Online Appendix: Estimating Macroeconomic News and Surprise Shocks*

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January 2, 2025

ABSTRACT

Appendix A lists our data sources. Appendix B proves the existence of an orthogonal rotation matrix in the structural VAR model. Appendices C and D describe in more detail the baseline model and larger-scale DSGE model. Appendix E discusses the surprise shock max share estimator. Appendix F compares our analysis with the simulation evidence reported in Kurmann and Sims (2021). Appendix G provides additional simulation and estimation results.

^{*}The views expressed in this paper are our own and do not necessarily reflect the views of the Federal Reserve Bank of Dallas or the Federal Reserve System.

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A DATA SOURCES

We use the following time-series provided by Haver Analytics:

- 1. Civilian Noninstitutional Population: 16 Years & Over Not Seasonally Adjusted, Quarterly, Thousands (LN16N@USECON)
- 2. Gross Domestic Product: Implicit Price Deflator Seasonally Adjusted, Quarterly, 2012=100 (DGDP@USNA)
- 3. Real Gross Domestic Product Seasonally Adjusted, Quarterly, Billions of Chained 2012\$ (GDPH@USECON)
- 4. **Real Personal Consumption Expenditures** Seasonally Adjusted, Quarterly, Billions of Chained 2012\$ (CH@USECON))
- 5. **Real Private Fixed Investment** Seasonally Adjusted, Quarterly, Billions of Chained 2012\$ (FH@USECON)
- 6. Hours: Private Sector, Nonfarm Payrolls Seasonally Adjusted, Quarterly, Billions of Hours (LHTPRIVA@USECON)
- 7. Fernald Utilization-Adjusted Total Factor Productivity Quarterly, Percent, Annual Rate (TFPMQ@USECON)
- 8. Capital Share of Income, Quarterly (TFPJQ@USECON)
- 9. Effective Federal Funds Rate Quarterly Average, Annual Percent (FFED@USECON)
- 10. S&P 500 Stock Price Index, Quarterly Average (SP500@USECON)
- Real Research and Development Seasonally Adjusted, Quarterly, Billions of Chained 2012\$ (FNPRH@USECON)
- 12. Net Stock: Private Fixed Assets, Annual, Billions of Dollars (EPT@CAPSTOCK)
- 13. Net Stock: Durable Goods, Annual, Billions of Dollars (EDT@CAPSTOCK)
- 14. Depreciation: Private Fixed Assets, Annual, Billions of Dollars (KPT@CAPSTOCK)
- 15. Depreciation: Durable Goods, Annual, Billions of Dollars (KDT@CAPSTOCK)

We also used the following data from other sources:

 Information & Communication Technologies Standards Index from Baron and Schmidt (2019). Data is available at https://www.law.northwestern.edu/researchfaculty/clbe/innovationeconomics/data/technologystandards.

- 2. **Patent-Based Innovation Index** from Cascaldi-Garcia and Vukotić (2022). This is a quarterly version of the Kogan et al. (2017) annual index, which is based on counts of patents where each patent is weighted by its impact on the firm's stock price. Data is available at https://sites.google.com/site/cascaldigarcia/research.
- 3. U.S. Patent & Trade Office Patent Count from Marco et al. (2015). This is a quarterly count of new patent applications, excluding those classified as "missing" and "not classified". See https://www.uspto.gov/ip-policy/economic-research/ research-datasets/historical-patent-data-files.
- 4. Macroeconomic Forecasts from the Survey of Professional Forecasters (SPF). We use the one and four-quarter ahead mean predictions for the unemployment rate (UNEMP), the GDP deflator (PGDP), real non-residential fixed investment (RNRESIN), and corporate profits (CPROF). These are used to construct the exogenous patent-innovation series of Miranda-Agrippino et al. (2022) that controls for SPF forecasts but not for exogenous policy shocks. Details about the construction are in Section 2.2 of Miranda-Agrippino et al. (2022). For the SPF data, see https://www.philadelphiafed.org/surveys-and-data/real-time-data-research/survey-of-professional-forecasters.

