Adverse Selection, Private Collateral Provision, and Government Intervention

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Motivation

- Adverse selection is a major issue that freezes credit market.
  - Example: During the 2008 Financial Crisis, the issuance of corporate bonds declined because of asymmetric information regarding the underlying firm value.
- Credit market failure may have spillover into other markets.
  - Example: The 2008 Financial Crisis sparks the Great Recession.

Goal: Collateral Provision and Policy Implication

- How the damaging effect of adverse selection problem in financial markets transmits to other markets through the collateral provision channel.
  - Collateral scarcity reflected in inefficiency, high asset prices, and low real rates of interest. $\Rightarrow$ collateral provision channel is important!
- The implications for government policy in the presence of adverse selection.
- A model of exchange under secured credit with the following features:
  - Scarcity of collateral and private collateral creation;
  - Adverse selection with costly screening;
  - Consolidated government with various policy tools.

Key Mechanism: Collateral Provision Channel

- Collateral is essential to secure credit transactions, but collateral is scarce.
- Banks use government debt and loan as collateral.
- However, banks encounter adverse selection problem while lending.
  - Households have private information regarding the valuation of their assets.
- Adverse selection impedes credit transactions by limiting collateral provision.

Policy Implication: Key Findings

- Nominal interest rate policy
  - Nominal interest rate policy is constrained by the zero lower bound.
  - The optimal nominal interest rate policy may reduce collateral in the economy in the presence of adverse selection.

- I propose a new loan subsidy program aim to alleviate adverse selection:
  - Central bank provides subsidies to banks to encourage lending .
  - Welfare improves as such a program saves aggregate screening cost and increases private collateral provision.

Related Literature and Contributions

- adverse selection causes financial market collapse and government responses
  - Empirical papers about 2008 Financial crisis: *Gorton (2008, 2009)*, *Heider et al.(2015)*;
  - Optimal policy design: *Tirole (2012)*, *Philippon and Skreta (2012)*;
  - Search and market liquidity: *Guerrieri and Shimer (2014)*, *Chiu and Koeppl (2016)*.

  [Contribution!] new transmission channel — spillover through the collateral market

- asymmetric information in collateral market and monetary policy
  - Collateral misrepresentation: *Williamson (2018)*, *Kang (2019)*.

  [Contribution!] government invertention by mitigating incentive problems

Environment

A Model of Exchange under Secured Credit

- Discrete time $t = 0, 1, 2, \cdots$, and two sub-periods in each period: Centralized market (CM, Walrasian market) and Decentralized market (DM, pairwise matching).
- Three sets of agents:
  - A unit mass of buyers: buyers can only produce in the *CM*;
  - A unit mass of sellers: sellers can only produce in the *DM*;
  - An infinite mass of bankers: bankers provide financial contracts in the *CM*.
- Financial frictions: limited commitment and lack of record-keeping.
  - Exchange must be secured with assets.
  - Financial assets: bond, currency, service-generating asset, loan, deposit claim.

Buyer's Preference

- Supply labor and enjoy the service flows from the service-generating asset in the centralized market (CM) and consume goods in the decentralized market (DM):

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[-H_t + \gamma_t a_t + u(x_t) \right]$$

  - $0 < \beta < 1$ is discount factor;
  - H_t is labor supply in the CM;
  - $\gamma_t a_t$ is the service flows from holding a_t units of the assets with a preference shock γ_t;
  - x_t is consumption in DM.

Buyer: Preference Shock and Asymmetric Information

- Type-dependent preference shock: $\gamma_t \sim G_i(\cdot)$, with type $i \in \{g, b\}$.
  - γ_t can be interpreted as buyer's heterogenous personal use of the assets.
  - A fraction of α of the buyers are good types.

- Good types have a higher probability to get a high shock.
  - Monotone likelihood ratio property:

$$\frac{g_g(x)}{g_b(x)} < \frac{g_g(y)}{g_b(y)} \quad \text{and} \quad \forall x < y.$$

- Types are agents' private information (source of adverse selection).

Seller's Preference

- Consume goods in the centralized market (CM) and supply labor in the decentralized market (DM):

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t [X_t - h_t]$$

  - X_t is consumption in CM;
  - h_t is labor supply in the DM.

Banker's Preference

- Bankers supply labor and consume goods in the centralized market (CM):

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t [X_t^{bk} - H_t^{bk}]$$

  - X_t^{bk} is labor supply in *CM*;
  - H_t^{bk} is consumption in the *CM*.

