Conventional vs. Unconventional Monetary Policy under Financial Repression

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Motivation

- Post 2008, quantitative easing (QE) – the large-scale purchases of assets by central banks – has become an essential weapon in the arsenal of central banks worldwide.
- Indeed, in the aftermath of the pandemic, many emerging markets emulated their developed peers with bond-buying programs to mitigate the fallout to the financial sector from the crisis.
- Much of the literature has found QE policies effective, particularly when the interest rate is constrained by the zero lower bound (Bernanke, 2020).
- However, the literature is silent on the effectiveness of these programs in the presence of financial repression.

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Conventional & Unconventional Monetary Policy

- Monetary policy tries to influence long-term rate (Aggregate Demand) in 2 ways:
  1. Conventional Policy: cut short-term rates in expectation that they bring down the long-term rates.
  2. Unconventional Policy: directly bring down long-term rates due to asset purchases by Central Bank.
     - Usually triggered when short rates already quite low.
- In this paper, we focus on the distortions induced by financial repression in monetary transmission under both conventional and unconventional policies.

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Financial Repression

- (Reinhart et al., 2011): It occurs when governments implement policies to channel funds to themselves, that in a deregulated market environment would go elsewhere.
- These policies include directed lending to the government by captive domestic audiences (such as pension funds or domestic banks), explicit or implicit caps on interest rates etc.
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Findings

1. Exogenous QE perverts the expected results.
   - The term premium on private long-term debt increases so that investment and output contract.
2. On the other hand, conventional policy shock is expansionary as it reduces the private cost of borrowing (contrary to (Lahiri & Patel, 2016)).
3. Contrary to literature (Carlstrom et al., 2017; Karadi & Nakov, 2021), we find adverse effects of the endogenous QE policy (long rate targeting) in case of financial shocks.
4. However, it works favorably when there are real shocks in the economy.

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Model - Variant of (Sims & Wu, 2020)

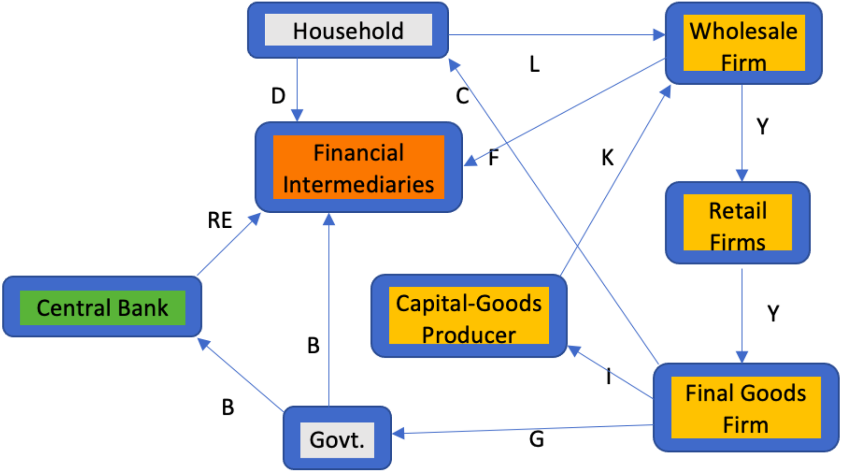

Figure: Schematic Diagram

1. Leverage Constraint

- Depositors want the banks to have their “skin in the game”.
- Therefore, banks could only attract deposits proportional to their net-worth.
- (Gertler & Karadi, 2011)(JME) models this moral hazard problem as a limited enforcement (or leverage) constraint.
- Each period, an intermediary could divert some of the assets for its own purpose and thus default on paying back depositors their due.
- Taking such banks to bankruptcy, depositors can retrieve only a part of their deposits back.
- So, they deposit only when the following holds:

$$V_{it} \geq \theta_t(Q_t f_{i,t} + \Delta Q_{B,t} b_{i,t}) \qquad (1)$$

where, $V_{i,t} = max\ (1-\sigma)\mathbb{E}_t \sum_{j=1}^{\infty} \sigma^{j-1} \Lambda_{t,t+j} n_{i,t+j}$.

