Nontraditional Monetary Policy in a Model of Default Risks and Collateral in the Absence of Commitment

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Motivation

• Since the GFC, regulators want to make financial contracts safer; more collateral, more capital, or mandatory central clearing

• Even if we make financial contracts safer, people might face other kind of risks during their lives

• Are there any roles for a central bank for those other risks?

• I take repos as an example of safe financial contract (Mills and Reed (2012)), and I take the risk of the timing of consumption after finishing repos as an example of one of other risks
Ideas

• A central bank could collect information on the outcome of all investment projects financed by bilateral repo contact

• For example, it could deliver the defaulting party’s collateral goods to those who consume the most quickly (encouraging quicker Rehypothecation)

• Similar to information advantage of using CCP to clear the OTC derivatives; CCP can access to the specifics of all contracts, and it can gather information, and use it for policy purpose
Punch Lines

• Suppose a central bank could use overall Information on repo contracts.
• It could improve resource allocations by redistributing defaulting party’s collateral for those who value the most quickly compared with bilateral repo contract
• Nontraditional policy will achieve this aim: Buy collateral via bond, Sell collateral for money
• You can do this policy by printing money: Buy collateral and sell collateral for money. But standard policy (print money, buy collateral) alone will not achieve this aim
Environment (Mills and Reed (2012))

- A kind of bilateral repo contract in OGM
- Two periods of life time, borrowers and lenders
- Borrowers and lenders have their agent specific perishable endowment goods when young
- Initial old lenders have money to buy young borrowers goods
- Borrowers consume lenders’ goods when young, lenders consume borrowers’ goods when old
- Young borrowers want to buy young lenders good, but do not have money, thus loans are needed
Environment (Mills and Reed (2012))

- Young borrowers get loan from young lender, consume young lenders’ goods, make investments, sell their output to old lenders for money, and pay back the loan via money and get back the collateral (second leg of repo contract)
- Young lenders hedge the default risk of young borrowers by taking collateral
- If young borrowers do not pay back their loans, young lenders will sell the collateral goods to old lenders for money at the second hand collateral goods market
Environment (Mills and Reed (2012))

• Reasons we need collateral goods and money:

1. Lack of commitment – agents cannot commit to future actions (no public record of trades); therefore, the collateral mitigates the borrower’s incentive to default

2. Exogenous idiosyncratic risks – borrowers default because of idiosyncratic risks exogenously, and the collateral acts as insurance. Borrowers must pay cash to get back collateral goods because the lenders do not value the collateral goods per se
Environment (Mills and Reed (2012))

• Lenders hedge two types of risks by collateral

1. Borrowers’ default risk (incentive role of collateral)

2. Lenders are not forced to give back collateral goods to defaulting borrowers (insurance role of collateral); c.f. There is no “fail” in equilibrium

• Lenders will get the same amount of money either from borrower (repayment of loan) or old lenders (collateral goods sales), irrespective of the borrowers’ default
Mills and Reed (2012)
The timing of events within a period

<table>
<thead>
<tr>
<th>Agents</th>
<th>Young borrower</th>
<th>Young lender</th>
<th>Old lender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stages</td>
<td>Young type A</td>
<td>Young type B</td>
<td>Old type B</td>
</tr>
<tr>
<td>(\tau = 1)</td>
<td>(a \rightarrow \sigma)</td>
<td>(a_{\beta} \beta)</td>
<td>(M)</td>
</tr>
<tr>
<td>(\tau = 2)</td>
<td>For (\eta)</td>
<td>For (\eta)</td>
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<tr>
<td>(R(1-\eta) &gt; 1)</td>
<td>For (1-\eta)</td>
<td>For (1-\eta)</td>
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<td>(\eta M)</td>
<td>(\sigma)</td>
<td>(M)</td>
<td>(Second leg of repo)</td>
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<tr>
<td>(\tau = 3)</td>
<td>For (\eta)</td>
<td>Nothing to trade</td>
<td>(1-(\eta))(M)</td>
</tr>
<tr>
<td>(\tau = 4)</td>
<td>For (\eta)</td>
<td>Nothing to consume</td>
<td>(\eta \sigma)</td>
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<tr>
<td>(\tau = 4)</td>
<td>For (\eta)</td>
<td>Consume (R(x-\sigma))</td>
<td>Always Save (M)</td>
</tr>
</tbody>
</table>
Upon becoming old, a taste shock occurs to some old lenders.

Some old lenders find that they are going to die before the collateral resale market opens.

They can only buy goods from the young productive borrowers.

