DEUTSCHE BUNDESBANK EUROSYSTEM

Safe Asset Shortage and Collateral Re-use

Stephan Jank (Bundesbank), Emanuel Moench (Frankfurt School), Michael Schneider (Bundesbank)

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Motivation

Safe assets play an important role in the economy:

- Store value over time
- Serve as collateral in financial transactions

Concern since GFC: Supply of safe assets has not kept up with demand.

Quantitative Easing (QE) by Central Banks has contributed to scarcity.

This has affected market functioning in repo and cash bond markets (D'Amico et al. 2018, Schlepper et al. 2018, Arrata et al. 2020, Corradin and Maddaloni 2020, ...).

For some types of safe assets, market can respond to scarcity by increasing supply e.g. via securitization.

This Paper

For sovereign bonds, market can also adjust to scarcity: by *re-using* available collateral more effectively.

We quantify the role of this "collateral re-use channel" in the context of safe asset scarcity induced by central bank bond purchases.

Show that **banks increase collateral re-use** in response to QE-induced scarcity.

Find non-linear effects of QE on (repo) market functioning:

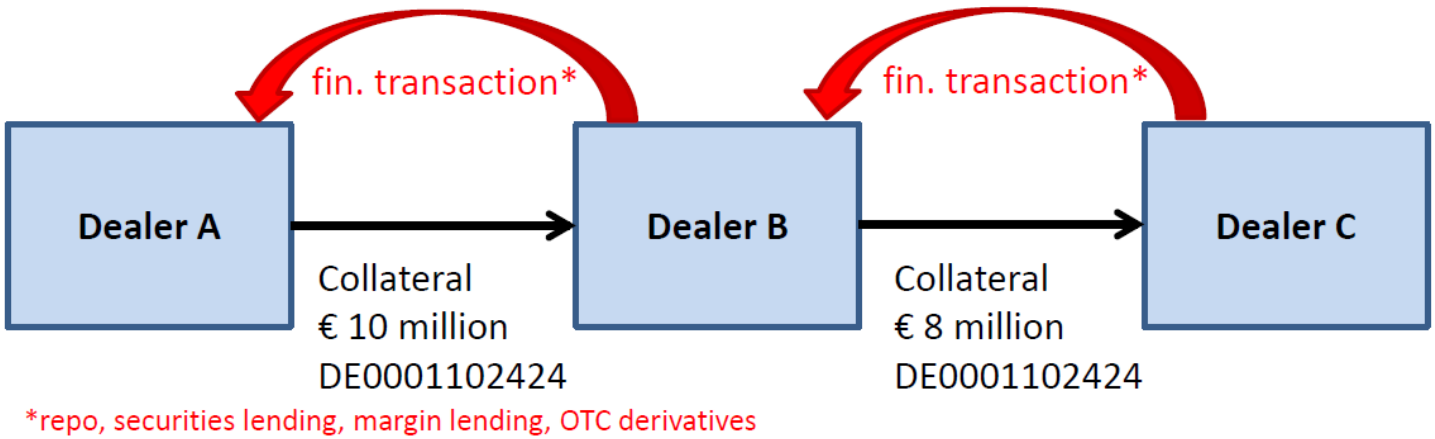
- When re-use is low, additional re-use dampens scarcity effects.
- When re-use already high, QE disproportionally increases specialness spreads, fails-to-deliver, repo market vol, mispricing in cash market.

$\Rightarrow$ *Self-healing* role of collateral re-use, but with limits

What is collateral re-use?

"Any use of assets delivered as collateral in a transaction by an intermediary or other collateral taker." (FSB, 2017)

Example:



- Dealer B receives a security as collateral in a transaction with dealer A.
- Transactions include repo, securities lending, margin lending, OTC derivatives.
- Dealer B can re-use this security to back another independent transaction with dealer C.

Costs and benefits of collateral re-use

- Benefits of collateral re-use:
  - Increased availability of collateral
  - Reduced transaction and funding costs
  - Beneficial for market liquidity and functioning
- Costs of collateral re-use:
  - Build-up of excessive leverage
  - Increase in interconnectedness
  - Amplification of shocks

Growing theoretical literature:

→ Trade-off between economic efficiency and financial stability

Lee, 2017, Brumm et al. 2022, ...

