Liquidity Hoarding and Interbank Market Spreads: The Role of Counterparty Risk

Florian Heider	Marie Hoerova	Cornelia Holthausen
ECB	ECB	ECB

#### Conference on "Central Bank Liquidity Tools" NY Fed, February 19, 2009

The views expressed are solely those of the authors.

# Interbank market: Some facts



▲ロト ▲園ト ▲ヨト ▲ヨト ニヨー のへ(で)

# Interbank market: Some facts



▲□ > ▲圖 > ▲ 臣 > ▲ 臣 > → 臣 = ∽ 의 < ⊙ < ⊙

## Interbank market: Some facts



▲□ > ▲圖 > ▲ 臣 > ▲ 臣 > → 臣 = ∽ 의 < ⊙ < ⊙

# What do we do?

Study interbank market in the presence of counterparty risk

Parsimonious model to understand some of the mechanisms

- Parsimonious model to understand some of the mechanisms
- Environment:
  - maturity transformation, tradeoff between liquidity and return

◆□▶ ◆□▶ ◆三▶ ◆三▶ 三三 のへぐ

- Parsimonious model to understand some of the mechanisms
- Environment:
  - maturity transformation, tradeoff between liquidity and return

idiosyncratic liquidity risk; no aggregate liquidity shocks

Parsimonious model to understand some of the mechanisms

Environment:

maturity transformation, tradeoff between liquidity and return

- idiosyncratic liquidity risk; no aggregate liquidity shocks
- counterparty risk

Parsimonious model to understand some of the mechanisms

Environment:

- maturity transformation, tradeoff between liquidity and return
- idiosyncratic liquidity risk; no aggregate liquidity shocks
- counterparty risk
- Introduce asymmetric information about counterparty risk:
  privately-observed shocks to asset risk *after* portfolio allocation

Parsimonious model to understand some of the mechanisms

Environment:

- maturity transformation, tradeoff between liquidity and return
- idiosyncratic liquidity risk; no aggregate liquidity shocks
- counterparty risk
- Introduce asymmetric information about counterparty risk:
  privately-observed shocks to asset risk *after* portfolio allocation

Three possible regimes with different market rates (depending on parameters):

Three possible regimes with different market rates (depending on parameters):

・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・

I. full participation of borrowers and lenders

Three possible regimes with different market rates (depending on parameters):

・ロト・日本・モート モー うへぐ

- I. full participation of borrowers and lenders
- $\blacksquare$  II. safe borrowers drop out  $\rightarrow$  adverse selection

Three possible regimes with different market rates (depending on parameters):

- I. full participation of borrowers and lenders
- $\blacksquare$  II. safe borrowers drop out  $\rightarrow$  adverse selection
- III. market breakdown:
  - $\blacksquare$  all lenders drop out  $\rightarrow$  liquidity hoarding
  - all borrowers drop out

Three possible regimes with different market rates (depending on parameters):

- I. full participation of borrowers and lenders
- $\blacksquare$  II. safe borrowers drop out  $\rightarrow$  adverse selection
- III. market breakdown:
  - $\blacksquare$  all lenders drop out  $\rightarrow$  liquidity hoarding
  - all borrowers drop out
- Framework to examine policy responses:
  - ex ante interventions
  - crisis management

Three possible regimes with different market rates (depending on parameters):

- I. full participation of borrowers and lenders
- $\blacksquare$  II. safe borrowers drop out  $\rightarrow$  adverse selection
- III. market breakdown:
  - $\blacksquare$  all lenders drop out  $\rightarrow$  liquidity hoarding
  - all borrowers drop out
- Framework to examine policy responses:
  - ex ante interventions
  - crisis management

- Three periods: t = 0, 1, and 2
- Diamond-Dybvig consumers deposit with the bank at t = 0

(ロ)、(型)、(E)、(E)、 E) の(の)

- Three periods: t = 0, 1, and 2
- Diamond-Dybvig consumers deposit with the bank at t = 0

 $\blacksquare$  Deposits fully insured  $\rightarrow$  no bank runs

- Three periods: t = 0, 1, and 2
- Diamond-Dybvig consumers deposit with the bank at t = 0

◆□▶ ◆□▶ ◆三▶ ◆三▶ 三三 のへぐ

- $\blacksquare$  Deposits fully insured  $\rightarrow$  no bank runs
- Competitive, profit-maximizing banks

