Optimal Macro-Financial Policies in a New Keynesian Model with Privately Optimal Risk Taking

ASSET 2023

Alfred Duncan
University of Kent

João Pedro De Camargo Mainente
University of Kent

Charles Nolan
University of Glasgow

Overview

- **What we do:**
- **We aim to:**
- **We find that:**

Overview

- **What we do:**
  - Extension to the standard three equation New Keynesian model – Duncan & Nolan (2019).
  - Households that supplies labour and capital and entrepreneurs that produce a common product.
  - Aggregate risks can be traded, however idiosyncratic production risk cannot.
- **We aim to:**
- **We find that:**

Overview

- **What we do:**
  - Extension to the standard three equation New Keynesian model – Duncan & Nolan (2019).
  - Households that supplies labour and capital and entrepreneurs that produce a common product.
  - Aggregate risks can be traded, however idiosyncratic production risk cannot.
- **We aim to:**
  - How risk aversion affect equilibrium risk allocation and optimal policies.
  - When should monetary policy respond to financial factors.
  - When should macroprudential policy respond to technology shocks and marginal costs.
- **We find that:**

Overview

- **What we do:**
  - Extension to the standard three equation New Keynesian model – Duncan & Nolan (2019).
  - Households that supplies labour and capital and entrepreneurs that produce a common product.
  - Aggregate risks can be traded, however idiosyncratic production risk cannot.
- **We aim to:**
  - How risk aversion affect equilibrium risk allocation and optimal policies.
  - When should monetary policy respond to financial factors.
  - When should macroprudential policy respond to technology shocks and marginal costs.
- **We find that:**
  - Higher risk aversion by households increases economy volatility – *Safety Trap*.
  - Accommodative monetary policy is best suited to respond to temporary technology shocks.
  - Macroprudential policy is best suited to responding to persistent technology shocks.

Related Literature

- **Extensions to the Canonical New Keynesian Model**
  - Jermann and Quadrini (2012), Cúrdia and Woodford (2016) and Sims et al. (2021)
- **Financial Externalities**
  - Schmitt-Grohe and Uribe (2012), Farhi and Werning (2016), Di Tella (2017), Duncan and Nolan (2021)
- **Safety Trap**
  - Caballero and Farhi (2017)
- **Macroprudential and Monetary Policy**
  - Allen and Rogoff (2011), Korinek and Simsek (2016), Caballero and Simsek (2019)

Model Summary

- **IS Curve**

$$x_t = \mathbb{E}_t\left[x_{t+1}\right] - \frac{1}{\sigma}\left(i_t - \mathbb{E}_t\left[\pi_{t+1}\right]\right) + \omega(1-\psi)\mathbb{E}_t\left[\Delta l_{t+1}\right] + \omega\psi(1-\rho_\xi)\xi_t \tag{1}$$

- **Leverage Curve**

$$l_t = \phi l_{t-1} + (1-\phi)\left(\omega\sigma\Delta\xi_t - \xi_{t-1} - \underbrace{\frac{\sigma-1}{\psi}\Delta x_t}_{\text{financial accelerator}}\right) - \delta_t \tag{2}$$

- **Phillips Curve**

$$\pi_t = \beta\mathbb{E}_t\left[\pi_{t+1}\right] + \lambda \mathrm{pp}_t \tag{3}$$

- **Producer Prices**

$$\mathrm{pp}_t = \underbrace{(\sigma - 1 + \chi)\, x_t - \chi a_t}_{\text{benchmark model marginal costs}} + \underbrace{\sigma\omega(1-\psi) l_t - \sigma\omega\psi\xi_t}_{\text{consumption inequality wealth effect}} + \underbrace{\tau_t}_{\text{labour wedge}} \tag{4}$$

Model In Depth – Agents

- **Population of households** that enjoys consumption (c_t), dislike labour(n_t) and holds wealth (q_t):

$$v(q_t) = \max_{z_t, c_t, n_t, q_{t+1}} \mathbb{E}_t \left\{ \frac{c_t^{1-\sigma}}{1-\sigma} - \frac{n_t^{1+\varphi}}{1+\varphi} + \beta v(q_{t+1}) \right\}$$

s.t.

