.3	0.0	0.0

Notes: Entries are shares (%) of forecast-error variance at business-cycle frequencies. Q3 results from `SW2007_PS3_2025.log`; original `usmodel` from `usmodel_q3.log`.

Central-bank reading of the Q3 estimates. The posterior mode for the inflation coefficient is $r_\pi = 1.98$, comfortably satisfying the Taylor principle, while the smoothing parameter remains high at $\rho = 0.81$; the output-gap and output-growth terms are small at $r_y = 0.08$ and $r_{\Delta y} = 0.23$. Together, these imply a policy that leans hard against inflation, adjusts rates gradually, and places limited weight on real activity—qualitatively consistent with SW (2007). The deep frictions mirror standard post-1990s estimates: price and wage stickiness near 0.69-0.73, sizeable indexation on wages ($\iota_w \approx 0.62$) but more modest on prices ($\iota_p \approx 0.33$), strong habits ($h \approx 0.69$), and sizable investment adjustment costs ($\phi \approx 5.5$). Productivity and government-spending processes are highly persistent ($\rho_a \approx 0.96$, $\rho_g \approx 0.97$), whereas the risk-premium process is much less so ($\rho_b \approx 0.20$). The MP shock is only mildly persistent ($\rho_m \approx 0.14$), so the surprise component dies out within a quarter, leaving the endogenous persistence to the policy rule and nominal rigidities. The FEVD indicates MP shocks explain a non-trivial share of rate volatility (about 0.17%) but a smaller share of inflation variance, consistent with inflation being driven largely by markup shocks in this sample; nonetheless, policy innovations measurably discipline inflation and activity via expected-real-rate channels.

Where Q3 differs from SW2007. Variance decompositions highlight a fundamental re-allocation of nominal variation across wedges. In the Q3 baseline, wage and price mark-up shocks dominate inflation and the policy rate (about 51% and 28% of the rate, respectively), while TFP and mark-ups together drive output (roughly 31% and 42%). By contrast, the unmodified SW2007 assigns almost all of inflation and interest-rate variability to the risk-premium process ($\approx$93-98%). This is neither empirically plausible nor consistent with sticky-price/wage theory, and it compresses the monetary transmission channel.

Figure 1: Impulse Responses to Demand Shocks and Monetary Policy Shock, Q3 Baseline

(a) Demand block (risk premium, spending, investment-specific)
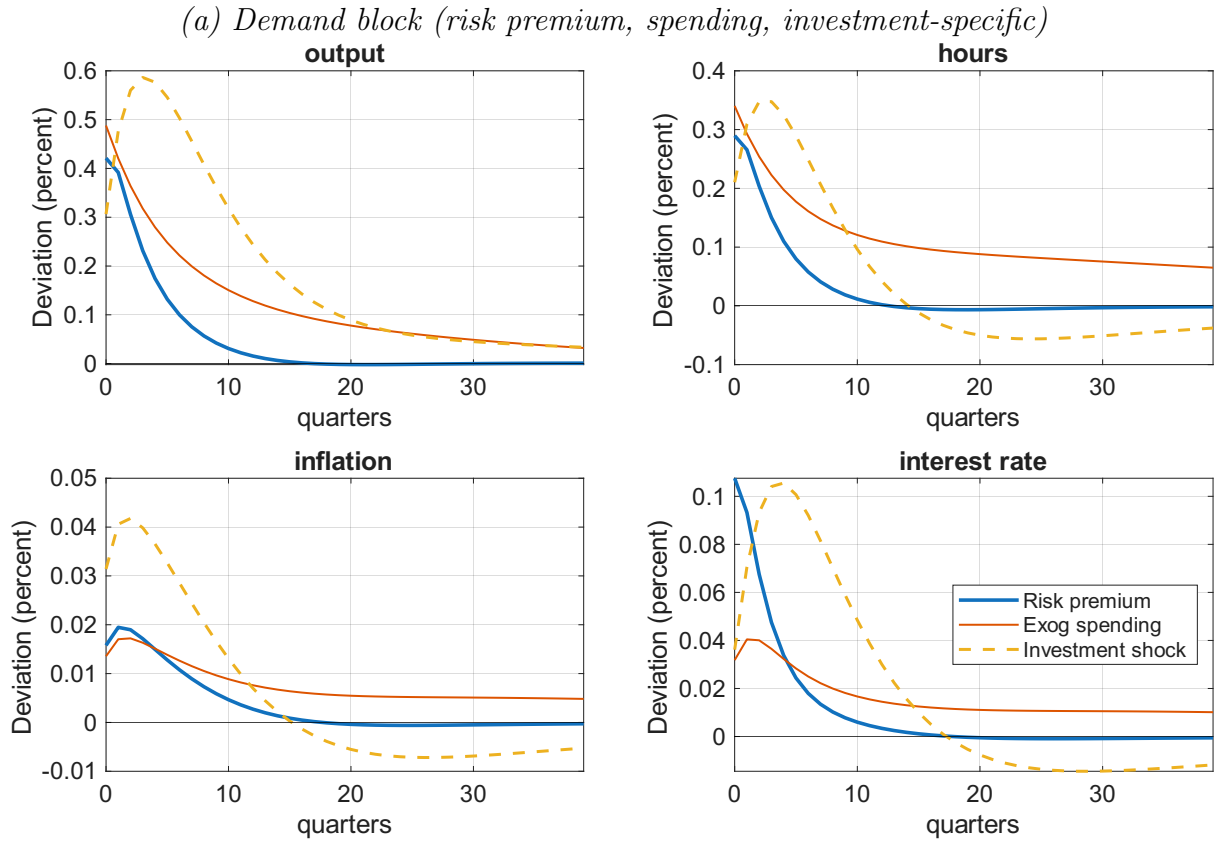
Notes: Output, hours, inflation, and the policy rate following a one-s.d. risk-premium shock (b_t), exogenous spending shock (g_t), and investment-specific technology shock (q_t). Line styles/legend as in the figure file.

(b) Monetary policy shock
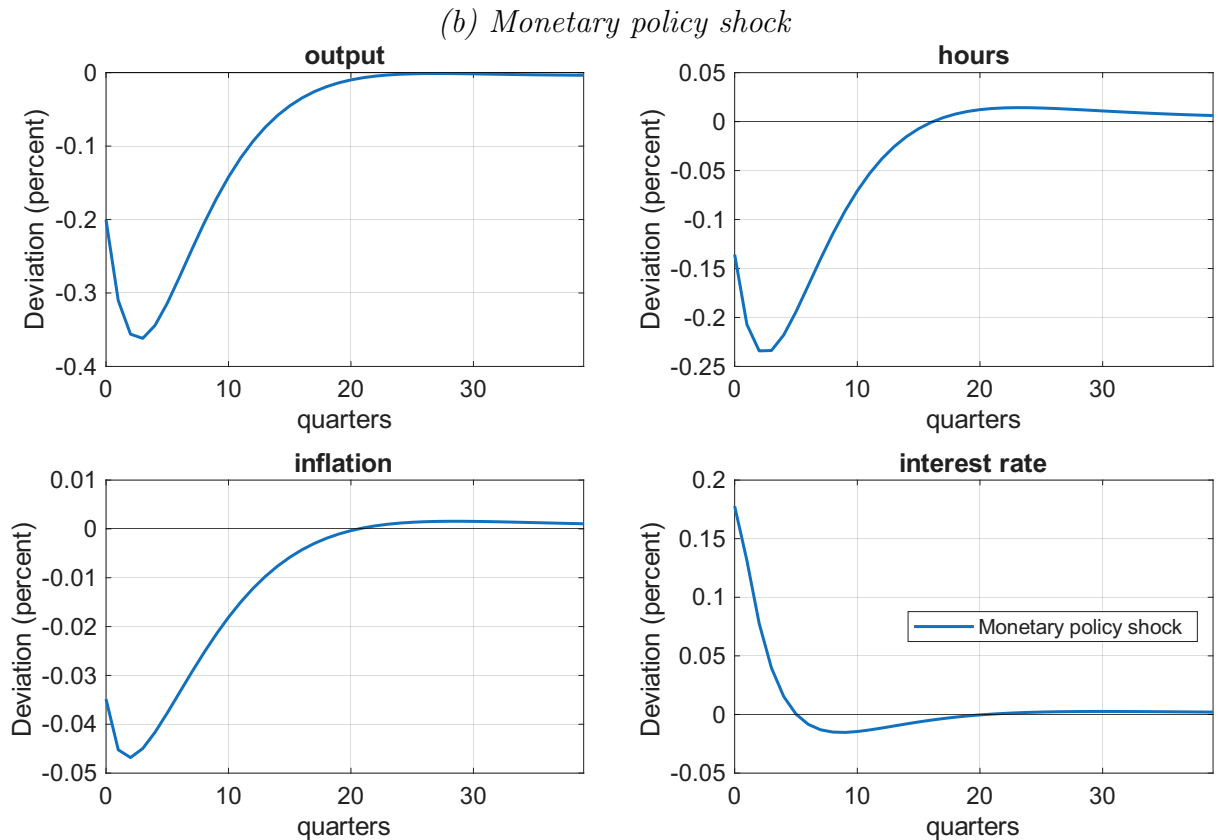
Notes: Output, hours, inflation, and the policy rate following a one-s.d. monetary policy shock (m_t). Line styles/legend as in the figure file.

Co-movements and policy transmission. Under Q3, the unconditional correlation between inflation and the policy rate is positive ($\text{corr}(\pi, i) \approx 0.65$), while output and inflation are mildly *negatively* correlated ($\text{corr}(y, \pi) \approx -0.30$), indicating that policy reacts systematically to inflationary pressure and that supply-side mark-ups matter for price dynamics. The original run instead implies a very tight positive association of inflation with the policy rate (≈ 0.95) and a strong positive y-π co-movement, again reflecting the risk-premium dominance.

Policy takeaways. From a policy standpoint, the Q3 estimates describe a regime that

- (i) anchors inflation expectations via $r_\pi > 1$;

- (ii) tempers real-side amplification through high smoothing.

Because nominal wedges (price/wage mark-ups) explain the bulk of nominal variability, systematic policy remains effective: a contractionary innovation raises real rates on impact, curbing inflation with limited output sacrifice relative to a risk-premium-driven world. This reading aligns with the central-bank literature that cautions against over-attributing inflation to demand wedges and underscores the role of price/wage stickiness in shaping transmission.