- Three periods: t = 0, 1, and 2
- Diamond-Dybvig consumers deposit with the bank at t = 0
- Deposits fully insured  $\rightarrow$  no bank runs
- Competitive, profit-maximizing banks
- At t = 0, banks can invest deposits in two assets:

Date	t = 0	t = 1	t=2
Short-term liquid asset	-1	1	1
Long-term illiquid asset	-1	l < 1	R with prob. $p, pR > 10 with prob. 1 - p$

- Three periods: t = 0, 1, and 2
- Diamond-Dybvig consumers deposit with the bank at t = 0
- Deposits fully insured  $\rightarrow$  no bank runs
- Competitive, profit-maximizing banks
- At t = 0, banks can invest deposits in two assets:

Date	t = 0	t = 1	t=2
Short-term liquid asset	-1	1	1
Long-term illiquid asset	-1	l < 1	R with prob. $p, pR > 10 with prob. 1 - p$

After investment is made, privately-observed shock to illiquid asset risk:

◆□▶ ◆□▶ ◆臣▶ ◆臣▶ 臣 のへぐ

After investment is made, privately-observed shock to illiquid asset risk:

◆□▶ ◆□▶ ◆三▶ ◆三▶ 三三 のへぐ

- with prob. q, safer than expected  $\rightarrow p_s > p$
- with prob. 1 q, riskier than expected  $\rightarrow p_r < p$

$$P = qp_s + (1-q)p_r$$

After investment is made, privately-observed shock to illiquid asset risk:

- with prob. q, safer than expected  $\rightarrow p_s > p$
- with prob. 1 q, riskier than expected  $\rightarrow p_r < p$

$$\bullet p = qp_s + (1-q)p_r$$

• pR > 1, but can be that  $p_rR < 1$ 

- After investment is made, privately-observed shock to illiquid asset risk:
  - with prob. q, safer than expected  $\rightarrow p_s > p$
  - with prob. 1 q, riskier than expected  $\rightarrow p_r < p$

$$\bullet p = qp_s + (1-q)p_r$$

• pR > 1, but can be that  $p_rR < 1$ 

Assume: riskier assets have lower liquidation value,  $l_s > l_r$ 

- After investment is made, privately-observed shock to illiquid asset risk:
  - with prob. q, safer than expected  $\rightarrow p_s > p$
  - with prob. 1 q, riskier than expected  $\rightarrow p_r < p$

$$p = qp_s + (1-q)p_r$$

• pR > 1, but can be that  $p_rR < 1$ 

Assume: riskier assets have lower liquidation value,  $l_s > l_r$ 

isomorphic to  $R_s < R < R_r$  (riskier asset has a higher return)

- After investment is made, privately-observed shock to illiquid asset risk:
  - with prob. q, safer than expected  $\rightarrow p_s > p$
  - with prob. 1 q, riskier than expected  $\rightarrow p_r < p$

$$p = qp_s + (1-q)p_r$$

• pR > 1, but can be that  $p_rR < 1$ 

Assume: riskier assets have lower liquidation value,  $l_s > l_r$ 

- isomorphic to  $R_s < R < R_r$  (riskier asset has a higher return)
- only need type-specific  $\frac{R}{T}$  (opportunity cost of liquidation)

- After investment is made, privately-observed shock to illiquid asset risk:
  - with prob. q, safer than expected  $\rightarrow p_s > p$
  - with prob. 1 q, riskier than expected  $\rightarrow p_r < p$

$$p = qp_s + (1-q)p_r$$

• pR > 1, but can be that  $p_rR < 1$ 

Assume: riskier assets have lower liquidation value,  $l_s > l_r$ 

- isomorphic to  $R_s < R < R_r$  (riskier asset has a higher return)
- only need type-specific  $\frac{R}{T}$  (opportunity cost of liquidation)

• At t = 1, a bank faces uncertainty about the liquidity demand:

(ロ)、(型)、(E)、(E)、 E) の(の)

• At t = 1, a bank faces uncertainty about the liquidity demand:

• fraction  $\pi_h$  of banks: high liquidity demand

- fraction  $\pi_l = 1 \pi_h$  of banks: low liquidity demand
- uncorrelated with the shock to the illiquid asset

• At t = 1, a bank faces uncertainty about the liquidity demand:

