Money Market Functioning and Interbank Uncertainty

1. Interbank Uncertainty and Bank Lending
   Altavilla - Carboni - Lenza - Uhlig: ACLU
2. Money Markets, Collateral and Monetary Policy
   de Fiore - Hoerova - Uhlig: dFHU

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Outline

1. Does interbank uncertainty matter for bank lending?

2. Monetary policy consequences of interbank uncertainty?

Overview

- **Interbank market:**
  - Crucial for financial system.
  - Crucial for monetary policy.
- **Question 1: Does interbank uncertainty matter for bank lending?**
  - Altavilla - Carboni - Lenza - Uhlig (2018), “Interbank Uncertainty and Bank Lending”.
  - **Empirical** approach. Panel of bank lending rates.
  - **Key insight**: new interbank uncertainty measure. Substantial impact on bank lending rates.
- **Question 2: Monetary policy consequences of interbank uncertainty?**
  - de Fiore - Hoerova - Uhlig (2018), “Money Markets, Collateral and Monetary Policy”.
  - **Theoretical** approach. Gertler-Karadi-Kiyotaki meets Bianchi-Bigio.
  - **Key insight**: without sufficient liquidity injection, substantial output losses.

Outline

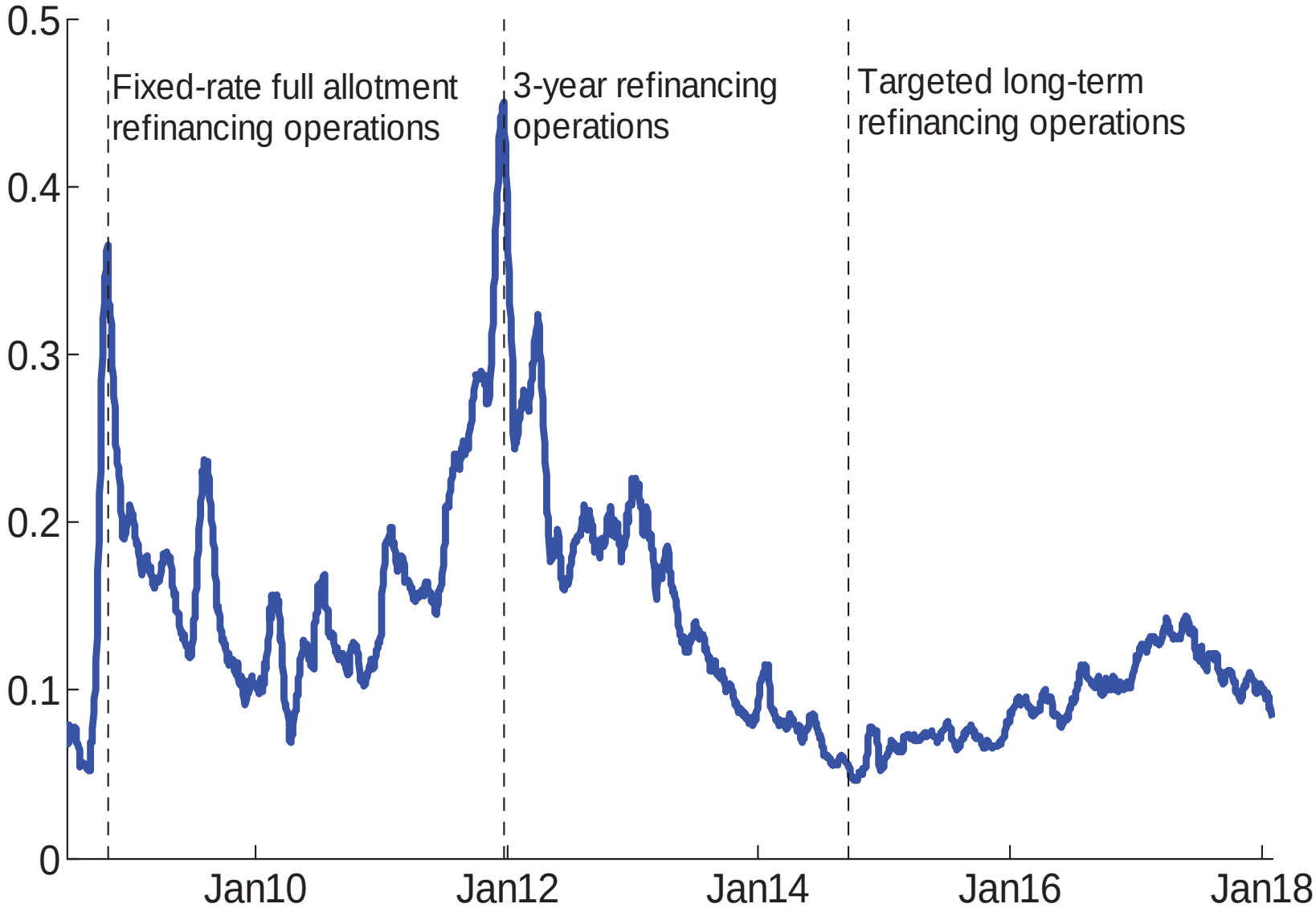
Interbank Uncertainty

Altavilla - Carboni - Lenza - Uhlig or **ACLU** (2018) , “Interbank Uncertainty and Bank Lending”:

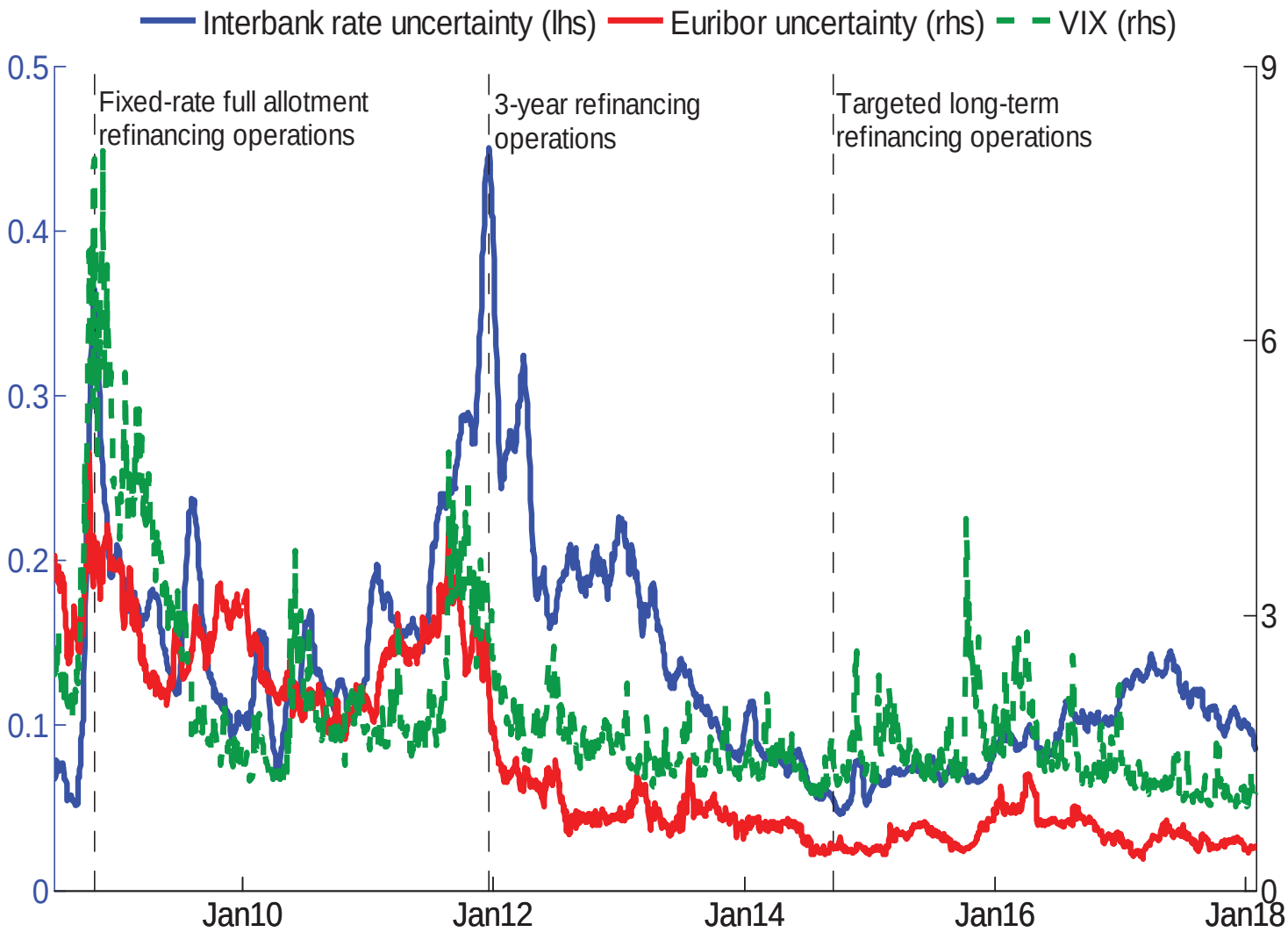
Interbank Uncertainty
:=
cross-sectional dispersion in the interbank market rates for overnight unsecured loans among Euro area banks.