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2. Regulatory Constraint

- Following (Chari et al., 2020)(JPE), all intermediaries are required to hold a certain minimum fraction (Γ_t) of their bonds assets in the form of government bonds i.e.

$$Q_{B,t} b_{i,t} \geq \Gamma_t (Q_{B,t} b_{i,t} + Q_t f_{i,t})$$

$$=> Q_{B,t} b_{i,t} \geq \gamma_t Q_t f_{i,t} \tag{2}$$

where $\gamma_t = \frac{\Gamma_t}{1-\Gamma_t}$.

Intermediaries' Problem

- Balance sheet equation of an intermediary i looks as follows:

$$Q_t f_{i,t} + Q_{B,t} b_{i,t} + re_{i,t} = d_{i,t} + n_{i,t} \tag{3}$$

- Its net worth evolves as follows:

$$n_{i,t+1} = (R^F_{t+1} - R^D_t) Q_t f_{i,t} + (R^B_{t+1} - R^D_t) Q_{B,t} b_{i,t} + (R^{re}_t - R^D_t) re_{i,t} + R^D_t n_{i,t} \tag{4}$$

where, $R^F_{t+1} = \frac{1+\kappa Q_{t+1}}{Q_t}$ and $R^B_{t+1} = \frac{1+\kappa Q_{B,t+1}}{Q_{B,t}}$.

- Each period an intermediary tries to maximize V_{it} subject to both leverage and regulatory constraints.
- Setting the lagrangian for intermediary's maximisation problem:

$$\mathbb{L}_t = V_{it} + \lambda_{it}[V_{it} - \theta_t (Q_t f_{i,t} + \Delta Q_{B,t} b_{i,t})] + \zeta_{it}[Q_{B,t} b_{i,t} - \gamma_t Q_t f_{i,t}]$$

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- First order conditions:

$$\mathbb{E}_t[\Lambda_{t,t+1}\Pi_{t+1}^{-1}\Omega_{i,t+1}(R_{t+1}^F - R_t^D)] = \frac{\lambda_{it}}{1+\lambda_{it}}\theta_t + \frac{\zeta_{it}}{1+\lambda_{it}}\gamma_t \quad (5)$$

$$\mathbb{E}_t[\Lambda_{t,t+1}\Pi_{t+1}^{-1}\Omega_{i,t+1}(R_{t+1}^B - R_t^D)] = \frac{\lambda_{it}}{1+\lambda_{it}}\theta_t\Delta - \frac{\zeta_{it}}{1+\lambda_{it}} \quad (6)$$

$$R_t^{re} = R_t^D \quad (7)$$

where, $\Omega_{i,t+1} = 1 - \sigma + \sigma\frac{\partial V_{it+1}}{\partial n_{i,t+1}}$.

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Key Intuitions

1. Due to binding leverage constraint ($\lambda_{it} \neq 0$), term-premiums exist.
2. Due to binding regulatory constraint ($\zeta_{it} \neq 0$), return on govt. bonds is always lower than the laissez-faire case ($\tilde{\zeta}_{it} = 0$).

$$\mathbb{E}_t[\Lambda_{t,t+1}\Pi_{t+1}^{-1}\Omega_{i,t+1}(R_{t+1}^B - \tilde{R}_{t+1}^B)] = -\frac{\zeta_{it}}{1+\lambda_{it}} \tag{8}$$

3. In the absence of binding regulatory constraint ($\zeta_{it} = 0$), private and govt. bond returns move in same direction.
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Central Bank

- Balance sheet equation of Central Bank:

$$Q_{B,t}b_{cb,t} = re_t \tag{9}$$

- Taylor rule for short-term rate:

$$lnR_t^{re} = (1-\rho_r)lnR^{re} + \rho_r lnR_{t-1}^{re} + (1-\rho_r)[\phi_\pi(ln\Pi_t - ln\Pi) + \phi_y(lnY_t - lnY_{t-1})] + s_r\epsilon_{r,t} \tag{10}$$