Q4. Re-estimation of SW2007 over 1980Q1-2015Q4 and Comparison to Q3

Table 3: Posterior Mode Estimates: 1965Q1-2004Q4 vs. 1980Q1-2015Q4

Parameter	Description	Dynare Name	Q4 (1980-2015)	Q3 (1965-2004)	SW (2007)
Structural Parameters					
α	Capital share	calfa	0.2109	0.2127	0.19
σ_c	Intertemporal substitution	csigma	1.5330	1.4504	1.39
h	Habit formation	chabb	0.5966	0.6857	0.71
ξ_w	Calvo prob. (wages)	cprobw	0.7692	0.7329	0.73
σ_l	Labor supply elasticity	csigl	1.0518	1.9554	1.92
ξ_p	Calvo prob. (prices)	cprobp	0.8264	0.6931	0.65
ι_w	Indexation (wages)	cindw	0.4283	0.6202	0.59
ι_p	Indexation (prices)	cindp	0.2411	0.3253	0.22
ψ	Capital utilization cost	czcap	0.8589	0.5731	0.54
ϕ	Investment adjustment cost	csadjcost	6.3138	5.5245	5.48
Φ	Fixed costs	cfc	1.5072	1.6276	1.61
Monetary Policy Parameters (Taylor rule)					
r_π	Response to inflation	crpi	1.7901	1.9760	2.03
ρ	Interest-rate persistence	crr	0.8324	0.8075	0.81
r_y	Response to output gap	cry	0.0363	0.0754	0.08
$r_{\Delta y}$	Response to output growth	crdy	0.2039	0.2266	0.22
Shock Process Parameters					
ρ_a	Persistence: productivity	crhoa	0.9757	0.9573	0.95
ρ_b	Persistence: risk premium	crhob	0.5463	0.2000	0.18
ρ_g	Persistence: gov. spending	crhog	0.9661	0.9713	0.97
ρ_{qs}	Persistence: invest. specific	crhoqs	0.8714	0.7086	0.71
ρ_m	Persistence: monetary policy	crhoms	0.2655	0.1438	0.12
ρ_p	Persistence: price mark-up	crhopinf	0.8908	0.8826	0.90
ρ_w	Persistence: wage mark-up	crhow	0.9203	0.9632	0.97
μ_p	MA term: price mark-up	cmap	0.7792	0.7228	0.74
μ_w	MA term: wage mark-up	cmaw	0.8993	0.8721	0.88
ρ_{ga}	Feedback tech. on spending	cgy	0.4934	0.5548	0.52

Notes: Q4 modes are from `SW2007_PS3_2025_Q4.log`. Q3 modes are from Section 1. SW(2007) entries replicate Table 1a in their paper. Relative to Q3, the 1980-2015 sample features (i) *greater nominal rigidity* (higher ξ_p, ξ_w and lower indexation ι_p, ι_w), (ii) *stronger real frictions* (larger ϕ and higher utilization costs ψ), and (iii) *more persistent financial and investment disturbances* (ρ_b, ρ_{qs}).

Central-bank reading of the Q4 estimates (vs. Q3). Three features stand out.
(i) Monetary stance.
The inflation coefficient remains safely above unity ($r_\pi = 1.79$) while policy smoothing rises ($\rho = 0.83$), and the output-gap weight roughly halves ($r_y \approx 0.04$). This points to a more *gradualist*, inflation-targeting regime that leans a bit less on real-activity feedback than in Q3. The policy shock is also more persistent ($\rho_m \approx 0.27$), lengthening the footprint of rate innovations.
(ii) Deeper nominal and real frictions.
Relative to Q3, price and wage stickiness increase markedly ($\xi_p \approx 0.83$, $\xi_w \approx 0.77$) while

Table 4: Forecast-Error Variance Decomposition (percent, business-cycle horizons)

Variable	Q4 (1980-2015)							Q3 (1965-2004)						
	ea	eb	eg	eqs	em	ep	ew	ea	eb	eg	eqs	em	ep	ew
y	32.6	3.9	3.6	39.4	7.4	9.5	3.6	31.2	1.9	3.9	9.8	3.0	8.1	42.2
π	6.0	2.4	3.1	19.1	10.9	45.4	13.2	3.9	0.7	1.3	4.4	5.3	33.5	50.9
i	7.4	13.6	4.5	57.7	11.1	3.3	2.6	10.4	8.5	4.8	23.5	16.8	7.7	28.3

Notes: Q4 shares are from `SW2007_PS3_2025_Q4.log`; Q3 shares reproduce Table 2. Columns: *ea* (TFP), *eb* (risk premium), *eg* (gov. spending), *eqs* (investment-specific technology), *em* (monetary policy), *ep* (price mark-up), *ew* (wage mark-up). The post-1980 sample shifts output and policy-rate variability decisively toward q_t (investment-specific technology), while inflation variability is primarily price mark-up driven with non-trivial contributions from q_t and monetary shocks.

indexation declines (especially on prices), pushing the Phillips curves toward a more forward-looking—flatter—configuration. Habits fall and both investment adjustment and utilization costs rise, tempering expenditure switching and making capital services less nimble.

(iii) Shock anatomy and co-movements.

The FEVD reallocates variability away from wage mark-ups toward investment-specific technology (q_t): q_t explains $\sim 40\%$ of output and nearly 58% of the policy rate, while price mark-ups now lead inflation dynamics (about 45%). Contemporaneous correlations are consistent with this re-allocation: $\text{corr}(y, \pi)$ turns mildly positive (≈ 0.15, from negative in Q3), and $\text{corr}(\pi, i)$ remains positive (≈ 0.57), indicating a systematic but smoother policy reaction to inflationary pressure as mark-up shocks recede relative to technology and investment disturbances.

IRFs: transmission channels. The Taylor rule remains active against inflation but with slightly lower r_π and higher smoothing, consistent with a more inertial operating procedure. The MP shock becomes *more* persistent ($\rho_m \approx 0.27$), but its innovation variance falls. IRFs show a smoother path for i_t and milder disinflation/output costs on impact. FEVDs indicate MP innovations account for $\sim 11\%$ of policy-rate variance (down from Q3) but *more* of inflation variance ($\sim 11\%$ vs. 5%), reflecting a cleaner nominal environment with less noise from markup shocks.

The policy-rate IRFs are increasingly dominated by the *inertia channel* (high ρ) in early horizons, with the *inflation-feedback channel* (via r_π) taking over more slowly as price dynamics materialize under higher Calvo stickiness and lower indexation. This pattern is precisely what the FEVD reallocations toward q_t and ep_t imply.

Figure 2: Impulse Responses to Risk-Premium, Spending, and Investment-Specific Shocks: Q4 Re-estimation

(a) Demand block
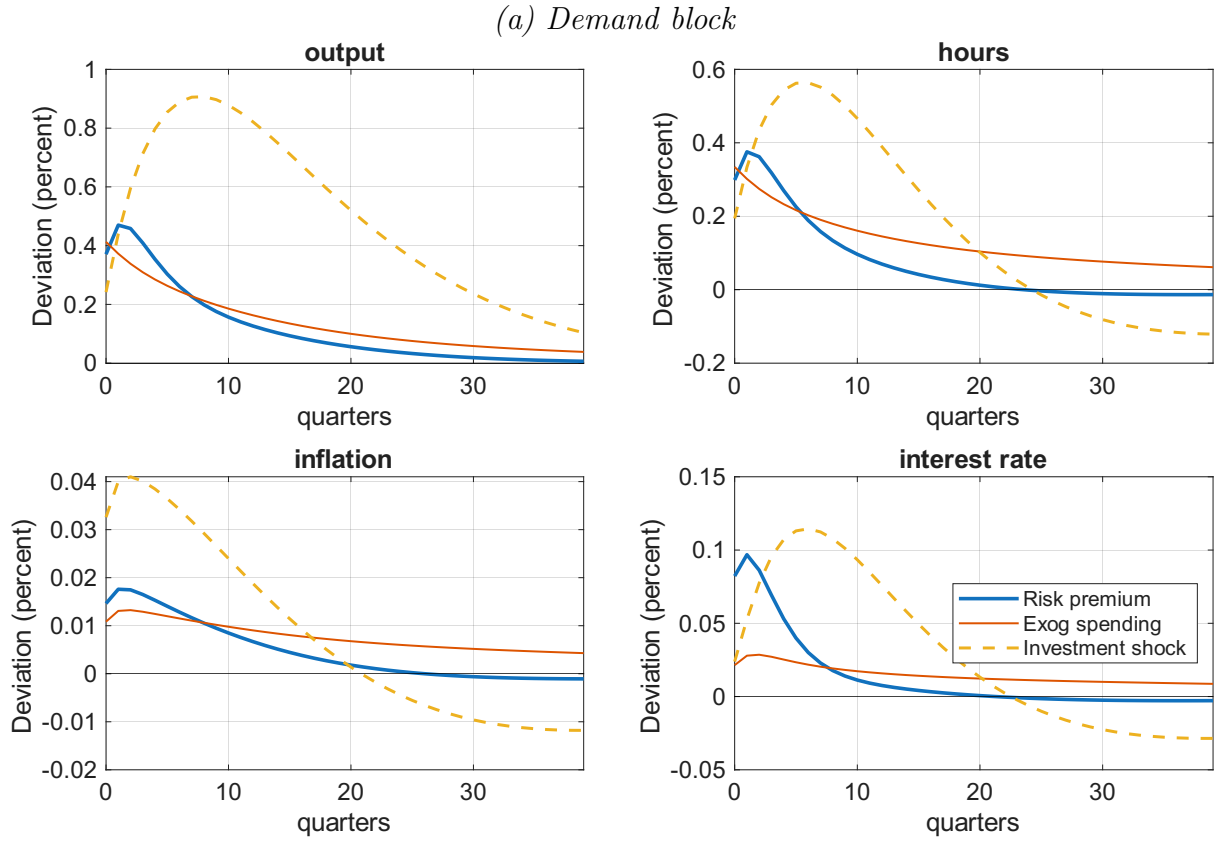
Notes: Output (y), hours (ℓ), inflation (π), and the policy rate (i) IRFs to one-s.d. innovations in b_t, g_t, and q_t from the Q4 estimation. Line styles/legend as in the figure file.