Empirical literature on collateral re-use

Lack of data to measure collateral re-use:

- Ongoing data collection initiatives (e.g., EU Securities Financing Transaction Regulation, SFTR).

Empirical literature

- Rough estimate of collateral re-use based on hand-collected data from annual reports of the largest collateral dealers. (Singh and Aitken, 2010; Singh, 2011; Kirk et al., 2014)
- Approximation of collateral re-use from repo transaction data (Fuhrer, Guggenheim, and Schumacher, 2016)
- Dealer-level collateral re-use from U.S. confidential supervisory data (Infante, Press, and Saravay, 2020; Infante and Saravay, 2021)

Our advantage: granular dealer-security level data

Roadmap

1. **Data and descriptive statistics on collateral re-use**
2. **Asset purchases and collateral re-use**
3. **Mitigating effects of collateral re-use on scarcity**
4. **Collateral re-use and (repo) market functioning**

Roadmap

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Data

- Bundesbank Securities Holdings Statistics (SHS): item-level data on German banks'

  (1.) outright ownership,
  (2.) Incoming collateral (received in sec. lending/repo transactions),
  (3.) Outgoing collateral (posted in sec. lending/repo, short selling).

  $\rightarrow$ Allows us to compute banks' collateral re-use activity for 2008:Q1–2012:Q4, 2013:M1–2017:M12.

- Merged with security-level information on Eurosystem sovereign bond (PSPP) purchases for 2015:M3 - 2017:M12.

- Dealer-security-level analysis for investment grade euro area sovereign debt, security-level analysis for German Bunds due to market coverage.

Measuring collateral re-use: Intensive margin

Rate of collateral re-use

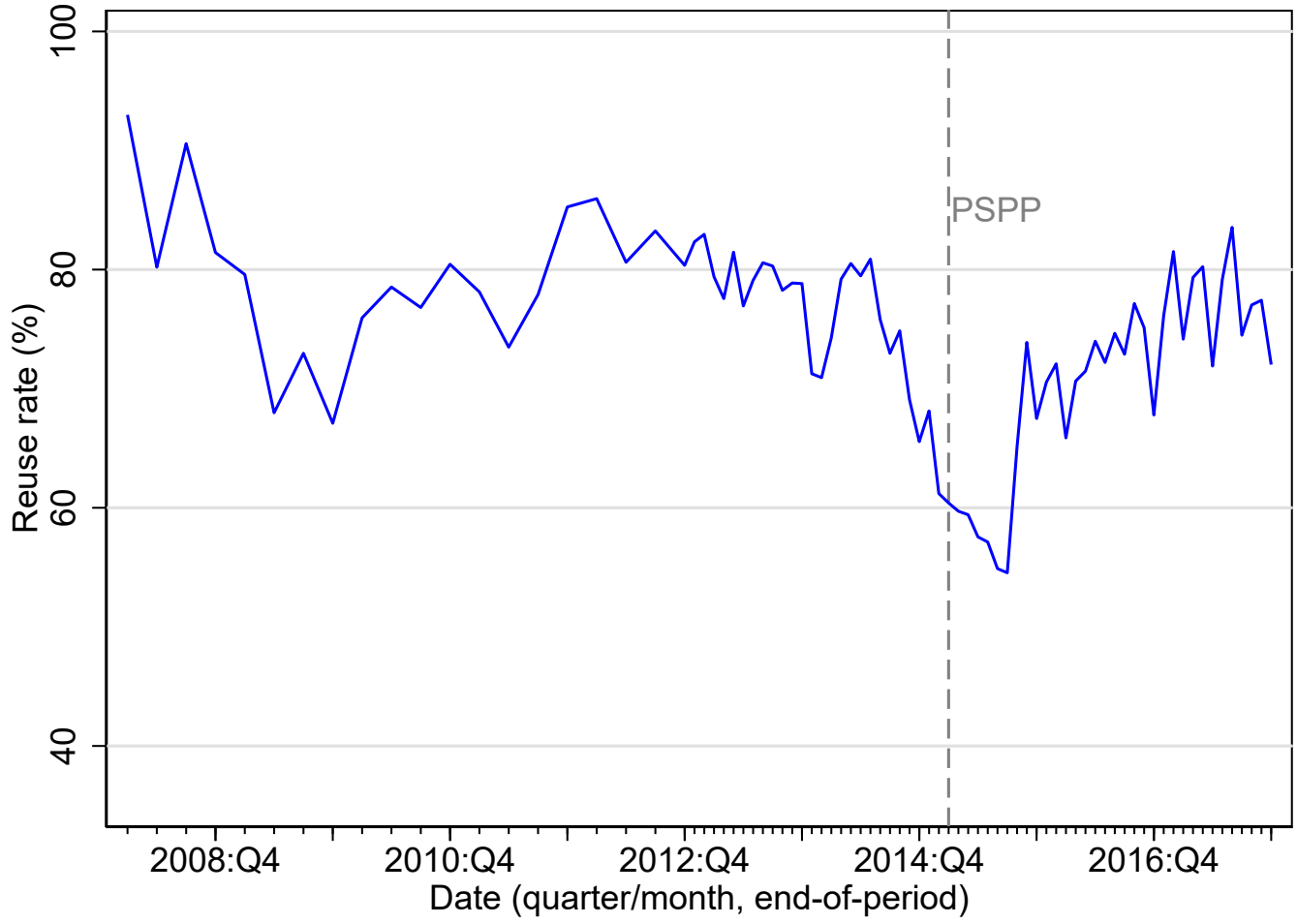
$$\textit{Re-use rate}_{i,j} = \left(\frac{Outgoing_{ij}}{Incoming_{ij} + Outright\ ownership_{ij}} \right)$$