B EXISTENCE OF AN ORTHOGONAL ROTATION MATRIX

Consider the model in Section 2. Observe that either $\gamma_{n,2}\gamma_{n,3} > 0$ and $\gamma_{\ell,2}\gamma_{\ell,3} < 0$ or $\gamma_{n,2}\gamma_{n,3} < 0$ and $\gamma_{\ell,2}\gamma_{\ell,3} > 0$. Using (R1-1) and the solution for γ_s , $\gamma_{\ell,2}$, and $\gamma_{\ell,3}$ in Proposition 1 implies

$$\begin{split} \gamma_{s,1}^2 + \gamma_{s,2}^2 + \gamma_{s,3}^2 &= 1 - \gamma_{n,1}^2 + (\gamma_{n,1}\gamma_{n,2}/\gamma_{s,1})^2 + (\gamma_{n,1}\gamma_{n,3}/\gamma_{s,1})^2 \\ &= 1 - \gamma_{n,1}^2 + (\gamma_{n,1}^2/\gamma_{s,1}^2)(\gamma_{n,2}^2 + \gamma_{n,3}^2) \\ &= 1 \\ \gamma_{\ell,2}^2 + \gamma_{\ell,3}^2 &= 1 - \gamma_{s,2}^2 - \gamma_{n,2}^2 + 1 - \gamma_{s,3}^2 - \gamma_{n,3}^2 \\ &= \gamma_{s,1}^2 + \gamma_{n,1}^2 \\ &= 1 \end{split}$$

$$\begin{split} \gamma_{s,1}\gamma_{n,1} + \gamma_{s,2}\gamma_{n,2} + \gamma_{s,3}\gamma_{n,3} &= \gamma_{s,1}\gamma_{n,1} - \gamma_{n,1}\gamma_{n,2}^2/\gamma_{s,1} - \gamma_{n,1}\gamma_{n,3}^2/\gamma_{s,1} \\ &= \gamma_{s,1}\gamma_{n,1} - (\gamma_{n,2}^2 + \gamma_{n,3}^2)\gamma_{n,1}/\gamma_{s,1} \\ &= 0 \\ \gamma_{n,2}\gamma_{\ell,2} + \gamma_{n,3}\gamma_{\ell,3} &= \gamma_{n,2}(\pm\sqrt{1 - \gamma_{\ell,3}^2}) + \gamma_{n,3}(\pm\sqrt{1 - \gamma_{\ell,2}^2}) \\ &= \gamma_{n,2}(\pm\sqrt{\gamma_{s,3}^2 + \gamma_{n,3}^2}) + \gamma_{n,3}(\pm\sqrt{\gamma_{s,2}^2 + \gamma_{n,2}^2}) \\ &= \gamma_{n,2}(\pm\sqrt{(\gamma_{n,1}^2/\gamma_{s,1}^2 + 1)\gamma_{n,3}^2}) + \gamma_{n,3}(\pm\sqrt{(\gamma_{n,1}^2/\gamma_{s,1}^2 + 1)\gamma_{n,2}^2}) \end{split}$$

$$\begin{split} &= \gamma_{n,2}(\pm \sqrt{\gamma_{n,3}^2/\gamma_{s,1}^2}) + \gamma_{n,3}(\pm \sqrt{\gamma_{n,2}^2/\gamma_{s,1}^2}) \\ &= \begin{cases} \frac{1}{\sqrt{\gamma_{s,1}^2}} \left(\gamma_{n,2}\sqrt{\gamma_{n,3}^2} + \gamma_{n,3}\sqrt{\gamma_{n,2}^2}\right) & \text{if } \gamma_{\ell,2} > 0 \text{ and } \gamma_{\ell,3} > 0 \\ \frac{1}{\sqrt{\gamma_{s,1}^2}} \left(-\gamma_{n,2}\sqrt{\gamma_{n,3}^2} - \gamma_{n,3}\sqrt{\gamma_{n,2}^2}\right) & \text{if } \gamma_{\ell,2} < 0 \text{ and } \gamma_{\ell,3} < 0 \\ \frac{1}{\sqrt{\gamma_{s,1}^2}} \left(\gamma_{n,2}\sqrt{\gamma_{n,3}^2} - \gamma_{n,3}\sqrt{\gamma_{n,2}^2}\right) & \text{if } \gamma_{\ell,2} < 0 \text{ and } \gamma_{\ell,3} > 0 \\ \frac{1}{\sqrt{\gamma_{s,1}^2}} \left(\gamma_{n,2}\sqrt{\gamma_{n,3}^2} - \gamma_{n,3}\sqrt{\gamma_{n,2}^2}\right) & \text{if } \gamma_{\ell,2} > 0 \text{ and } \gamma_{\ell,3} > 0 \\ \frac{1}{\sqrt{\gamma_{s,1}^2}} \left(\gamma_{n,2}\sqrt{\gamma_{n,3}^2} - \gamma_{n,3}\sqrt{\gamma_{n,2}^2}\right) & \text{if } \gamma_{\ell,2} > 0 \text{ and } \gamma_{\ell,3} < 0 \\ 0 & \text{if } \gamma_{n,2}\gamma_{n,3} < 0 \\ 0 & \text{if } \gamma_{n,2}\gamma_{n,3} < 0 \\ 0 & \text{if } \gamma_{n,2}\gamma_{n,3} > 0 \\ \gamma_{s,2}\gamma_{\ell,2} + \gamma_{s,3}\gamma_{\ell,3} = (\gamma_{n,1}/\gamma_{s,1})(\gamma_{n,2}\gamma_{\ell,2} + \gamma_{n,3}\gamma_{\ell,3}) \\ &= 0 \\ \gamma_{s,2}\gamma_{s,3} + \gamma_{n,2}\gamma_{n,3} + \gamma_{\ell,2}\gamma_{\ell,3} = (\gamma_{n,1}^2/\gamma_{s,1}^2 + 1)\gamma_{n,2}\gamma_{n,3} - (\gamma_{n,2}/\gamma_{n,3})\gamma_{\ell,2}^2 \\ &= \gamma_{n,2}\gamma_{n,3}/\gamma_{s,1}^2 - (\gamma_{n,2}/\gamma_{n,3})(\gamma_{n,3}^2/\gamma_{s,1}^2) \\ &= 0 \end{split}$$