Consolidated Government

- The consolidated government budget constraint:

$$\bar{c} + \bar{b} = \tau_0, \quad t = 0;$$
$$\bar{c} + \bar{b} = \frac{\bar{c} + R\bar{b}}{\pi} + \tau, \quad t = 1, 2, 3, \ldots.$$

- Fiscal authority determines the supply of the consolidated government debt $v = \bar{c} + \bar{b}$.
  - Assume a suboptimal fiscal policy such that v is scarce such that $r = \frac{R}{\pi} < \frac{1}{\beta}$.

- Central bank determines the composition of v.

Banking

Loan Contract and Deposit Contract

- Banks provide loan contract to create additional private collateral that can be used to secure their deposit liability.
  - It is beneficial as the government debt v is scarce.
  - However, banks are subject to adverse selection while lending.
- Deposit contract plays an liquidity insurance role which helps an efficient allocation of the assets.

Loan Contract: Costly Screening

- In the *CM* of period t:
  - Buyers know their types, which are their private information;
  - Banks write the loan contract;
  - Buyers take the loan contract and report a type.
- In the *CM* of period $t+1$:
  - Preference shocks are realized, which is public observed;
  - Following the screening probability, banks verify if buyers are truthtelling costly;
    - Banks can access a screening technology with a fixed cost of $e > 0$ to verify a buyer's type.
  - Loans are redeemed following the payment schedule in the loan contract.

Loan Contract: Payment Schedule and Screening Probability

- The loan contract does not exist for some parameter values, while if it exists, it is a separating contract.

- Separating loan contract:
  - Only Buyer reports type g are screened (with screening probability π^g);
  - The unique equilibrium contract for a type g buyer is a debt contract with promised payment $\bar{r}^g \in [0, 1]$; ‣ debt contract
  - There exists a continuum of equilibrium contracts for a type b buyer, one of these contracts is a debt contract, characterized by the promised payment $\bar{r}^b \in [0, 1]$.

- Competitive banks, in expectation, earn the safe asset return rate r for each type.

Deposit Contract

- Assume limitations on the information technology to verify means of payment.
  - A fraction ρ of sellers only accept currency;
  - The remaining $1 - \rho$ of sellers accept either deposits or currency.

- A deposit contract grants the depositor the ability to
  - withdraw currency if needed;
  - trade with higher-yielding deposit claims if feasible.

Bank's Problem: Asset Portfolio and Deposit Contract

- Competitive banks issue deposit contract (k, c, d) and determine asset portfolio $(m^i, b^i, \ell^{i,s})$ — note that $\ell^{i,s} = 0$ when loan contract does not exist.

$$\max_{k,c,d,b^i,\ell^{i,s} \geq 0} -k + \rho u\left(\frac{\beta c}{\pi}\right) + (1-\rho)u\left(\beta d\right)$$

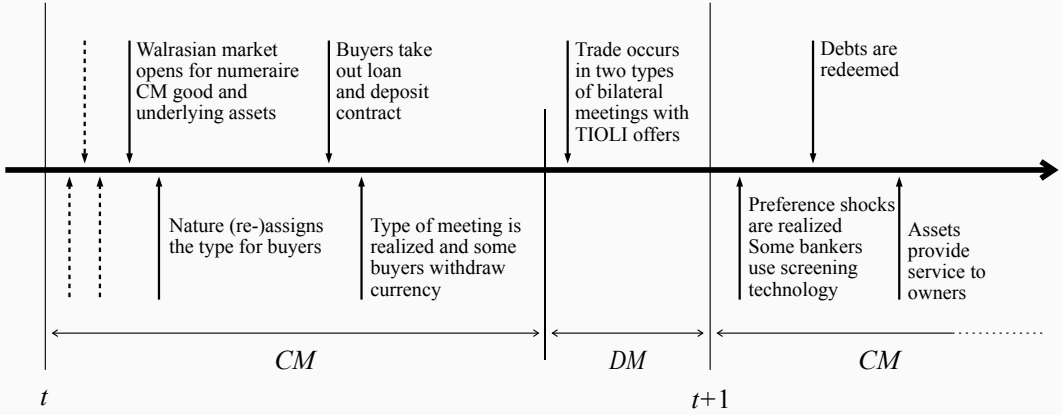
subject to

$$\left\{ \begin{array}{c} k - \rho c - \beta\left(1-\rho\right)d \\ -\left(b^i + \ell^{i,s}\right) + \beta\frac{R\left(b^i+\ell^{i,s}\right)}{\pi} \end{array} \right\} \geq 0 \quad \text{(Participation Constraint)},$$

$$-\left(1-\rho\right)d + \frac{R\left(b^i + \ell^{i,s}\right)}{\pi} \geq 0 \qquad \text{(Collateral Constraint)}.$$