(b) Monetary policy shock
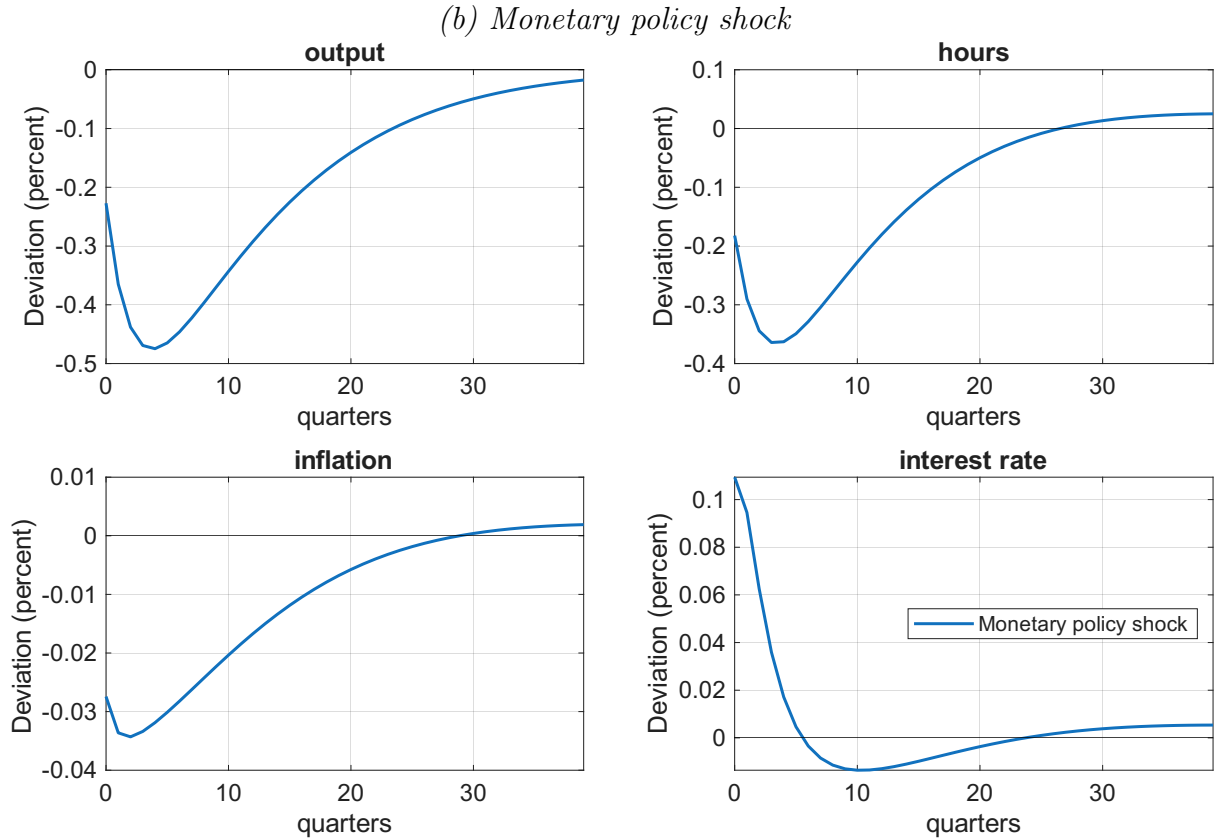
Notes: Later sample with higher price stickiness, lower price indexation; slightly lower r_π and higher ρ than Q3.

Policy takeaways (1980-2015).   The re-estimation describes a regime that

- (i) keeps the Taylor principle intact;

- (ii) relies more on rate smoothing and less on output-gap feedback;

- (iii) faces price formation that is more forward-looking and stickier. With wage mark-ups no longer dominating inflation, systematic policy remains effective yet needs patience: higher smoothing and flatter Phillips curves make disinflations more gradual. The prominence of q_t cautions that real-side investment disturbances—and their interaction with policy via real rates—are first-order drivers of business-cycle comovement in this period.

Q5. Re-estimation of SW2007 over 1967Q1-1991Q4 and Comparison to Q3

Table 5: Posterior Mode Estimates: 1967Q1-1991Q4 vs. 1965Q1-2004Q4

| Parameter	Description	Dynare Name	Q5 (1967-1991)	Q3 (1965-2004)	SW (2007)
Structural Parameters					
α	Capital share	calfa	0.2123	0.2127	0.19
σ_c	Intertemporal substitution (inv.)	csigma	1.1106	1.4504	1.39
h	Habit formation	chabb	0.7143	0.6857	0.71
ξ_w	Calvo prob. (wages)	cprobw	0.7434	0.7329	0.73
σ_l	Labor supply elasticity (inv.)	csigl	1.9156	1.9554	1.92
ξ_p	Calvo prob. (prices)	cprobp	0.5583	0.6931	0.65
ι_w	Indexation (wages)	cindw	0.5732	0.6202	0.59
ι_p	Indexation (prices)	cindp	0.3708	0.3253	0.22
ψ	Capital utilization cost	czcap	0.3971	0.5731	0.54
ϕ	Investment adjustment cost	csadjcost	3.9275	5.5245	5.48
Φ	Fixed costs	cfc	1.4865	1.6276	1.61
Monetary Policy Parameters (Taylor rule)					
r_π	Response to inflation	crpi	1.8342	1.9760	2.03
ρ	Interest-rate persistence	crr	0.7813	0.8075	0.81
r_y	Response to output gap	cry	0.0933	0.0754	0.08
$r_{\Delta y}$	Response to output growth	crdy	0.2114	0.2266	0.22
Shock Process Parameters					
ρ_a	Persistence: productivity	crhoa	0.8572	0.9573	0.95
ρ_b	Persistence: risk premium	crhob	0.4845	0.2000	0.18
ρ_g	Persistence: gov. spending	crhog	0.9131	0.9713	0.97
ρ_{qs}	Persistence: invest. specific	crhoqs	0.8836	0.7086	0.71
ρ_m	Persistence: monetary policy	crhoms	0.1607	0.1438	0.12
ρ_p	Persistence: price mark-up	crhopinf	0.8356	0.8826	0.90
ρ_w	Persistence: wage mark-up	crhow	0.8941	0.9632	0.97
μ_p	MA term: price mark-up	cmap	0.6649	0.7228	0.74
μ_w	MA term: wage mark-up	cmaw	0.7201	0.8721	0.88
ρ_{ga}	Feedback tech. on spending	cgy	0.5637	0.5548	0.52

Notes: Q5 modes come from `SW2007_PS3_2025_Q5.log`, Q3 modes from Section 1. Relative to Q3, the pre-1992 sample exhibits *less price rigidity, more price indexation*, and markedly higher persistence of financial (ρ_b) and investment-specific (ρ_{qs}) disturbances.

### Table 6: Forecast-Error Variance Decomposition (percent, business-cycle horizons)

	Q5 (1967-1991)							Q3 (1965-2004)						
Variable	*ea*	*eb*	*eg*	*eqs*	*em*	*ep*	*ew*	*ea*	*eb*	*eg*	*eqs*	*em*	*ep*	*ew*
y	12.7	10.5	4.3	25.5	5.2	5.0	36.8	31.2	1.9	3.9	9.8	3.0	8.1	42.2
π	5.1	4.3	0.7	10.6	6.6	25.2	47.5	3.9	0.7	1.3	4.4	5.3	33.5	50.9
i	7.4	24.2	2.2	28.2	15.2	4.6	18.2	10.4	8.5	4.8	23.5	16.8	7.7	28.3

Notes: Q5 shares are computed from `SW2007_PS3_2025_Q5.log`. The pre-1992 sample reallocates output and rate variability toward q_t (investment-specific technology) and raises the role of the risk-premium b_t for the policy rate. Inflation remains mark-up dominated, but price mark-ups contribute less than in Q3 while q_t and monetary shocks play a larger role.

Figure 3: Impulse Responses to Demand Shocks and Monetary Policy Shock: Q5 Re-estimation

(a) Demand block
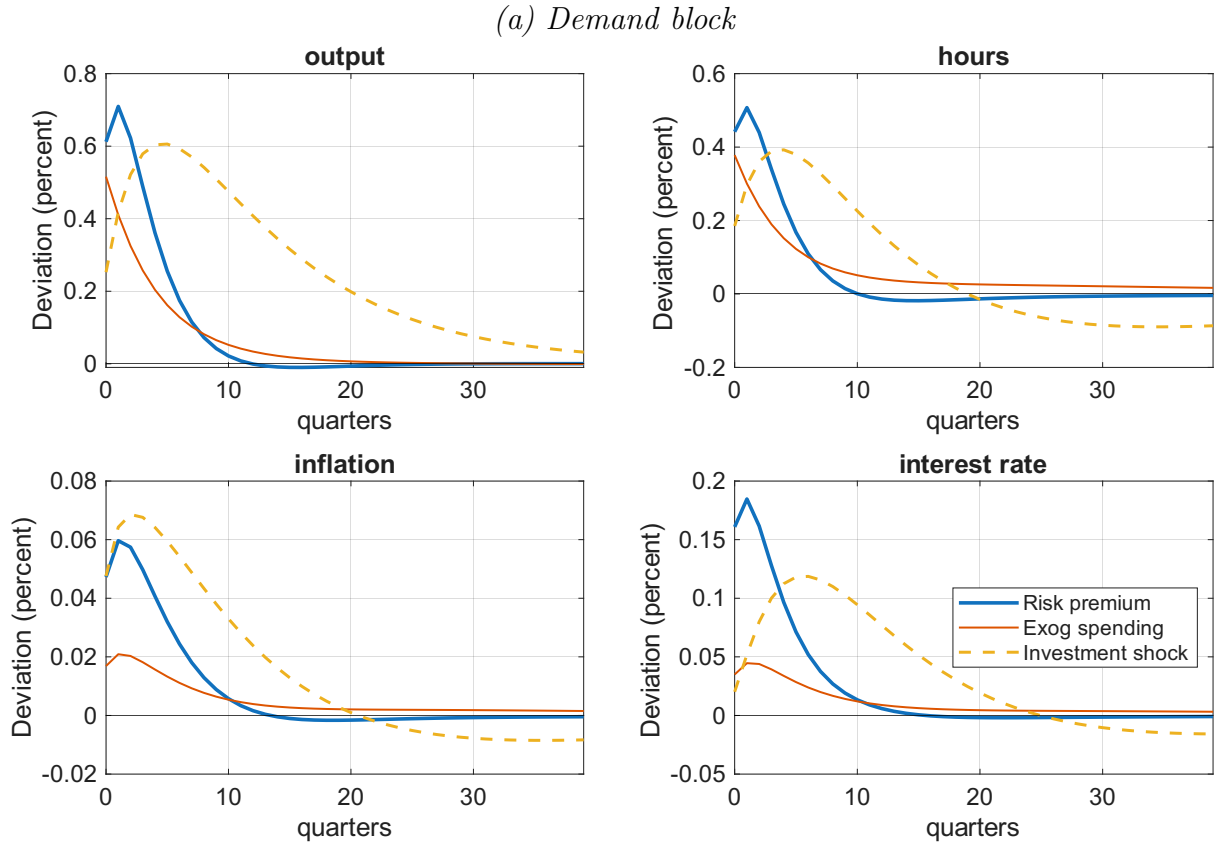
Notes: Output (y), hours (ℓ), inflation (π), and policy rate (i) responses to one-s.d. shocks to b_t, g_t, and q_t. Line styles/legend as in the figure file.