- Govt. bonds with Central Bank:

$$b_{cb,t} = (1-\rho_b)b_{cb} + \rho_b b_{cb,t-1} + s_b\epsilon_{b,t} \tag{11}$$

- Govt. bonds market clearing condition:

$$\overline{b_G} = b_t + b_{cb,t} \tag{12}$$

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Term Premium

- Following (Carlstrom et al., 2017),

$$log(Term\ Premium) = log(long\text{-}term\ yield) - log(short\text{-}term\ yield)$$

$$\Rightarrow TP_{i,t} = \frac{RL_t^i}{R_t^{EH}}\ ;\ i \in \{B, F\} \tag{13}$$

- In order to calculate yield of short-term bond, imagine a hypothetical bond whose return is R_t^D. Then, calculate yield using that price.

$$R_t^D = \frac{1 + \kappa Q_{t+1}^{EH}}{Q_t^{EH}} \tag{14}$$

$$\Rightarrow R_t^{EH} = \frac{1}{Q_t^{EH}} + \kappa \tag{15}$$

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1. Exogenous QE shock

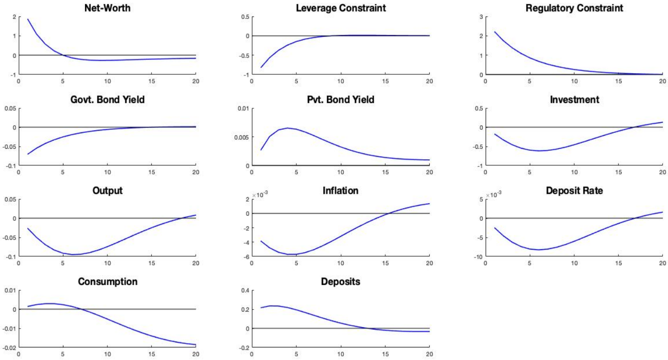

Figure: Impulse Responses to a positive QE shock

2. Conventional Policy shock

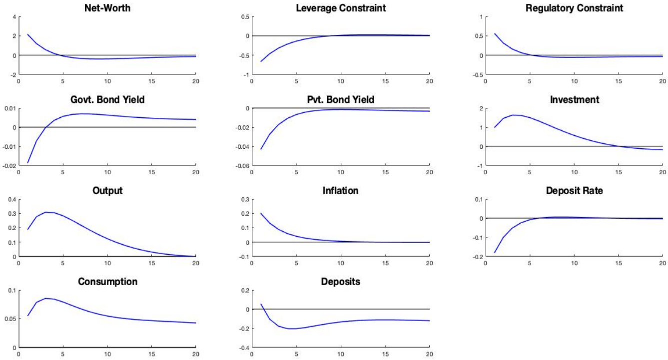

Figure: Impulse Responses to a negative policy rate shock

3. Credit Shock

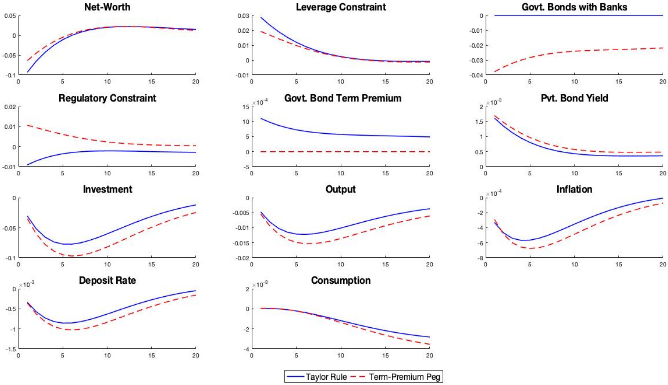

Figure: Impulse Responses to a positive credit shock under different monetary policy regimes

3. Credit Shock

Table: Comparison of Welfare Costs under alternative monetary policy regimes (Measured in percentage points of steady state consumption stream)