since $\gamma_{s,1}^2 = 1 - \gamma_{n,1}^2 = \gamma_{n,2}^2 + \gamma_{n,3}^2$. Thus, (R1-1)-(R1-6) and (R2-1)-(R2-6) are satisfied, and there exists a Q that is orthogonal.

C BASELINE DSGE MODEL

We detrend the model by scaling trending variables, x_t , as $\tilde{x}_t \equiv x_t/z_t^{1/(1-\alpha)}$, where z_t is the permanent component of TFP. The equilibrium system is given by

$$r_t^k = \alpha m c_t s_t g_t (\tilde{k}_{t-1}/n_t)^{\alpha - 1} \tag{C.1}$$

$$\tilde{w}_t = (1 - \alpha)mc_t s_t g_t^{-\alpha/(1-\alpha)} (\tilde{k}_{t-1}/n_t)^{\alpha}$$
(C.2)

$$\Delta_t^p \tilde{y}_t = s_t g_t^{-\alpha/(1-\alpha)} \tilde{k}_{t-1}^{\alpha} n_t^{1-\alpha}$$
(C.3)

$$\tilde{w}_t = \chi n_t^\eta \tilde{c}_t \tag{C.4}$$

$$1 = E_t[x_{t+1}r_t/\pi_{t+1}] \tag{C.5}$$

$$\tilde{c}_t + \tilde{\imath}_t = \tilde{y}_t \tag{C.6}$$

$$\tilde{k}_t = (1 - \delta)\tilde{k}_{t-1}/g_{y,t} + \mu_t \tilde{\imath}_t \tag{C.7}$$

$$1/\mu_t = E_t[x_{t+1}(r_{t+1}^k + (1-\delta)/\mu_{t+1})]$$
(C.8)

$$p_{f,t} = \frac{\epsilon_p}{\epsilon_p - 1} (\tilde{f}_{1,t} / \tilde{f}_{2,t})$$
(C.9)

$$\tilde{f}_{1,t} = mc_t \tilde{y}_t + \theta_p E_t [g_{y,t+1} x_{t+1} (\pi_{t+1}/\bar{\pi})^{\epsilon_p} \tilde{f}_{1,t+1}]$$
(C.10)

$$\tilde{f}_{2,t} = \tilde{y}_t + \theta_p E_t[g_{y,t+1}x_{t+1}(\pi_{t+1}/\bar{\pi})^{\epsilon_p - 1}\tilde{f}_{2,t+1}]$$
(C.11)

$$\Delta_t^p = (1 - \theta_p) p_{f,t}^{-\epsilon_p} + \theta_p (\pi_t / \bar{\pi})^{\epsilon_p} \Delta_{t-1}^p$$
(C.12)

$$1 = (1 - \theta_p) p_{f,t}^{1 - \epsilon_p} + \theta_p (\pi_t / \bar{\pi})^{\epsilon_p - 1}$$
(C.13)

