Financial Crises, Bank Risk Exposure and Government Financial Policy

Mark Gertler, Nobuhiro Kiyotaki and Albert Queralto
NYU, Princeton and NYU

Motivation

How exogenous shocks may cause a financial crises through the bank balance-sheet channel?

How can credit policy mitigate the crises?

Why do banks choose the risky balance-sheet structure? How does the anticipation of credit policy make the bank balance-sheet more risky?

What would be the policy to mitigate this moral hazard of the banks?

Model: Aggregate production function:

$$Y_t = A{K_t}^{\alpha} L_t^{1-\alpha}, \quad 0 < \alpha < 1$$

Capital in process at t for t+1:

$$S_t = I_t + (1-\delta) K_t$$

Capital stock is subject to capital quality shock

$$K_t = \psi_t S_{t-1},$$

$$\begin{aligned} \psi_t &= \widetilde{\psi}_t \widetilde{\psi}_t^D, \\ \ln \widetilde{\psi}_t^D &= \begin{cases} -(1-\pi)\Delta, \ wp \ \pi \\ \pi\Delta, \ wp \ 1-\pi \end{cases} \end{aligned}$$

Resource constraint

$$Y_t = C_t + \left[1 + f\left(\frac{I_t}{I_{t-1}}\right)\right] I_t + G_t$$

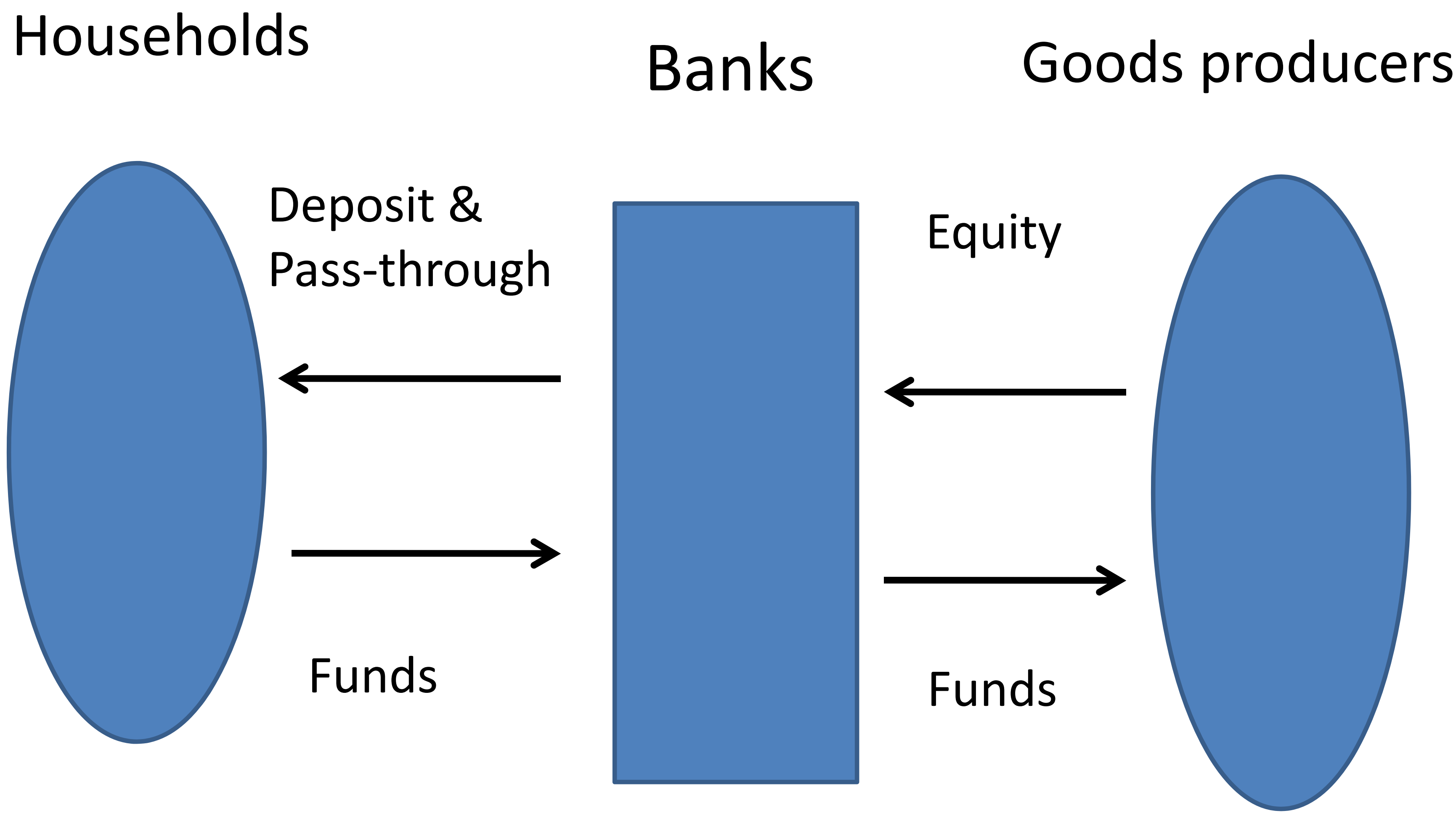
The goods producer hires workers to produce $\longrightarrow$ profit per unit of capital:

