Lecture 3

Financial Intermediation, Dynamic Contracting

and

Unconventional Monetary Policy

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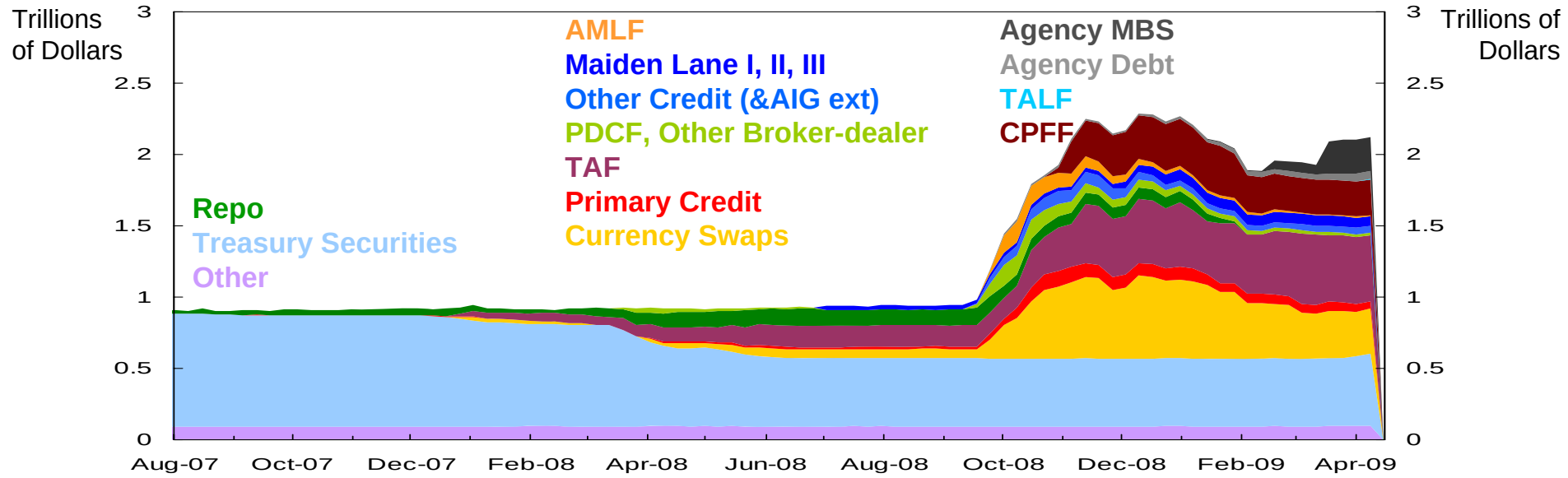
Unconventional vs. Conventional Monetary Policy

Conventional: The central bank adjusts the short term rate to affect the market structure of interest rates.

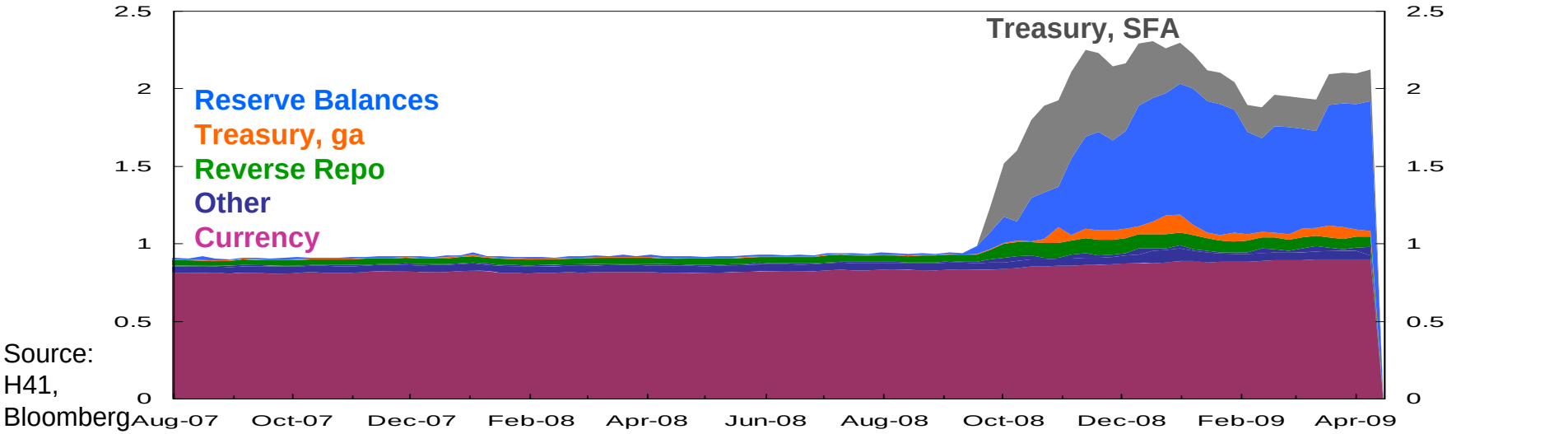
Unconventional: The central bank lends directly in private credit markets.