$$x_t = \beta \tilde{c}_{t-1} / (\tilde{c}_t g_{y,t}) \tag{C.14}$$

$$r_t = \bar{r} (\pi_t / \bar{\pi})^{\phi_\pi} \tag{C.15}$$

$$g_{y,t} = g_t^{1/(1-\alpha)}$$
(C.16)

$$\ln s_t = \rho_s \ln s_{t-1} + \sigma_s \varepsilon_{s,t} \tag{C.17}$$

$$\ln g_t = (1 - \rho_g) \ln \bar{g} + \rho_g \ln g_{t-1} + \sigma_g \varepsilon_{g,t}$$
(C.18)

$$\ln \mu_t = \rho_\mu \ln \mu_{t-1} + \sigma_\mu \varepsilon_{\mu,t} \tag{C.19}$$

Table 1: Baseline DSGE model calibration at quarterly frequency

Parameter	Value	Parameter	Value
Discount Factor (β)	0.995	Steady-State Hours (\bar{n})	0.3333
Cost Share of Capital (α)	0.3343	Steady-State TFP Growth Rate (\bar{g})	1.0026
Capital Depreciation Rate (δ)	0.025	TFP News Shock Persistence (ρ_g)	0.6
Frisch Labor Supply Elasticity $(1/\eta)$	0.5	TFP Surprise Shock Persistence (ρ_s)	0.8
Goods Elasticity of Substitution (ϵ_p)	11	MEI Shock Persistence (ρ_{μ})	0.9
Calvo Price Stickiness (θ_p)	0.75	TFP News Shock SD (σ_g)	0.003
Taylor Rule Inflation Response (ϕ_{π})	1.5	TFP Surprise Shock SD (σ_s)	0.007
Steady-State Inflation Rate $(\bar{\pi})$	1.005	MEI Shock SD (σ_{μ})	0.007

D LARGER-SCALE DSGE MODEL

We detrend the same way as in the baseline model except $\tilde{\lambda}_t \equiv \lambda_t z_t^{1/(1-\alpha)}$, $\tilde{f}_{1,t}^w \equiv f_{1,t}^w/z_t^{(1+\epsilon_w)/(1-\alpha)}$, and $\tilde{f}_{2,t}^w \equiv f_{2,t}^w/z_t^{\epsilon_w/(1-\alpha)}$. The labor share $\omega_{\ell,t} = w_{\ell,t} l_{s,t}/y_t$. The equilibrium system is given by

$$r_{k,t} = \alpha m c_t s_t (\tilde{k}_{s,t}/l_{s,t})^{\alpha - 1} \tag{D.1}$$

$$\tilde{w}_{\ell,t} = (1-\alpha)mc_t s_t (\tilde{k}_{s,t}/l_{s,t})^{\alpha}$$
(D.2)

$$\Delta_t^p \tilde{y}_t = s_t \tilde{k}_{s,t}^{\alpha} l_{s,t}^{1-\alpha} - \bar{F}$$
(D.3)

$$\tilde{\lambda}_t = (\tilde{c}_t - b\tilde{c}_{t-1}/g_{y,t})^{-1} - \beta b E_t [(\tilde{c}_{t+1}g_{y,t+1} - b\tilde{c}_t)^{-1}]$$
(D.4)

$$1 = E_t[x_{t+1}r_t/\pi_{t+1}] \tag{D.5}$$

$$r_{k,t} = \gamma_1 + \gamma_2(u_t - 1) \tag{D.6}$$

$$\theta \kappa_3 e_t^{\kappa_4 - 1} = \tilde{\lambda}_t \tilde{w}_t h_t \tag{D.7}$$

$$\theta \kappa_1 h_t^{\kappa_2 - 1} = \tilde{\lambda}_t \tilde{w}_t e_t \tag{D.8}$$

$$\theta(\kappa_0 + (\kappa_1/\kappa_2)h_t^{\kappa_2} + (\kappa_3/\kappa_4)e_t^{\kappa_4})$$

$$= \tilde{\lambda}_t \tilde{w}_t \left[e_t h_t - \frac{\psi}{2} (n_t/n_{t-1} - 1)^2 - \psi(n_t/n_{t-1} - 1)(n_t/n_{t-1}) \right]$$
(D.9)
+ $\beta \psi E_t [\tilde{\lambda}_{t+1} \tilde{w}_{t+1} (n_{t+1}/n_t - 1)(n_{t+1}/n_t)^2]$

$$\tilde{k}_t = (1-\delta)\tilde{k}_{t-1}/g_{y,t} + \mu_t \tilde{i}_t \tag{D.10}$$