• fraction  $\pi_h$  of banks: high liquidity demand

- fraction  $\pi_l = 1 \pi_h$  of banks: low liquidity demand
- uncorrelated with the shock to the illiquid asset
- Interbank market can develop: banks with excess liquidity lend to those with a shortage

• At t = 1, a bank faces uncertainty about the liquidity demand:

• fraction  $\pi_h$  of banks: high liquidity demand

• fraction  $\pi_l = 1 - \pi_h$  of banks: low liquidity demand

uncorrelated with the shock to the illiquid asset

Interbank market can develop: banks with excess liquidity lend to those with a shortage

Assume: Interbank market anonymous and competitive

• At t = 1, a bank faces uncertainty about the liquidity demand:

• fraction  $\pi_h$  of banks: high liquidity demand

• fraction  $\pi_l = 1 - \pi_h$  of banks: low liquidity demand

uncorrelated with the shock to the illiquid asset

Interbank market can develop: banks with excess liquidity lend to those with a shortage

Assume: Interbank market anonymous and competitive

### Timeline



Banks allocate deposits between liquid and illiquid assets.

and shocks to illiquid asset's long-term asset realizes. risk realized

Banks borrow and lend on an interbank market at an interest rate r.

Additionally, they can liquidate some of their illiquid asset holdings and/or keep cash in re-

serves.

Impatient consumers withdraw deposits.

Interbank loans are repaid.

Patient consumers withdraw their deposits.

▲ロト ▲帰ト ▲ヨト ▲ヨト 三日 - の々ぐ
Interbank interest rate *r* is given by no arbitrage:

Interbank interest rate *r* is given by no arbitrage:

$$(\pi_{l}\boldsymbol{p}\boldsymbol{p}+\pi_{h}\boldsymbol{p})(1+\boldsymbol{r})=(\pi_{l}\boldsymbol{p}+\pi_{h}\boldsymbol{p})\,\boldsymbol{R}$$

Interbank interest rate *r* is given by no arbitrage:

$$(\pi_l p p + \pi_h p) (1 + r) = (\pi_l p + \pi_h p) R$$
  
or  
$$1 + r = R \frac{1}{p \pi_l + \pi_h}$$

■ Interbank interest rate *r* is given by no arbitrage:

or 
$$(\pi_l p p + \pi_h p) (1 + r) = (\pi_l p + \pi_h p) R$$
$$1 + r = R \frac{1}{p \pi_l + \pi_h}$$

■ Since <sup>1</sup>/<sub>pπ<sub>l</sub>+π<sub>h</sub></sub> > 1, there is a "risk premium" → liquidity costly since lending is risky!

■ Interbank interest rate *r* is given by no arbitrage:

or  

$$(\pi_l p p + \pi_h p) (1+r) = (\pi_l p + \pi_h p) R$$

$$1+r = R \frac{1}{p\pi_l + \pi_h}$$

■ Since <sup>1</sup>/<sub>pπ<sub>l</sub>+π<sub>h</sub></sub> > 1, there is a "risk premium" → liquidity costly since lending is risky!

In Regime I:

risk premium < liquidation premium for safer borrowers</p>

■ Interbank interest rate *r* is given by no arbitrage:

or  

$$(\pi_l p p + \pi_h p) (1+r) = (\pi_l p + \pi_h p) R$$

$$1+r = R \frac{1}{p\pi_l + \pi_h}$$

■ Since <sup>1</sup>/<sub>pπ<sub>l</sub>+π<sub>h</sub></sub> > 1, there is a "risk premium" → liquidity costly since lending is risky!

In Regime I:

risk premium < liquidation premium for safer borrowers</p>

no impairment to market functioning

■ Interbank interest rate *r* is given by no arbitrage:

or  

$$(\pi_l p p + \pi_h p) (1+r) = (\pi_l p + \pi_h p) R$$

$$1+r = R \frac{1}{p\pi_l + \pi_h}$$

■ Since <sup>1</sup>/<sub>pπ<sub>l</sub>+π<sub>h</sub></sub> > 1, there is a "risk premium" → liquidity costly since lending is risky!

In Regime I:

risk premium < liquidation premium for safer borrowers</p>

no impairment to market functioning

■ Safer borrowers drop out if risk premium too high ↔ interest rate *r* too high

◆□▶ ◆□▶ ◆臣▶ ◆臣▶ 臣 の�?