$$Z_t = \frac{Y_t - W_t L_t}{K_t} = \alpha A \left(\frac{L_t}{K_t}\right)^{1-\alpha}$$

Goods producer sells equity to banks in order to finance new investment. Each equity pays dividend:

$\psi_{t+1} Z_{t+1}$, $(1\text{-}\delta)\,\psi_{t+1}\psi_{t+2} Z_{t+2}$, $(1\text{-}\delta)^2\,\psi_{t+1}\psi_{t+2}\psi_{t+3} Z_{t+3}$,..

$Q_t =$ price of the producer's equity sold to bankers $=$ price of investment goods


Households
Banks
Goods producers
Deposit &
Pass-through
Equity
Funds
Funds

Each household consists of many members, $1 - f$ workers, f bankers

Workers supply labor and bring wages back to the household

Each banker manages a bank, retains some earning and brings back the rest to the household

Perfect consumption insurance within the household

Each period, bankers exit to become workers and bring back the retained earning with prob $1 - \sigma$

$(1 - \sigma) f$ workers become bankers with ξ fraction of total asset of the household as the start-up fund

The household chooses $(C_t, L_t, I_t, D_{ht}, e_{ht})$ to maximize

$$E_t \sum_{\tau=t}^{\infty} \beta^{\tau-t} \frac{1}{1-\gamma} \left(C_\tau - hC_{\tau-1} - \frac{\chi}{1+\varphi} L_\tau^{1+\varphi} \right)^{1-\gamma},$$

$$s.t. \quad C_t + D_{ht} + q_t e_{ht}$$

$$= W_t L_t + \Pi_t - T_t + R_t D_{ht-1} + [Z_t + (1\text{-}\delta) q_t] \psi_t e_{ht-1}$$

D_{ht} is short-term debt, e_{ht} is pass-through security of banks, and Π_t is net transfer from banks and capital goods production

$$1 = E_t(\Lambda_{t,t+1}) R_{t+1} = E_t(\Lambda_{t,t+1} R_{et+1})$$

$$\Lambda_{t,\tau} = \beta^{\tau-t} \frac{u_{C\tau}}{u_{Ct}}, \; R_{et+1} = \psi_{t+1} \frac{Z_{t+1} + (1-\delta) q_{t+1}}{q_t}$$

$$Q_t = 1 + f\left(\frac{I_t}{I_{t-1}}\right) + \frac{I_t}{I_{t-1}} f'\left(\frac{I_t}{I_{t-1}}\right) - E_t \Lambda_{t,t+1} \left(\frac{I_{t+1}}{I_t}\right)^2 f'\left(\frac{I_{t+1}}{I_t}\right)$$

The bank raises fund by issuing deposit d_t and pass-through e_t in order to purchase producers' equity:

$$Q_t s_t = n_t + q_t e_t + d_t$$

The net worth of the bank is

$$n_t = [Z_t + (1\text{-}\delta)Q_t]\,\psi_t s_{t-1} - [Z_t + (1\text{-}\delta)q_t]\,\psi_t e_{t-1} - R_t d_{t-1}$$