(b) Monetary policy shock
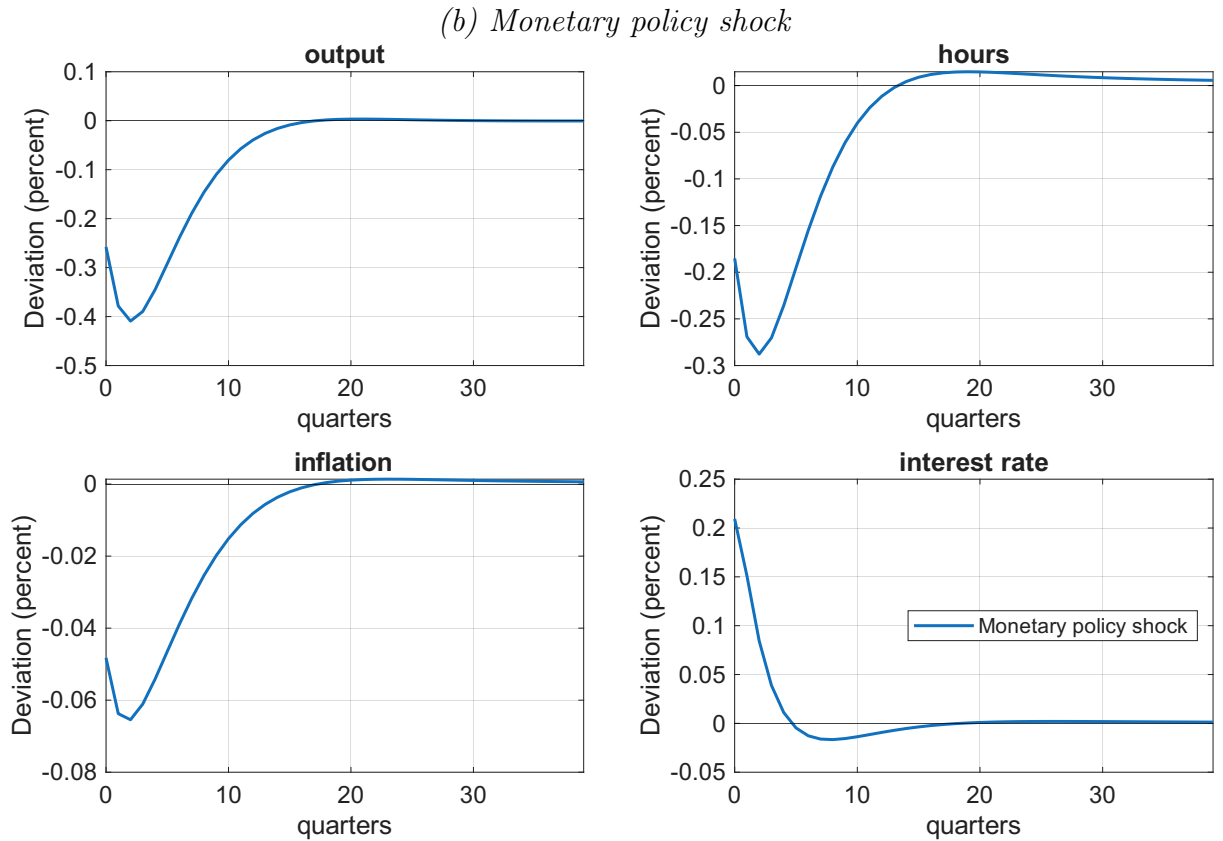
Notes: Earlier subsample with lower price stickiness and higher price indexation; slightly lower smoothing than Q3.

Central-bank reading of the Q5 estimates (vs. Q3).   *(i) Monetary stance.*
The Taylor principle still holds ($r_\pi = 1.83$), but the rule is slightly less aggressive and a touch less inertial than in Q3. Combined with a higher steady-state inflation level and greater shock persistence (ρ_b, ρ_{qs}), monetary innovations leave a more visible footprint on the rate, while inflation remains primarily governed by cost-push forces.
(ii) Price/wage formation.
Lower price stickiness (shorter contracts) together with *higher price indexation* makes the Phillips curve more backward-looking and raises intrinsic inflation persistence. Wage contracts are slightly stickier, but with less MA and serial persistence than Q3. The result is that:

- (i) mark-up shocks still dominate inflation variance ($\approx 72.7\%$);

- (ii) investment disturbances transmit more strongly to prices and the policy rate through marginal-cost and intertemporal channels.

(iii) Shock anatomy and co-movements.
The FEVD shifts output and the policy rate toward q_t and b_t; $\mathrm{corr}(\pi, i)$ remains strongly positive, while $\mathrm{corr}(y, \pi)$ is near zero rather than distinctly negative, consistent with a period in which supply/cost-push and investment drivers of activity often coincided with monetary tightening episodes.

IRFs: transmission channels in 1967-1991.   Under a less sticky but more indexed price process, IRFs display:

(i) faster near-term pass-through of shocks to inflation, but with persistence coming from indexation rather than contract duration;

(ii) larger and more persistent real responses to q_t due to lower adjustment and utilization costs;

(iii) policy-rate responses that are front-loaded to investment and risk-premium shocks and less tightly tied to wage-markups than in Q3. For a decomposition-style reading, early-horizon movements are driven by the intertemporal channel (real-rate effects on c and i), while later horizons reflect cost-push persistence through indexation.

Policy takeaways (pre-1992 sample).   A central bank facing lower price rigidity but stronger indexation should expect cost-push persistence alongside stronger investment-driven cycles. The estimated rule is appropriately active but slightly less aggressive than in Q3; credible inflation control still relies on $r_\pi > 1$, but patience is required as indexation prolongs the disinflation path. The prominence of q_t warns that real-rate management—via forward guidance or term-premium channels—plays an outsized role in stabilizing activity over this period.

Q6. Kimball Aggregator vs. Dixit-Stiglitz (1966Q1-2004Q4)

Table 7: Posterior Modes (SW sample): Kimball vs. Dixit-Stiglitz

Parameter	Description	Kimball	Dixit–Stiglitz
Monetary policy (Taylor rule)			
r_π	Inflation feedback (`crpi`)	1.955	1.968
ρ	Interest-rate smoothing (`crr`)	0.804	0.783
r_y	Output-gap level (`cry`)	0.074	0.069
$r_{\Delta y}$	Output growth (`crdy`)	0.232	0.228
Nominal frictions			
ξ_p	Calvo prob. (prices, `cprobp`)	0.685	0.839
ξ_w	Calvo prob. (wages, `cprobw`)	0.725	0.812
ι_p	Indexation (prices, `cindp`)	0.335	0.346
ι_w	Indexation (wages, `cindw`)	0.616	0.653
ε_p	Kimball curvature (prices, `curvp`)	10.000	0.000
ε_w	Kimball curvature (wages, `curvw`)	10.000	0.000
Selected deep real parameters			
σ_c	Intertemporal elasticity (`csigma`)	1.382	1.348
λ	Habit (`chabb`)	0.692	0.693
φ	Inv. adj. cost, level (`csadjcost`)	5.577	5.308
ψ	Utilization cost slope (`czcap`)	0.636	0.660
Φ	Fixed costs (`cfc`)	1.637	1.629
α	Capital share (`calfa`)	0.216	0.218

Notes: Posterior modes from Q6 re-estimations on the original SW sample (1966Q1-2004Q4). "Kimball" allows state-dependent demand elasticities via $\varepsilon_{p,w} > 0$; DS sets $\varepsilon_{p,w} = 0$. Monetary-policy parameters are virtually unchanged across aggregators, while Kimball attains *lower* Calvo probabilities with similar overall nominal rigidity.

Central-bank reading. For policy design, the aggregator choice leaves the *stance* of estimated policy intact (aggressive on inflation, with meaningful smoothing) and preserves the shock rankings that matter for risk assessments: mark-ups dominate nominal variability, productivity and wage mark-ups shape medium-run real dynamics. The Kimball aggregator achieves these patterns with more plausible contract lengths and, thus,a more credible Phillips curve slope. Practically, this means optimal policy exercises (e.g., inflation-forecast targeting) will deliver very similar prescriptions under either aggregator, but the Kimball specification better reconciles micro evidence on price/wage changes with macro dynamics—an advantage when communicating model structure to the policy committee.

IRFs: transmission under Kimball vs. DS. Comparing panels (a) and (b) in Figure 4 reveals three robust features:

- **Monetary policy shock:** Both models imply a gradual policy-rate path (large ρ) and a hump-shaped disinflation. Kimball attenuates and spreads out the pass-through to inflation; DS produces a more front-loaded disinflation and a larger initial

output contraction (Figures 5). Under Kimball, the short-run inflation fall is slightly *more* gradual despite lower ξ_p, consistent with real rigidity from $\varepsilon_p > 0$; output and hours display very similar near-term declines, suggesting that the sacrifice ratio is not materially altered by the aggregator once the rule coefficients are held at the (estimated) values.