Example:

Dealer	ISIN	Outright ownership	Collateral			Re-use rate
			incoming	outgoing	re-used	
A	DE0...	20	100	90	75	75%

Re-use rate = (100/(100+20))*90/100 = 90/(100+20) = 75%

Re-use rate over time



Note: Aggregate over euro area sovereign bonds (maturity 1-30 years) of German dealers.

Measuring collateral re-use: Extensive margin

Follow FSB (2017) and measure collateral re-use as:

$$Re\text{-}use_{ij} = \left(\frac{Incoming_{ij}}{Incoming_{ij} + Outright\ ownership_{ij}} \right) \times Outgoing_{ij}$$

Example:

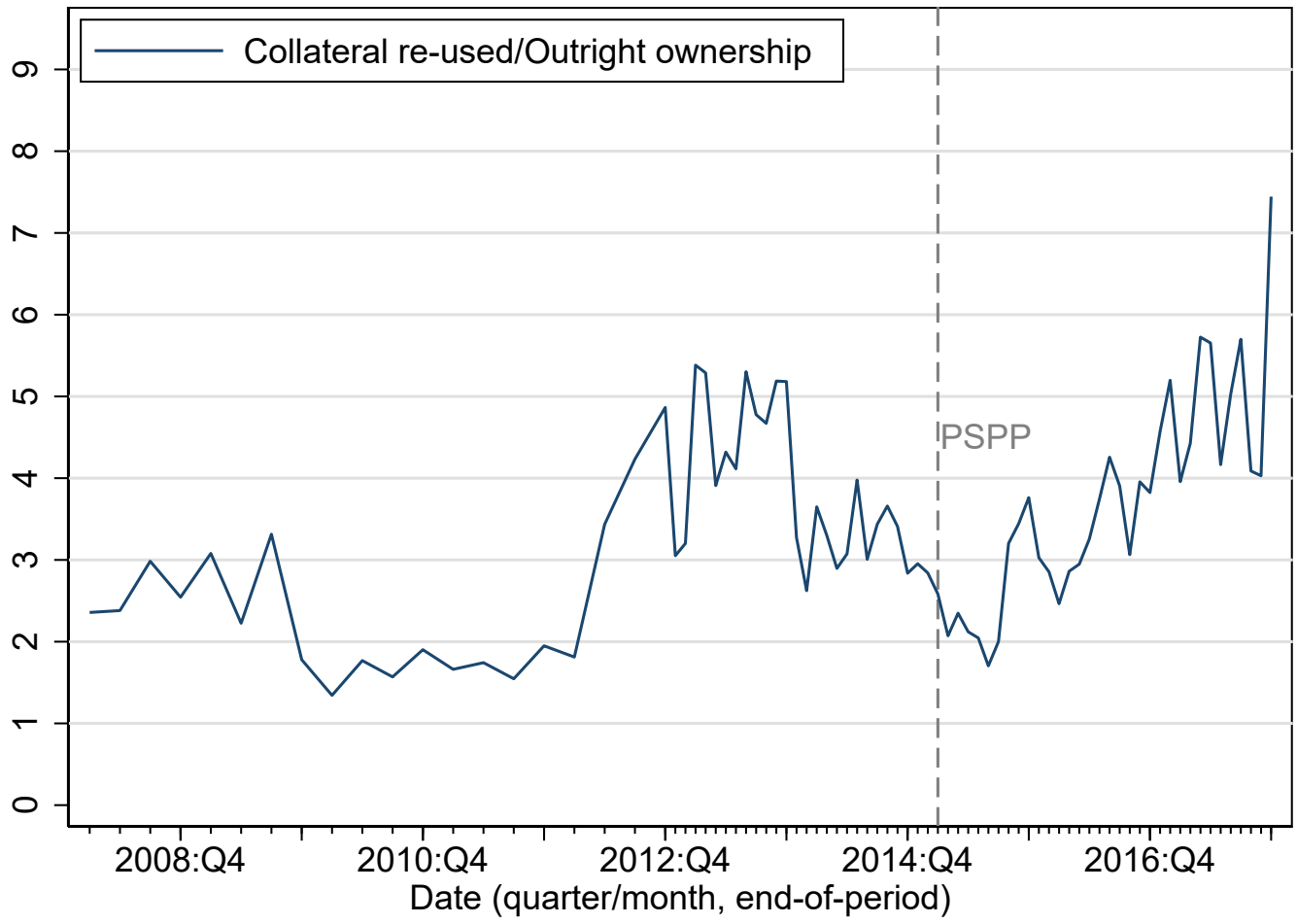
Dealer	ISIN	Outright ownership	Collateral		
			incoming	outgoing	re-used
A	DE0...	20	100	90	75

Assumption: Proportional use of incoming and outright-owned collateral when posting collateral (common market practice).