The value of the bank at the end of period t is

$$V_t = V(s_t, x_t, n_t) = E_t \sum_{\tau=t+1}^{\infty} (1-\sigma)\sigma^{\tau-t}\Lambda_{t,\tau} n_\tau$$

After the bank obtains funds, the banker may steal a fraction. The incentive constraint for the bank not to steal is

$$V(s_t, x_t, n_t) \geq \Theta(x_t)\, Q_t s_t$$

$$\Theta(x_t) = \theta\left(1 + \varepsilon x_t + \frac{\kappa}{2} x_t^2\right), \text{ where } x_t = \frac{q_t e_t}{Q_t s_t}$$

Bellman equation

$$
\begin{aligned}
& V\left(s_t, x_t, n_t\right)=(\mu_{st}+\mu_{et} x_t) Q_t s_t+\nu_t n_t \\
= \ & E_t \Lambda_{t, t+1}\left\{(1-\sigma) n_{t+1}+\sigma \underset{s_{t+1}, x_{t+1}}{Max} V\left(s_{t+1}, x_{t+1}, n_{t+1}\right)\right\}
\end{aligned}
$$

The optimization of bank implies

$$
\begin{aligned}
\nu_t &= E_t(\Lambda_{t,t+1}\Omega_{t+1})R_{t+1} \\
\mu_{st} &= E_t[\Lambda_{t,t+1}\Omega_{t+1}(R_{kt+1}-R_{t+1})] \\
\mu_{et} &= E_t[\Lambda_{t,t+1}\Omega_{t+1}(R_{t+1}-R_{et+1})] \\
\phi_t &= \frac{\nu_t}{\Theta\left(x_t\right)-(\mu_{st}+\mu_{et} x_t)},\ x_t=x\left(\frac{\mu_{et}}{\mu_{st}}\right), x^{\prime}>0 \\
\Omega_{t+1} &= 1-\sigma+\sigma[\nu_{t+1}+\phi_{t+1}(\mu_{st+1}+x_{t+1}\mu_{et+1})] \\
R_{kt+1} &= \psi_{t+1} \frac{Z_{t+1}+(1-\delta) Q_{t+1}}{Q_t}
\end{aligned}
$$

Credit Policies: Central bank purchases a fraction ζ_t of producers' equities with the administrative cost of $\Gamma_t(Q_t S_{gt})$

$$S_{gt} = \zeta_t S_t, \text{ where } \zeta_t = v_g \left[E_t \left(R_{kt+1} \right) - R_{t+1} - (R_k - R) \right]$$

Macro prudential policy: Tax on banks for the risky asset holding and subsidize their pass-through issue

$$(1 + \tau_t) Q_t s_t = n_t + (1 + \tau_t^s) q_t e_t + d_t$$

Government budget constraint:

$$\begin{aligned} & G + \Gamma_t(Q_t S_{gt}) + Q_t S_{gt} + R_t D_{gt-1} \\ = \ & T_t + [Z_t + (1\text{-}\delta) Q_t] \psi_t S_{gt-1} + D_{gt} \end{aligned}$$

The market of producers' equities implies

$$Q_t(S_t - S_{gt}) = Q_t S_{pt} = \phi_t N_t$$

The aggregate net worth of banks is

$$\begin{aligned} N_t &= (\sigma + \xi)[Z_t + (1-\delta)Q_t]\psi_t S_{pt-1} \\ &\quad -\sigma[Z_t + (1-\delta)q_t]\psi_t e_{ht-1} - \sigma R_t D_{t-1} \end{aligned}$$