Section 13.3 of the Federal Reserve Act: "In unusual and exigent circumstances.. the Federal Reserve may lend directly to private borrowers to the extent it judges the loans to be adequately secured."

Federal Reserve Assets



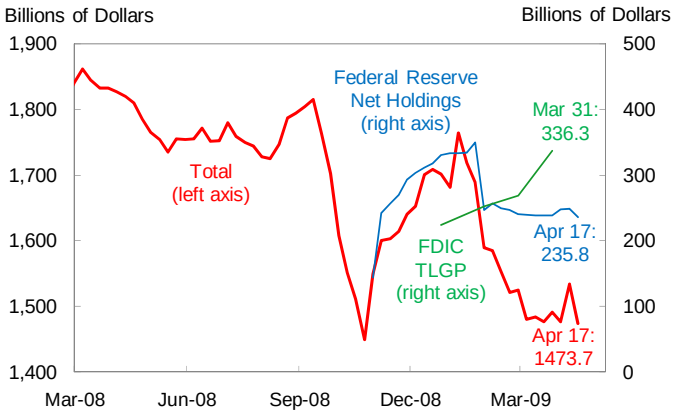
Federal Reserve Liabilities



Source: H41, Bloomberg

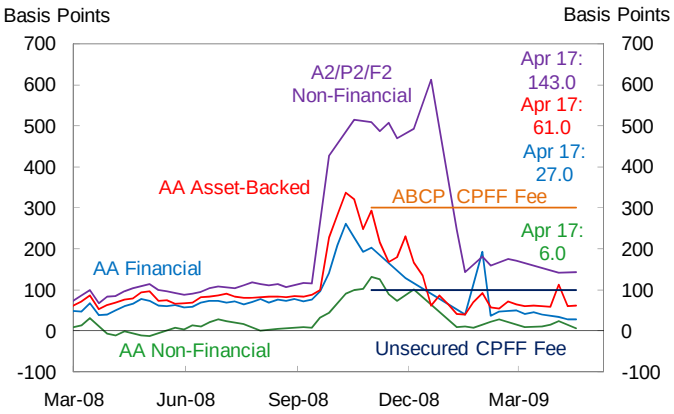
Liquidity Facilities

CPFF and Commercial Paper Outstanding



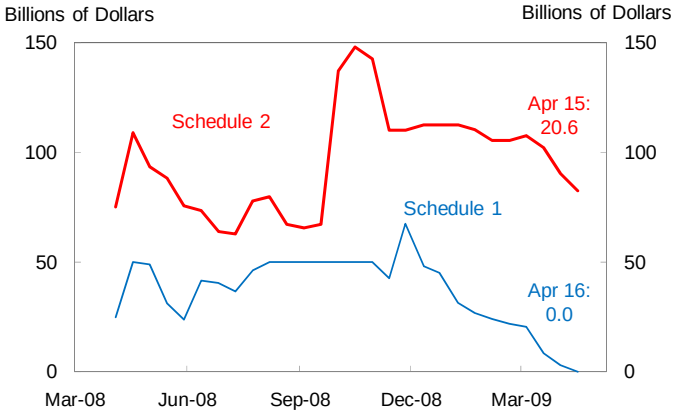
Source: Federal Reserve Board, Haver, FDIC

3-month CP Rates over OIS



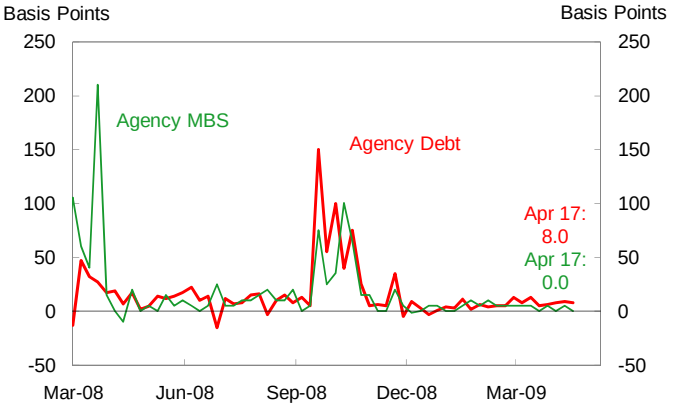
Source: Federal Reserve Board, Haver, Bloomberg