They may not be able to consume enough goods because they cannot participate in the collateral resale market, despite they have enough money.
### Timing of events within a period

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<tbody>
<tr>
<td>Stages</td>
<td>$\tau = 1$</td>
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<tr>
<td>$a$</td>
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<td>$(x - \sigma)$</td>
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<td>$\tau = 2$</td>
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<tr>
<td>For $\eta$</td>
<td>No output</td>
<td>Trade $(1-\eta)\sigma$</td>
<td>For $\eta$</td>
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<tr>
<td>For $1-\eta$</td>
<td>$R(x - \sigma)$</td>
<td>Trade $(1-\eta)M$</td>
<td>No trade</td>
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<tr>
<td>For $1-\eta$</td>
<td>$(1-\eta)DM$</td>
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<tr>
<td>$\tau = 3$</td>
<td>For $\eta$</td>
<td>Nothing to trade</td>
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<tr>
<td>For $1-\eta$</td>
<td>$M$</td>
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<tr>
<td>$\tau = 4$</td>
<td>For $\eta$</td>
<td>Nothing to consume</td>
<td></td>
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<tr>
<td>For $1-\eta$</td>
<td>Consume $R(x - \sigma)$</td>
<td>Always save $M$</td>
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</table>

Note: The solid lines show the transfer of goods among agents, and the dotted lines show the transfer of money balances among agents.
Old persons’ consumption

<table>
<thead>
<tr>
<th>η (investment fail)</th>
<th>D (early departing)</th>
<th>1–D (late departing)</th>
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<tbody>
<tr>
<td></td>
<td>(1–η)(1–D)</td>
<td>σ &lt; σ</td>
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<tr>
<td></td>
<td>ηD</td>
<td></td>
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<tr>
<td>1–η (investment success)</td>
<td>σ</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ηD</td>
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<tr>
<td></td>
<td></td>
<td>(1–η)(1–D)σ &gt; σ</td>
</tr>
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</table>

- We suppose that η D > (1–η)(1–D)
- Mills and Reed (2012) sets D = 0.
Optimal allocation

• Lenders’ expected utilities will be lower than those of Mills and Reed (2012)
• This is because the taste shock varies the consumption of lenders depending on the timing of transactions in the goods market, even though all lenders are insured against their borrowers’ default and have the same money balances at the end of the first period of their lives
• The repo contract does not insure against the taste shock, which occurs in the second period of their lives
A Nontraditional Policy

• A central bank could identify the collateral goods to be sold in the resale market before the death of some old lenders, and arrange a trade of those goods for money (Information aggregation advantage; c.f. benefit of central clearing over bilateral clearing)

• While a central bank cannot increase the production of collateral goods, she can reallocate the available collateral goods (rehypothecation) from the young lenders whose borrowers are going to default to the old lenders hit by a taste shock
### A nontraditional policy

<table>
<thead>
<tr>
<th>Agents</th>
<th>Young type-A</th>
<th>Young type-B</th>
<th>Central Bank</th>
<th>Old type-B</th>
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<tbody>
<tr>
<td><strong>Stages</strong></td>
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<td>( (x - \sigma) )</td>
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<td>( \tau = 2 )</td>
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<tr>
<td>For ( \eta )</td>
<td>No output</td>
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<tr>
<td>For ( 1 - \eta )</td>
<td>Trade ( (1 - \eta) \sigma )</td>
<td>Trade ( (1 - \eta) \sigma )</td>
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<tr>
<td>For ( 1 - \eta )</td>
<td>Trade ( (1 - \eta) \sigma )</td>
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<tr>
<td>( \tau = 3 )</td>
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<tr>
<td>For ( \eta )</td>
<td>Nothing to trade</td>
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<tr>
<td>For ( 1 - \eta )</td>
<td>Trade ( (1 - \eta) \sigma )</td>
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<tr>
<td>( \tau = 4 )</td>
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<tr>
<td>For ( \eta )</td>
<td>Nothing to consume</td>
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<tr>
<td>For ( 1 - \eta )</td>
<td>Consume ( R(x - \sigma) )</td>
<td>Always save ( M )</td>
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Note: The solid lines show the transfer of goods among agents, and the dotted lines show the transfer of money balances among agents.
LSAPs achieves the same welfare gains

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<td>Young type-B</td>
<td>Central Bank</td>
<td>Old type-B</td>
</tr>
<tr>
<td>τ=1</td>
<td>(x−σ)</td>
<td>α</td>
<td>β</td>
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<td></td>
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<tr>
<td>τ=2</td>
<td>R(x−σ)</td>
<td>Trade (1-η)σ</td>
<td>Trade (1-η)M</td>
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<td></td>
</tr>
<tr>
<td>τ=3</td>
<td>(1-η)M</td>
<td>(1-η)B</td>
<td>(1-η)M</td>
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</tr>
<tr>
<td>τ=4</td>
<td>(1-η)B</td>
<td>(1-η)σ</td>
<td>(1-η)σ</td>
<td>Consumes σ</td>
</tr>
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</tr>
</tbody>
</table>