The equilibrium of pass-through and deposit implies

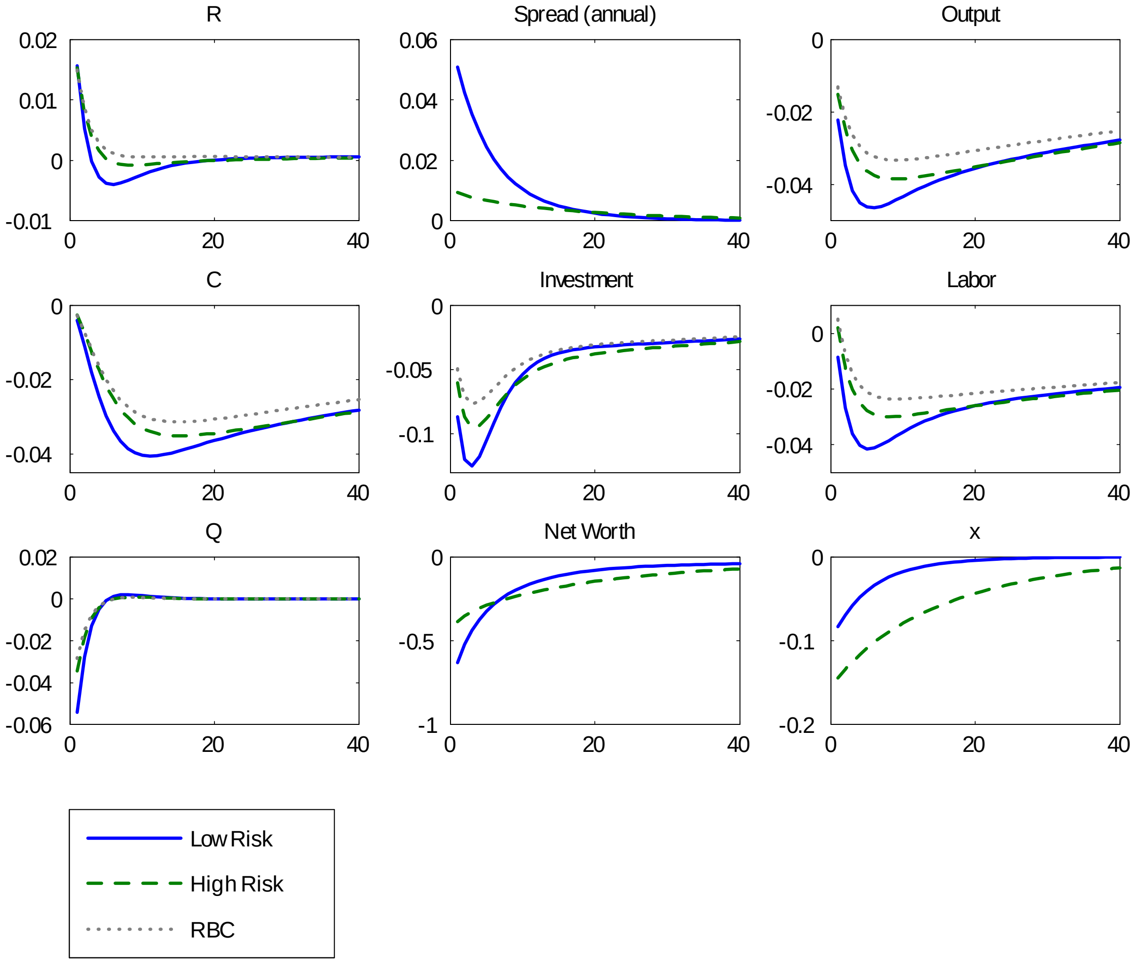
$$\begin{aligned} q_t e_{ht} &= x_t \cdot Q_t S_{pt} \\ D_{ht} - D_{gt} &= D_t = (1 - x_t) Q_t S_{pt} - N_t \end{aligned}$$

Table 1: Parameter Values

γ	2	Risk aversion
β	0.99	Discount factor
α	0.33	Capital share
δ	0.02	Depreciation rate
χ	0.25	Utility weight of labor
φ	1/3	Inverse Frisch elasticity of labor supply
If''/f'	1	Inverse elasticity of investment to the price of capital
h	0.75	Habit parameter
σ	0.9685	Survival rate of bankers
ξ	0.0289	Transfer to entering bankers
		Asset diversion parameters:
θ	0.264	
ϵ	-1.21	
κ	13.41	