$$\mu_t q_t = 1 + \varphi(\Phi_t - \tilde{\delta}) \tag{D.11}$$

$$q_t = E_t [x_{t+1}(r_{k,t+1}u_{t+1} - \gamma_1(u_{t+1} - 1) - \frac{\gamma_2}{2}(u_{t+1} - 1)^2$$
(D.12)

$$-\frac{\varphi}{2}(\Phi_{t+1} - \tilde{\delta})^2 + \varphi(\Phi_{t+1} - \tilde{\delta})\Phi_{t+1} + (1 - \delta)q_{t+1})]$$

$$\Phi_t = \tilde{\imath}_t g_{y,t} / \tilde{k}_{t-1} \tag{D.13}$$

$$l_t = e_t h_t n_t \tag{D.14}$$

$$l_t = \Delta_t^w l_{s,t} \tag{D.15}$$

$$\tilde{k}_{s,t} = u_t \tilde{k}_{t-1} / g_{y,t} \tag{D.16}$$

$$x_t = \beta \tilde{\lambda}_t / (\tilde{\lambda}_{t-1} g_{y,t}) \tag{D.17}$$

$$\tilde{p}_t = \frac{\epsilon_p}{\epsilon_p - 1} (\tilde{f}_{1,t}^p / \tilde{f}_{2,t}^p) \tag{D.18}$$

$$\tilde{f}_{1,t}^{p} = mc_{t}\tilde{y}_{t} + \theta_{p}E_{t}[x_{t+1}\pi_{t}^{-\epsilon_{p}\gamma_{p}}\bar{\pi}^{-\epsilon_{p}(1-\gamma_{p})}\pi_{t+1}^{\epsilon_{p}}\tilde{f}_{1,t+1}^{p}g_{y,t+1}]$$
(D.19)
$$\tilde{c}_{p}^{p} = \tilde{c}_{t+1} + \theta_{p}E_{t}[x_{t+1}\pi_{t}^{-\epsilon_{p}\gamma_{p}}\bar{\pi}^{-\epsilon_{p}(1-\gamma_{p})}\pi_{t+1}^{\epsilon_{p}}\tilde{f}_{1,t+1}^{p}g_{y,t+1}]$$
(D.20)

$$\tilde{f}_{2,t}^{p} = \tilde{y}_{t} + \theta_{p} E_{t} [x_{t+1} \pi_{t}^{(1-\epsilon_{p})\gamma_{p}} \bar{\pi}^{(1-\epsilon_{p})(1-\gamma_{p})} \pi_{t+1}^{\epsilon_{p}-1} \tilde{f}_{2,t+1}^{p} g_{y,t+1}]$$
(D.20)

$$\Delta_{t}^{p} = (1 - \theta_{p})\tilde{p}_{t}^{-\epsilon_{p}} + \theta_{p}\pi_{t-1}^{-\epsilon_{p}/p}\bar{\pi}^{-\epsilon_{p}(1-\gamma_{p})}\pi_{t}^{\epsilon_{p}}\Delta_{t-1}^{p}$$
(D.21)
$$1 - (1 - \theta_{p})\tilde{r}^{1-\epsilon_{p}} + \theta_{p}-(1 - \epsilon_{p})\gamma_{p} = (1 - \epsilon_{p})(1 - \gamma_{p}) - \epsilon_{p} - 1$$
(D.22)

$$1 = (1 - \theta_p)\tilde{p}_t^{1 - \epsilon_p} + \theta_p \pi_{t-1}^{(1 - \epsilon_p)\gamma_p} \bar{\pi}^{(1 - \epsilon_p)(1 - \gamma_p)} \pi_t^{\epsilon_p - 1}$$
(D.22)

$$\tilde{w}_{\ell,t}^* = \frac{\epsilon_w}{\epsilon_w - 1} (\tilde{f}_{1,t}^w / \tilde{f}_{2,t}^w), \tag{D.23}$$

$$\tilde{f}_{1,t}^{w} = \tilde{w}_{\ell,t}^{\epsilon_{w}} \tilde{w}_{t} l_{s,t} + \theta_{w} \bar{g}_{y} E_{t} [x_{t+1} \pi_{t+1}^{\epsilon_{w}} \pi_{t}^{-\epsilon_{w} \gamma_{w}} \bar{\pi}^{-\epsilon_{w} (1-\gamma_{w})} \tilde{f}_{1,t+1}^{w} (g_{y,t+1}/\bar{g}_{y})^{1+\epsilon_{w}}]$$
(D.24)