Equilibrium

Timing of Events



Equilibrium Condition: Collateral Market Clearing

- Demand for collateral

$$D(r,R) = (1-\rho) \underbrace{x^d u'\left(x^d\right)}_{\text{deposit transaction}} + \rho \underbrace{x^c u'\left(x^c\right)}_{\text{currency transaction}}$$

  - $D(r,R)$ is strictly increasing in the real interest rate r and strictly decreasing in the nominal interest rate R.

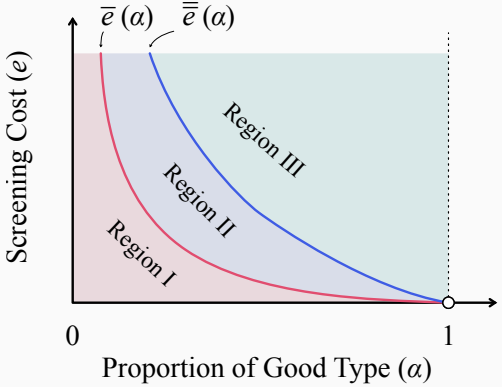
- Supply of collateral

$$S(r) = \underbrace{v}_{\text{exogenous government debt}} + \underbrace{\left[\alpha \ell^g + (1-\alpha)\,\ell^b\right]}_{\text{endogenous loan}}$$

  - If loan contract does not exist, $S(r)$ is constant in r;
  - If loan contract exist, $S(r)$ is strictly decreasing in r.

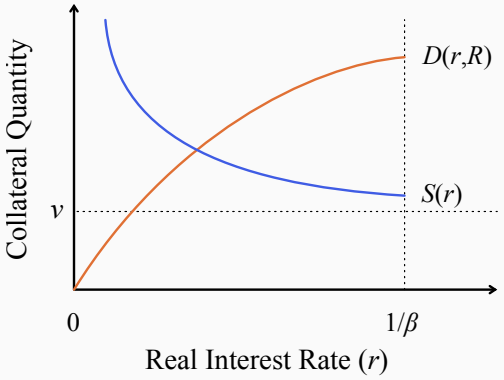
Existence of Loan Contract ▸ proposition

- Based on the parameter values (α, e), different adverse selection severity results in three types of equilibrium.



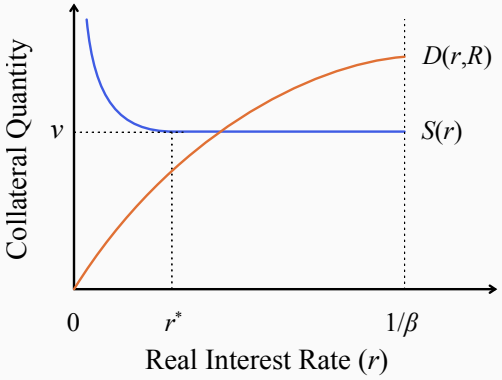
Type I Equilibrium: Adverse Selection is Mild

- When adverse selection is mild, the loan contract always exists.



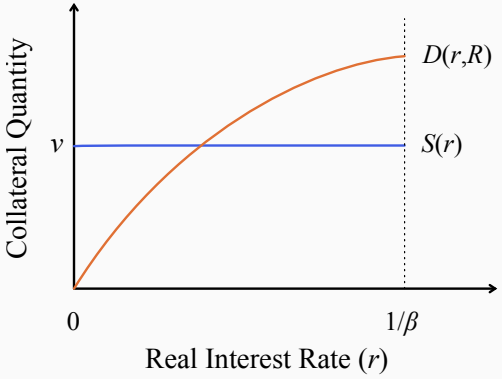
Type II Equilibrium: Adverse Selection is Moderate

- When adverse selection is moderate, there is a cutoff real interest rate r^* and the loan contract does not exist when $r > r^*$.



Type III Equilibrium: Adverse Selection is Severe

- When adverse selection is severe, it always shuts down the loan market.