TSLF Schedule 1 & 2 Total Outstanding



Source: Federal Reserve Board

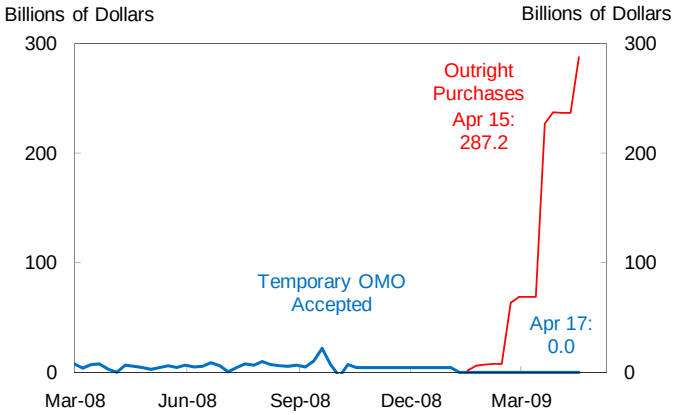
Overnight Financing Spreads



Source: Bloomberg

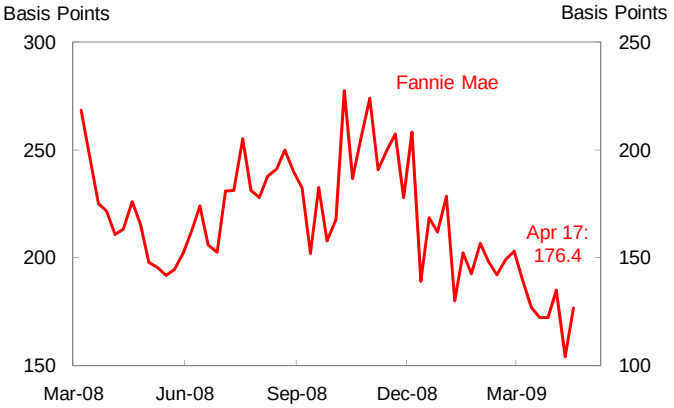
Note: Spreads are between overnight agency debt and MBS and Treasury general collateral repo rates

Agency MBS Transactions



Source: Federal Reserve Board, Haver

Agency MBS to Average 5y and 10y Yields



Source: FRB, Haver, Bloomberg

Note: Spreads are agency 30 year on-the-run coupon to average of 5 and 10 year yields

Issues

Current crisis has featured a disruption of financial intermediation.

The Fed has used unconventionary monetary policy to combat it:

However, existing quantitative models not adequate:

- Baseline models (Christiano/Eichenbaum/Evans, Smets/Wouters) have frictionless capital markets
- Models with financial frictions (Bernanke/Gertler/Gilchrist, Christiano, Motto, Rostagno) consider frictions on non-financial firms and do not model credit policy.

Gertler/Karadi 2009

- Develop a quantitative monetary DSGE model that allows for financial intermediaries that face endogenous balance sheet constraints.

- Use the model to simulate a crisis that has some of the features of the current downturn.

- Assess how unconventional monetary policy (direct central bank intermediation.) could moderate the downturn.

- Compute the optimal "uncoventional" response to the downturn and the welfare gains.

Model

Monetary DSGE with Balance-Sheet Constrained Financial Intermediaries

Agents

- Households
- Financial Intermediaries (face financial constraints)
- Intermediate Goods Producer
- Capital Producers
- Monopolistically competitve retailers (set nominal prices on a staggered basis)
- Central Bank

Households

- Within each household, $1-f$ "workers" and f "bankers".
- Workers supply labor and return their wages to the household.
- Each banker manages a financial intermediary and also transfers earnings back to household.
- Perfect consumption insurance within the family.

Households (con't)

To limit bankers' ability to save to overcome financial constraints:

- With i.i.d prob. $1-\theta$, a banker exits next period. (average survival time $= \frac{1}{1-\theta}$)
- Upon exiting, a banker transfers retained earnings to the household and becomes a worker.
- Each period, $(1-\theta)f$ workers randomly become bankers, keeping the number in each occupation constant
- Each new banker receives a "start up" transfer from the family.

Households (con't)

$$\max E_t \sum_{i=0}^{\infty} \beta^i [\ln(C_{t+i} - hC_{t+i-1}) - \frac{\chi}{1+\varphi} L_{t+i}^{1+\varphi}]$$

s.t.

$$C_t = W_t L_t + \Pi_t + T_t + R_t B_t - B_{t+1}$$

- $B_t \equiv$ short term debt (intermediary deposits and government debt)
- $\Pi_t \equiv$ payouts to the household from firm ownership net the transfer it gives to its new bankers.