- Safer borrowers drop out if risk premium too high ↔ interest rate *r* too high
- Only riskier borrowers in the market  $\rightarrow$  interest rate  $r_r$ :

$$1 + r_r = \frac{\pi_I p + \pi_h (1 - q) p_r}{\pi_I p p_r + \pi_h (1 - q) p_r} R$$

◆□▶ ◆□▶ ◆三▶ ◆三▶ 三三 のへぐ

- Safer borrowers drop out if risk premium too high ↔ interest rate *r* too high
- Only riskier borrowers in the market  $\rightarrow$  interest rate  $r_r$ :

$$1 + r_{r} = \frac{\pi_{l} p + \pi_{h} (1 - q) p_{r}}{\pi_{l} p p_{r} + \pi_{h} (1 - q) p_{r}} R$$

◆□▶ ◆□▶ ◆三▶ ◆三▶ 三三 のへぐ

Adverse selection has two effects:

- Safer borrowers drop out if risk premium too high ↔ interest rate *r* too high
- Only riskier borrowers in the market  $\rightarrow$  interest rate  $r_r$ :

$$1 + r_r = \frac{\pi_I p + \pi_h (1 - q) p_r}{\pi_I p p_r + \pi_h (1 - q) p_r} R$$

- Adverse selection has two effects:
  - Ienders get repaid less often

- Safer borrowers drop out if risk premium too high ↔ interest rate *r* too high
- Only riskier borrowers in the market  $\rightarrow$  interest rate  $r_r$ :

$$1 + r_r = \frac{\pi_I p + \pi_h (1 - q) p_r}{\pi_I p p_r + \pi_h (1 - q) p_r} R$$

- Adverse selection has two effects:
  - Ienders get repaid less often
  - only riskier banks borrow

- Safer borrowers drop out if risk premium too high ↔ interest rate *r* too high
- Only riskier borrowers in the market  $\rightarrow$  interest rate  $r_r$ :

$$1 + r_r = \frac{\pi_I p + \pi_h (1 - q) p_r}{\pi_I p p_r + \pi_h (1 - q) p_r} R$$

- Adverse selection has two effects:
  - Ienders get repaid less often
  - only riskier banks borrow
- Implies that  $r_r > r$  holds

- Safer borrowers drop out if risk premium too high ↔ interest rate *r* too high
- Only riskier borrowers in the market  $\rightarrow$  interest rate  $r_r$ :

$$1 + r_r = \frac{\pi_I p + \pi_h (1 - q) p_r}{\pi_I p p_r + \pi_h (1 - q) p_r} R$$

- Adverse selection has two effects:
  - Ienders get repaid less often
  - only riskier banks borrow
- Implies that  $r_r > r$  holds

Lack of supply: lenders drop out

• interest rate  $r_r$  is high:  $r_r > r...$ 



#### Lack of supply: lenders drop out

• interest rate  $r_r$  is high:  $r_r > r$ ...but is it high enough?

(ロ)、(型)、(E)、(E)、 E) の(の)

Lack of supply: lenders drop out

• interest rate  $r_r$  is high:  $r_r > r$ ...but is it high enough?

◆□▶ ◆□▶ ◆三▶ ◆三▶ 三三 のへぐ

Ienders' outside option: reinvest in liquid asset

Lack of supply: lenders drop out

• interest rate  $r_r$  is high:  $r_r > r$ ...but is it high enough?

Ienders' outside option: reinvest in liquid asset

• if  $p_r(1+r_r) < 1 \rightarrow$  lenders hoard liquidity

Lack of supply: lenders drop out

• interest rate  $r_r$  is high:  $r_r > r$ ...but is it high enough?

Ienders' outside option: reinvest in liquid asset

• if  $p_r(1+r_r) < 1 \rightarrow$  lenders hoard liquidity

• necessary that  $p_r R < 1 \rightarrow$  return on riskier projects really bad!

Lack of supply: lenders drop out

• interest rate  $r_r$  is high:  $r_r > r$ ...but is it high enough?

Ienders' outside option: reinvest in liquid asset

• if  $p_r(1+r_r) < 1 \rightarrow$  lenders hoard liquidity

• necessary that  $p_r R < 1 \rightarrow$  return on riskier projects really bad!

- Lack of demand: all borrowers drop out
  - if risk premium > liquidation premium for riskier borrowers

Lack of supply: lenders drop out

• interest rate  $r_r$  is high:  $r_r > r$ ...but is it high enough?