$$q_{t+1} = (1 + r_{t+1})q_t + w_t n_t + \Pi_t - c_t \underbrace{- \int_{s \in S} p_t(s) z_t(s_t) ds + z_t(s_{t+1})}_{\text{aggregate risk trades}}$$

Model In Depth – Agents

- **Population of entrepreneurs** that hires labour to produce a wholesale good with a risky technology:

$$v^e(q_t^e) = \max_{z_t^e, c_t^e, q_{t+1}^e} \mathbb{E}_{\Theta,t} \left\{ \log(c_t^e) + \beta^e v^e(q_{t+1}^e) \right\}$$

s.t.

$$q_{t+1}^e = R_t(\theta_t, s_t) q_t^e - c_t^e - \int_{s \in S} p_t(s) z_t^e(s_t) ds + z_t^e(s_{t+1})$$

- Entrepreneurs output:

$$f(k_t^e, n_t^e; a_t, \theta_t) = a_t \nu(\theta_t) k_t^{\alpha} n_t^{1-\alpha}$$

Model In Depth – Macroprudential policy

- Mechanism design approach
  - Influences the allocation of exposure to aggregate risk.

- Entrepreneurs can hide income and consumption from external creditors (within periods) and wealth from macroprudential policymaker (across periods).
  - Same risk free rate for households and entrepreneurs.

- In expectation, expected growth of marginal utility are equated to the same discount rate:

$$\sigma \mathbb{E}_t [\Delta c_{t+1}] = \mathbb{E}_t \left[\Delta c^e_{t+1}\right] - \mathbb{E}_t [\rho_{t+1}]$$

Model In Depth – Macroprudential policy

- Mechanism design approach
  - Influences the allocation of exposure to aggregate risk.

- Entrepreneurs can hide income and consumption from external creditors (within periods) and wealth from macroprudential policymaker (across periods).
  - Same risk free rate for households and entrepreneurs.

- In expectation, expected growth of marginal utility are equated to the same discount rate:

$$\sigma \mathbb{E}_t \left[\Delta c_{t+1} \right] = \mathbb{E}_t \left[\Delta c^e_{t+1} \right] - \mathbb{E}_t \left[\rho_{t+1} \right]$$

- Aggregate risk sharing implies that

$$\sigma \Delta c_t = \Delta c^e_t - \rho_t - (1 - \sigma\omega(1-\psi))\delta_t$$

Model In Depth – Macroprudential policy

- Mechanism design approach
  - Influences the allocation of exposure to aggregate risk.
- Entrepreneurs can hide income and consumption from external creditors (within periods) and wealth from macroprudential policymaker (across periods).
  - Same risk free rate for households and entrepreneurs.
- In expectation, expected growth of marginal utility are equated to the same discount rate:

$$\sigma \mathbb{E}_t \left[\Delta c_{t+1}\right] = \mathbb{E}_t \left[\Delta c^e_{t+1}\right] - \mathbb{E}_t \left[\rho_{t+1}\right]$$

- Aggregate risk sharing implies that

$$\sigma \Delta c_t = \Delta c^e_t - \rho_t - (1 - \sigma\omega(1-\psi))\delta_t$$

- Macroprudential wedge is unpredictable:

$$\mathbb{E}_t[\delta_{t+1}] = 0$$

Model In Depth – Macroprudential policy

- Mechanism design approach
  - Influences the allocation of exposure to aggregate risk.
- Entrepreneurs can hide income and consumption from external creditors (within periods) and wealth from macroprudential policymaker (across periods).
  - Same risk free rate for households and entrepreneurs.
- In expectation, expected growth of marginal utility are equated to the same discount rate:

$$\sigma \mathbb{E}_t \left[\Delta c_{t+1} \right] = \mathbb{E}_t \left[\Delta c^e_{t+1} \right] - \mathbb{E}_t \left[\rho_{t+1} \right]$$

- Aggregate risk sharing implies that

$$\sigma \Delta c_t = \Delta c^e_t - \rho_t - (1 - \sigma\omega(1-\psi))\delta_t$$

- Macroprudential wedge is unpredictable:

$$\mathbb{E}_t[\delta_{t+1}] = 0$$

- Macroprudential policy is an ex ante intervention that affects elasticity of net wealth (entrepreneurs) to unanticipated economic shocks.