Financial Intermediaries

- Intermediary Balance Sheet

$$Q_t S_{jt} = N_{jt} + B_{jt}$$

- Evolution of Net Worth

$$\begin{aligned} N_{jt+1} &= R_{kt+1} Q_t S_{jt} - R_{t+1} B_{jt} \\ &= (R_{kt+1} - R_{t+1}) Q_t S_{jt} + R_{t+1} N_{jt} \end{aligned}$$

Financial Intermediaries (con't)

$$
\begin{aligned}
V_{jt} &= \max E_t \sum_i (1-\theta)\theta^i \beta^i \Lambda_{t,t+i}(N_{jt+1+i}) \\
&= \max E_t \sum_i (1-\theta)\theta^i \beta^i \Lambda_{t,t+i}[(R_{kt+1+i} - R_{t+1+i})Q_{t+i}S_{jt+i} \\
&\qquad + R_{t+1+i}N_{jt+i}]
\end{aligned}
$$

- With Frictionless Capital Markets:

$$E_t \beta \Lambda_{t,t+1+i}(R_{kt+1+i} - R_{t+1+i}) = 0$$

- With Capital Market Frictions:

$$E_t \beta \Lambda_{t,t+1+i}(R_{kt+1+i} - R_{t+1+i}) \geq 0$$

Financial Intermediaries (con't)

- Agency Problem: After the banker/intermediary borrows funds at the end of period t, it may divert the fraction λ of total assets back to its family.

- If the intermediary does not honor its debt, depositers can liquidate the intermediate and obtain the fraction $1 - \lambda$ of initial assets

- Incentive Constraint:

$$V_{jt} \geq \lambda Q_t S_{jt}$$

Financial Intermediaries (con't)

- Simplifying V_{jt} :

$$V_{jt} = v_t \cdot Q_t S_{jt} + \ \eta_t N_{jt}$$

$$\begin{aligned} v_t &= E_t\{(1-\theta)\beta\Lambda_{t,t+1}(R_{kt+1} - R_{t+1}) + \beta\Lambda_{t,t+1}\theta x_{t,t+1} v_{t+1}\} \\ \eta_t &= E_t\{(1-\theta) + \beta\Lambda_{t,t+1}\theta z_{t,t+1}\eta_{t+1}\} \end{aligned}$$

with $x_{t,t+i} \equiv Q_{t+i}S_{jt+i}/Q_t S_{jt}$, $z_{t,t+i} \equiv N_{jt+i}/N_{jt}$.

Financial Intermediaries (con't)

- The incentive constraint becomes:

$$v_t \cdot Q_t S_{jt} + \eta_t N_{jt} \geq \lambda Q_t S_{jt}$$

- When constraint binds:

$$\begin{aligned} Q_t S_{jt} &= \frac{\eta_t}{\lambda - v_t} N_{jt} \\ &= \phi_t N_{jt} \end{aligned}$$

where ϕ_t is the intermediaries "leverage" ratio.

Financial Intermediaries (con't)

$$\phi_t = \frac{\eta_t}{\lambda - v_t}$$

$$\begin{aligned} v_t &= E_t\{(1-\theta)\beta\Lambda_{t,t+1}(R_{kt+1} - R_{t+1}) + \beta\Lambda_{t,t+1}\theta x_{t,t+1} v_{t+1}\} \\ \eta_t &= E_t\{(1-\theta) + \beta\Lambda_{t,t+1}\theta z_{t,t+1}\eta_{t+1}\} \end{aligned}$$

$$z_{t,t+i} \equiv N_{jt+i}/N_{jt} = (R_{kt+1} - R_{t+1})\phi_t + R_{t+1}$$

$$x_{t,t+i} \equiv Q_{t+i}S_{jt+i}/Q_tS_{jt} = \phi_{t+1}N_{t+1}/\phi_tN_t = (\phi_{t+1}/\phi_t)z_{t,t+i}$$

$\Longrightarrow$ Leverage ratio ϕ_t does not depend on firm specific factors.

Financial Intermediaries (con't)

- Since the leverage ratio ϕ_t does not depend on firm-specific factors, we can aggregate:

$$Q_t S_{pt} = \phi_t N_t$$

- where:

$Q_t S_{pt} \equiv$ total assets privately intermediated

$N_t \equiv$ total intermediary capital

Credit Policy

- Central bank intermediation supplements private intermediation:

$$Q_t S_t = Q_t S_{pt} + Q_t S_{gt}$$

- The central bank issues government debt that pays R_{t+1} and then lends to non-financial firms at R_{kt+1}.

- Efficiency cost of τ per unit of gov't credit provided.

- Unlike private intermediaries, the central bank is not "balance-sheet" constrained.

Credit Policy (con't)

$$Q_t S_{gt} = \psi_t Q_t S_t$$

- $\Longrightarrow$

$$\begin{aligned} Q_t S_t &= Q_t S_{pt} + Q_t S_{gt} \\ &= \phi_t N_t + \psi_t Q_t S_t \end{aligned}$$

$\Longrightarrow$

$$Q_t S_t = \frac{1}{1-\psi_t} \phi_t N_t$$

- $Q_t S_t$ is increasing in the intensity of credit policy, as measured by ψ_t.