Data: volume-weighted standard deviation of interbank rates for overnight unsecured loans, extracted from TARGET2 per Furfine algorithm, daily data, June 2008 - July 2018.

Interbank Uncertainty



Interbank Uncert. vs Other Measures of Uncertainty



Data Description

Variable	av.	σ	5th	25th	50th	75th	95th
bank lending rate	4.0	1.8	1.6	2.6	3.7	5.0	7.2
interbank uncert.	0.14	0.07	0.06	0.09	0.12	0.17	0.27
bank CDS	1.8	2.6	0.5	0.8	1.2	1.9	5.3
capital ratio	8.8	17.5	1.3	4.4	7.2	10.8	20.7
ECB credit	2.3	6.6	0.0	0.0	0.0	2.0	12.0
assets	75.7	138.9	2.5	10.4	28.1	72.8	348.1
deposit rate	1.8	1.4	0.1	0.7	1.5	2.7	4.4
sov. secur.	4.2	6.4	0.0	0.0	1.8	5.9	16.3
3-month OIS	0.8	1.4	-0.4	0.0	0.3	0.8	4.1
unempl. rate	0.6	0.4	4.3	5.9	8.1	10.7	22.6

Data: 323 banks, operating in 18 Euro area countries, covering 80% of assets held by Euro area MFIs. June 2007 - June 2018, monthly.

Regression Analysis

$$\begin{aligned} Y_{i,j,t} &= \alpha_i + \beta_0 \sigma_t + \beta_1 B_{i,j,t-1} \times \sigma_t + \\ & \beta_2 r_t + \beta_3 B_{i,j,t-1} + \beta_4 C_{i,j,t-1} + \beta_5 Z_{j,t} + \epsilon_{i,j,t} \end{aligned}$$

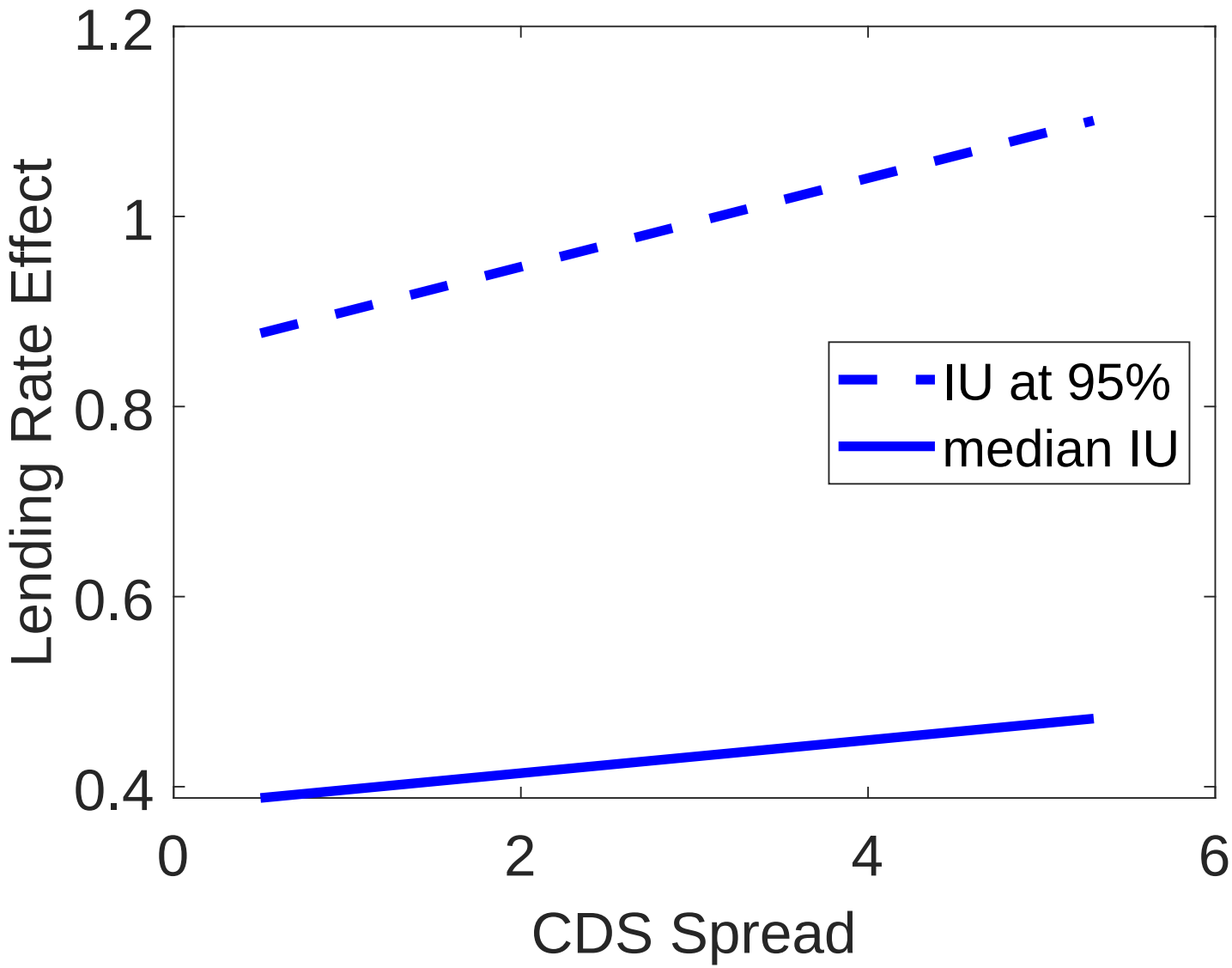
where

- $Y_{i,j,t}$: lending rates applied by bank i in country j and month t on loans to non-financial corporations.
- σ_t: Interbank rate uncertainty.
- $B_{i,j,t-1}$: a vector of bank-level variables:
  1. banks' credit default swap (CDS) spreads.
  2. capital ratio: bank capital over main assets.
  3. ECB credit over main assets
- Other controls: borrowing volumes in interbank market (over main assets), banks' holdings of sov. securities (over main assets), CDS premia squared, bank fixed effects α_i, three-month EONIA (OIS) spot rate r_t, country-specific unemploym. rate is in $Z_{j,t}$.