Model in Depth – Welfare Measure

- Negishi (1960) method for Pareto weights – policy intervention motivated by efficiency and not distribution of wealth.
- Entrepreneurs: consume a significant share of output and any policy that harms them without a sufficient offset in households is likely undesirable.
- Quadratic loss function

$$2\Lambda = (1+\omega)\frac{\varepsilon}{\lambda}\pi_t^2 + (1+\omega)\frac{1+\varphi}{1-\alpha}x_t(x_t - 2a_t) + (\sigma - 1)\, x_t^2$$
$$\underbrace{+\omega\left((1+\sigma\omega)(1-\psi)l_t + (\sigma-1)x_t\right)\left((1-\psi)l_t - \psi\xi_t\right)}_{\text{Distribution of consumption}}$$
$$\underbrace{+\omega l_t(\kappa_{ll} l_t + \kappa_{l\xi}\xi_t)}_{\text{Entrepreneurs' consumption risk}} \quad + \text{t.i.p.}$$

The Safety Trap

Proposition

An increase in the representative household's coefficient of relative risk aversion can increase the volatility of the path of output.

- **Intuition**
  - Individual risk averse households seek protection from aggregate fluctuation.
  - Entrepreneurs are the counterpart of the risk trade.
  - Concentration of risk among entrepreneurs $\implies$ larger fluctuations in net-wealth and amplification of aggregate shocks.

$$I_t = \phi I_{t-1} + (1-\phi)\left(\omega\sigma\Delta\xi_t - \xi_{t-1} - \underbrace{\frac{\sigma-1}{\psi}\Delta x_t}_{\text{financial accelerator}}\right) - \delta_t$$

Optimal policy – log utility

- Leverage curve under log-utility

$$l_t = \phi l_{t-1} + (1-\phi)\left(\omega\Delta\xi_t - \xi_{t-1} - \cancel{\frac{\sigma-1}{\psi}\Delta x_t}\right) - \delta_t$$

- From $\mathbb{E}_t[\delta_{t+1}] = 0$ we get

$$\mathbb{E}_t[l_{t+1}] = \phi l_t + (1-\phi)\left[\omega\mathbb{E}_t[\xi_{t+1}] - (\omega+1)\xi_t\right]$$

- **Monetary Policy:** Optimal path of output and inflation as functions of leverage, uncertainty and technology shocks

- **Prudential Policy:** Optimal path of leverage.

- With nominal rigidities, under log utility divine coincidence holds for technology shocks $\Longrightarrow$ focus on uncertainty shocks.

Optimal policy – log utility

- **Optimal Monetary Policy**
  - Similar trade-offs to cost-push shocks.
  - Bears a welfare cost from inflation, but generates increase in welfare by smoothing output, consumption and labour paths.
  - Leverage remains invariant to monetary stimulus.
  - Optimal policy:

$$p_t = \varphi_1 p_{t-1} + \frac{\beta^{-1}\lambda}{\varphi_2 - \phi}\left(\mu_I I_t + \mu_\xi (1-\gamma)\xi_t\right)$$