Evolution of Net Worth

$$N_t = N_{et} + N_{nt}$$

$$N_{et} = \theta[(R_{kt} - R_t)\phi_t + R_t]N_{t-1}$$

$$N_{nt} = \frac{\xi}{1-\theta}(1-\theta)Q_t S_{t-1}$$

$\Rightarrow$

$$N_t = \theta[(R_{kt} - R_t)\phi_t + R]N_{t-1} + \xi Q_t S_{t-1}$$

Intermediate Goods Firms

- At the end of period t, an intermediate goods producer acquires capital K_{t+1} for use in $t+1$
- No adjustment costs and no financing frictions
- The firm finances K_{t+1} by obtaining funds from intermediaries.
- It issues S_t claims equal to the number of units of capital acquired K_{t+1} and prices each claim at the price of a unit of capital Q_t :

$$Q_t K_{t+1} = Q_t S_t$$

Intermediate Goods Firms (con't)

- Production

$$Y_{t+1} = A_{t+1}(U_{t+1}K_{t+1})^{\alpha}L_{t+1}^{1-\alpha}$$

- Objective

$$\max E_t\beta\Lambda_{t,t+1}[P_{mt+1}Y_{t+1} + (Q_{t+1} - \delta(U_{t+1}))\xi_{t+1}K_{t+1} - R_{kt+1}Q_tK_{t+1} - W_{t+1}L_{t+1}]$$

- ξ_{t+1} is a shock to "capital quality."

  in the aggregate

$$K_{t+2} = I_{t+1} + (1 - \delta(U_{t+1}))\xi_{t+1}K_{t+1}$$

Intermediate Goods Firms (con't)

F.O.N.C.

$$E_t \beta \Lambda_{t,t+1} R_{kt+1} = E_t \{ \beta \Lambda_{t,t+1} \frac{P_{mt+1} \alpha \frac{Y_{t+1}}{K_{t+1}} + (Q_{t+1} - \delta(U_{t+1})) \xi_{t+1}}{Q_t} \}$$

$$P_{mt+1} \alpha \frac{Y_{t+1}}{U_{t+1}} = \delta'(U_{t+1})$$

$$P_{mt+1} \alpha \frac{Y_{t+1}}{L_{t+1}} = W_{t+1}$$

Capital Producing Firms

- Produce new capital to sell to the market, subject to adjustment costs on the rate of net investment.
- Q_t relation for investment:

$$Q_t[1 - S\left(\frac{I_{nt}}{I_{nt-1}}\right) - S'\left(\frac{I_{nt}}{I_{nt-1}}\right)] = [1 - \beta E_t \Lambda_{t,t+1} \cdot Q_{t+1} S'\left(\frac{I_{nt+1}}{I_{nt}}\right)\left(\frac{I_{nt+1}}{I_{nt}}\right)^2]$$

$$I_{nt} = I_t - \delta(U_t))\psi_t K_t$$

Retail Firms

- Monopolistically competitive retailers by input from intermediate goods producers and re-package as final output.

- Set nominal prices on a staggered basis

- $P_{m,t}$ is marginal cost ($(P_{m,t})^{-1}$ is the markup).

Resource and Government Budget Constraints

- Resource Constraint

$$Y_t = C_t + I_t + G + \tau \psi_t Q_t K_{t+1}$$

- Government Budget Constraint

$$G + \tau \psi_t Q_t K_{t+1} = T_t + (R_{kt} - R_t) B_{gt-1}$$

Central Bank Policy

- Interest Rate Policy

$$i_t = (1-\rho)[\bar{i} + \iota_\pi \pi_t + \iota_y(\log Y_t - \log Y_t^*) + \rho i_{t-1} + \epsilon_t$$

with

$$1 + i_t = R_{t+1}\frac{P_{t+1}}{P_t}$$

- Credit Policy

$$\psi_t = \psi + \nu[E_t(R_{kt+1} - R_{t+1}) - (R_k - R)]$$

Table 1: Parameter Values for Baseline Model

	Households	
β	0.995	Discount rate
h	0.700	Habit parameter
χ	5.584	Relative utility weight of labor
φ	0.333	Inverse Frisch elasticity of labor supply
	Financial Intermediaries	
λ	0.383	Fraction of capital that can be diverted
ξ	0.003	Proportional transfer to the entering bankers
θ	0.972	Survival rate of the bankers
	Intermediate good firms	
α	0.330	Effective capital share
u	1.000	Steady state utilization rate
$\delta(u)$	0.025	Steady state depreciation rate
ζ	1.000	Elasticity of marginal depreciation with respect to utilization rate
	Capital Producing Firms	
η_i	2.500	Inverse elasticity of net investment to the price of capital
	Retail firms	
ε	11.000	Elasticity of substitution
γ	0.750	Probability of keeping prices fixed
γ_P	0.500	Measure of price indexation
	Government	
κ_π	1.500	Inflation coefficient of the Taylor rule
κ_X	-0.500	Output gap coefficient of the Taylor rule
$\frac{G}{Y}$	0.200	Steady state proportion of government expenditures