Collateral re-used = (100/(100+20))*90 = 75

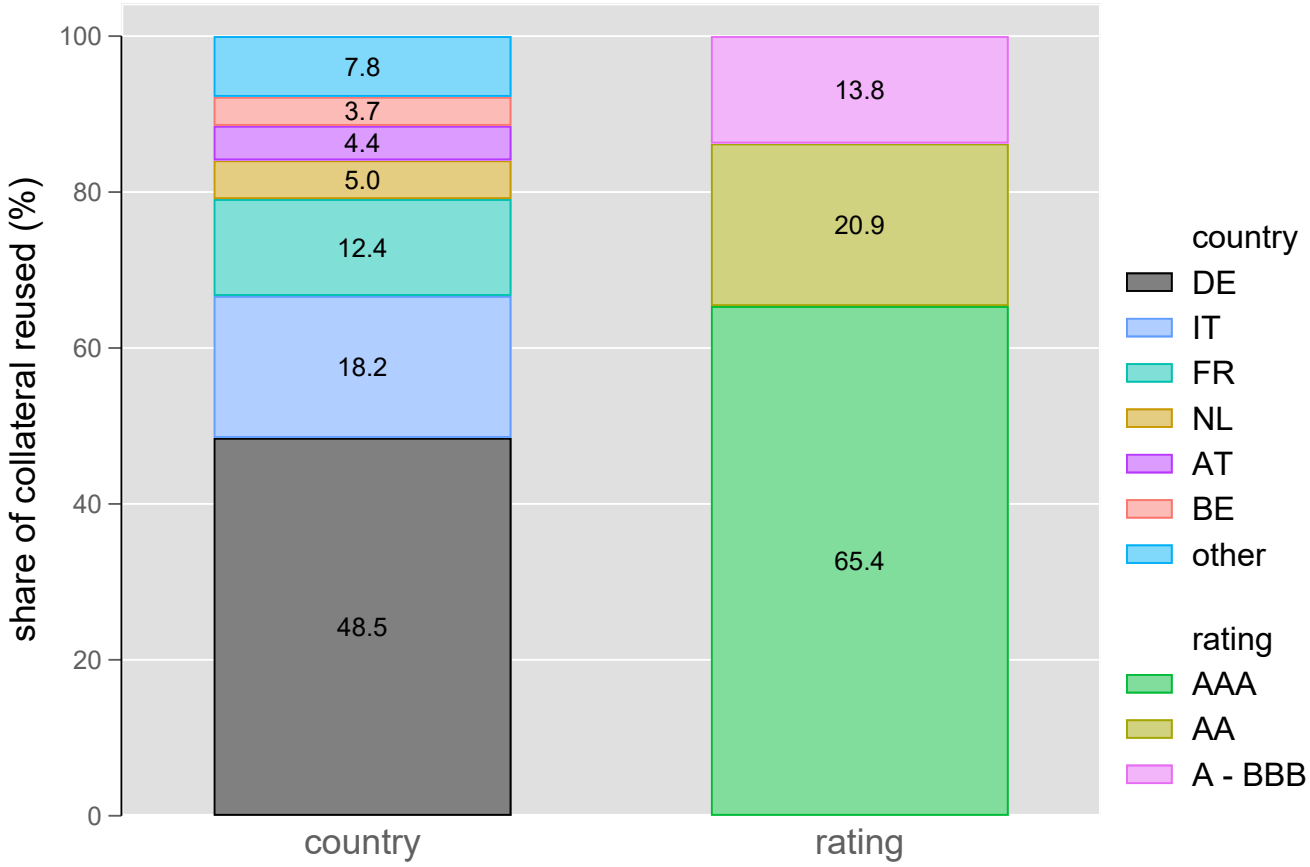
▸ Example: detail

Collateral re-use over time



Note: Aggregate over euro area sovereign bonds (maturity 1-30 years) of German dealers.

Type of collateral re-used by German banks



Note: Share of collateral reused by issuer country (left) and issuer rating (right). *Other countries*: Spain, Finland, Greece, Ireland, and Portugal. Time-series average of 2008-2017 at quarterly frequency.

▸ Time-series: domestic vs. other euro area collateral

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Asset purchases and collateral re-use

How do banks adjust re-use in response to purchase-induced scarcity?

$$\begin{aligned}\Delta \textit{Re-use rate}_{i,j,t} &= \beta_0 + \beta_1 \textit{PSPP}_{i,t} + \gamma' \text{Controls}_{i,t} \\ &\quad + \alpha_{j,t} + \alpha_{i,j} + \alpha_{m,c,t} + \varepsilon_{i,j,t}\end{aligned}$$

- $\Delta \textit{Re-use rate}_{i,j,t}$: change in re-use rate of bank j in bond i in month t
- $\textit{PSPP}_{i,t}$: Eurosystem asset purchases (PSPP) in % of amount outstanding $\rightarrow$ Collateral supply reduction
- $\text{Controls}_{i,t}$: Other collateral demand/supply factors (re-issuances, on-the-run status, cheapest-to-deliver)
- $\alpha_{j,t}$ bank×time fixed effects (dealer-specific shocks)
- $\alpha_{i,j}$ bank×bond fixed effects (dealers' specialization)
- $\alpha_{m,c,t}$ maturity bucket×country×time fixed effects (Arrata et al. 2020)

Asset purchases and collateral re-use (cont'd)