Ienders' outside option: reinvest in liquid asset

• if  $p_r(1+r_r) < 1 \rightarrow$  lenders hoard liquidity

• necessary that  $p_r R < 1 \rightarrow$  return on riskier projects really bad!

- Lack of demand: all borrowers drop out
  - if risk premium > liquidation premium for riskier borrowers

# Comparative statics: Level and dispersion of risk



▲ロト ▲圖 ト ▲ 画 ト ▲ 画 ト の Q ()

• Liquidity requirements:



Liquidity requirements:

always feasible, prevent liquidation of safer banks

(ロ)、(型)、(E)、(E)、 E) の(の)

#### Liquidity requirements:

- always feasible, prevent liquidation of safer banks
- but distort: 1) portfolio allocation; 2) price of liquidity

◆□▶ ◆□▶ ◆三▶ ◆三▶ 三三 のへぐ

#### Liquidity requirements:

- always feasible, prevent liquidation of safer banks
- but distort: 1) portfolio allocation; 2) price of liquidity

◆□▶ ◆□▶ ◆三▶ ◆三▶ 三三 のへぐ

• beneficial if  $I_s$  low or  $\pi_h q$  high

#### Liquidity requirements:

- always feasible, prevent liquidation of safer banks
- but distort: 1) portfolio allocation; 2) price of liquidity

◆□▶ ◆□▶ ◆三▶ ◆三▶ 三三 のへぐ

- beneficial if  $I_s$  low or  $\pi_h q$  high
- Market transparency:

#### Liquidity requirements:

- always feasible, prevent liquidation of safer banks
- but distort: 1) portfolio allocation; 2) price of liquidity
- beneficial if  $I_s$  low or  $\pi_h q$  high
- Market transparency:
  - two markets emerge: one for safer and one for riskier banks

#### Liquidity requirements:

- always feasible, prevent liquidation of safer banks
- but distort: 1) portfolio allocation; 2) price of liquidity
- beneficial if  $I_s$  low or  $\pi_h q$  high
- Market transparency:
  - two markets emerge: one for safer and one for riskier banks

• lower interest rate for safer borrowers:  $r_{tr}^{s} < r < r_{tr}^{r}$ 

#### Liquidity requirements:

- always feasible, prevent liquidation of safer banks
- but distort: 1) portfolio allocation; 2) price of liquidity
- beneficial if  $I_s$  low or  $\pi_h q$  high
- Market transparency:
  - two markets emerge: one for safer and one for riskier banks

- lower interest rate for safer borrowers:  $r_{tr}^{s} < r < r_{tr}^{r}$
- no distortion but not feasible if risk premia high

#### Liquidity requirements:

- always feasible, prevent liquidation of safer banks
- but distort: 1) portfolio allocation; 2) price of liquidity
- beneficial if  $I_s$  low or  $\pi_h q$  high
- Market transparency:
  - two markets emerge: one for safer and one for riskier banks

- lower interest rate for safer borrowers:  $r_{tr}^{s} < r < r_{tr}^{r}$
- no distortion but not feasible if risk premia high

• Liquidity provision by the central bank:

• Liquidity provision by the central bank:

• subsidized interest rate:  $r_{CB} < r$ 

◆□▶ ◆□▶ ◆臣▶ ◆臣▶ 臣 の�?

• Liquidity provision by the central bank:

- subsidized interest rate:  $r_{CB} < r$
- but CB still makes profit ← unit cost of (public) liquidity

◆□▶ ◆□▶ ◆臣▶ ◆臣▶ 臣 の�?

• Liquidity provision by the central bank:

- subsidized interest rate:  $r_{CB} < r$
- but CB still makes profit ← unit cost of (public) liquidity
- $\blacksquare$  CB can take on liquidity from lenders  $\rightarrow$  full intermediation

Liquidity provision by the central bank:

- subsidized interest rate:  $r_{CB} < r$
- but CB still makes profit ← unit cost of (public) liquidity
- $\blacksquare$  CB can take on liquidity from lenders  $\rightarrow$  full intermediation
- Interbank loan guarantees: must be sufficiently comprehensive
Liquidity provision by the central bank:

- subsidized interest rate:  $r_{CB} < r$
- but CB still makes profit ← unit cost of (public) liquidity
- $\blacksquare$  CB can take on liquidity from lenders  $\rightarrow$  full intermediation