Figure 1: Responses to Technology (a) , Monetary (m) and Wealth (w) Shocks

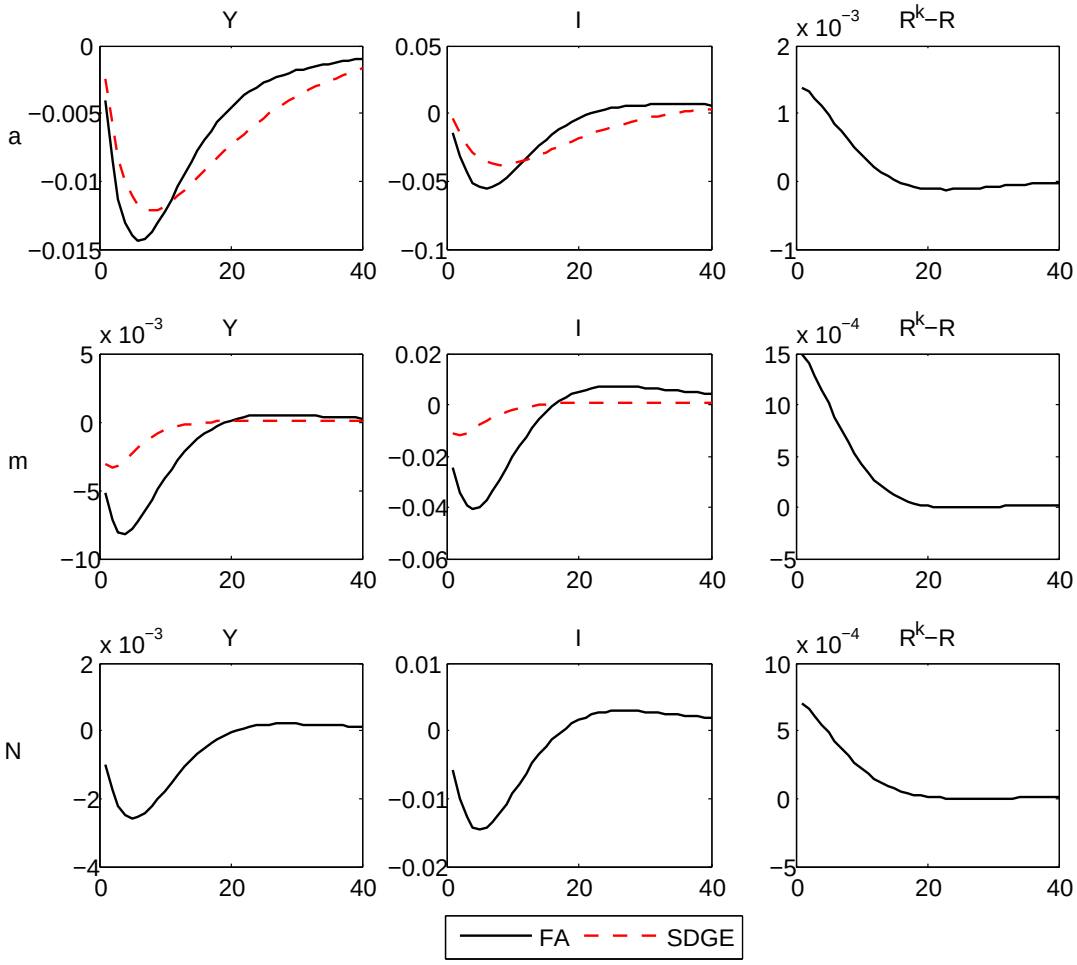


Figure 2: Responses to a Capital Quality Shock

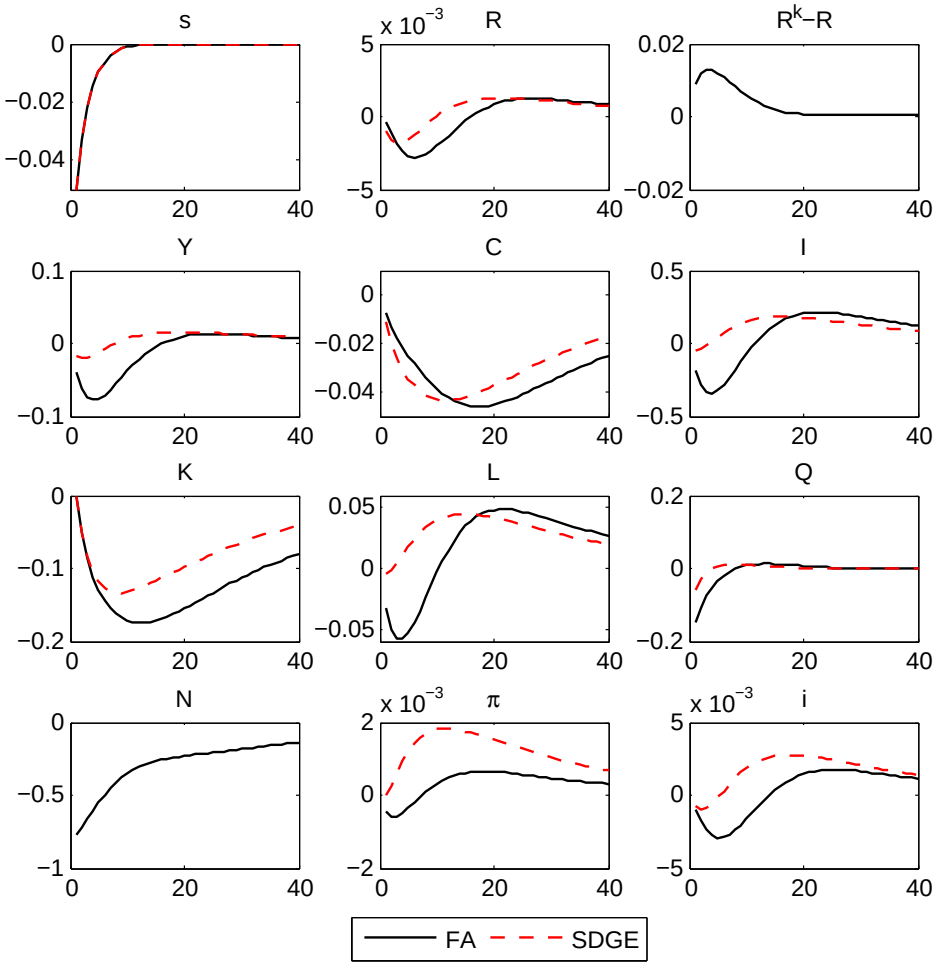
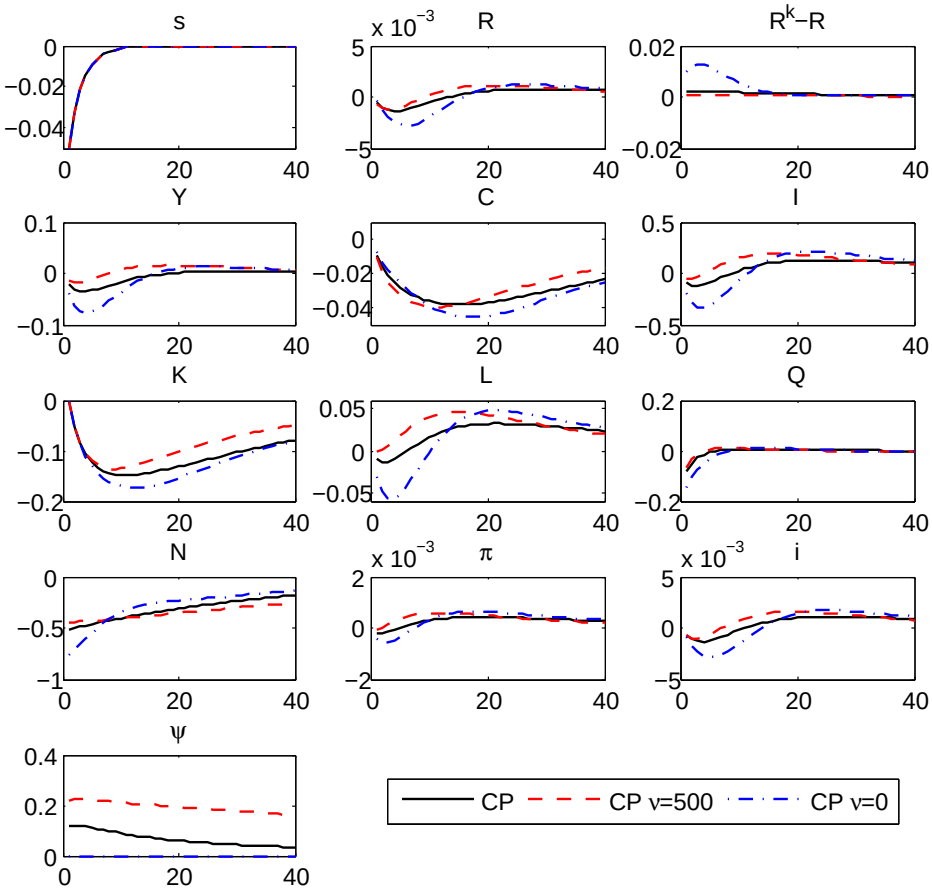


Figure 3: Responses to a Capital Quality Shock with Credit Policy



Welfare and Optimal Policy

- Household Utility

$$\Omega_t = U(C_t, L_t) + \beta E_t \Omega_{t+1}$$

- Take a quadratic approximation and combine with a quadratic of the model.

- Solve numerically for the reduced form, given values of the policy-parameters.

- Find numerically the optimal value of the credit policy parameter υ conditional on a "crisis" shock.

- Find the consumption adjustment equivalent that the makes the houshehold indifferent between the optimal policy response vs. no response.