$$f_{2,t}^{w} = \tilde{w}_{\ell,t}^{\epsilon_{w}} l_{s,t} + \theta_{w} \bar{g}_{y} E_{t} [x_{t+1} \pi_{t+1}^{\epsilon_{w}-1} \pi_{t}^{(1-\epsilon_{w})\gamma_{w}} \bar{\pi}^{(1-\epsilon_{w})(1-\gamma_{w})} f_{2,t+1}^{w} (g_{y,t+1}/\bar{g}_{y})^{\epsilon_{w}}]$$
(D.25)

$$\Delta_t^w = (1 - \theta_w) \left(\frac{\tilde{w}_{\ell,t}^*}{\tilde{w}_{\ell,t}}\right)^{-\epsilon_w} + \theta_w \pi_{t-1}^{-\epsilon_w \gamma_w} \bar{\pi}^{-\epsilon_w (1 - \gamma_w)} \pi_t^{\epsilon_w} \left(\frac{\tilde{w}_{\ell,t-1} \bar{g}_y}{\tilde{w}_{\ell,t} g_{y,t}}\right)^{-\epsilon_w} \Delta_{t-1}^w \tag{D.26}$$

$$\tilde{w}_{\ell,t}^{1-\epsilon_w} = (1-\theta_w)(\tilde{w}_{\ell,t}^*)^{1-\epsilon_w} + \theta_w \pi_{t-1}^{\gamma_w(1-\epsilon_w)} \bar{\pi}^{(1-\gamma_w)(1-\epsilon_w)} \pi_t^{\epsilon_w-1} \left(\frac{\tilde{w}_{\ell,t-1}\bar{g}_y}{g_{y,t}}\right)^{1-\epsilon_w}$$
(D.27)

$$r_{t} = r_{t-1}^{\rho_{r}} (\bar{r}(\pi_{t}/\bar{\pi})^{\phi_{\pi}} (\tilde{y}_{t}g_{y,t}/(\tilde{y}_{t-1}\bar{g}_{y}))^{\phi_{y}})^{1-\rho_{r}} \exp(\sigma_{r}\varepsilon_{r,t})$$
(D.28)

$$\tilde{c}_{t} + \tilde{i}_{t} + \frac{\psi}{2} (n_{t}/n_{t-1} - 1)^{2} \tilde{w}_{t} n_{t} + \frac{\varphi}{2} (\Phi_{t} - \tilde{\delta})^{2} \tilde{k}_{t-1}/g_{y,t}$$

$$(D.29)$$

$$+(\gamma_1(u_t-1)+\frac{\gamma_2}{2}(u_t-1)^2)k_{t-1}/g_{y,t}=\tilde{y}_t$$

$$g_{y,t} = g_t^{1/(1-\alpha)}$$
 (D.30)

$$\ln s_t = \rho_s \ln s_{t-1} + \sigma_s \varepsilon_{s,t} \tag{D.31}$$

$$\ln g_t = (1 - \rho_g) \ln g + \rho_g \ln g_{t-1} + \sigma_g \varepsilon_{g,t}$$
(D.32)

$$\ln \mu_t = \rho_\mu \ln \mu_{t-1} + \sigma_\mu \varepsilon_{\mu,t} \tag{D.33}$$

Parameter	Value	Parameter	Value
Discount Factor (β)	0.99	Taylor Rule Inflation Response (ϕ_{π})	1.5
Cost Share of Capital (α)	0.3333	Taylor Rule Output Response (ϕ_y)	0.5
Capital Depreciation Rate (δ)	0.025	Taylor Rule Smoothing (ρ_r)	0.8
Utilization Function Curvature (γ_2)	0.01	Steady-State Inflation Rate $(\bar{\pi})$	1
Internal Habit Persistence (b)	0.8	Steady-State Employment Share (\bar{n})	3/5
Capital Adjustment Cost (φ)	2	Steady-State Labor Preference (\overline{G})	1/3
Employment Adjustment Cost (ψ)	2	Steady-State Effort (\bar{e})	5
Frisch Elasticity of Hours (η)	1	Steady-State Hours (\bar{h})	1/3
Elasticity of Effort to Hours (ϵ_{eh})	4	Steady-State Output Growth Rate (\bar{g}_y)	1.0026
Goods Elasticity of Substitution (ϵ_{μ}) 11	TFP News Shock Persistence (ρ_g)	0.7
Labor Elasticity of Substitution (ϵ_w) 11	TFP Surprise Shock Persistence (ρ_s)	0.9
Calvo Price Stickiness (θ_p)	0.75	MEI Shock Persistence (ρ_{μ})	0.8
Calvo Wage Stickiness (θ_w)	0.9	TFP News Shock SD (σ_g)	0.002125
Price Indexation (γ_p)	0	TFP Surprise Shock SD (σ_s)	0.000425
Wage Indexation (γ_w)	1	MEI Shock SD (σ_{μ})	0.00425