- **Mark-up shocks:** Wage mark-ups generate the largest and most persistent swings in inflation and activity in both models. Under Kimball, the same mark-up impulse produces a somewhat smoother inflation path with comparable output costs, mirroring the variance shares in Table 7.

- **Risk-premium and q_t shocks:** Consumption/investment comovement and the hump in output are virtually identical; Kimball's slightly higher φ nudges investment adjustment costs up, marginally dampening the near-term investment overshoot versus DS.

Figure 4: Impulse Responses under Alternative Aggregators (SW sample)

(a) Kimball aggregator   *(b) Dixit–Stiglitz aggregator*
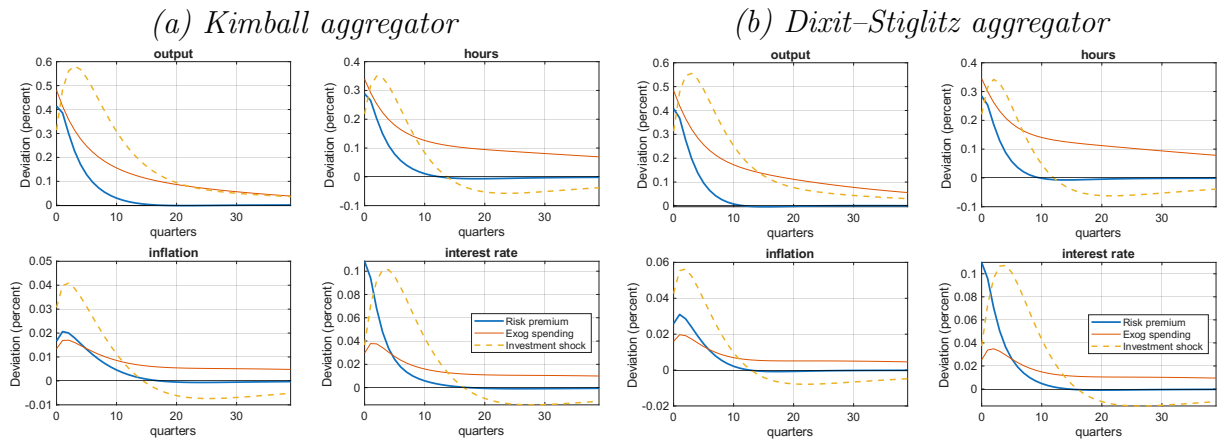
Notes: Model-consistent IRFs (quarterly) to the standard SW shock block (risk-premium b_t, government spending g_t, investment-specific q_t, monetary policy r_t, price and wage mark-ups). Variables shown are output, hours, inflation, and policy rate. Line styles correspond to those in the exported PDFs. The sample is 1966Q1-2004Q4; all parameters are posterior modes in Table 7.

Figure 5: Impulse Responses under Alternative Aggregators (SW sample)

(a) Kimball aggregator   *(b) Dixit–Stiglitz aggregator*
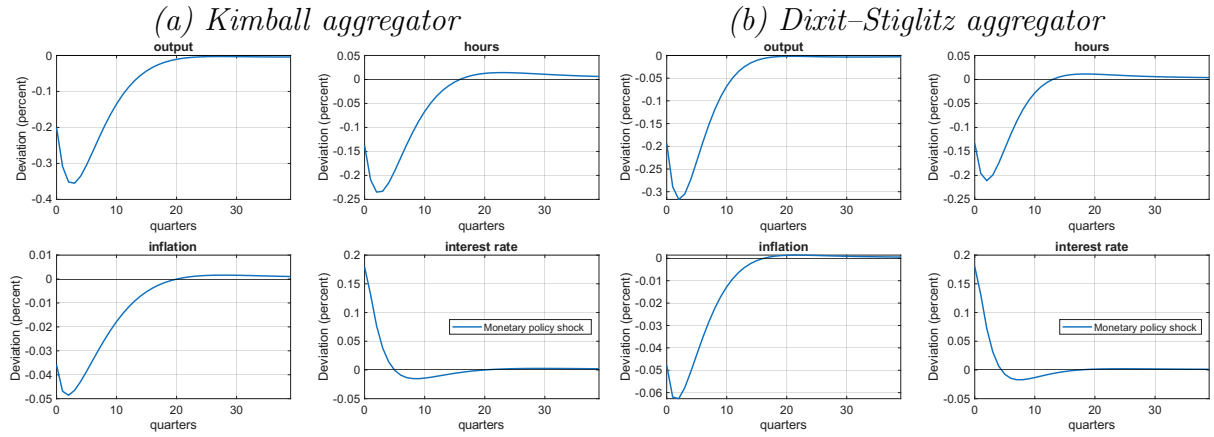
Notes: One s.d. innovation to the monetary policy rule. Kimball curvature attenuates the immediate pass-through to inflation and generates more hump-shaped real activity responses, reflecting stronger strategic complementarity in price setting. Same shock under DS. With weaker real rigidity, disinflation from a policy tightening is more front-loaded and the output gap response is sharper on impact.

Policy implications. The aggregator choice does *not* overturn the core messages:

- (i) policy reacts gradually (sizable inertia) and aggressively to inflation (Taylor principle);

- (ii) mark-up and investment disturbances remain central for nominal vs. real volatility, respectively; and

- (iii) when q_t is in the driver's seat, patience is warranted—the policy rate must lean against stronger real-side momentum while inflation pressure materializes with a lag. Kimball's smoother near-term pass-through marginally increases the value of forward-looking communication, but it does not call for different rule coefficients, judging by the dynamics in our figures.

Relative to DS, the Kimball aggregator delivers substantially *lower* estimated Calvo rigidities (prices: 0.69 vs. 0.84; wages: 0.73 vs. 0.81) while keeping monetary-policy coefficients very close (Table 7).

For policy analysis over 1965-2004, the Kimball aggregator is preferable: it fits better and yields nominal rigidity estimates that square with micro evidence and SW's original rationale for adopting Kimball. Because the monetary rule is stable across specifications, differences in IRFs mostly reflect the aggregator's real rigidity rather than changes in systematic policy. For counterfactuals and risk assessment, Kimball's smoother inflation response and more hump-shaped real dynamics suggest more gradualism in the transmission of both demand and policy shocks, consistent with the central-bank reading of a flatter effective Phillips curve.

Q7. Fixing Calvo Probabilities at 0.5 with the Dixit-Stiglitz Aggregator (1965Q1-2004Q4)

Table 8: Posterior Modes under Fixed Calvo: Comparison with Q6 (DS)

| Parameter	Description	Dynare Name	Q7 (Calvo fixed at 0.5)	Q6 (DS, estimated)
Monetary policy (Taylor rule)				
r_π	Response to inflation	`crpi`	2.0369	1.9681
ρ	Interest-rate smoothing	`crr`	0.6764	0.7832
r_y	Output gap	`cry`	0.0476	0.0686
$r_{\Delta y}$	Output growth	`crdy`	0.2178	0.2278
Nominal frictions (DS aggregator; Calvo fixed in Q7, estimated in Q6)				
ξ_p	Calvo prob. (prices)	`cprobp`	0.5000	0.8395
ξ_w	Calvo prob. (wages)	`cprobw`	0.5000	0.8117
ι_p	Indexation (prices)	`cindp`	0.7844	0.3456
ι_w	Indexation (wages)	`cindw`	0.7501	0.6534
Selected deep real parameters				
σ_c	Intertemporal elasticity (inv.)	`csigma`	1.5555	1.3483
h	Habit formation	`chabb`	0.4812	0.6927
ϕ	Investment adjustment cost	`csadjcost`	2.7698	5.3076
ψ	Utilization-cost slope	`czcap`	0.8185	0.6603
Φ	Fixed costs	`cfc`	1.6516	1.6290

Notes: Q7 fixes $\xi_p = \xi_w = 0.5$ (two-quarter contracts) under the *same* DS aggregator used in Q6. With shorter contracts, the estimation shifts nominal persistence toward indexation and (more persistent) mark-up processes; policy remains active with *less* smoothing than in Q6.

Table 9: Variance Decomposition (percent, business-cycle horizons): Fixed-Calvo (Q7) vs. Q6 (DS)

Variable	Q7 (Calvo 0.5)							Q6 (DS)						
	ea	*eb*	*eg*	*eqs*	*em*	*ep*	*ew*	*ea*	*eb*	*eg*	*eqs*	*em*	*ep*	*ew*
y	24.7	0.3	3.9	4.1	0.2	17.6	49.2	23.6	1.4	4.2	7.1	1.7	6.3	55.7
π	5.6	10.2	0.9	11.0	17.9	21.3	33.1	3.8	1.2	1.1	5.9	6.7	27.1	54.3
r	8.3	18.5	2.5	30.2	6.7	10.6	23.3	9.2	8.5	3.6	21.5	15.4	7.6	34.3

Notes: Under shorter contracts (Q7), inflation and the policy rate load relatively *more* on demand/investment/monetary disturbances and *less* on wage mark-ups than in Q6, consistent with a steeper effective Phillips curve.