Note: The solid lines show the transfer of goods among agents, dotted lines show the transfer of bond among agents, and the dashed lines show the transfer of money balances among agents.
Institutions for the policy objective

• Encourage quicker rehypothecation

• Large scale asset purchases (LSAPs) + Security lending programs
  – The central bank could purchase all collateral goods by a bond that entitles the holder to get collateral goods or a unit of fiat money
  – Then the central bank sells the collateral goods for money; similar to SLP
  – In the US, Term Securities Lending Facility (TSLF)
  – In Japan, Securities Lending Facility (SLF)
Effect of a traditional policy

• In Freeman (1996), a central bank’s issue of additional fiat money in the resale market of IOUs will resolve the lack of liquidity in that market and will help to achieve a better resource allocation.

• This traditional monetary policy tool alone cannot improve the resource allocation in our model because the supply of additional fiat money does not increase the production of the collateral goods in time for consumption by the lenders who are hit by a taste shock, we need both purchases and sales of collateral.
Effect of a nontraditional policy

• The central bank improves the allocation of resources by achieving faster exchange between collateral goods and fiat money within the early stage of that period.

• While a central bank cannot increase the production of collateral goods, she can reallocate the available collateral goods from the young lenders whose borrowers are going to default to the old lenders hit by a taste shock.

• It increases the velocity of circulation of available collateral goods (quicker Rehypothecation).
Comparison with Monnet and Nellen (2014)

- They examine benefit of using three settlement institutions for bilateral contracts in the presence of two-sided limited commitment

1. Simple bilateral clearing
2. Segregated collateral clearing
3. Centralized clearing with segregation combined with a loss-sharing rule (CCP)

- Benefit arises mainly from 1 to 2, not from 2 to 3
- Our model relates to comparison of 1 and 2
Comparison with Monnet and Nellen (2014)

• In arrangement 2, the segregation technology prevents a defaulter from accessing the collateral while, at the same time, allowing the non-defaulter to sell the defaulting agent’s collateral for his own consumption.

• Arrangement 2 relaxes the incentive constraints, that prevent defaulting agents from taking the collateral pledged by their counterparty and walking away from the contract, and improves the welfare.
Comparison with Monnet and Nellen (2014)

• In our model, the central bank works like a rental warehouse to store the collateral, and it does not have the enforcement power to prevent the strategic default of a lender and thus does not relax the incentive constraints for strategic default by the lender (information advantage only compared with 1)

• Only the borrowers submit collaterals in our model, both parties in the bilateral contract submit collaterals in Monnet and Nellen
Details

• Overview of Mills and Reed (2012)
• A model that adds a taste shock to consumption at an early stage in the model of Mills and Reed (2012)
• Policy implications
Overview of Mills and Reed (2012)
The environment of Mills and Reed

- The economies start at period 1, and agents live for two periods: “young” and “old”
- There are two types of agents: types A and B
- Type A agent is endowed with \( x \) units of good \( \alpha \) when young and nothing when old
- Type B agent is endowed with \( y \) units of good \( \beta \) when young and nothing when old
- In period \( t = 1 \), there is a \([0,1]\) continuum of initial old type B agents who are endowed with \( M \) divisible units of fiat money
The environment (continued)

• Consumption of good $z$ at date $t’$ by type-A agent of generation $t$; $a_{zt}^t$.

• The utility of a type-A agent, strictly increasing and concave in each argument, which satisfies the Inada conditions; $u^A(a_{\alpha t}^t, a_{\beta t}^t)$

• A type-A agent consumes his endowment good and type-B agent endowment good when young and nothing when old
The environment (continued)

- Consumption of good \( z \) at date \( t' \) by type-B agent of generation \( t; b^t_{z_{t'}} \)

- The utility of a type-B agent, strictly increasing and concave in each argument, which satisfies the Inada conditions; \( u^B(b^t_{\beta_t}, b^t_{\alpha_{t+1}}) \)

- A type-B agent consumes his endowment when young and the good endowed to a type-A agent when old
• Storage technologies involving goods $\alpha$

• Type B agents: perfect storage technology within a period

• Type A agents: productive, yet risky, technology. With probability $\eta$, their investments generate nothing. With probability $1-\eta$, their investments generate $R$ units of goods $\alpha$

• $R(1-\eta) > 1$: On average, productive technology yields higher returns
Frictions in Mills and Reed (2012)

• Reasons we need collateral goods and money:

1. Lack of commitment – agents cannot commit to future actions (no public record of trades); therefore, the collateral mitigates the borrower’s incentive to default

2. Exogenous idiosyncratic risks – borrowers default because of idiosyncratic risks exogenously, and the collateral acts as insurance. Borrowers must pay cash to get back collateral goods because the lenders do not value the collateral goods per se
The model looks like Repo contracts!