Table 2: Steady States

	No Policy		**Credit Policy**		**Macroprudential Policy** ($\tau^s = 0.0061$)	
	Low Risk	High Risk	Low Risk	High Risk	Low Risk	High Risk
Output	23.821	23.53	24.18	23.85	24.04	23.83
C	18.58	18.37	18.82	18.58	18.73	18.57
L	8.16	8.08	8.26	8.16	8.22	8.15
K	209.52	206.16	214.34	210.46	212.48	210.41
N	31.77	38.02	30.05	37.11	30.85	37.72
Risk Free Rate (%)	4.08	3.72	4.06	3.68	4.05	3.56
Spread (%)	0.99	1.46	0.89	1.38	0.94	1.48
x (%)	10.12	15.16	9.63	13.35	18.77	21.98
ν	1.63	1.38	1.76	1.42	1.81	1.54
μ_e	0.05	0.15	0.03	0.12	0.03	0.08
μ_s	0.29	0.16	0.33	0.19	0.37	0.27
ϕ	6.59	5.42	7.13	5.67	6.89	5.58
$QK/(N + xQK)$	3.95	2.98	4.23	3.23	3.00	2.51
N/xQK	1.50	1.22	1.46	1.32	0.77	0.82
SD shock (%)	0.69	2.07	0.69	2.07	0.69	2.07
SD output growth (%)	1.09	2.53	0.81	2.43	0.80	2.29


R
Spread (annual)
Output
C
Investment
Labor
Q
Net Worth
x
0.02
0.01
0
-0.01
0.06
0.04
0.02
-0.02
-0.04
-0.05
-0.1
-0.06
-0.5
-1
-0.2
20
40
Low Risk
High Risk
RBC