Welfare and Policy Evaluation

Welfare Function

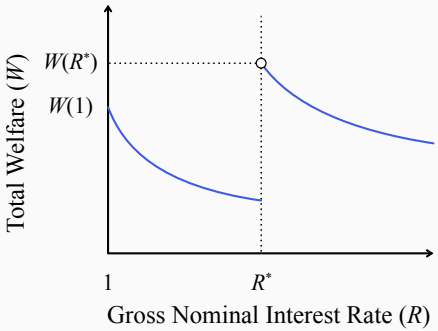
- Define total welfare

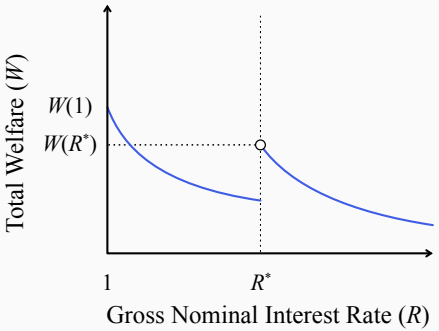
$$W\left(x^c, x^d\right) = \underbrace{\rho\left[u\left(x^c\right) - x^c\right] + (1-\rho)\left[u\left(x^d\right) - x^d\right]}_{\text{weighted sum of the total surplus from DM exchanges}} - \underbrace{\alpha \pi^g e}_{\text{aggregate screening cost}}$$

Nominal Interest Rate Policy

- Conventional monetary policy has involved the central bank changing the target nominal interest rate R.

- An optimal nominal interest rate policy may shut down the loan market when adverse selection is present. (optimal $R^* \to r^*$) ▸ loan contract





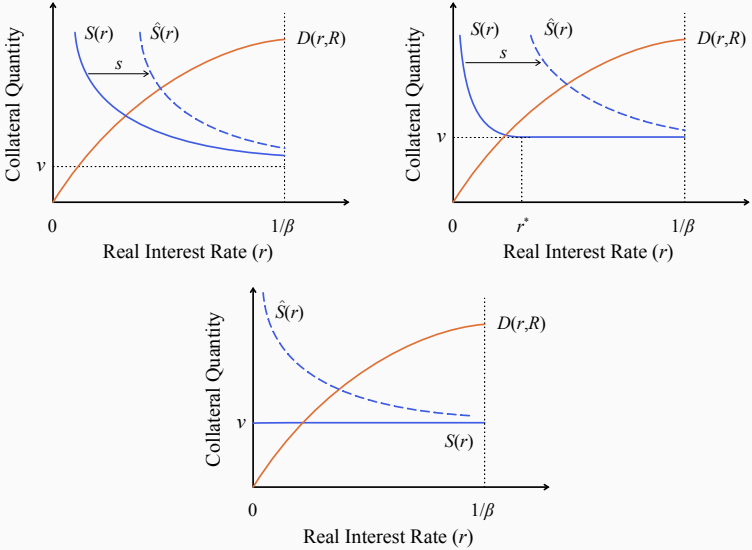
Loan Subsidy Program

- Central bank subsidies loan repayment $0 < s < r$ to private banks.
- Given the subsidy payment s, competitive banks solve π^g, $\bar{r}^g$ and $\bar{r}^b$ by

$$\bar{r}^b - \int_0^{\bar{r}^b} G_b(\tilde{\gamma}) \mathrm{d}\tilde{\gamma} = r - s,$$
$$\bar{r}^g - \int_0^{\bar{r}^g} G_g(\tilde{\gamma}) \mathrm{d}\tilde{\gamma} = \pi^g e + r - s,$$
$$(1 - \pi^g) \left[\bar{r}^g - \int_0^{\bar{r}^g} G_b(\tilde{\gamma}) \mathrm{d}\tilde{\gamma} \right] + \pi^g \mathbb{E}_b [\tilde{\gamma}] = r - s.$$

- The goal: encourage lending to increase collateral provision.

Optimal Subsidy Program: Evaluation



Conclusion

Conclusion

- Adverse selection hinders collateral provision, which causes inefficiency in secured credit transactions.
- Without further intervention, the nominal interest rate policy may shut down the loan market as the screening cost is too high.
- The optimal loan subsidy program improves welfare by addressing the adverse selection problem in the loan market, which facilitates private collateral provision.

Appendix!