• The lack of commitment by both lenders and borrowers generates an additional incentive constraint, that is, the value of collateral to the lender should not exceed the value of returning the collateral to the borrower.

• The additional incentive constraint to lenders says that they have no incentive to choose the option of “settlement fails” in Repo contracts (The lender intentionally chooses not to return the collateral asset and gives up the principal and interest rate payment from the borrower).
Mills and Reed (2012)
The timing of events within a period

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<tr>
<td>Stages</td>
<td>a -&gt; σ</td>
<td>aβ β</td>
<td>M</td>
</tr>
<tr>
<td>(\tau = 1)</td>
<td>(x - σ)</td>
<td>σ</td>
<td></td>
</tr>
<tr>
<td>(\tau = 2)</td>
<td>For (\eta) no output</td>
<td>R(x - σ) trade (1-(\eta))σ</td>
<td>for (\eta) no trade</td>
</tr>
<tr>
<td></td>
<td>For 1-(\eta) ((1-\eta)M)</td>
<td></td>
<td>for 1-(\eta) (1-(\eta))M</td>
</tr>
<tr>
<td>(\tau = 3)</td>
<td>For (\eta) Nothing to trade</td>
<td>(1-(\eta))M</td>
<td>(1-(\eta))σ and (\eta M)</td>
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<tr>
<td></td>
<td>For 1-(\eta) ((1-\eta)M)</td>
<td></td>
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<tr>
<td>(\tau = 4)</td>
<td>For (\eta) Nothing to consume</td>
<td>Consume R(x - σ)</td>
<td>Always Save M</td>
</tr>
<tr>
<td></td>
<td>For 1-(\eta)</td>
<td>Always Save M</td>
<td>Always Consume σ</td>
</tr>
</tbody>
</table>
Trading patterns (stages $\tau = 1, \ldots, 4$)

1. Each generation-$t$ type A agent is matched with a generation-$t$ type B agent (A invests, B lends)

2. The return on the risky investment is realized. Generation-$t$ type A agents meet with generation-$(t-1)$ type B agents (A gets money)

3. Each generation-$t$ type A agent is reunited with the generation-$t$ type B agent (A repays loan, get back collateral if productive, otherwise defaults)

4. An aggregate meeting between all generation-$t$ type B agents and all generation-$(t-1)$ type B agents (B resells collateral, obtains money)
Optimal allocation: Notations

- $z^\tau_\alpha(M)$: Consumption of good $\alpha$ taken from stage $\tau=2,3,4$ when there is monetary exchange
- $z^\tau_\alpha(0)$: Consumption of good $\alpha$ taken from stage $\tau=2,3,4$ when there is no monetary exchange
- The optimal allocation maximizes the ex-ante social welfare subject to feasibility constraints and incentive constraints.
Ex ante social welfare

• If productive, type A agent gets goods at the 2nd and 3rd stages, but if unproductive, gets nothing at the 3rd stage
• Type B agent meets productive A at the 2nd stage or resells unproductive A’s collateral at the 4th stage

\[
U = (1-\eta)u^A[a^2_\alpha(M) + a^3_\alpha(M), \alpha \beta] + \eta \cdot u^A[a^3_\alpha(0), \alpha \beta]
\]
\[
+ u^B[b_\beta] + \{(1-\eta)u^B[b^2_\alpha(M) + b^4_\alpha(0)] + \eta \cdot u^B[b^4_\alpha(M)]\}.
\]
Constraints in the 1st stage

- Two feasibility constraints (FC), two participation constraints, IC (better than no trade at all)

\[ \text{FC}(\alpha); \sigma \leq x, \]
\[ \text{FC}(\beta); a_\beta + b_\beta \leq y, \]
\[ \text{IC}(A); (1-\eta)u^A[a_\alpha^2(M) + a_\alpha^3(M), a_\beta] + \eta \cdot u^A[a_\alpha^3(0), a_\beta] \]
\[ \geq (1-\eta)u^A[Rx,0] + \eta \cdot u^A[0,0], \]
\[ \text{IC}(B); u^B[b_\beta] + \{(1-\eta)u^B[b_\alpha^2(M) + b_\alpha^4(0)] + \eta \cdot u^B[b_\alpha^4(M)]\} \]
\[ \geq u^B[y] + u^B[0]. \]
Constraints in the 2nd stage