Monetary Policy	Welfare Cost (ξ)
Term-Premium Pegging	2.0
Taylor Rule	1.82

Model

4. Productivity shock with & without Term-Premium Peg

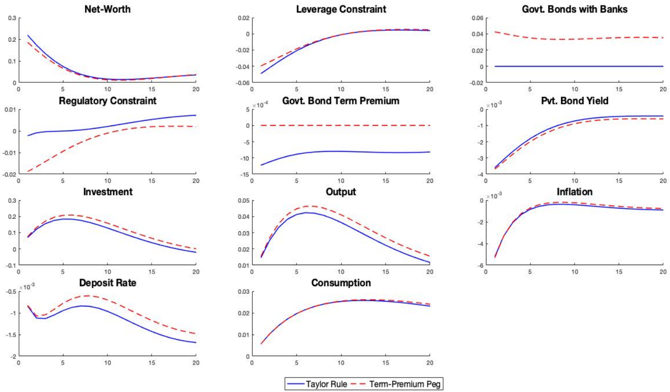

Figure: Impulse Responses to a positive productivity shock under different monetary policy regimes

4. Productivity Shock

Table: Comparison of Welfare Costs under alternative monetary policy regimes (Measured in percentage points of steady state consumption stream)

Monetary Policy	Welfare Cost (ξ)
Term-Premium Pegging	-3.86
Taylor Rule	-3.51

Related Literature

- The work in this paper straddles two broad strands of literature.
  1. (Carlstrom et al., 2017; Gertler & Karadi, 2011, 2013; Sims & Wu, 2020) - all build DSGE models with segmented asset markets and financial frictions to quantify the effects of unconventional monetary policy on macroeconomic aggregates.
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Household

- Utility function:

$$U_t = \mathbb{E}_t \sum_{i=0}^{\infty} \beta^i \left\{ ln(C_{t+i} - hC_{t+i-1}) - \chi \frac{L_{t+i}^{1+\eta}}{1+\eta} \right\} \tag{16}$$

- Budget Constraint:

$$P_t C_t + D_t = W_t L_t + R_{t-1}^D D_{t-1} + DIV_t - P_t X - P_t T_t \tag{17}$$

- First-order conditions:

$$\mu_t = \frac{1}{C_t - hC_{t-1}} - \beta h \mathbb{E}_t \frac{1}{C_{t+1} - hC_t} \tag{18}$$

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Wholesale Firm

- Production function:

$$Y_{w,t} = A_t(u_t K_t)^{\alpha} L_{d,t}^{1-\alpha} \tag{21}$$

- Capital accumulation: $K_{t+1} = \hat{I}_t + (1 - \delta(u_t))K_t$
- "Loan In Advance" constraint:

$$\psi P_t^K \hat{I}_t \leq Q_t CF_{w,t} \tag{22}$$

- First order conditions:

$$w_t = (1-\alpha)p_{w,t}A_t(u_t K_t)^{\alpha} L_{d,t}^{-\alpha} \tag{23}$$

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Retail Firms

- The nominal profits of a retailer f are thus given by:

$$DIV_{R,t}(f) = P_t(f)Y_t(f) - P_{w,t}Y_{w,t}(f)$$

- $Y_{w,t}(f) = Y_t(f)$.
- Putting the demand for retailer $f's$ output from final goods firm's solution, we get the profits in real terms as follows:

$$div_{R,t}(f) = P_t(f)^{1-\epsilon_p} P_t{}^{\epsilon_p - 1} Y_t - p_{w,t} P_t(f)^{-\epsilon_p} P_t{}^{\epsilon_p} Y_t$$

- First order condition w.r.t $P_t(f)$:

$$\Pi_t^{\#} = \frac{P_t^{\#}}{P_t} = \frac{\epsilon_p}{\epsilon_p - 1} \frac{x_{1,t}}{x_{2,t}} \tag{28}$$

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Final Goods Firm

- CES production function:

$$Y_t = \left(\int_0^1 Y_t(f)^{\frac{\epsilon_p - 1}{\epsilon_p}} df \right)^{\frac{\epsilon_p}{\epsilon_p - 1}} \tag{31}$$