 Table 2: Larger-scale DSGE model parameterization at quarterly frequency

E SURPRISE SHOCK MAX SHARE ESTIMATOR

An implication of our analysis in Section 2 is that we can either estimate γ_s given an estimate of γ_n obtained by maximizing the TFP forecast error variance share at a long horizon or, alternatively, we can estimate γ_n given an estimate of γ_s obtained by maximizing the TFP forecast error variance share at a short horizon. In other words, the estimator of γ_n is not unique. This raises the question of which estimator should be used when there is no TFP measurement error. A surprise shock max share estimator can be defined as

$$\gamma_s = \operatorname{argmax} \ \Omega_{1,1}(H_s), \quad \Omega_{1,1}(H_s) \equiv \frac{\sum_{\tau=0}^{H_s} \Phi_{1,\tau} P \gamma_s \gamma'_s P' \Phi'_{1,\tau}}{\sum_{\tau=0}^{H_s} \Phi_{1,\tau} \Sigma \Phi'_{1,\tau}}$$

subject to the restriction that $\gamma'_s \gamma_s = 1$ and that the responses of selected variables to the surprise shock match patterns that would be expected of a surprise shock, where $\gamma_s = (\gamma_{s,1}, \gamma_{s,2}, \gamma_{s,3})'$ denotes the first column in the orthogonal rotation matrix Q and the horizon H_s is set to four quarters. Similarly inaccurate results are obtained for shorter horizons.

Figure 1 shows that not only is the surprise shock max share estimator much more biased than the original estimator, but it also tends to generate impulse responses that are increasing when the population response is declining and that are declining when the population response is increasing. In fact, responses to these surprise shocks look much like one would expect responses to a news shock to look like. Moreover, the responses to the news shock are of the opposite sign of the



Figure 1: Impulse responses from alternative estimators based on the baseline DSGE model

Notes: VAR(4) model with T = 10,000 and $\mathbf{y}_t = (a_t, y_t, i_t)'$.

(a) News shock

population responses. Thus, this alternative estimator should not be used in applied work.

F COMPARISON WITH OTHER SIMULATION EVIDENCE

Contrary to our findings, Kurmann and Sims (2021) report having some success identifying the news shock in a Monte Carlo exercise with T = 10,000 based on a larger-scale DSGE model. The key difference is not the structure of the model, but that they use a different parameterization for the TFP process ($\rho_g = 0.7$, $\rho_s = 0.9$, $\sigma_g = 0.002125$ and $\sigma_s = 0.000425$). They note that their TFP parameterization is based on standard values in the literature. However, most DSGE models feature either a stationary or permanent TFP shock process. When a model features both processes, standard values from models with only one process can lead to TFP moments that are at odds with actual data. The most notable difference from our calibration is that the standard deviation of their surprise shock is only about 6% of our baseline value.

Table 3a reports simulated moments when using the Kurmann and Sims (2021) parameterization of the TFP process in our baseline model. These results show that their specification is at odds with the data. In particular, the autocorrelation of TFP growth is quite high in the model but

Moment	Data	Model	Moment	Data	Model
$SD(\tilde{a}_t)$	2.01	1.46	$SD(\tilde{\imath}_t)$	9.63	7.47
$SD(\Delta a_t)$	0.80	0.30	$AC(\tilde{a}_t)$	0.87	0.88
$SD(\tilde{y}_t)$	3.13	1.88	$AC(\Delta a_t)$	-0.09	0.67

 Table 3: Data and model-implied moments under Kurmann and Sims (2021) TFP parameters

(b) Larger-scale model

(a) Baseline model

Moment	Data	Model	Moment	Data	Model
$SD(\tilde{a}_t)$	2.01	2.67	$SD(\tilde{\imath}_t)$	9.63	12.15
$SD(\Delta a_t)$	0.80	0.59	$AC(\tilde{a}_t)$	0.87	0.88
$SD(\tilde{y}_t)$	3.13	5.15	$AC(\Delta a_t)$	-0.09	0.43

Notes: A tilde denotes a detrended variable and Δ is a log change. In the data, a_t is Fernald utilizationadjusted TFP. For the baseline model, actual and measured TFP coincide. For the larger-scale model, a_t , is measured TFP (TFP^u_t).

close to zero in the data. Table 3b shows that this continues to be the case even when we use the larger-scale DSGE model and allow for TFP measurement error. While the 0.43 autocorrelation of the growth rate of measured TFP is lower than what is reported in the baseline model, it remains well above the data.