	Dependent variable: ΔRe-use rate$_t$				
PSPP$_{i,t}$ (%)	0.60**	0.57**	0.69**	0.73***	0.89***
	(2.29)	(2.15)	(2.46)	(2.65)	(2.80)
Δ Amount outstanding$_{i,t}$	-0.11**	-0.11**	-0.10*	-0.09*	-0.10*
	(-2.26)	(-2.20)	(-1.84)	(-1.74)	(-1.77)
Dummy: On the run$_{i,t}$	4.89***	4.54**	5.21**	5.24***	5.90***
	(2.70)	(2.44)	(2.56)	(2.63)	(2.85)
Dummy: Cheapest-to-deliver$_{i,t}$	0.12	0.06	0.12	0.26	0.48
	(0.08)	(0.04)	(0.08)	(0.17)	(0.30)
Constant	-0.45	-0.39	-0.51	-0.56*	-0.73**
	(-1.40)	(-1.22)	(-1.54)	(-1.72)	(-2.12)
Fixed effects:					
dealer	yes	-	-	-	-
time	yes	-	-	-	-
bond	yes	yes	-	-	-
dealer×time	-	yes	yes	yes	yes
dealer×bond	-	-	yes	yes	yes
country×time	-	-	-	yes	-
maturity bucket×country×time	-	-	-	-	yes
R^2	0.015	0.098	0.108	0.122	0.148
N	35,927	35,747	35,093	35,093	35,026

t-statistics based on clustered standard errors (bond×time) are provided in parentheses.
*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

$\rightarrow$ purchase of 1% of amount outstanding increases re-use rate by 0.89%

Channels of collateral re-use adjustment

Adjustment of overall amount of collateral re-used via two channels:

1. Adjustment of re-use rate (intensive margin)
2. Adjustment of incoming collateral (extensive margin)

Dependent variable:	ΔRe-use Rate$_t$	$\Delta \log(\text{Incoming})_t$	$\Delta \log(\text{Re-use Amt.})_t$
Panel A: Euro area collateral			
Asset purchases$_t$ (%)	0.89***	0.11**	0.15**
	(2.80)	(1.98)	(2.43)
R^2	0.148	0.107	0.138
N	35,026	35,026	35,026
Panel B: German collateral			
Asset purchases$_t$ (%)	1.25**	0.14	0.22**
	(2.52)	(1.61)	(2.42)
R^2	0.169	0.113	0.168
N	10,054	10,054	10,054
Fixed effects:	dealer×time + dealer×bond + maturity bucket×country×time		

t-statistics based on clustered standard errors (bond×time) are provided in parentheses.
*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

▸ Robustness: Upper/lower bound

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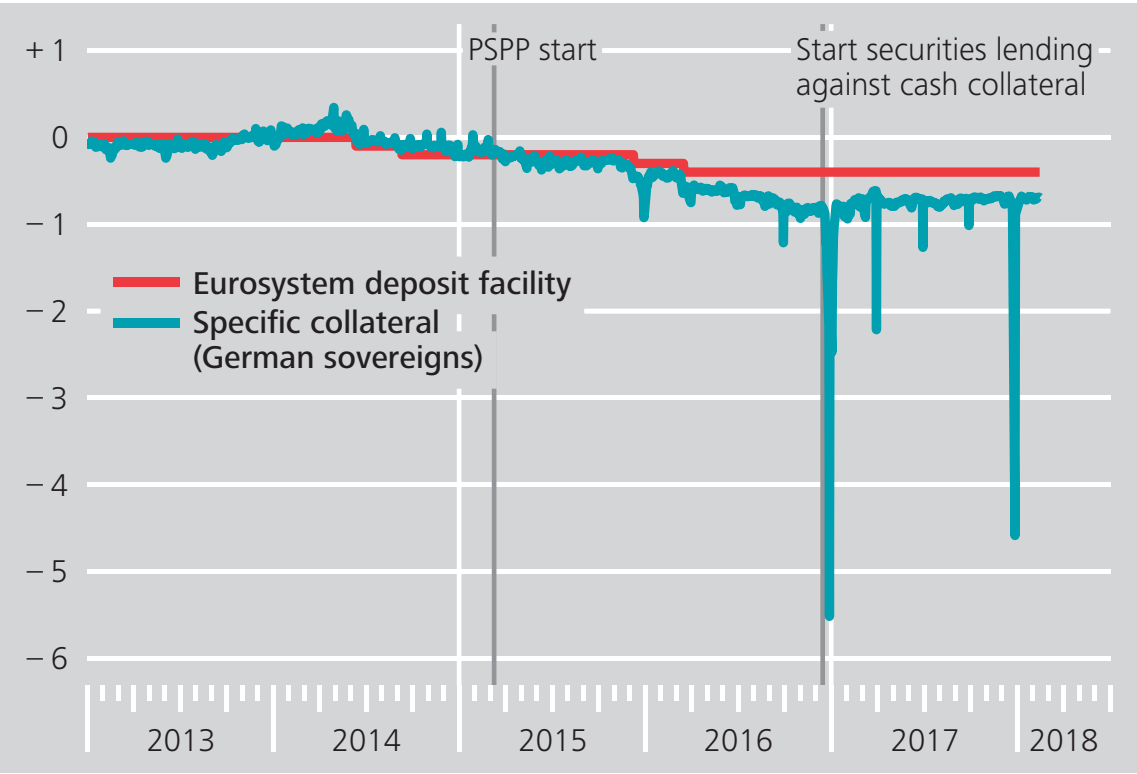
Euro area specific collateral repo market