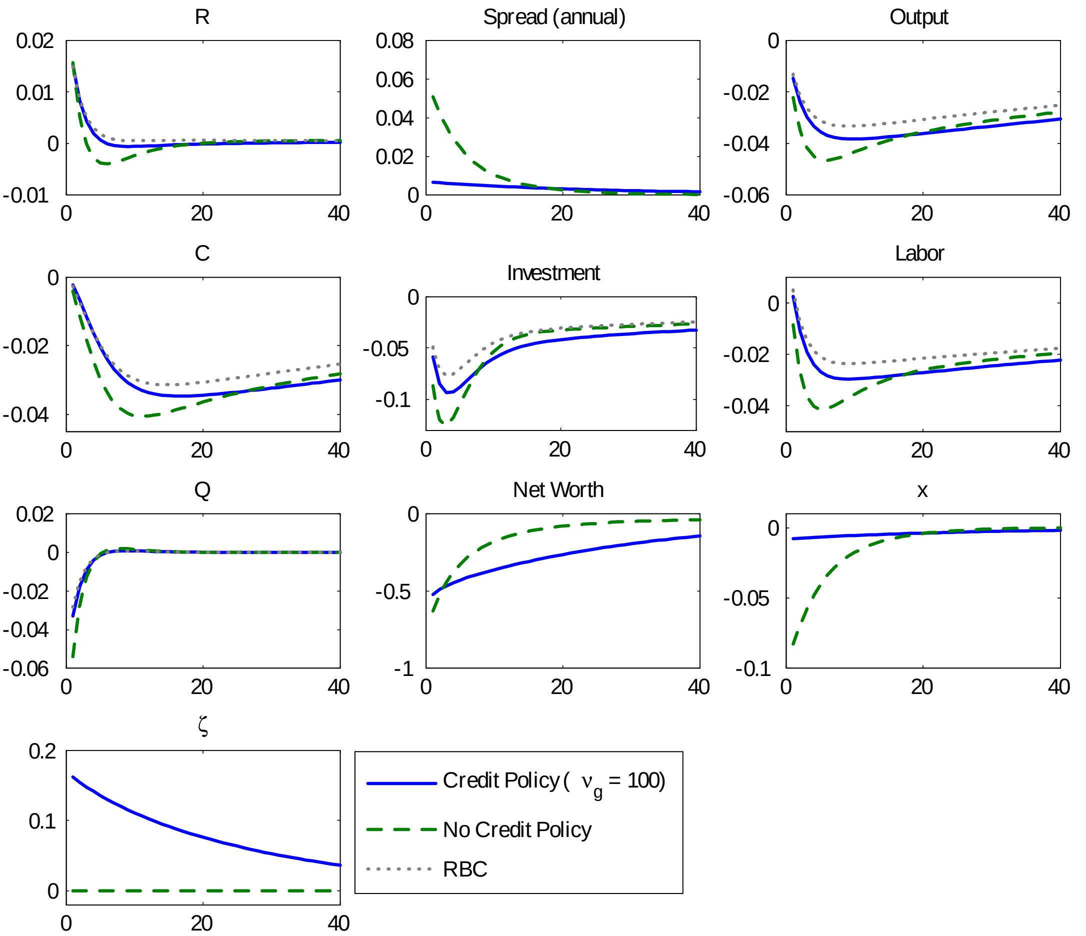


Figure 2. Credit Policy Response to Crisis: Low Risk Economy

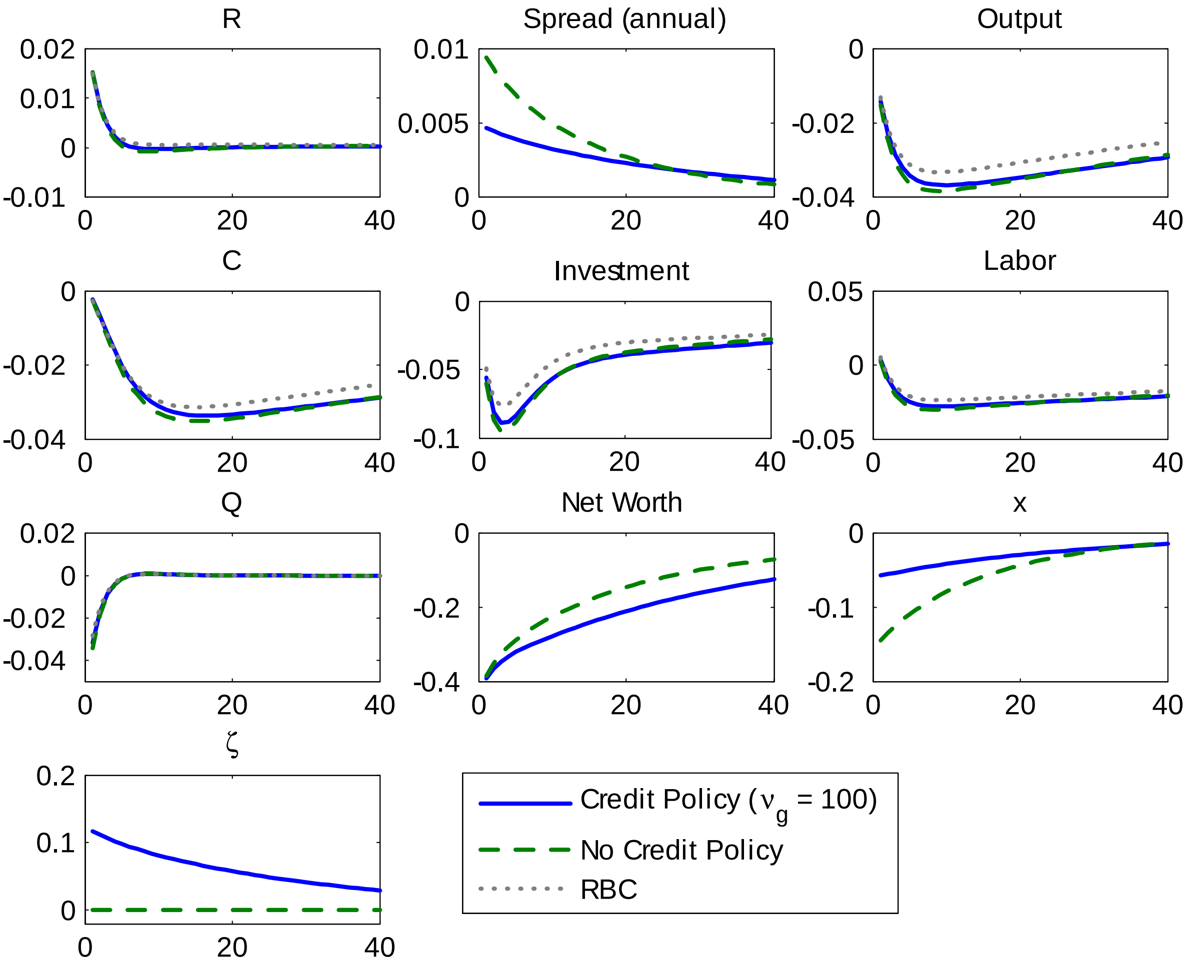


Figure 3. Credit Policy Response to Crisis: High Risk Economy

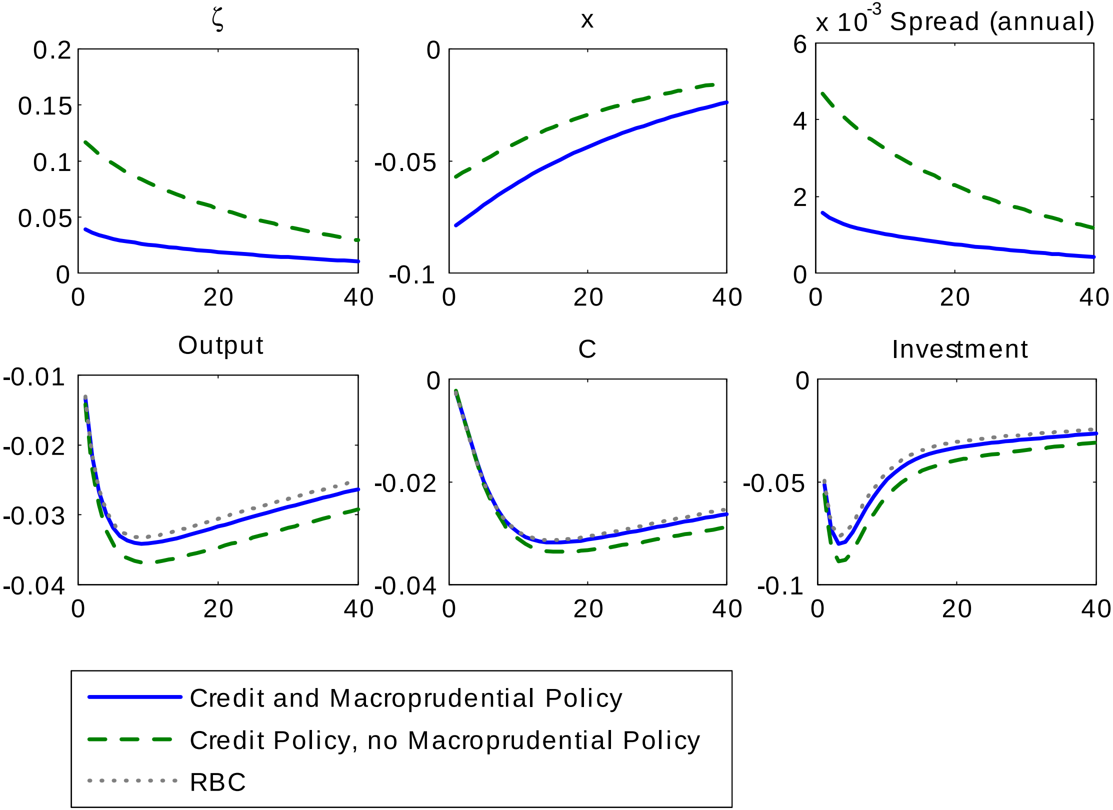


Figure 5. Macroprudential along with Credit Policy in the High Risk Economy

Table 3: Welfare Effects of Policy

	Welfare gain from no policy in consumption equivalents (%)			
*Efficiency cost of credit policy** *(bps)*	0	10	25	50
Credit Policy	0.268	0.220	0.149	0.029
Macroprudential Policy	0.285	0.285	0.285	0.285
Macroprudential and Credit Policy	0.337	0.332	0.325	0.313

*The corresponding values of (τ_1, τ_2) for efficiency costs of credit policy equal to 10, 25 and 50 bps are, respectively: (0.000125,0.0012), (0.000313,0.0031) and (0.000625,0.0062).