The unrealistically high persistence of the TFP growth process under the Kurmann and Sims (2021) parameterization is important for understanding their findings because it drives the forecast error variance decomposition of TFP in the DSGE model. As shown in Table 4, the news shock explains the vast majority of the variance at all horizons when using the Kurmann-Sims parameterization in the baseline model and in the larger-scale DSGE model. Thus, their parameterization effectively eliminates the surprise shock and makes it much easier for the KS estimator to identify the news shock. This explains the comparatively high accuracy of the KS estimator in their simulation analysis.

G ADDITIONAL RESULTS

This section presents several additional results:

- RMSEs based on the max share news estimator, where the news variable is measured with error and data is simulated from the larger-scale DSGE model (Table 5).
- Empirical impulse responses from 9-variable VAR models with alternative TFP news series of different lengths (Figure 2).

Table 4: Forecast error variance decompositions under Kurmann and Sims (2021) TFP parameters

	Horizon				
Shock	4	8	20	40	80
News	98.6	99.6	99.9	99.9	100.0
Surprise	1.4	0.4	0.1	0.1	0.0
MEI	0.0	0.0	0.0	0.0	0.0

(a) Baseline model, true TFP $(\ln a_t)$

(b) Larger-scale model, true TFP $(\ln a_t)$

	Horizon				
Shock	4	8	20	40	80
News	98.6	99.6	99.9	99.9	100.0
Surprise	1.4	0.4	0.1	0.1	0.0
MEI	0.0	0.0	0.0	0.0	0.0

(c) Larger-scale model, measured TFP ($\ln \text{TFP}_t^u$)

		Horizon				
Shock	4	8	20	40	80	
News	72.1	79.1	52.6	84.0	94.5	
Surprise	1.0	0.6	0.4	0.3	0.1	
MEI	27.0	20.3	47.0	15.8	5.4	

Notes: MEI denotes marginal efficiency of investment.

Table 5: RMSE over 40 quarters based on the larger-scale DSGE model

Estimator	TFP	Output	Investment	Total	
KS Max Share	10.3	10.4	19.3	40.0	
Max Share News ($\sigma_n = 0$)	6.4	2.8	7.6	16.8	
Max Share News ($\sigma_n = 0.2\sigma_g$)	6.4	3.0	8.1	17.4	
Max Share News ($\sigma_n = 0.5\sigma_g$)	6.4	3.6	9.1	19.1	

Notes: VAR(4) model with T = 10,000, where $\mathbf{y}_t = (\text{TFP}_t^u, y_t, i_t)'$ for the KS estimator and $\mathbf{y}_t = (z_{t+1}^n, \text{TFP}_t^u, y_t, i_t)'$ for the max share news estimator.



Figure 2: Max share news estimates for alternative measures of TFP news



REFERENCES

- BARON, J. AND J. SCHMIDT (2019): "Technological Standardization, Endogenous Productivity and Transitory Dynamics," Manuscript, Northwestern University.
- CASCALDI-GARCIA, D. AND M. VUKOTIĆ (2022): "Patent-Based News Shocks," *Review of Economics and Statistics*, 104, 51–66.
- KOGAN, L., D. PAPANIKOLAOU, A. SERU, AND N. STOFFMAN (2017): "Technological Innovation, Resource Allocation, and Growth," *Quarterly Journal of Economics*, 132, 665–712.
- KURMANN, A. AND E. SIMS (2021): "Revisions in Utilization-Adjusted TFP and Robust Identification of News Shocks," *Review of Economics and Statistics*, 103, 216–235.
- MARCO, A., M. CARLEY, S. JACKSON, AND A. F. MYERS (2015): "The USPTO Historical Patent Data Files Two Centuries of Innovation," USPTO Economic Working Paper No. 2015-1.
- MIRANDA-AGRIPPINO, S., S. H. HOKE, AND K. BLUWSTEIN (2022): "Patents, News, and Business Cycles," Manuscript, Bank of England.