Interbank loan guarantees: must be sufficiently comprehensive

• full: 
$$1 + r_{FG} = R$$
; cost:  $(1 - p) R \pi_h L_h$ 

Liquidity provision by the central bank:

- subsidized interest rate:  $r_{CB} < r$
- but CB still makes profit ← unit cost of (public) liquidity
- $\blacksquare$  CB can take on liquidity from lenders  $\rightarrow$  full intermediation

Interbank loan guarantees: must be sufficiently comprehensive

• full: 
$$1 + r_{FG} = R$$
; cost:  $(1 - p) R \pi_h L_h$ 

■ partial:  $1 + r_{PG} > R$ ; cost  $(\hat{p} - p) (1 + r_{PG}) \pi_h L_h$ 

Liquidity provision by the central bank:

- subsidized interest rate:  $r_{CB} < r$
- but CB still makes profit ← unit cost of (public) liquidity
- $\blacksquare$  CB can take on liquidity from lenders  $\rightarrow$  full intermediation

Interbank loan guarantees: must be sufficiently comprehensive

- full:  $1 + r_{FG} = R$ ; cost:  $(1 p) R \pi_h L_h$
- partial:  $1 + r_{PG} > R$ ; cost  $(\hat{p} p) (1 + r_{PG}) \pi_h L_h$
- cost(partial)>cost(full) possible as r<sub>PG</sub> > r<sub>FG</sub>

Liquidity provision by the central bank:

- subsidized interest rate:  $r_{CB} < r$
- but CB still makes profit ← unit cost of (public) liquidity
- $\blacksquare$  CB can take on liquidity from lenders  $\rightarrow$  full intermediation

Interbank loan guarantees: must be sufficiently comprehensive

• full: 
$$1 + r_{FG} = R$$
; cost:  $(1 - p) R \pi_h L_h$ 

■ partial:  $1 + r_{PG} > R$ ; cost  $(\hat{p} - p) (1 + r_{PG}) \pi_h L_h$ 

cost(partial)>cost(full) possible as r<sub>PG</sub> > r<sub>FG</sub>

Asset purchases: CB not exposed to liquidity risk

Liquidity provision by the central bank:

- subsidized interest rate:  $r_{CB} < r$
- but CB still makes profit ← unit cost of (public) liquidity
- $\blacksquare$  CB can take on liquidity from lenders  $\rightarrow$  full intermediation

Interbank loan guarantees: must be sufficiently comprehensive

• full: 
$$1 + r_{FG} = R$$
; cost:  $(1 - p) R \pi_h L_h$ 

- partial:  $1 + r_{PG} > R$ ; cost  $(\hat{p} p) (1 + r_{PG}) \pi_h L_h$
- cost(partial)>cost(full) possible as r<sub>PG</sub> > r<sub>FG</sub>

Asset purchases: CB not exposed to liquidity risk

• price  $P > l_{\theta}$ = "fire-sale", P set only to reflect counterparty risk

Liquidity provision by the central bank:

- subsidized interest rate:  $r_{CB} < r$
- but CB still makes profit ← unit cost of (public) liquidity
- $\blacksquare$  CB can take on liquidity from lenders  $\rightarrow$  full intermediation

Interbank loan guarantees: must be sufficiently comprehensive

• full: 
$$1 + r_{FG} = R$$
; cost:  $(1 - p) R \pi_h L_h$ 

- partial:  $1 + r_{PG} > R$ ; cost  $(\hat{p} p) (1 + r_{PG}) \pi_h L_h$
- cost(partial)>cost(full) possible as r<sub>PG</sub> > r<sub>FG</sub>

Asset purchases: CB not exposed to liquidity risk

• price  $P > l_{\theta}$ = "fire-sale", P set only to reflect counterparty risk

# Summary



・ロト ・ 日 ・ モー・ モー・ ・ 日 ・ うへぐ

# Thank you!

◆□▶ ◆□▶ ◆臣▶ ◆臣▶ 臣 のへで

#### Interbank market: Secured vs Unsecured



▲ロト ▲園ト ▲ヨト ▲ヨト ニヨー のへ(で)

## Interbank market: Secured vs Unsecured



▲□▶ ▲圖▶ ▲臣▶ ▲臣▶ ―臣 … のへで