Figure 4: One year consumption equivalent welfare gains from optimal credit policy as a function of efficiency costs tau and steady state markup

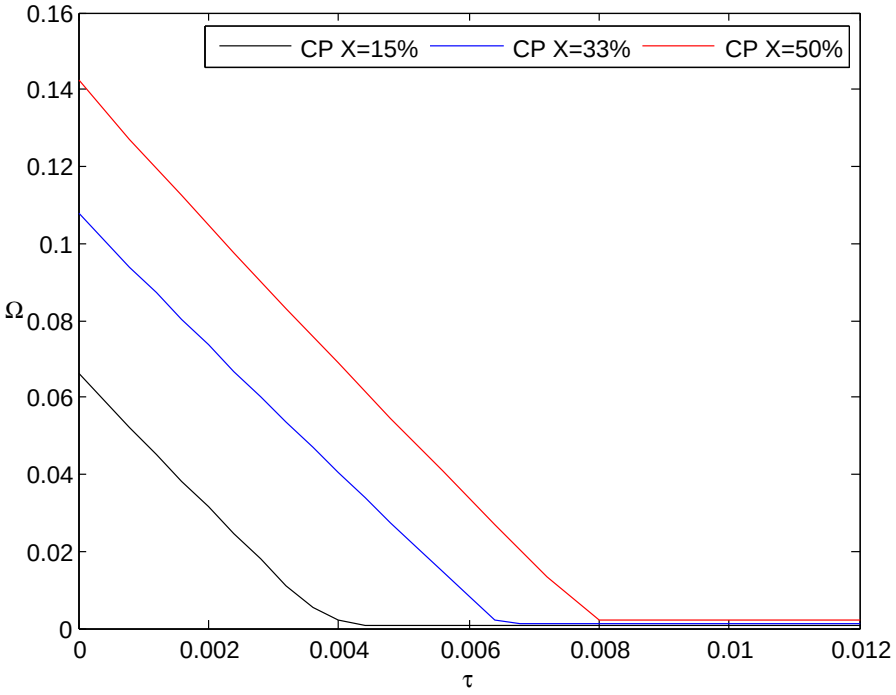


Figure 5: One year consumption equivalent welfare gains from optimal credit policy as a function of efficiency costs tau and steady state markup with high labor supply elasticity

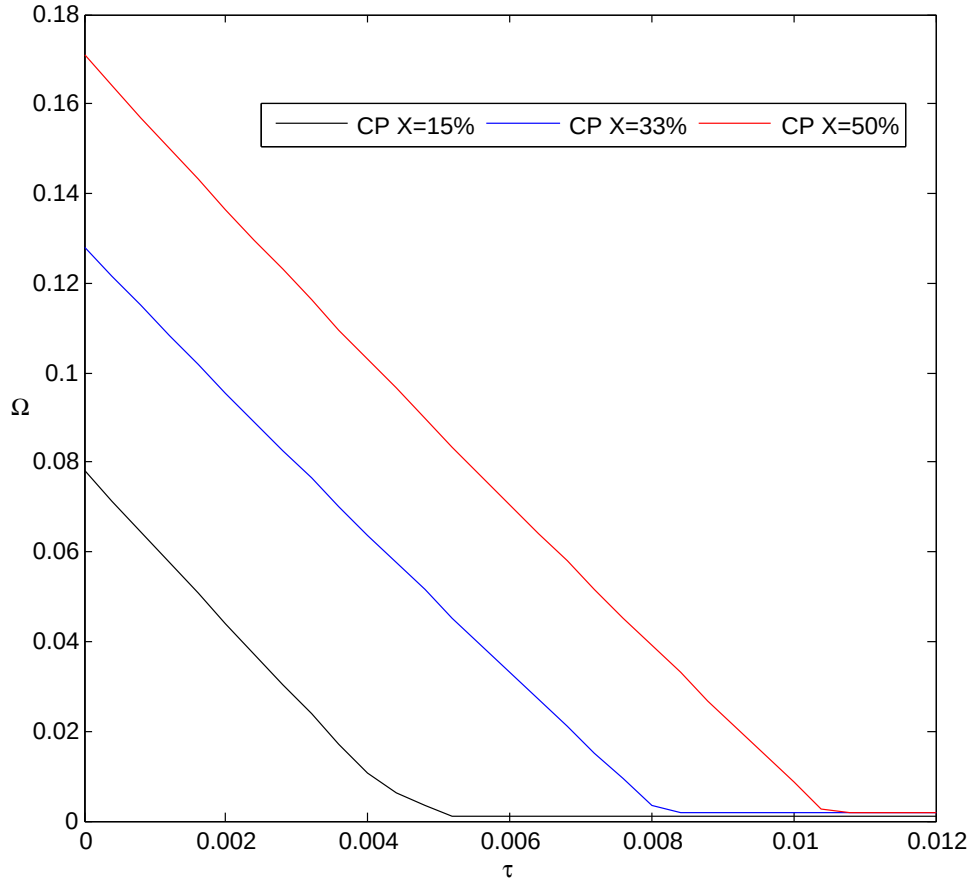


Figure 6: Credit vs. premium policy