Buyer's Problem

- To ensure that no buyer defaults in any state

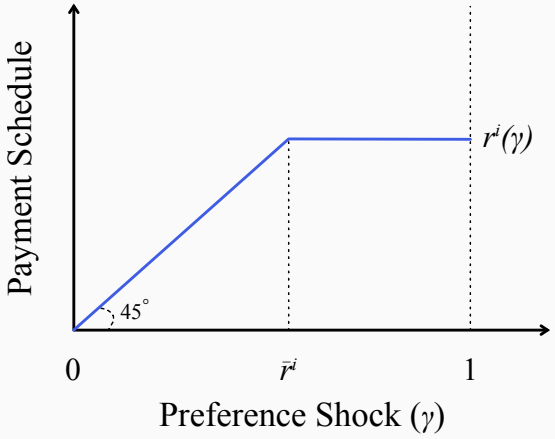
$$\ell^g = a\left(1 + \frac{\psi}{\bar{r}^g}\right),$$
$$\ell^b = a\left(1 + \frac{\psi}{\bar{r}^b}\right).$$

- Buyer maximizes

$$\max_a \left\{ \begin{array}{c} -\psi + \beta\left[\psi + \alpha\mathbb{E}_g[\tilde{\gamma}] + (1-\alpha)\mathbb{E}_b[\tilde{\gamma}]\right] + \\ +\alpha\left(1 + \frac{\psi}{\bar{r}^g}\right)\left(1 - \beta\mathbb{E}\left[r^g\left(\tilde{\gamma}\right)\right]\right) + \\ +(1-\alpha)\left(1 + \frac{\psi}{\bar{r}^b}\right)\left(1 - \beta\mathbb{E}\left[r^b\left(\tilde{\gamma}\right)\right]\right) \end{array} \right\} a,$$

Debt Contract with Promised Payment $\bar{r}^i$

- A debt contract with promised payment $\bar{r}^i$ is defined as a payment schedule such that $r^i(\tilde{\gamma}) = \tilde{\gamma}$ if $\tilde{\gamma} < \bar{r}^i$, while $r^i(\tilde{\gamma}) = \bar{r}^i$ if $\tilde{\gamma} \geq \bar{r}^i$. back



Existence of Loan Contract when $r < \frac{1}{\beta}$

Proposition

In an economy with a low real interest rate $r \in (0, \frac{1}{\beta})$, $\forall \alpha \in (0,1)$, *there exist* $0 < \bar{e}(\alpha) < \bar{\bar{e}}(\alpha)$, *such that,*

1. *if* $e \in (0, \bar{e}(\alpha)]$, *loan contract exists* $\forall r \in (0, \frac{1}{\beta})$;
2. *if* $e \in (\bar{e}(\alpha), \bar{\bar{e}}(\alpha)]$, *there exists* r^* *such that loan contract exists when* $r \in (0, r^*]$ *while such contract does not exist when* $r \in (r^*, \frac{1}{\beta})$;
3. *if* $e \in (\bar{\bar{e}}(\alpha), \infty)$, *no loan contract exists* $\forall r \in (0, \frac{1}{\beta})$.

Moreover, $\lim_{\alpha \to 0} \bar{e}(\alpha) = \bar{\bar{e}}(\alpha) = \infty$, $\lim_{\alpha \to 1} \bar{e}(\alpha) = \bar{\bar{e}}(\alpha) = 0$, *and* $\bar{e}(\alpha)$ *and* $\bar{\bar{e}}(\alpha)$ *are strictly decreasing in* α.

back

Loan Contract

- π^g, $\bar{r}^g$ and $\bar{r}^b$ are determined by the following equations: ‣ NIRP

$$\bar{r}^b - \int_0^{\bar{r}^b} G_b(\tilde{\gamma})\mathrm{d}\tilde{\gamma} = r,$$
$$\bar{r}^g - \int_0^{\bar{r}^g} G_g(\tilde{\gamma})\mathrm{d}\tilde{\gamma} = \pi^g e + r,$$
$$(1-\pi^g)\left[\bar{r}^g - \int_0^{\bar{r}^g} G_b(\tilde{\gamma})\mathrm{d}\tilde{\gamma}\right] + \pi^g \mathbb{E}_b\left[\tilde{\gamma}\right] = r.$$

- A separating loan contract exists if and only if $\bar{r} > \bar{r}^g$, where

$$\alpha\left[\bar{r} - \int_0^{\bar{r}} G_g(\tilde{\gamma})\mathrm{d}\tilde{\gamma}\right] + (1-\alpha)\left[\bar{r} - \int_0^{\bar{r}} G_b(\tilde{\gamma})\mathrm{d}\tilde{\gamma}\right] = r.$$