Developments on the repo market

Chart 1

Interest/repo rate %



Source: Broker Tec.

Deutsche Bundesbank

Mitigating effects of collateral re-use on scarcity

To what degree does collateral re-use mitigate safe asset scarcity?

$$\begin{aligned}\Delta \textit{specialness}_{i,t} &= \beta_0 + \beta_1 \textit{PSPP}_{i,t} + \beta_2 \textit{Re-use}_{i,t-1} \\ &\quad + \beta_3 \textit{PSPP}_{i,t} \times \textit{Re-use}_{i,t-1} \\ &\quad + \gamma' \textit{Controls}_{i,t} + \alpha_i + \alpha_{m,t} + \varepsilon_{i,t}\end{aligned}$$

- $\Delta \textit{specialness}_{i,t}$: mly change in specialness rate of bond i (maximum repo-rate of DE collateral – repo rate of bond i)
- $\textit{PSPP}_{i,t}$: PSPP purchases of bond i in % of outstanding in month t
- $\textit{Re-use}_{i,t-1}$: lagged level of re-use of bond i:
  - $\rightarrow$ $\log(\textit{Re-use}/\textit{Outright ownership})$
  - $\rightarrow$ *Re-use rate*

Focus on German government bonds as better market coverage.

▸ Repo

Mitigating effects of collateral re-use on scarcity (cont'd)

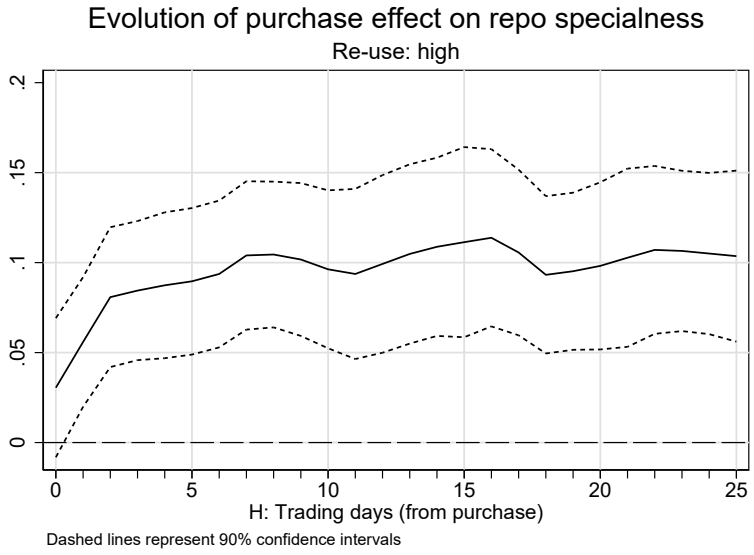
	Dependent variable: ΔSpecialness$_t$ (bps)		
PSPP$_t$ (%)	1.05***	1.16***	1.00***
	(3.19)	(3.64)	(3.20)
ΔSpecialness$_{t-1}$	-0.44***	-0.45***	-0.44***
	(-22.34)	(-23.96)	(-21.03)
Δ Amount outstanding$_t$	-0.64*	-0.66*	-0.65*
	(-1.95)	(-1.79)	(-1.97)
Dummy: On-the-run$_t$	24.30*	25.38	25.07*
	(1.68)	(1.64)	(1.71)
Dummy: Cheapest-to-deliver$_t$	-0.10	-0.22	-0.00
	(-0.12)	(-0.27)	(-0.00)
$\log(\textit{Re-use}/\textit{Outright ownership})_{i,t-1}$		1.13***	
		(3.37)	
PSPP$_t$ (%) $\times$ $\log(\textit{Re-use}/\textit{Outright ownership})_{i,t-1}$		0.52**	
		(2.50)	
Re-use rate$_{t-1}$			-1.47***
			(-2.73)
PSPP$_t$ (%) $\times$ *Re-use rate*$_{t-1}$			0.67*
			(1.87)
Constant	-0.41	-0.54	-0.40
	(-0.92)	(-1.0)	(-0.93)
Fixed effects:	bond + maturity bucket$\times$time		
R^2	0.594	0.595	0.597
N	1,671	1,634	1,671