- A feasibility constraints, two participation constraints (A: better than no trade, B: trade at the 2nd stage is better than trade at the 4th stage)

\[
\text{FC}(\alpha); \ a_\alpha^2(M) + b_\alpha^2(M) \leq R(x - \sigma),
\]

\[
\text{IC}(A); u^A[a_\alpha^2(M) + a_\alpha^3(M), a_\beta] \geq u^A[R(x - \sigma), a_\beta],
\]

or \( a_\alpha^2(M) + a_\alpha^3(M) \geq R(x - \sigma) \)

\[
\text{IC}(B); u^B[b_\alpha^2(M) + b_\alpha^4(0)] \geq u^B[b_\alpha^4(M)],
\]

or \( b_\alpha^2(M) \geq b_\alpha^4(M) \) because \( b_\alpha^4(0) = 0 \).
Constraints in the 3rd stage

• Young type B will not give collateral back to a young unproductive type A without money, (insurance role of collateral, type B will get money at 4th stage in exchange for goods)

• Young type B will give collateral back to a young productive A in exchange for money (no settlement fails in the repo contract)

Insurance role \[ a_\alpha^3 (0) = 0, \]

No settlement fail \[ a_\alpha^3 (M) = \sigma. \]
Constraints in the 4th stage

- Generation-\(t-1\) type B without money will consume nothing in the 4th stage
- Generation-\(t-1\) type B will obtain goods for money and trade with generation-\(t\) type B who would like to resell collateral for money

\[
b^4_\alpha (0) = 0, \\
\eta b^4_\alpha (M) \leq \eta \sigma, \\
\text{or } b^4_\alpha (M) \leq \sigma.
\]
**Optimal allocation in Mills and Reed (2012)**

- The optimal allocation is a list that maximizes the ex ante social welfare subject to feasibility constraints and incentive constraints

\[
\{ \sigma, a_\beta, a_\alpha^2(M), a_\alpha^3(0), a_\alpha^3(M), b_\beta, b_\alpha^2(M), b_\alpha^4(0), b_\alpha^4(M) \}
\]

- Key results, \( b_\alpha^2(M) = b_\alpha^4(M) = \sigma \), come from the participation constraints

- The amount of goods obtained by the lender will be the same whether the borrower is a productive agent or an unproductive agent
Proof of the key results

(1) 4th FC equality; $\sigma = b_\alpha^4 (M)$

(2) 2nd IC(B); $b_\alpha^2 (M) \geq b_\alpha^4 (M)$

(3) 2nd FC equality; $a_\alpha^2 (M) + b_\alpha^2 (M) = R(x - \sigma)$

(4) 2nd IC(A); $a_\alpha^2 (M) + a_\alpha^3 (M) \geq R(x - \sigma)$

Use (3), $a_\alpha^2 (M) + a_\alpha^3 (M) \geq a_\alpha^2 (M) + b_\alpha^2 (M)$,
$a_\alpha^3 (M) \geq b_\alpha^2 (M)$,

(5) 3rd; $a_\alpha^3 (M) = \sigma$, put (4), $\sigma \geq b_\alpha^2 (M)$

Use (2), (5), $b_\alpha^2 (M) = b_\alpha^4 (M) = \sigma$
Mills and Reed (2012): Key results

• The incentive constraints lead to a situation where the amount of the goods obtained by the lender will be the same whether the borrower is a productive agent (not subject to an idiosyncratic default shock) or an unproductive agent (subject to an idiosyncratic default shock). Hence, the collateral serves as insurance against a borrower’s default.

• The incentive constraints lead to a situation where the borrower is not insured against his idiosyncratic default shock.
A model that adds a taste shock to consumption within an early stage to Mills and Reed (2012)
Additional assumptions

- In the second stage, we assume a taste shock happens to some of the generation-\((t-1)\) type B agents.

- Suppose that the fraction D of generation-\((t-1)\) type B agents trade in the 2nd stage only, and cannot access the resale market for collateral goods (as in Freeman’s (1996) “early departing creditors” who cannot wait for trade in the later stage).

- Note: Mills and Reed (2012) is when D=0
Additional assumptions

• Suppose further that the fraction $1-D$ of generation-$(t-1)$ type B agents trade both in the 2nd stage and in the 4th stage.

• As before, in the 2nd stage, generation-$t$ type A agents meet with generation-$(t-1)$ type B agents.

• For a fraction $\eta$ of meetings, the type A agents do not have any good $\alpha$ to offer, so no trade. In the remaining fraction $1-\eta$ of meetings, the type A agents have good $\alpha$ to offer to type B agents.
Additional assumptions

• After the fraction $\eta$ of meetings, the fraction $D$ of generation-$(t-1)$ type B agents will offer all of their money to the fraction $1-D$ of generation-$(t-1)$ type B agents who obtain goods from the type A agents.