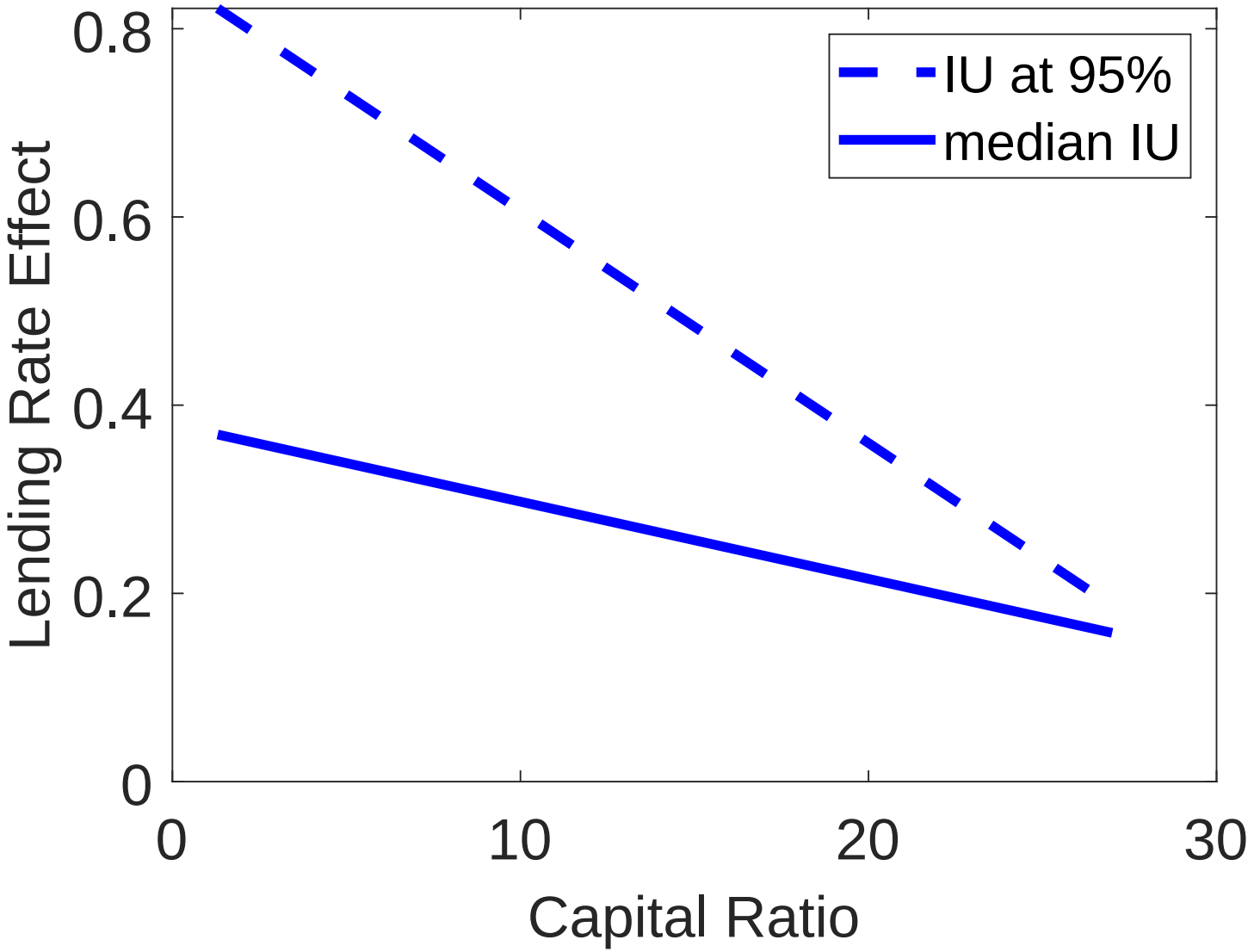
Benchmark results (Table 2, Col. 4):

σ_t	3.162***	(0.394)
σ_t x Bank CDS$_{i,j,t-1}$	0.195***	(0.055)
σ_t x Capital ratio$_{i,j,t-1}$	-0.110**	(0.045)
σ_t x ECB credit$_{i,j,t-1}$	-0.0801*	(0.043)
Bank CDS$_{i,j,t-1}$	-0.006	(0.0256)
Capital ratio$_{i,j,t-1}$	0.005	(0.0162)
ECB credit$_{i,j,t-1}$	0.0228**	(0.0088)
Deposit rate$_{i,j,t-1}$	0.149***	(0.0451)
Sovereign exposure$_{i,j,t-1}$	-0.011	(0.012)
Interbank credit$_{i,j,t-1}$	0.005	(0.004)
(Bank CDS$_{i,j,t-1}$)^2	-0.0003	(0.0005)
3-month OIS$_t$	0.781***	(0.0424)
Unemployment rate$_{j,t}$	0.101***	(0.0171)
Bank fixed effects	YES	
# Observation	12850	
R^2	0.79	

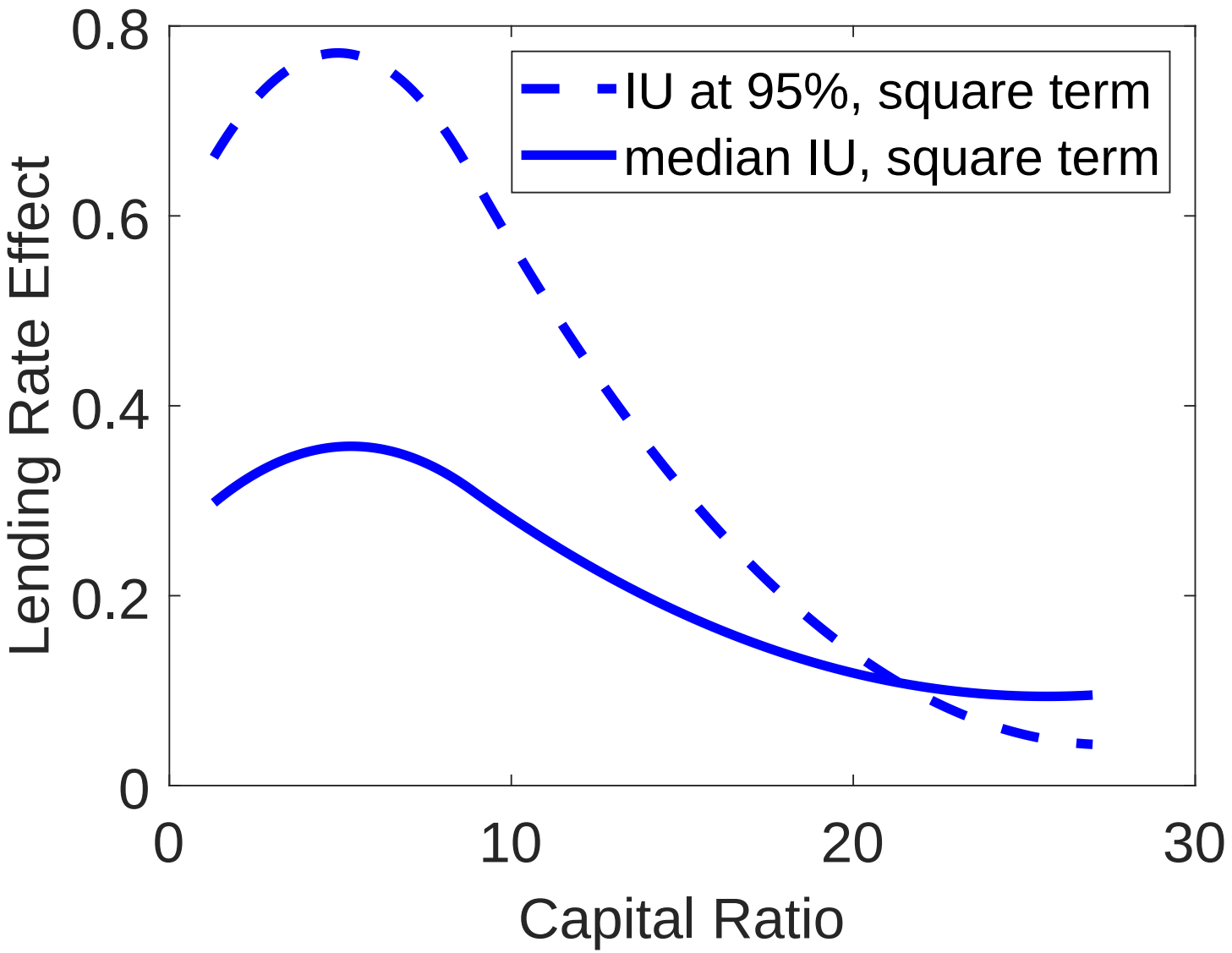
Interbank Uncertainty (IU) and CDS spreads, (4):