- Demand function for retailer $f's$ output as:

$$Y_t(f) = \left(\frac{P_t(f)}{P_t} \right)^{-\epsilon_p} Y_t$$

- Plugging it in equation (31) gives the final good price as an index of retailer prices:

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Capital Goods Producer

- Its production function is as follows:

$$\hat{I}_t = I_t \left[1 - S\left(\frac{I_t}{I_{t-1}}\right)\right] \tag{33}$$

- Nominal profits:

$$DIV_{K,t} = P_t^K I_t \left[1 - S\left(\frac{I_t}{I_{t-1}}\right)\right] - P_t I_t$$

- First order condition:

$$1 = p_t^k \left[1 - S\left(\frac{I_t}{I_{t-1}}\right) - S'\left(\frac{I_t}{I_{t-1}}\right)\frac{I_t}{I_{t-1}}\right] + \mathbb{E}_t\left[\Lambda_{t,t+1} p_{t+1}^k \left(\frac{I_{t+1}}{I_t}\right)^2 S'\left(\frac{I_{t+1}}{I_t}\right)\right]$$

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Government & Central Bank

- Budget constraint:

$$P_t G_t + B_{G,t-1} = P_t T_t + P_t T_{cb,t} + Q_{B,t}(B_{G,t} - \kappa B_{G,t-1}) \quad (34)$$

- CB's revenue each period:

$$P_t T_{cb,t} = B_{cb,t-1} + \kappa Q_{B,t} B_{cb,t-1} - R^{re}_{t-1} RE_{t-1} \quad (35)$$

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Aggregate Conditions

- Aggregate inflation:

$$1 = (1 - \phi_p){\Pi^{\#}}^{1-\epsilon_p} + \phi_p \Pi_t^{\epsilon_p - 1} \tag{36}$$

where, $\Pi_t^{\#} = \frac{P_t^{\#}}{P_t}$ and $\Pi_t = \frac{P_t}{P_{t-1}}$.

- Aggregate demand of retailers should equal the wholesale output, i.e.,

$$Y_{w,t} = \int_0^1 Y_t(f)df = Y_t \int_0^1 \left(\frac{P_t(f)}{P_t}\right)^{-\epsilon_p} df = Y_t \nu_t^p$$

where, $\nu_t^p = (1 - \phi_p){\Pi_t^{\#}}^{-\epsilon_p} + \phi_p \Pi_t^{\epsilon_p} \nu_{t-1}^p$ is a measure of price-dispersion in the retailer prices.

- Aggregate resource constraint:

$$Y_t = C_t + I_t + G_t \tag{37}$$

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where, $\nu_t^p = (1-\phi_p){\Pi_t^{\#}}^{-\epsilon_p} + \phi_p \Pi_t^{\epsilon_p} \nu_{t-1}^p$ is a measure of price-dispersion in the retailer prices.

- Aggregate resource constraint:

$$Y_t = C_t + I_t + G_t \tag{37}$$

Aggregate Conditions

- Aggregate inflation:

$$1 = (1-\phi_p){\Pi^{\#}}^{1-\epsilon_p} + \phi_p \Pi_t^{\epsilon_p - 1} \tag{36}$$

where, $\Pi_t^{\#} = \frac{P_t^{\#}}{P_t}$ and $\Pi_t = \frac{P_t}{P_{t-1}}$.

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Welfare Cost

- Fraction ξ of non-stochastic steady state consumption stream that households would be willing to give up to be indifferent.

$$U((1-\xi)C, L) = \mathbb{E}[U(C_t^a, L_t^a)] \tag{38}$$

- Here, $\{C, L\}$ are the constant steady state consumption and labor values, and $\{C_t^a, L_t^a\}$ correspond to the alternative policy.
- Solving for ξ, we get

$$\xi = 1 - exp[(1-\beta)(\mathbb{E}[W_t^a] - W^{ss})]$$

- W_t is the present discounted value of lifetime utility at time t and W^{ss} is its steady state value. Back
- $\xi > 0 \Rightarrow$ household needs to give up consumption under steady state if it wants to achieve same welfare as the alternative policy regime.
- However, $\xi < 0$ means that the household is better under alternative regime than the steady state.

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