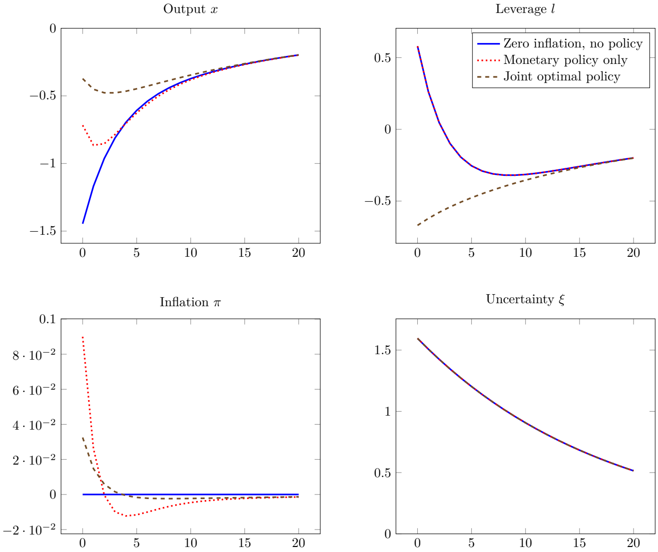
Optimal policy – log utility

- **Optimal Prudential Policy**
  - Countercyclical policy, lowering realised leverage in response to increase in the expected path of current and future price level, and risk of bearing costs of uncertainty.
  - Prudential policymaker can assess marginal impact on economic cost of inflation.

$$\delta_t = \left(\frac{\chi\omega\hat{\kappa}_{I\xi} + (1+\omega)\mu_I\mu_\xi\varsigma(1-\gamma)}{\chi\omega\hat{\kappa}_{II} + (1+\omega)\mu_I^2\varsigma} \left(\frac{\phi' - \phi}{\phi - \rho_\xi} \right) - \frac{1 - \omega(\phi' - 1)}{\phi' - \rho_\xi}(1 - \phi) \right) \epsilon_{\xi t}$$

Optimal policy – log utility

- **Reponse to Recessionary Uncertainty Shock**

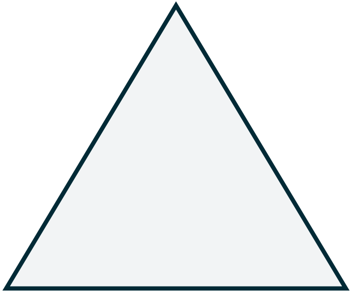


Optimal policy – log utility

- Under optimal monetary policy there is no motivation for the prudential policy to respond to technology shocks (Devine Coincidence).
- Aggregate demand response to technology shocks is non-optimal $\Longrightarrow$ role for macroprudential policy for aggregate demand management. IRF
  - Monetary Policy following a simple Taylor-type interest rule
- Optimal prudential policy is countercyclical, dampening the response of entrepreneurial net wealth to technology shock

Tractability Trilemma

Log-utility (Household): $\sigma = 1$



Strict Expected Inflation Targeting: $\mathbb{E}_t[\pi_{t+1}] = 0$

Fin. Stability Int. Rate: $\rho_t = 0$

Optimal policy – Deviations from log utility

- **Under strict expected inflation targeting ($\mathbb{E}_t[\pi_{t+1}] = 0$)**
  - Persistence of monetary policy is dampened (higher output growth today leads to lower output growth tomorrow $\implies$ increase in future leverage)
  - Policymakers should use both policies, but with greater reliance on prudential policy when technology shocks are persistent.

Optimal policy – Deviations from log utility

- **Under strict expected inflation targeting ($\mathbb{E}_t[\pi_{t+1}] = 0$)**
  - Persistence of monetary policy is dampened (higher output growth today leads to lower output growth tomorrow $\implies$ increase in future leverage)
  - Policymakers should use both policies, but with greater reliance on prudential policy when technology shocks are persistent.

- **Under financial stability interest rate ($\rho_t = 0$)**
  - If economy starts with an output gap and non-target inflation: no way to return to target inflation and eliminate output gap
    - Temporary departure from financial stability to do so.
  - Prudential policy can affect the on-impact response of leverage to uncertainty shocks, but not the dynamic path

Final Remarks

- We present an extension to the benchmark New Keynesian model.
- We show that higher risk aversion can lead to a safety trap.
- Suitability of monetary and macroprudential policies depends on the persistency of shocks and how risk aversion of households.

Thank you!

▶ Reponse to Recessionary Technology Shock