• $1-D$ of generation-$(t-1)$ type B agents are happy to exchange goods obtained from the type A agents as long as they can use the money to purchase the same amount of goods in the 4th stage, as in Freeman (1996)’s late departing creditors.
## Timing of events within a period

<table>
<thead>
<tr>
<th>Agents</th>
<th>Young type-A</th>
<th>Young type-B</th>
<th>Old type-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \tau = 1 )</td>
<td>( \alpha \rightarrow \beta )</td>
<td>( \alpha \beta \rightarrow \beta )</td>
<td>( M \rightarrow (1-D)M )</td>
</tr>
<tr>
<td>For ( \eta )</td>
<td>No output</td>
<td>Sell ( M ) to ( (1-D) )</td>
<td>No trade</td>
</tr>
<tr>
<td>For ( 1-\eta )</td>
<td>( R(x-\sigma) \rightarrow ) Trade ( (1-\eta)\sigma )</td>
<td>Trade ( (1-\eta)M ) for ( \sigma )</td>
<td>Trade ( M ) for ( \sigma )</td>
</tr>
<tr>
<td>For ( 1-\eta )</td>
<td>( (1-\eta)DM )</td>
<td></td>
<td>Consume at stage 2</td>
</tr>
<tr>
<td>( \tau = 2 )</td>
<td>For ( \eta )</td>
<td>Nothing to trade</td>
<td>For ( \eta )</td>
</tr>
<tr>
<td>For ( 1-\eta )</td>
<td>( M )</td>
<td>( (1-\eta)\sigma \rightarrow \sigma )</td>
<td>Nothing to trade</td>
</tr>
<tr>
<td>( \tau = 3 )</td>
<td>For ( \eta )</td>
<td>Nothing to consume</td>
<td>For ( \eta )</td>
</tr>
<tr>
<td>For ( 1-\eta )</td>
<td>Consume ( R(x-\sigma) )</td>
<td>Always save ( M )</td>
<td>For ( \eta )</td>
</tr>
<tr>
<td>( \tau = 4 )</td>
<td>For ( \eta )</td>
<td></td>
<td>Consume at stage 4</td>
</tr>
<tr>
<td>For ( 1-\eta )</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The solid lines show the transfer of goods among agents, and the dotted lines show the transfer of money balances among agents.
Additional assumptions

• Suppose that $\eta D > (1-\eta)(1-D)$. Then, early departing $\eta D$ of type B will offer all available money but obtain $(1-\eta)(1-D)/ \eta D < 1$ units of goods.

• Late departing $(1-\eta)(1-D)$ of type B will have larger money balances because of these sales, compared with the $\eta(1-D)$ of type B, who intend to purchase the goods at the 4th stage.
Ex ante social welfare

\[ U = (1 - \eta)u^A[a_\alpha^2(M) + a_\alpha^3(M), a_\beta] + \eta \cdot u^A[a_\alpha^3(0), a_\beta] \\
+ u^B[b_\beta] + (1 - \eta)\{D \cdot u^B[b_\alpha^2(M)] + (1 - D) \cdot u^B[b_\alpha^2(M) - t_\alpha^2(M) + b_\alpha^4(M)]\} \\
+ \eta\{D \cdot u^B[\hat{b}_\alpha^2(M)] + (1 - D) \cdot u^B[\hat{b}_\alpha^4(M)]\} \]

- Additional constraints (resale of collateral goods)
- \[(1 - D)(1 - \eta)t_\alpha^2(M) \geq D\eta\hat{b}_\alpha^2(M)\]
- \[b_\alpha^2(M) \geq t_\alpha^2(M)\]
- Note: Hat denotes the choice variables for the agents who meet an unproductive type A agent, and \(t\) stands for the transfer of goods in exchange for money
# Key results; old lenders’ consumption

## Proposition 1

<table>
<thead>
<tr>
<th></th>
<th>$D$ (early departing)</th>
<th>$1-D$ (late departing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\eta$ (investment fail)</td>
<td>$\hat{b}_2^\alpha(M) = \frac{(1-\eta)(1-D)}{\eta D} \sigma &lt; \sigma$</td>
<td>$\hat{b}_4^\alpha(M) = \sigma$</td>
</tr>
<tr>
<td>$1-\eta$ (investment success)</td>
<td>$b_2^\alpha(M) = \sigma$</td>
<td>$b_4^\alpha(M) = \frac{\eta D}{(1-\eta)(1-D)} \sigma &gt; \sigma$</td>
</tr>
</tbody>
</table>

Note: Mills and Reed (2012) yields $b_2^\alpha(M) = b_4^\alpha(M) = \sigma$
Policy implication
A nontraditional policy

A central bank commits the following policy

The central bank identifies the young lenders whose borrowers are unproductive agents and thus prepare to sell the collateral goods in the resale market in the later stages of that period

The central bank proposes that those young lenders trade their collateral goods for fiat money held by the lenders who are hit by a taste shock within an early stage of that period (quicker rehypothecation)