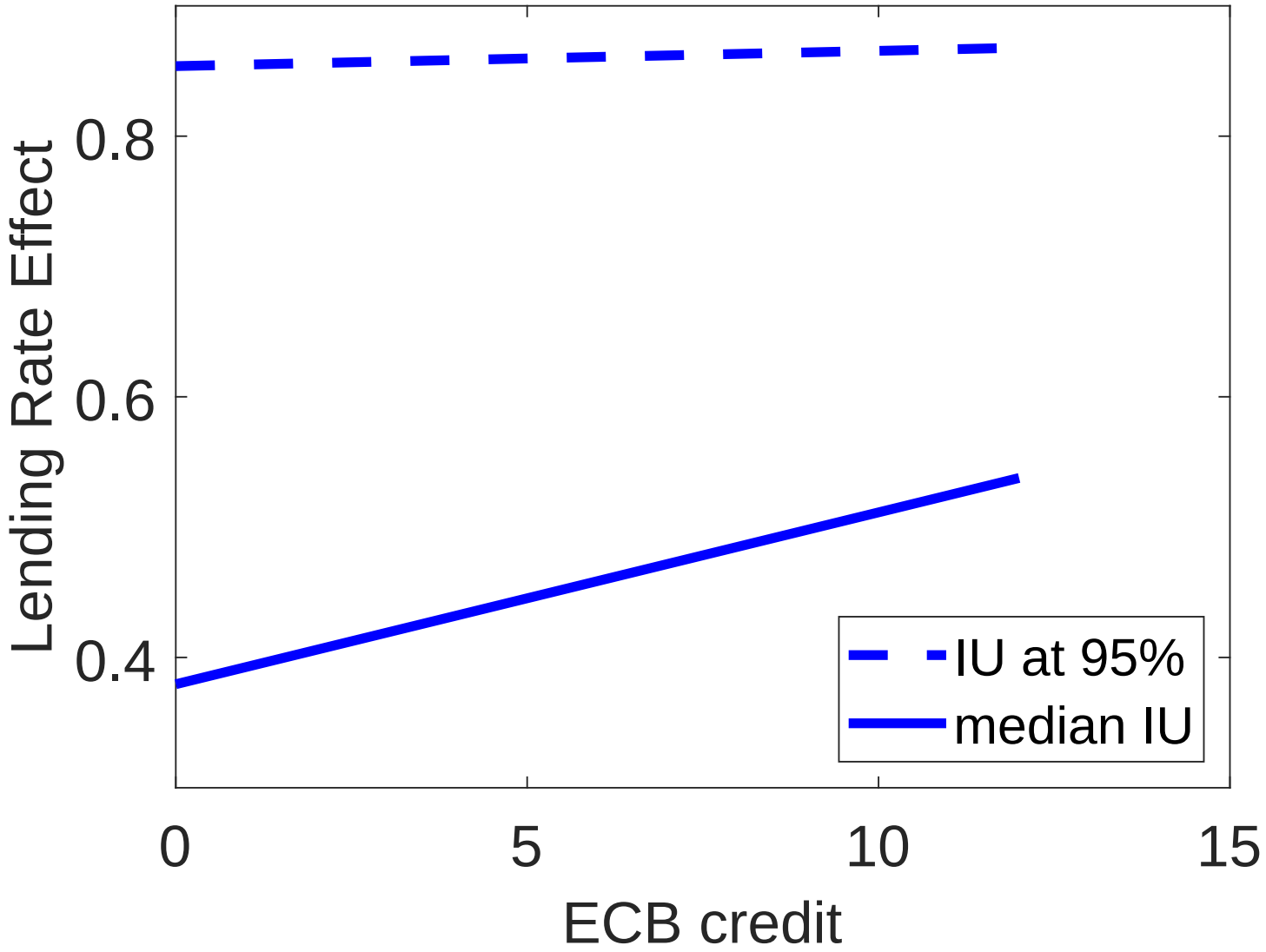
Interbank Uncertainty (IU) and capital ratios, (4):



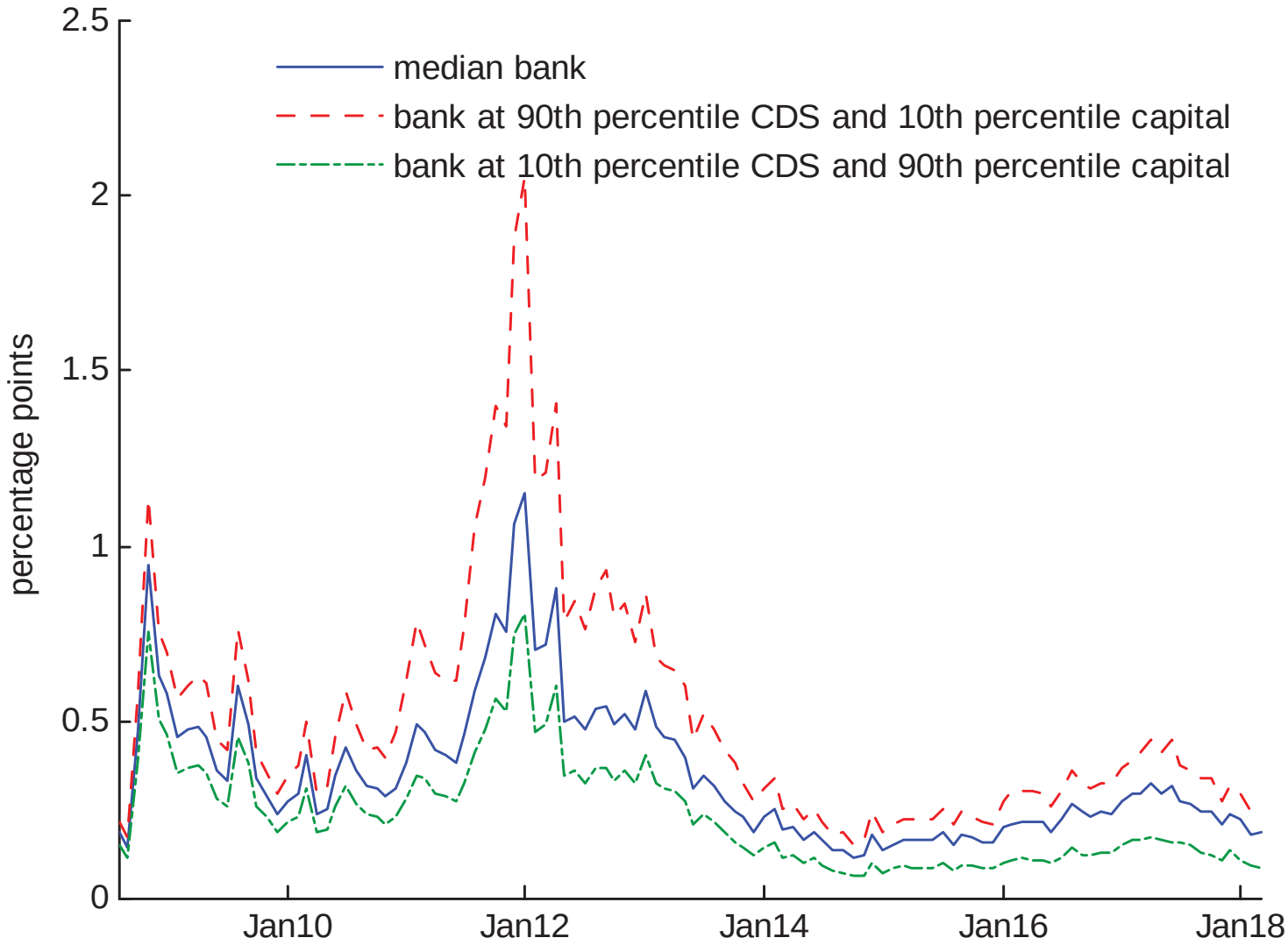
Interbank Uncertainty (IU) and capital ratios, (9):