Figure 6: Impulse Responses to Demand Shocks and Monetary Policy Shock: Q7 (DS, Calvo fixed at 0.5)

(a) Demand block
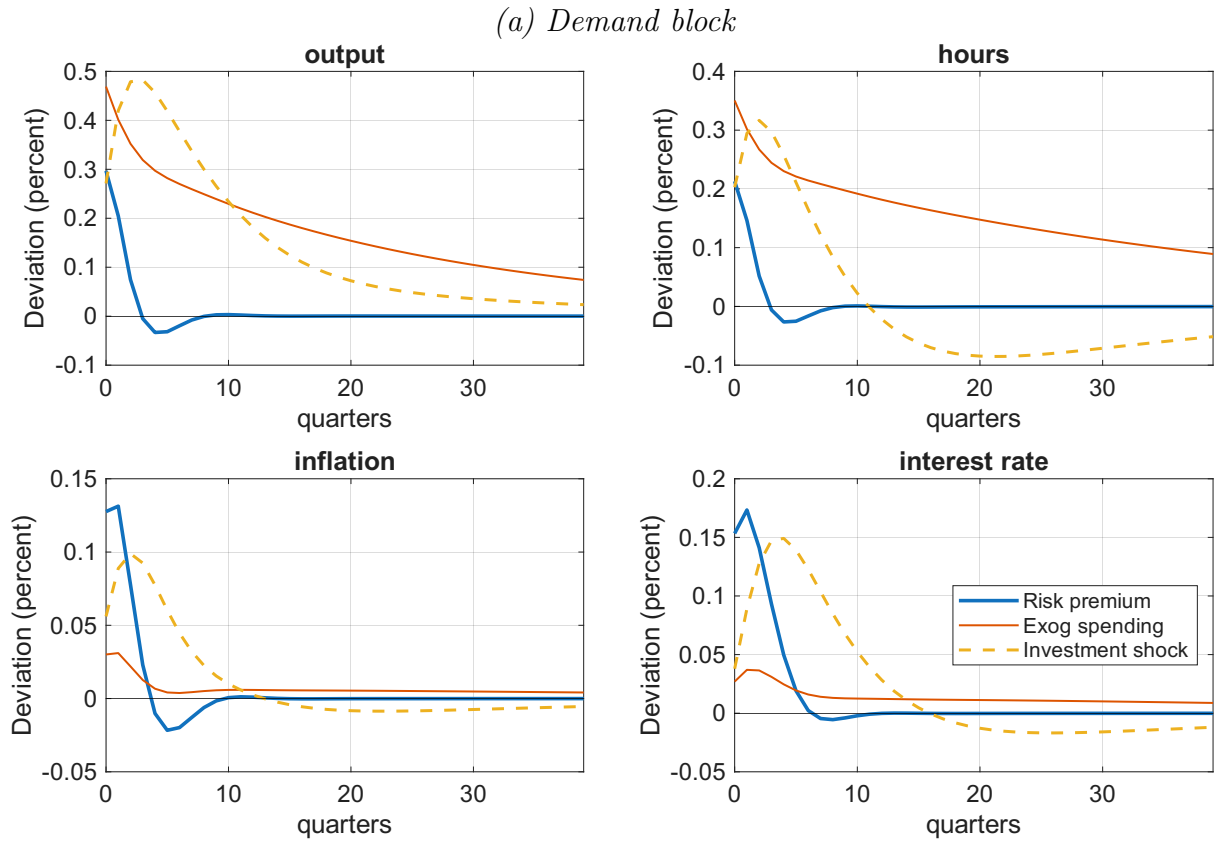
Notes: One-s.d. shocks to the risk premium (b_t), exogenous spending (g_t), and investment-specific technology (q_t) with **Calvo(0.5)**. Relative to Q6 (see `Q6_DS_demand.pdf`), y and ℓ display slightly smaller humps but *earlier* inflation pass-through and rate responses—consistent with a steeper NKPC and lower ϕ in Q7.

(b) Monetary policy shock
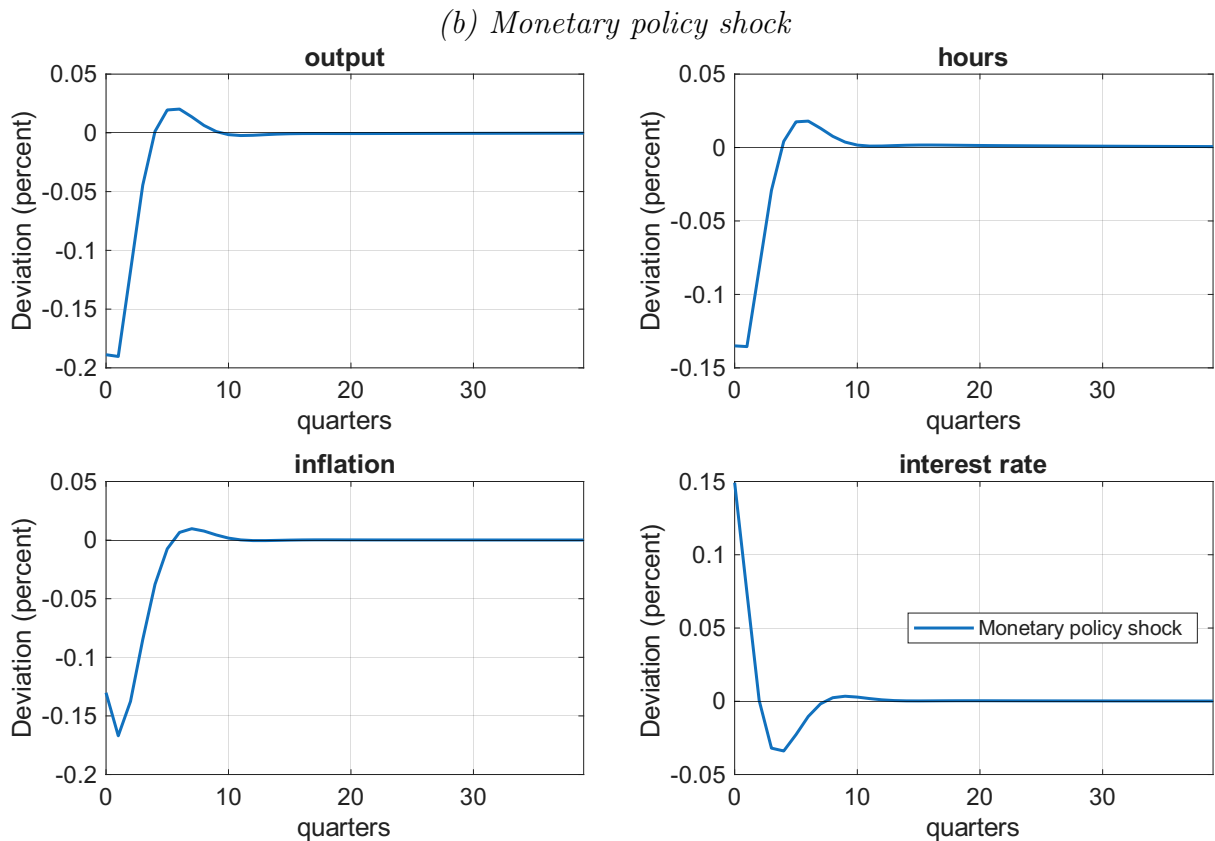
Notes: One-s.d. contractionary innovation. Versus Q6 (`Q6_DS_monetary.pdf`), Q7 yields a **more front-loaded** disinflation with a **lower and earlier** rate peak and **smaller** output/hour declines on impact, followed by faster normalization.

What is the meaning of the $\xi_p = \xi_w = 0.5$ test?   It is an *identification and robustness* check. By fixing both Calvo probabilities at 0.5 (two-quarter contracts), we shut down "long contracts" as the main source of nominal inertia. The estimation must then assign inflation persistence to

- (i) indexation (ι_p, ι_w);

- (ii) serially correlated mark-up shocks (ρ_p, μ_p) and (ρ_w, μ_w), and/or

- (iii) policy inertia (ρ).

If policy coefficients, IRFs, and variance shares remain economically plausible and broadly consistent with Q6, then the baseline inferences are *not* an artifact of estimated extreme stickiness.

Central-bank reading of our Q7 results (vs. Q6, DS).   *(i) Rule coefficients.*
The Taylor coefficient is a shade **higher** ($r_\pi = 2.04$ vs. 1.97) and smoothing **lower** ($\rho = 0.68$ vs. 0.78), implying an operating procedure that reacts more forcefully to inflation but glides back faster.
(ii) Nominal frictions.
Fixing $\xi_p = \xi_w = 0.5$ steepens the NKPC; the estimation compensates with **higher indexation** ($\iota_p \approx 0.78$, $\iota_w \approx 0.75$) and **more persistent** price/wage mark-up processes (higher ARs), while shock standard deviations for price and wage mark-ups are also higher than in Q6.
(iii) Shock attribution.
FEVDs shift π and r away from wage mark-ups and toward *eb*, *eqs*, and *em* (Table 9), indicating that with shorter contracts the nominal block transmits demand/investment shocks more directly into prices and policy.
(iv) Real propagation.
Lower ϕ and higher ψ in Q7 shorten and sharpen the capital/utilization adjustment, reducing hump length relative to Q6.

IRFs and transmission mechanics.   Under the DS aggregator, fixing $\xi_p = \xi_w = 0.5$ steepens the effective Phillips curve and, together with a *stronger* inflation response and *less* rate smoothing in the rule ($r_\pi : 1.97 \to 2.04$, $\rho : 0.78 \to 0.68$), delivers a **more front-loaded and deeper** disinflation for a **smaller** real contraction.
In the IRFs, inflation's trough in Q7 is roughly three times the Q6 decline ($\Delta\pi_{\min} \approx -0.16\%$ vs. $\approx -0.05\%$), while output and hours fall noticeably less on impact (Q7 $\Delta y_{\min} \approx -0.15\%$ vs. Q6 $\approx -0.25\%$; hours similarly), and the policy rate peaks *earlier* at a *lower* level before gliding down. This pattern is the joint consequence of more frequent reoptimizations (Calvo$= 0.5$) shifting persistence toward indexation (Q7 $\iota_p \approx 0.78$, $\iota_w \approx 0.75$) and of a less inertial operating procedure, which lowers the sacrifice ratio: the central bank achieves a

larger, quicker disinflation with milder and shorter real-side costs. Notably, the monetary-shock persistence itself is higher in Q7 (AR $\rho_m : 0.17 \to 0.31$), but the reduced policy smoothing keeps the rate path tighter and earlier, preventing protracted real drags while anchoring expected inflation more decisively. (Fig. 6b vs. Q6_DS).

Demand shocks (b_t, g_t, q_t)**:** Compared with Q6, activity responses are slightly less hump-shaped while inflation moves up *earlier* and somewhat *more*, prompting earlier rate adjustments (Fig. 6a vs. Q6_DS); this is the joint effect of shorter contracts (steeper slope) and lower ϕ.

Policy implications.

(i) The Taylor principle remains securely satisfied; with *less smoothing*, guidance can achieve earlier peaks without overshoot.

(ii) Shorter contracts lower the sacrifice ratio for a given disinflation path by making prices/wages re-optimize more often; use this to front-load disinflations when needed.

(iii) Because FEVD mass shifts from wage mark-ups to demand/investment/MP shocks, calibrate responses to the *origin* and *persistence* of disturbances rather than leaning mechanically on markup-driven narratives.