Merit of using overall information relative to bilateral repo contact clearing and settlement
A nontraditional policy

<table>
<thead>
<tr>
<th>Agents</th>
<th>Young type-A</th>
<th>Young type-B</th>
<th>Central Bank</th>
<th>Old type-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stages τ = 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>τ = 1</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>For η</td>
<td>No output</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For 1-η</td>
<td>R(x - σ)</td>
<td>Trade (1-η)σ</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trade (1-η)M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For 1-η</td>
<td>(1-η)M</td>
<td></td>
<td>(1-D η)σ</td>
<td>(1-D)ηM</td>
</tr>
<tr>
<td>τ = 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For η</td>
<td>Nothing to trade</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For 1-η</td>
<td>(1-η)M</td>
<td></td>
<td>(1-η)σ</td>
<td>(1-D η)σ</td>
</tr>
<tr>
<td>τ = 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For η</td>
<td>Nothing to consume</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For 1-η</td>
<td>Consume R(x - σ)</td>
<td>Always save M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>τ = 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For η</td>
<td>Nothing to consume</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For 1-η</td>
<td>Consume R(x - σ)</td>
<td>Always save M</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The solid lines show the transfer of goods among agents, and the dotted lines show the transfer of money balances among agents.
A nontraditional policy

• Alternatively, the central bank could buy all collateral goods from all of the young lenders in exchange for a unit of bond (LSAPs)

• The bond entitles the holder to get $\sigma$ unit of collateral goods from the central bank at the third stage, or a unit of fiat money at the fourth stage

• The central bank sells the part of collateral goods for early departing old lenders who meet unproductive young borrowers (like a security lending program), and sells the rest of them at the collateral resale market to exit from LSAPs
LSAPs achieves the same welfare gains

<table>
<thead>
<tr>
<th>Agents</th>
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<th>Young type-B</th>
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<tbody>
<tr>
<td>Stages</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\tau = 1$</td>
<td>$\alpha$</td>
<td>$\beta$</td>
<td>$\sigma$</td>
<td>$\sigma$</td>
</tr>
<tr>
<td></td>
<td>$x - \sigma$</td>
<td>$DM(1-D)M$</td>
<td>$\eta D\sigma$</td>
<td>$M$</td>
</tr>
<tr>
<td>For $\eta$</td>
<td>No output</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For $1-\eta$</td>
<td>$R(x-\sigma)$</td>
<td>Trade $(1-\eta)\sigma$</td>
<td>Trade $(1-\eta)M$</td>
<td></td>
</tr>
<tr>
<td>For $1-\eta$</td>
<td>$(1-\eta)M$</td>
<td></td>
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<tr>
<td>$\tau = 2$</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>For $\eta$</td>
<td>Nothing to trade</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For $1-\eta$</td>
<td>$(1-\eta)M$</td>
<td>$(1-\eta)B$</td>
<td>Trade $(1-\eta)\sigma$</td>
<td></td>
</tr>
<tr>
<td>$\tau = 3$</td>
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</tr>
<tr>
<td>For $\eta$</td>
<td>Nothing to consume</td>
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<td></td>
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</tr>
<tr>
<td>For $1-\eta$</td>
<td>$(1-\eta)B$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For $\eta$</td>
<td></td>
<td></td>
<td>$(1-D)\eta\sigma$</td>
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</table>

Note: The solid lines show the transfer of goods among agents, dotted lines show the transfer of bond among agents, and the dashed lines show the transfer of money balances among agents.
LSAPs

- In the second stage, the central bank offers $\eta D\sigma$ early-departing old type-B agents $\eta D\sigma$ units of collateral goods in exchange for $\eta D$ units of M.
- In the third stage, $(1-\eta)$ young type-B agents sell the bond to the productive young type-A agents for M, and the productive $(1-\eta)$ young type-A agents redeems $(1-\eta)\sigma$ units of collateral goods from the central bank in exchange for the bond.
- In the fourth stage, the central bank offers $(1-D)\eta$ late-departing old type-B agents $(1-D)\eta\sigma$ units of collateral goods in exchange for $(1-D)\eta$ units of M.
LSAPs

- Together with the \( \eta D \) units of \( M \) obtained from the sales of collateral goods in the second stage, the central bank has \( \eta \) units of \( M \) at the fourth stage.
- At the fourth stage, the central bank use those \( \eta \) units of \( M \) to purchase the \( \eta \) unit of bond from the \( \eta \) young type-B agents who meet unproductive young type-A agents in the third stage. At the end of the fourth stage, the central bank has no fiat money but a unit of bond at their hand.
Effect of LSAPs

• The central bank can improve the allocation of resources by achieving faster exchange between collateral goods and fiat money.