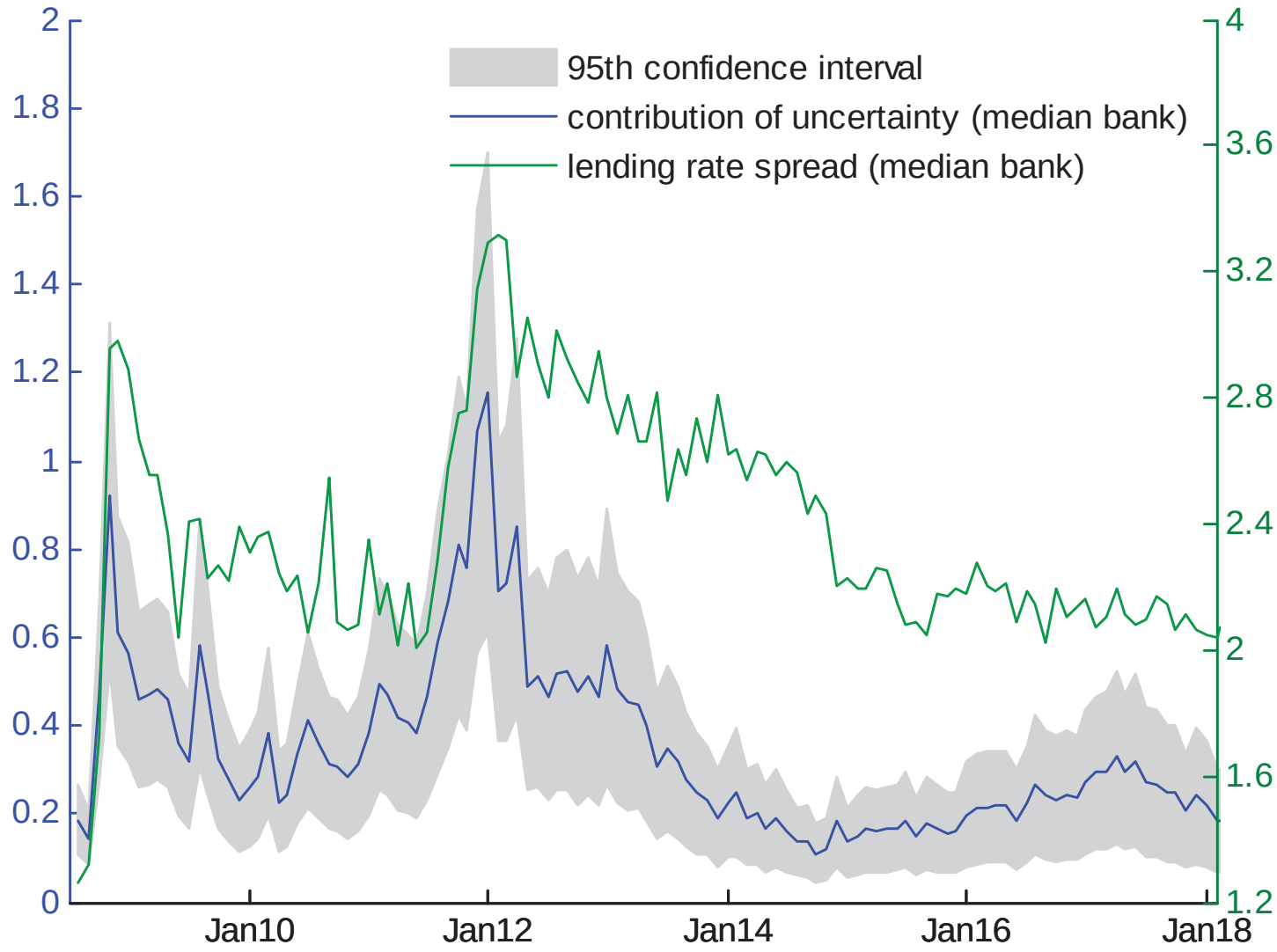
Interbank Uncertainty (IU) and ECB credit, (4):



Interbank Uncert., CDS spreads & Cap Ratios:



Contrib. of Interbank Uncertainty on Lending Rates



Conclusions from ACLU

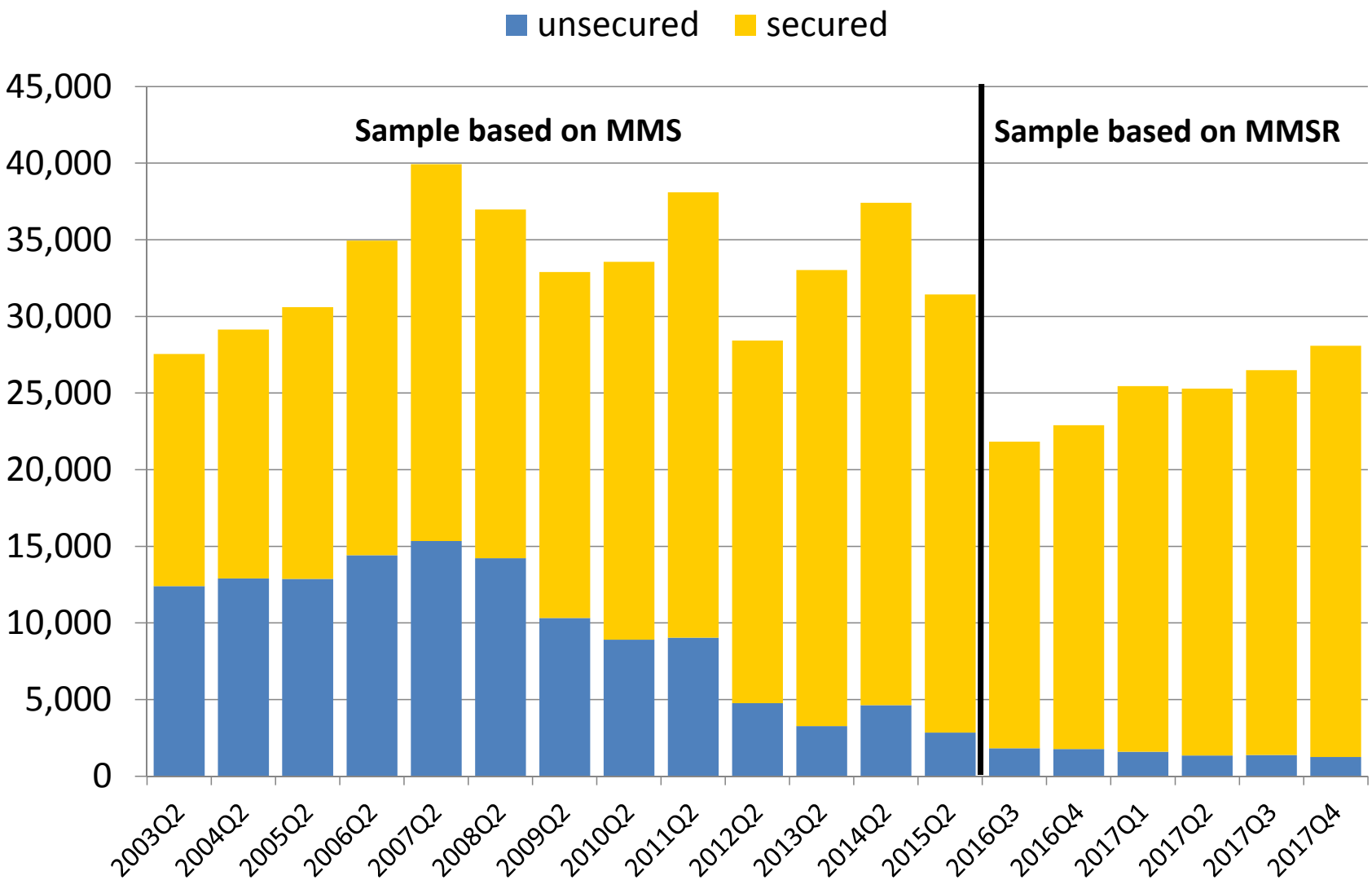
- New interbank uncertainty measure.
- Substantial impact on bank lending rates.
- Matters even when VIX, other variables are included.
- Interaction terms with CDS and capital ratio more important than these terms on their own.
- ECB credit relationship with lending rates flatten at high IU.