Q8. Subsample Estimation: Great Inflation vs. Great Moderation

Table 10: Posterior Mode Estimates: Great Inflation (A) vs. Great Moderation (B)

Parameter	Description	Dynare Name	(A) 1966Q2–1979Q2	(B) 1984Q1–2004Q4
Structural Parameters				
α	Capital share	calfa	0.1999	0.2302
σ_c	Intertemporal substitution	csigma	1.0711	1.4768
h	Habit formation	chabb	0.6796	0.7015
ξ_w	Calvo prob. (wages)	cprobw	0.6914	0.5399
σ_l	Labor supply elasticity	csigl	1.6373	2.1042
ξ_p	Calvo prob. (prices)	cprobp	0.5151	0.7594
ι_w	Indexation (wages)	cindw	0.5893	0.5407
ι_p	Indexation (prices)	cindp	0.3939	0.5062
ψ	Capital utilization cost	czcap	0.4004	0.7432
ϕ	Investment adj. cost	csadjcost	3.7700	7.0923
Φ	Fixed costs	cfc	1.3891	1.5587
g_{trend}	Deterministic growth trend	ctrend	0.3890	0.3890
c_β	Risk-premium steady state	constebeta	0.1656	0.1328
$\bar{\pi}$	Steady-state inflation	constepinf	0.6892	0.6490
c_ℓ	Labor disutility level	constelab	2.8077	2.9581
μ_p	MA term: price mark-up	cmap	0.5749	0.6336
μ_w	MA term: wage mark-up	cmaw	0.7142	0.6786
ρ_{ga}	Feedback tech. on spending	cgy	0.5646	0.4474
Monetary Policy Parameters (Taylor rule)				
r_π	Response to inflation	crpi	1.2962	1.8463
ρ	Interest-rate persistence	crr	0.7805	0.8082
r_y	Response to output gap	cry	0.1585	0.0160
$r_{\Delta y}$	Response to output growth	crdy	0.2014	0.1150
Shock Process Parameters				
ρ_a	Persistence: productivity	crhoa	0.8440	0.9606
ρ_b	Persistence: risk premium	crhob	0.3179	0.1063
ρ_g	Persistence: gov. spending	crhog	0.9333	0.9584
ρ_{qs}	Persistence: invest. specific	crhoqs	0.5889	0.6353
ρ_m	Persistence: monetary policy	crhoms	0.3626	0.5153
ρ_p	Persistence: price mark-up	crhopinf	0.7365	0.7944
ρ_w	Persistence: wage mark-up	crhow	0.9555	0.9671
Standard Deviations of Structural Shocks				
σ_{ea}	Std. dev. productivity shock	ea	0.5481	0.3539
σ_{eb}	Std. dev. risk-premium shock	eb	0.2473	0.1970
σ_{eg}	Std. dev. gov. spending shock	eg	0.5404	0.4087
σ_{eqs}	Std. dev. invest.-specific shock	eqs	0.4416	0.3566
σ_{em}	Std. dev. monetary policy shock	em	0.2203	0.0987
σ_{epinf}	Std. dev. price mark-up shock	epinf	0.2157	0.0744
σ_{ew}	Std. dev. wage mark-up shock	ew	0.1757	0.2984

Notes: (A) Great Inflation; (B) Great Moderation. Relative to (A), (B) shows stronger inflation focus (r_π), indicating a more aggressive anti-inflation stance,w hile r_y falls markedly (near zero), consistent with diminished direct responses to real activity in the Great Moderation. Deep parameters tilt toward higher price stickiness and larger ϕ, with more persistent TFP.

Figure 7: Impulse Responses to Demand and Monetary Shocks: Q8 Subsamples

(a) A: Demand block

(b) A: Monetary policy shock

(c) B: Demand block

(d) B: Monetary policy shock
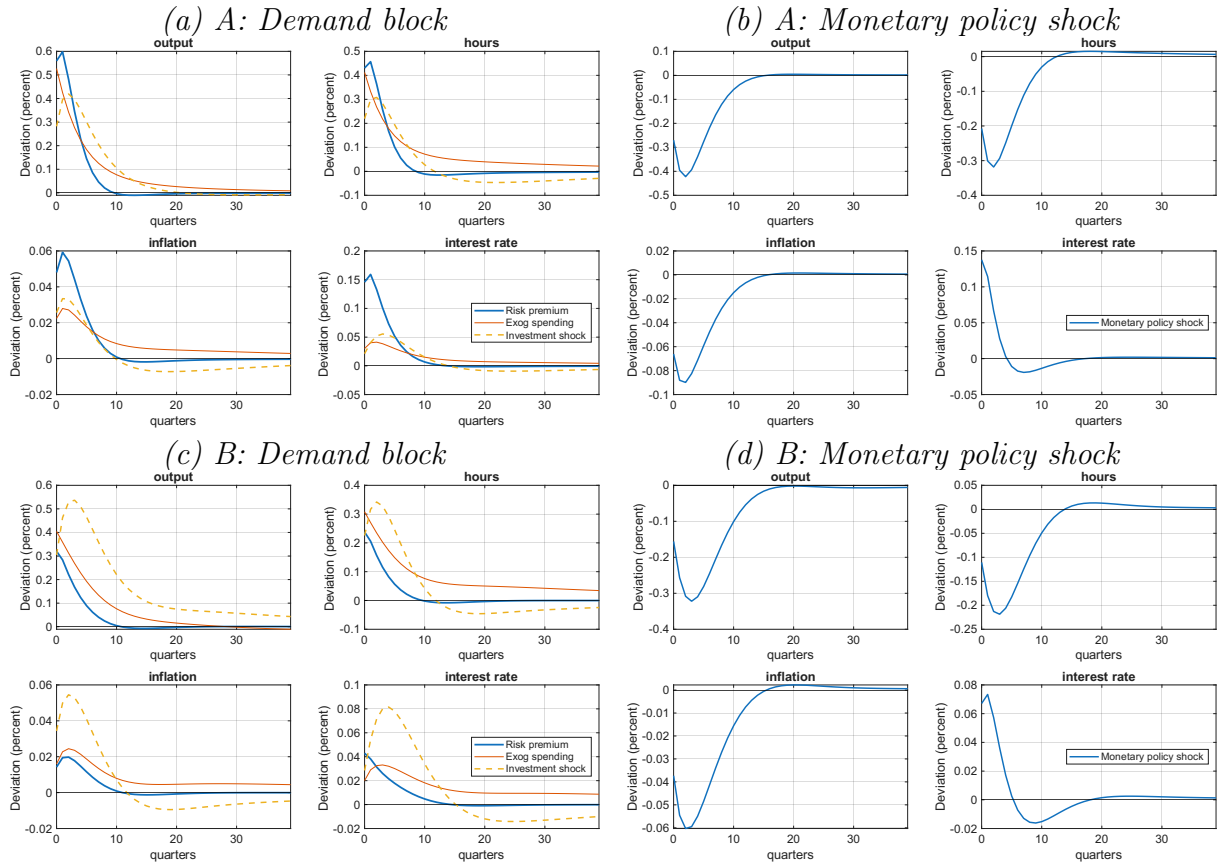
Notes: One-s.d. shocks. Great Inflation (A) vs. Great Moderation (B). (A) shows larger, more front-loaded i and π responses (higher σ_{η_m}, lower r_π); output costs on impact are bigger. (B) responses are smaller and smoother (much lower σ_{η_m}, higher r_π, higher ϕ): disinflation is gentler and activity humps—from q_t especially—are persistent but lower in amplitude.

Central-bank reading (A vs. B). Three facts stand out. First, the policy rule becomes more *inflation-focused* over time: r_π rises from about 1.30 in (A) to 1.85 in (B), while r_y collapses toward near zero and $r_{\Delta y}$ declines. Interest-rate smoothing is similar or slightly higher in (B). Second, the volatility of key disturbances falls sharply in (B): the standard deviations of productivity, monetary policy, and price mark-up shocks drop by roughly 35%, 55%, and 66%, respectively. Third, in (B), nominal and real frictions shift toward *more price stickiness* (higher ξ_p), *less wage stickiness* (lower ξ_w), and *steeper investment adjustment costs* (higher ϕ), with more persistent technology (ρ_a closer to one). These features flatten near-term price dynamics while damping and lengthening real adjustment.

Variance and co-movements. In (B), lower σ_{em} and σ_{epinf} reduce short-horizon variation in inflation and interest rates; decomposition assigns a relatively smaller role to monetary and price-markup innovations than in (A), while wage-markup forces remain influential for the real side. This dovetails with the observed moderation of nominal volatility in (B) under a rule that reacts primarily to inflation rather than output gaps.

IRFs and transmission mechanics. Scaled to one-s.d. shocks, (B) exhibits *smaller* and *smoother* disinflations: higher price stickiness and slightly higher smoothing spread the policy-rate path and mute the initial movement in inflation, while higher investment adjustment costs damp investment and deliver lower—but still persistent—real humps (especially after investment-specific shocks). In (A), larger innovations and a non-trivial reaction to output produce *bigger, more front-loaded* moves in the policy rate and inflation, with sharper near-term output costs. For the monetary policy shock specifically, (B) combines a much smaller innovation with slightly greater shock persistence and a stronger inflation response in the rule, yielding a gradual but effective disinflation with limited impact volatility.

Conclusion for Q8. We find the same three broad patterns emphasized by SW for their subsamples:

(i) broadly stable structural parameters with economically meaningful shifts in sticky-price/wage parameters (higher ξ_p, lower ξ_w) and higher ϕ in (B);

(ii) sizable declines in the standard deviations of productivity, monetary-policy, and price mark-up shocks in (B), consistent with lower macro volatility;

(iii) a lower policy response to output in (B) (near-zero r_y) alongside a strong response to inflation.