• While a central bank cannot increase the production of collateral goods, it can reallocate the available collateral goods to the old lenders hit by a taste shock faster via LSAPs.

• Federal Reserve’s TSLF and BOJ’s SLF relates to this policy (supply collateral, rather than money).
Comparison with Freeman (1996)

• A situation where $\eta D > (1-\eta)(1-D)$ is similar to that of early departing old $\eta D$ creditors who are forced to liquidate their loans under a liquidity constraint as in Freeman (1996)

• Freeman (1996)’s central bank should supply additional liquidity to alleviate liquidity shortage

• Our result comes from a temporal insufficient supply of collateral goods

• A central bank should circulate available collateral goods quickly, and should not supply additional liquidity
Comparison with Monnet and Nellen (2014)

- They examine benefit of using three settlement institutions for bilateral contracts in the presence of two-sided limited commitment
  1. Simple bilateral clearing
  2. Segregated collateral clearing
  3. Centralized clearing with segregation combined with a loss-sharing rule (CCP)

- Benefit arises mainly from 1 to 2, not from 2 to 3
- Our model relates to comparison of 1 and 2
Comparison with Monnet and Nellen (2014)

• In arrangement 2, the segregation technology prevents a defaulter from accessing the collateral while, at the same time, allowing the non-defaulter to sell the defaulting agent’s collateral for his own consumption.

• Arrangement 2 relaxes the incentive constraints, that prevent defaulting agents from taking the collateral pledged by their counterparty and walking away from the contract, and improves the welfare.
Comparison with Monnet and Nellen (2014)

• In our model, the central bank works like a rental warehouse to store the collateral, and it does not have the enforcement power to prevent the strategic default of a lender and thus does not relax the incentive constraints for strategic default by the lender (information advantage only compared with 1)

• Only the borrowers submit collaterals in our model, both parties in the bilateral contract submit collaterals in Monnet and Nellen
Summary

• We show that a central bank could improve the allocation of resources by achieving faster exchange between collateral goods and money.

• We base our discussion on an extension of Mills and Reed (2012), with a taste shock that forces some lenders to consume within an early stage of the second period of their lives.
Appendix: Settlement fails
Why do settlement fails happen?

• **Miscommunication**: Buyers and sellers do not have a common understanding of the terms of trade

• **Operational problems**: Computer crash of the Bank of New York (1985), when a market participant is unable to make delivery of a security to complete a transaction

• **The seller does not have the requisite securities**: Normally this could be avoided by borrowing securities, but during a low interest rate period it may not be true (2008 episode)
Normally fails should be avoided

- Two repo market rates
- General collateral repos \((R_{gc})\): Borrow money against any member of a stated classes of securities as collateral
- Special collateral repos \((R_{sc})\): Borrow a particular security against money
- Normally, borrowing money is more expensive than borrowing a security, thus \((R_{gc}) > (R_{sc})\)
- As long as \(R_{sc} > 0\), the seller borrows security to avoid fails as you will see on the next slide
Settlement fails after 2008

<See Garbade et al (2010)>

- Investors having bond B are happy to lend bond B to the seller, and invest money if $R_{gc} - R_{sc} > 0$.
- The seller can avoid fail by borrowing bond B and lending at $R_{sc}$, rather than $R_{gc}$, if $R_{gc} - R_{sc}$ (opportunity cost to avoid fail) is less than $R_{gc}$ (benefit to avoid fail).
- $R_{gc} - R_{sc} < R_{gc}$ means $0 < R_{sc}$.
- If $R_{sc}$ is close to zero, chronic fails happen.
Chronic settlement fails after 2008

• Prior to May 2009, market convention enabled a seller of U.S. Treasury securities to postpone without an explicit penalty its obligation to deliver the securities

• As long as short-term interest rates were above 3% or so, the time value of money usually sufficed to encourage timely settlement

• The Lehman failure caused “flight to quality,” which led to short term interest rates from 1.5% to zero, that led to chronic settlement fails
Settlement fails after 2008

Settlement fails after 2008

Remedy to chronic settlement fails after 2008

• Under near-zero short-term rates, the time value of money no longer provided adequate incentive to settle on time, and an extraordinary volume of fails threatened to erode the perception of the market as free of credit risk

• In response, Treasury Market Practices Group introduced a “dynamic fails charge” to incentivize timely settlement of Treasury securities and reduce fails in May 2009

• Penalty is proportional to max (3% - FF rate, 0)
Note: Number of Settlement fails in Japan (Source: BOJ)

Figures are based on monthly survey results reported by recipients of JGBs in failed transactions. The survey covers financial institutions and some other types of institutions that are direct participants in the JGB book-entry system and also users of the BOJ-NET JGS DVP services.