Outline

Interbank Money Markets

- de Fiore - Hoerova - Uhlig or **dFHU** (2018), “Money Markets, Collateral and Monetary Policy”.
- Constraints on Banks:
  - Capital constraints: Gertler-Karadi-Kiyotaki or GKK.
  - Liquidity constraints: Bianchi-Bigio or BB.
- Our paper: “GKK meets BB”.
- Interbank money markets are occasionally under much stress.
- Example: Euro area, recent decade.
  - Decline in unsecured lending, switch to secured lending.
  - Haircut increases on sovereign bonds of “periphery countries”.

Secured vs unsecured MM activity



Cumulative quarterly turnover in the unsecured (blue bars) and secured (yellow bars) euro area money markets in EUR billion.
Source: Euro Area Money Market Survey until 2015, Money Market Statistical Reporting transactions-based data thereafter.

ECB vs private haircuts on sovereign bonds

	ECB		Private	
	CQS1-2	CQS3	Germany	Portugal
2010	2.8	7.8	2.7	8.1
2011	2.8	7.8	3.0	10.1
2012	2.8	7.8	3.0	80.0
2013	2.8	7.8	3.0	80.0

Source: ECB and LCH Clearnet.

"CQS1-2": Credit Quality Securities type 1-2 (govt bonds of core EA countries) and of type 3 (govt bonds of periphery countries).

Interbank Uncertainty in **dFHU**

Interbank Uncertainty
or Money Market Frictions
:=
private sector haircuts $1 - \tilde{\eta}$
for "afternoon" interbank loans
secured with gov. bonds

Questions

1. How do money market frictions affect the macroeconomy?
2. How do bank leverage and liquidity constraints interact?
3. What does this imply for central bank policies?

Approach and Results

Approach:

- DSGE model with frictional interbank money market (MM) and a central bank (CB).
- Calibrate to Euro area.
- Comparative statics (or: steady states). Vary degree of friction.
- Compare CB policies.

Results:

- MM frictions lead banks to shift to unproductive resources and to delever. Lending and output declines.
- With tighter liquidity constraint, leverage constraint turns slack.
- CB balance sheet expansion alleviates liquidity constraints, attenuates output drop.

Model overview

Households

hold deposits D and money M, consume and work

Firms

produce output y and capital k

Government

issues bonds B, taxes and spends

Banks

hold capital k, bonds B, money M
take deposits D, CB loans F
manage liquidity in MMs

Foreigners

hold bonds B

Central Bank

holds bonds B, loans F to banks, issues money M

Some bank *I*: sequence of decisions.

- Morning (asset management) ("extended GKK"):
  - idiosyncratic type shock: with prob ξ_t, a bank is Connected", else Unconnected"
  - given type, choice of assets (capital $k_{t,I}$, bonds $B_{t,I}$, money $M_{t,I}$, dividends $\phi N_{t,I}$); liabilities (deposits $D_{t,I}$, CB loans $F_{t,I}$, net worth $N_{t,I}$)
- Afternoon (liquidity management) ("extended BB"):
  - iid liquidity shock $\omega_{It} \leq \omega^{\max}$
  - C banks: raise liquidity in the unsecured MM
  - U banks: can borrow in the secured MM or self-insure
  - reversal of liquidity shock at end of afternoon. Loans repaid.

Some bank I: value maximization, formally.

Given net worth N_t, pick $k_{t,I}, B_{t,I}, B^F_{t,I}, M_{t,I}, D_{t,I}, F_{t,I}$ to maximize end-of-period bank value

$$V_{t,I} = \psi_{t,k} P_t k_{t,I} + \psi_t B_{t,I} + \psi_{t,M} M_{t,I} - \psi_{t,D} D_{t,I} - \psi_{t,F} F_{t,I}$$

subject to, for $I = C, U$, the asset management constraints

$$\begin{aligned} V_{t,I} &\geq \lambda \left(P_t k_{t,I} + Q_t B_{t,I} + M_{t,I} \right) \\ P_t k_{t,I} + Q_t B_{t,I} + \phi N_t &= D_{t,I} + Q^F_t F_{t,I} + N_t \\ 0 \leq F_{t,I} &\leq \eta_t Q_t B^F_{t,I} \\ 0 \leq B^F_{t,I} &\leq B_{t,I} \\ 0 \leq M_{t,I}, \qquad 0 \leq D_{t,I}, &\qquad 0 \leq k_{t,I} \end{aligned}$$

and, for Unconnected banks, afternoon liquidity constraint:

$$\omega^{\max} D_{t,I} \leq M_{t,I} + \tilde{\eta}_t Q_t \left(B_{t,I} - B^F_{t,I} \right)$$

Relevant constraints for U-banks

- Liquidity constraint forU banks binds:

$$\omega^{\max} D_U = M_U + \tilde{\eta} Q \left(B_U - B_U^F \right)$$

- Five inequality constraints (switch off/on)
  - Gertler-Kiyotaki-Karadi leverage constraint:

$$\textbf{(blue:)}\ V_U \geq \lambda \left(P_t k_U + Q B_U + M_U \right)$$

  - Collateral constraint at the CB in the morning:

$$\textbf{(magenta:)}\ B_U^F \leq B_U$$

  - Short-sale constraints:

$$\begin{aligned} \textbf{(green:)} \quad M_U &\geq 0 \\ \textbf{(cyan:)} \quad F_U &\geq 0 \\ \textbf{(orange:)} \quad B_U &\geq 0 \end{aligned}$$

Numerical analysis

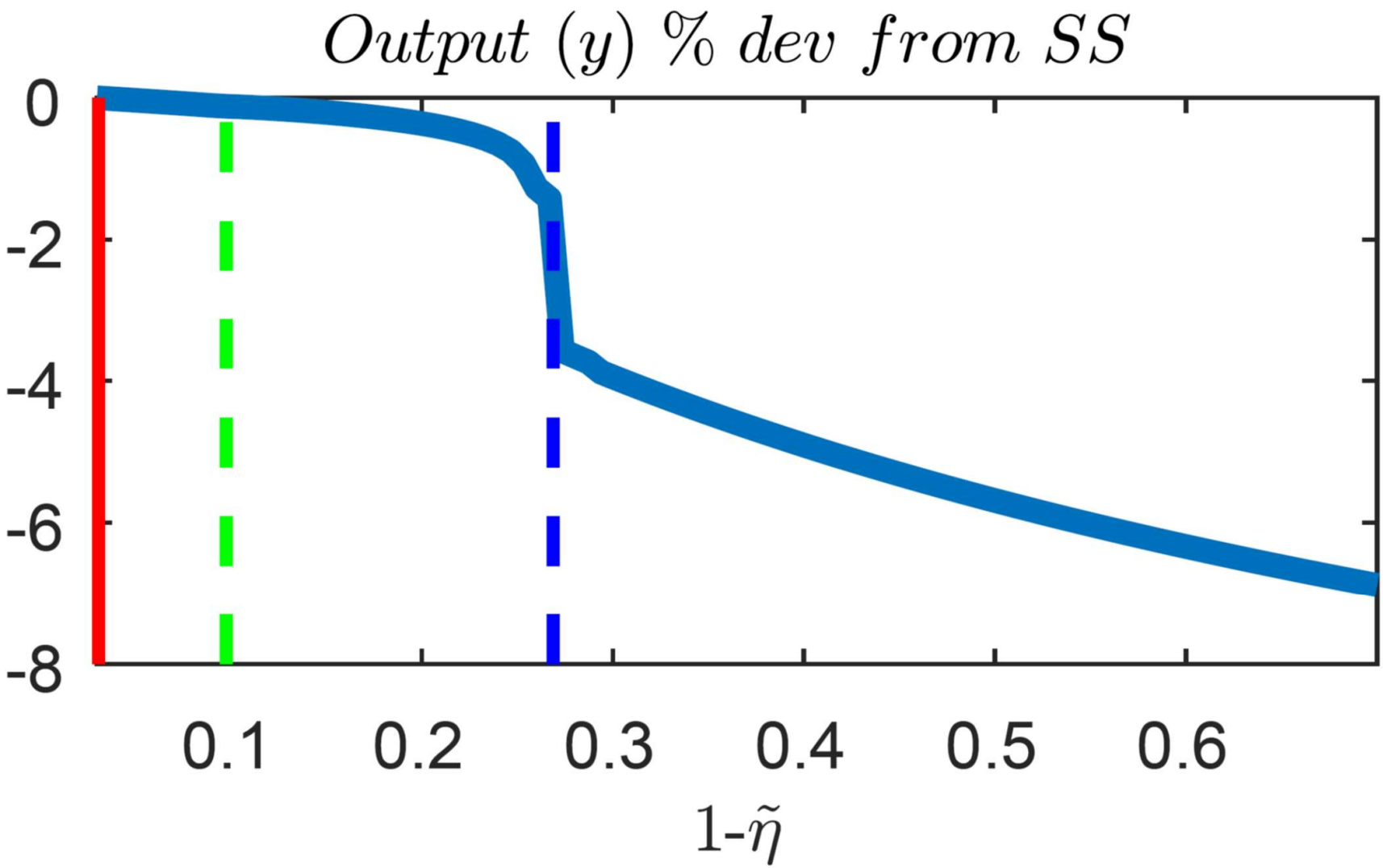
- Calibrate to Euro area.
- Comparative statics: increase in private haircut $1 - \tilde{\eta}$ on bonds