Q9. Diffuse Priors and RWMH on the SW Sample (1965Q1-2004Q4)

Why the first diffuse-prior run failed. Replacing SW's tight priors with diffuse ones can flatten the posterior around combinations of nominal frictions (Calvo probabilities and indexation), policy inertia, and mark-up ARMA terms. In our first pass, the optimizer did reach a local solution, but Dynare flagged a *non-positive-definite Hessian* at the putative mode, with singular-matrix warnings; hence the usual covariance approximation was invalid and results "most likely wrong." This is the classic symptom of (locally) weak curvature/near non-identification under weak priors, not a coding error.
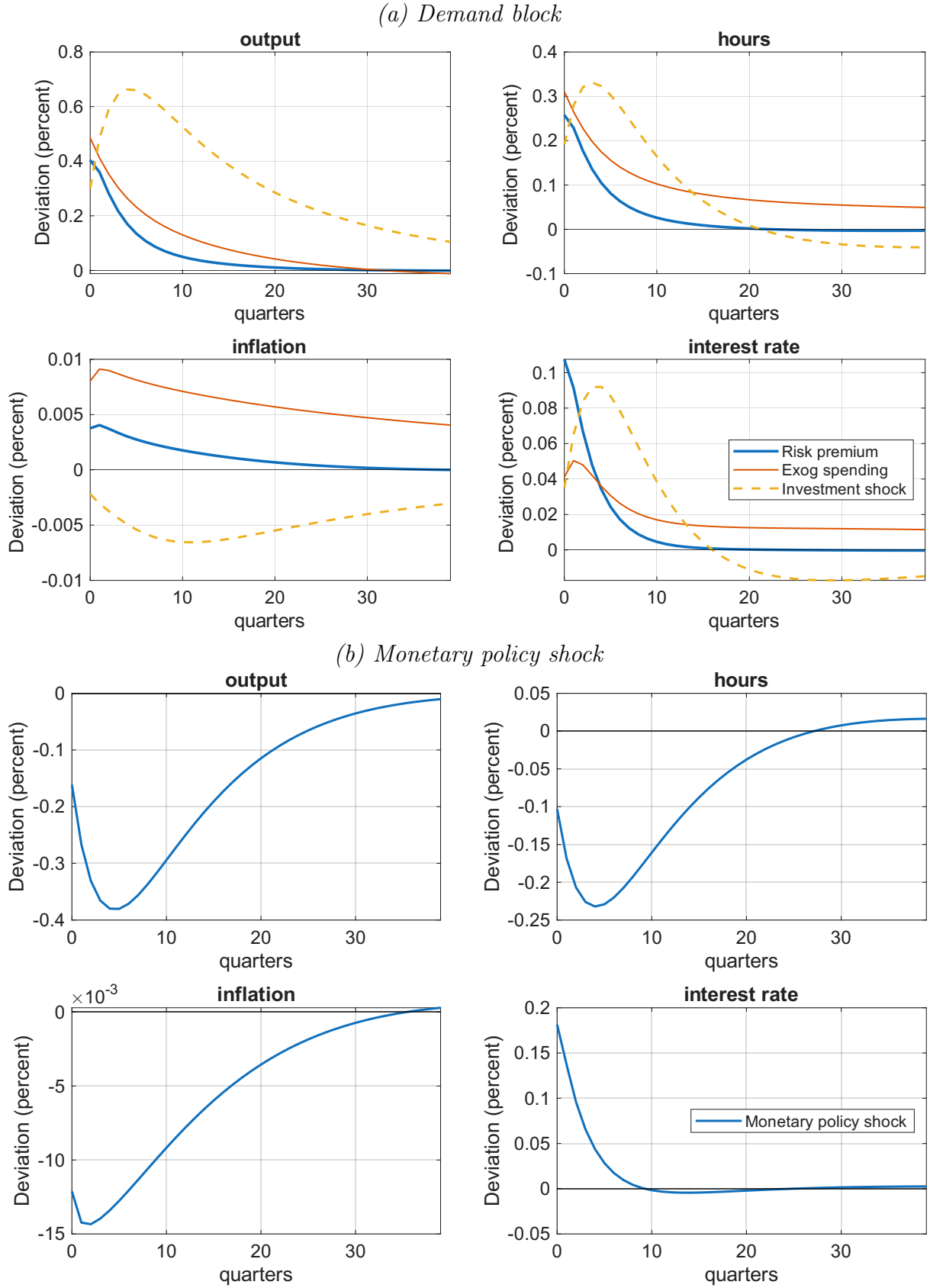
Following the prompt, we re-estimate with Random-Walk Metropolis-Hastings (RWMH). The second run exhibits healthy acceptance ratios ($\approx$ 29% and 41%), and Dynare's convergence/marginal-likelihood diagnostics complete cleanly.

Table 11: Posterior Estimates under Diffuse Priors (RWMH) vs. Q3 Baseline

Parameter	Description	Dynare Name	Q9 (RWMH, Post. mean)	Q3 (Mode)
Structural parameters				
α	Capital share	calfa	0.2049	0.2127
σ_c	Intertemporal substitution	csigma	1.6761	1.4504
h	Habit formation	chabb	0.7186	0.6857
ξ_w	Calvo prob. (wages)	cprobw	0.9326	0.7329
σ_l	Labor supply elasticity	csigl	3.9475	1.9554
ξ_p	Calvo prob. (prices)	cprobp	0.7382	0.6931
ι_w	Indexation (wages)	cindw	0.8236	0.6202
ι_p	Indexation (prices)	cindp	0.1832	0.3253
ψ	Utilization cost slope	czcap	0.7540	0.5731
ϕ	Investment adjustment cost	csadjcost	8.4036	5.5245
Φ	Fixed costs	cfc	1.8501	1.6276
Monetary policy (Taylor rule)				
r_π	Response to inflation	crpi	2.7777	1.9760
ρ	Interest-rate smoothing	crr	0.8823	0.8075
r_y	Response to output gap	cry	0.1361	0.0754
$r_{\Delta y}$	Response to output growth	crdy	0.2474	0.2266
Shock processes (ARMA/persistence and feedbacks)				
ρ_a	Persistence: productivity	crhoa	0.9615	0.9573
ρ_b	Persistence: risk premium	crhob	0.1367	0.2000
ρ_g	Persistence: gov. spending	crhog	0.9776	0.9713
ρ_{qs}	Persistence: invest. specific	crhoqs	0.6979	0.7086
ρ_m	Persistence: MP shock	crhoms	0.0527	0.1438
ρ_p	Persistence: price mark-up	crhopinf	0.9176	0.8826
ρ_w	Persistence: wage mark-up	crhow	0.7680	0.9632
ρ_{ga}	Tech. feedback in g_t	cgy	0.4756	0.5548
MA terms (mark-ups)				
μ_p	MA term: price mark-up	cmap	0.7490	0.7228
μ_w	MA term: wage mark-up	cmaw	0.7187	0.8721
Detrending/measurement constants				
γ	Trend growth	ctrend	0.3990	0.4272
$\bar{\pi}$	Steady inflation scaling	constepinf	1.1188	0.9099
$\bar{\beta}$	Discount scaling	constebeta	0.2288	0.1317
$\bar{\ell}$	Hours scaling	constelab	5.4972	5.0595
Std. deviations of structural shocks				
σ_{η_a}	TFP shock	ea	0.4288	0.4414
σ_{η_b}	Risk premium	eb	0.2572	0.2405
σ_{η_g}	Gov. spending	eg	0.5399	0.5149
$\sigma_{\eta_{qs}}$	Inv. specific	eqs	0.4233	0.4152
σ_{η_m}	Monetary policy	em	0.2278	0.2393
σ_{η_p}	Price mark-up	epinf	0.1004	0.1227
σ_{η_w}	Wage mark-up	ew	0.2592	0.2508

Notes: Q9 entries are posterior means from the RWMH run with diffuse priors; Q3 entries are posterior modes from the baseline. Source: model logs.

Figure 8: Impulse Responses under Diffuse Priors (RWMH), SW Sample

(a) Demand block

(b) Monetary policy shock

Notes: IRFs are from the RWMH re-estimation over 1965Q1-2004Q4. Parameters underlying these IRFs include a stronger anti-inflation response ($r_\pi \approx 2.71$) and higher smoothing ($\rho \approx 0.89$), together with very high wage stickiness ($\xi_w \approx 0.93$) and larger investment adjustment costs ($\phi \approx 8.4$).

Central-bank reading (diffuse priors vs. Q3).   *Policy stance.* The data, freed from tight priors, push the Taylor-rule inflation coefficient *up* and the smoothing parameter *up*: r_π rises from ≈ 1.976 to ≈ 2.7; ρ from ≈ 0.8075 to ≈ 0.8823 (Table 11). For an interest-rate path, that means a more forceful reaction to inflation pressures but implemented more gradually—precisely the combination that anchors expectations while avoiding unnecessary output volatility. The sampler diagnostics (acceptance ratios, convergence messages) support that these are data-driven posterior features rather than artifacts of a single local mode.

Nominal frictions. Wage contracts become *very* sticky in posterior mean ($\xi_w \approx 0.93$) and wage indexation is higher, whereas price indexation falls (Table 11). This shifts intrinsic persistence toward wages and reduces the backward-looking component in prices. The price Calvo probability increases only moderately relative to Q3, keeping price contract durations plausible.

Real propagation. Investment adjustment costs rise materially ($\phi \approx 8.4$ vs. 5.5), and utilization-cost slope ψ is higher. In IRFs, that shows up as more gradual investment dynamics after q_t or demand disturbances, with smaller near-term overshoots but persistence in levels—consistent with a steeper intertemporal margin that smooths capital adjustment (Figure 8).

Shock volatility. Relative to Q3, policy and price mark-up innovation variances decline, while risk-premium and wage mark-up variances are a bit higher (Table 11). This rebalancing is coherent with

 (i) a more aggressive, smoother policy that leaves less room for idiosyncratic policy shocks to drive nominal volatility, and

 (ii) wage-setting frictions bearing more of the persistence.

IRFs: what changes relative to Q3.   With r_π higher and ρ higher, the disinflation following a contractionary monetary innovation is *decisive yet smoothed*: inflation falls promptly without an excessive overshoot, and the policy rate path is more inertial. Wage-driven price dynamics (high ξ_w, higher ι_w) make inflation's medium-run persistence slightly more governed by labor-market mark-ups than in Q3, while lower price indexation reduces the purely backward-looking component on the price side. For q_t shocks, larger ϕ pushes investment and output responses toward a slower, more hump-shaped adjustment—what you'd expect if capital reallocation is costlier under the diffuse-prior posterior (Figure 8).

A contractionary innovation produces a **decisive yet gradual** disinflation: inflation falls promptly with less front-loading; the policy rate path is smoother; output and hours responses are milder on impact but slightly more persistent due to higher real/nominal rigidities. This pattern follows directly from $r_\pi \uparrow$, $\rho \uparrow$, $\xi_w \uparrow$, and $\phi \uparrow$.