- Compare three CB policies:
  1. constant CB balance sheet (BS), $\approx$ fix M
  2. collateralized lending at a fixed rate ("FRFA")
  3. outright purchases of bonds to maintain constant π ("QE")

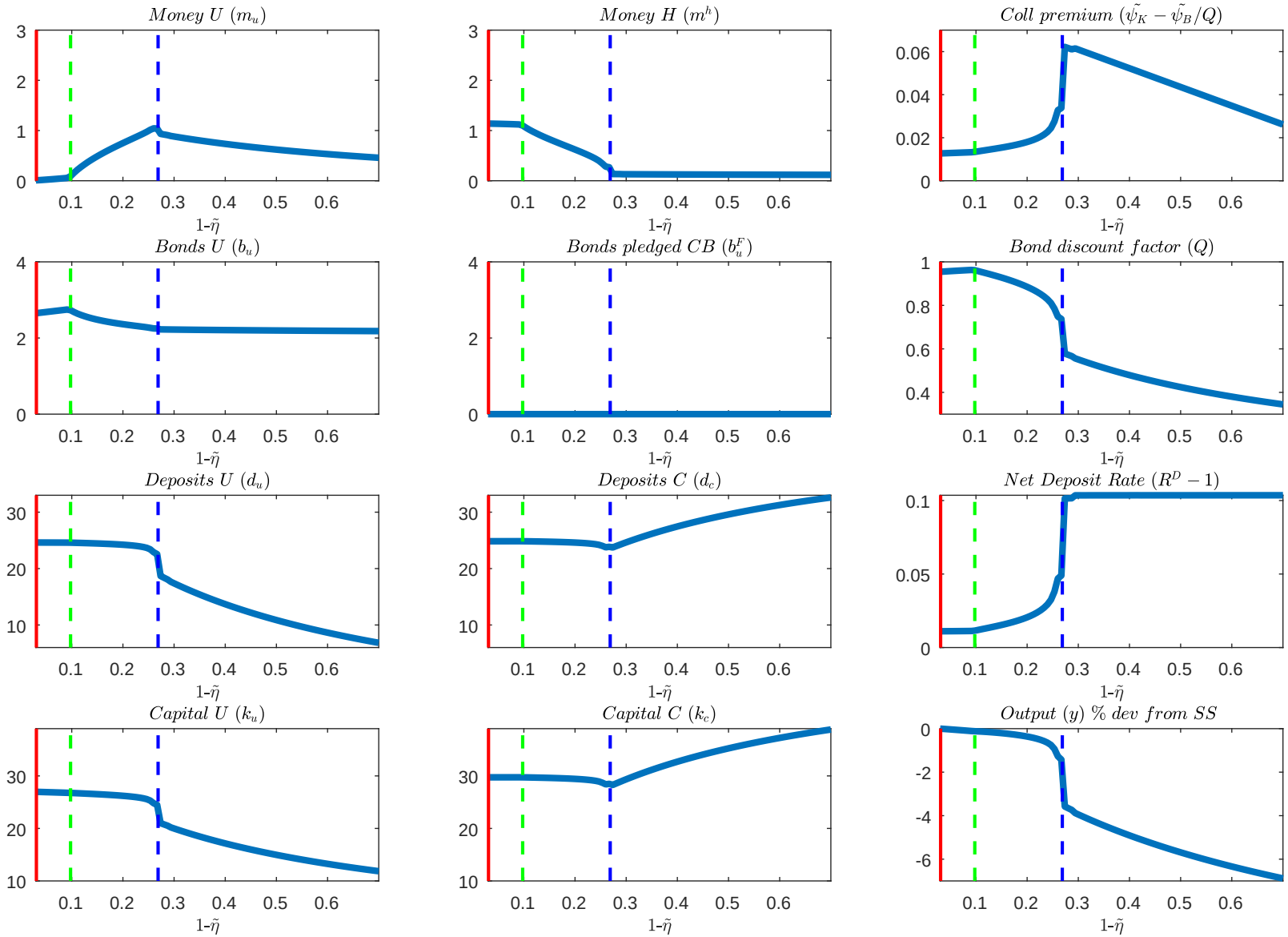
1. Secured MM friction, const BS

- Large output contractions:
  - increase in $1-\tilde{\eta}$ from 3% to 40%: $\Delta y = -5\%$
- Mechanisms: for higher levels of private haircut $1-\tilde{\eta}$,
  - bonds less valuable as collateral in the private market $\rightarrow$U banks hold money ("kink"1)
  - bond collateral value low, money scarce $\rightarrow$U banks severely constrained in the afternoon
  - leverage constraint turns slack ("kink"2): $\rightarrow$ U banks dramatically reduce deposit funding
  - C banks take on some deposits but capital and output lower than in the calibrated s.-s.

Secured MM friction, const balance sheet



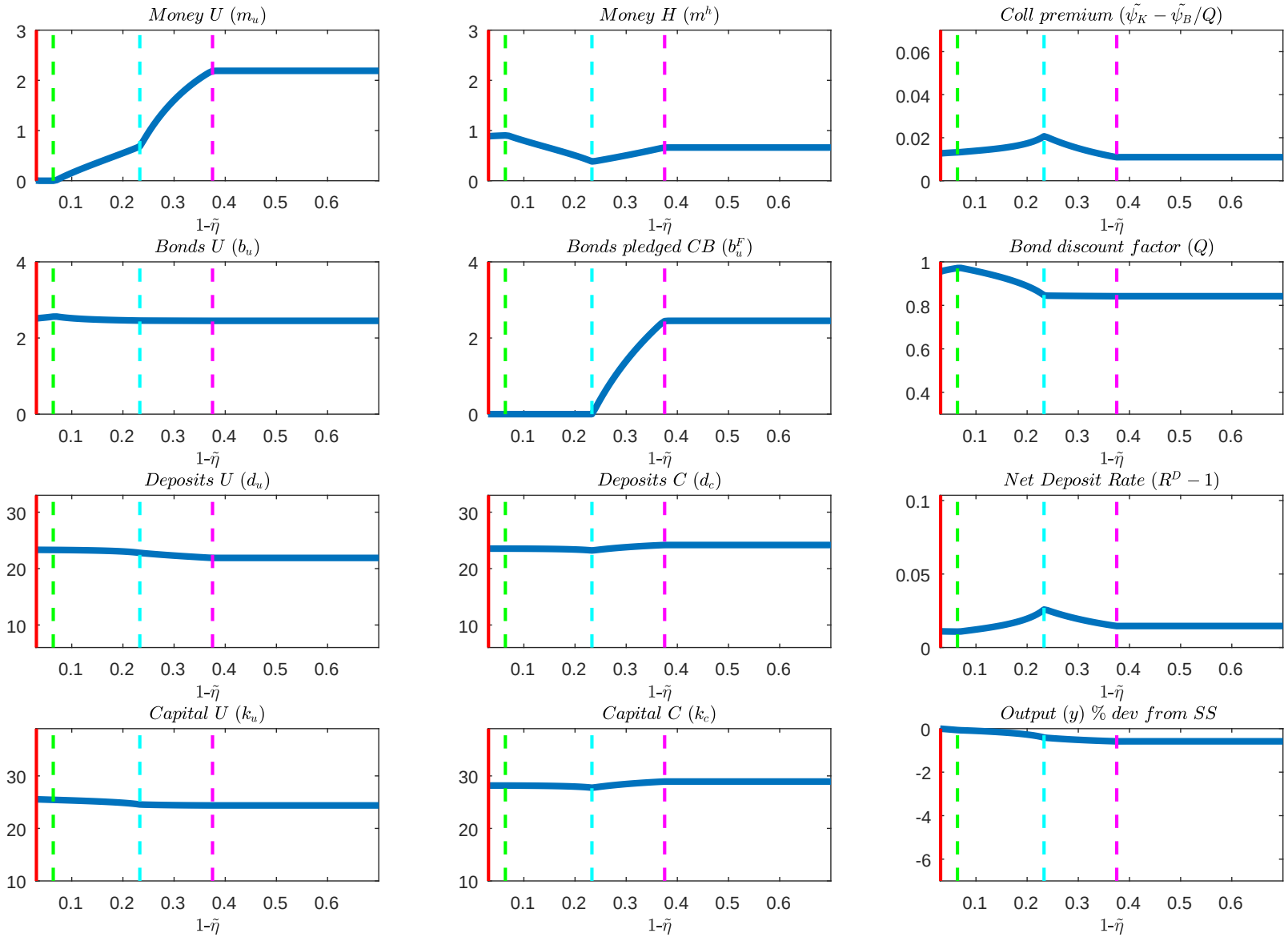
Secured MM friction, const balance sheet



2. Secured MM friction, FRFA policy

- FRFA prevents leverage constraint from turning slack (U banks top up deposit funding with CB funding)
  - increase in $1-\tilde{\eta}$ from 3% to 40%: $\Delta y = -0.5\%$
- Mechanisms: for higher levels of private haircut $1-\tilde{\eta}$,
  - bonds less valuable as collateral in the private market $\rightarrow$U banks hold money ("kink"1)
  - bond collateral value low, money scarce, deposit funding expensive $\rightarrow$U banks access CB funding ("kink"2)
  - U banks pledge all their collateral to the CB ("kink"3)
  - private haircuts beyond this level do not affect the macroeconomy

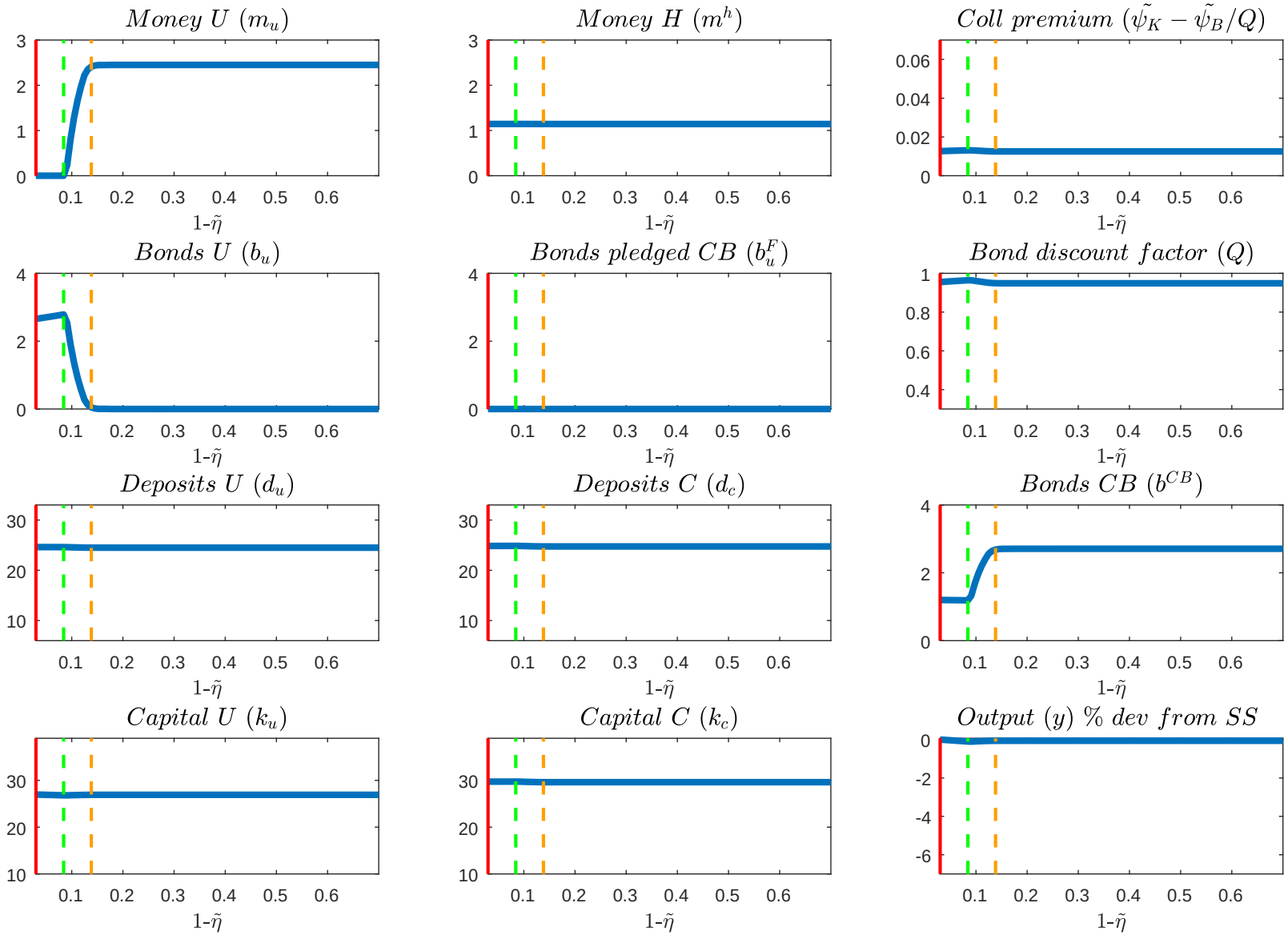
Secured MM friction, FRFA policy



3. Secured MM friction, QE policy

- QE prevents leverage constraint from turning slack (U banks substitute bonds with low collateral value for money)
  - maintains low opportunity cost of holding money
  - increase in $1-\tilde{\eta}$ from 3% to 40%: $\Delta y = -0.1\%$
- Mechanisms: for higher levels of private haircut $1-\tilde{\eta}$,
  - bonds less valuable as collateral in the private market $\rightarrow$U banks sell some bonds and hold money ("kink"1)
  - opportunity cost of holding money constant $\rightarrow$U sell all bonds, mostly to the CB ("kink"2)
  - private haircuts beyond this level do not affect the macroeconomy

Secured MM friction, QE policy



Conclusions from dFHU

1. How do money market frictions affect the macroeconomy?
   - banks divert resources into unproductive assets (bonds, money) or de-lever $\rightarrow$ decline in lending and output
2. How do bank leverage and liquidity constraints interact?
   - liquidity constraint very tight $\rightarrow$ leverage constraint may turn slack $\rightarrow$ large decline in lending and output
3. What does this imply for central bank policies?
   - BS expansion alleviates liquidity constraints, attenuates output drop
   - smallest output drop & stable inflation achieved via outright purchases