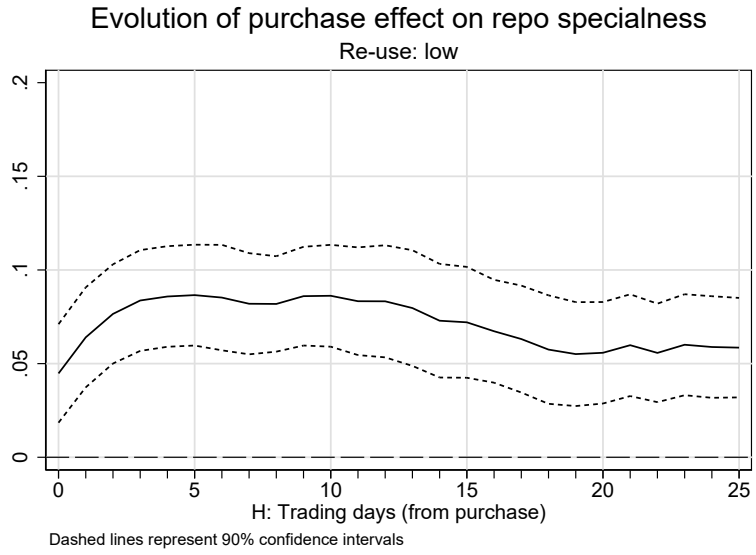
t-statistics based on standard errors clustered at bond level are provided in parentheses.
*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

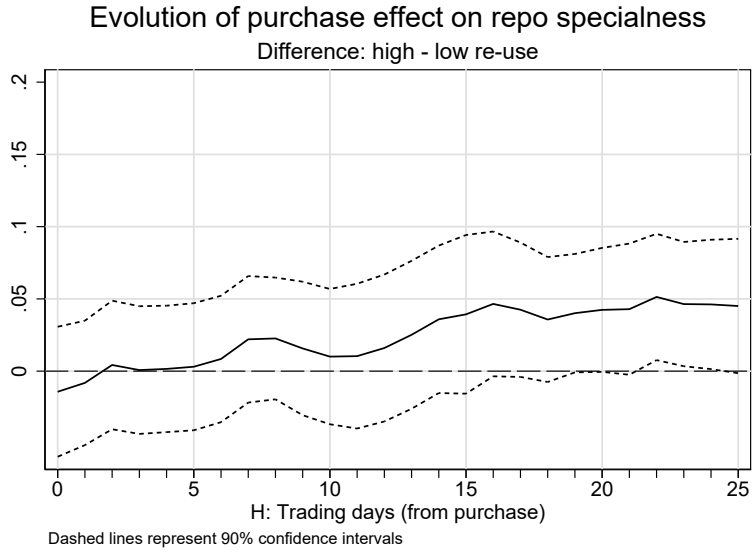
▸ Robustness: high market share

Asymmetric persistence of purchases on specialness

Does collateral re-use affect persistence of scarcity effects on repo rates?







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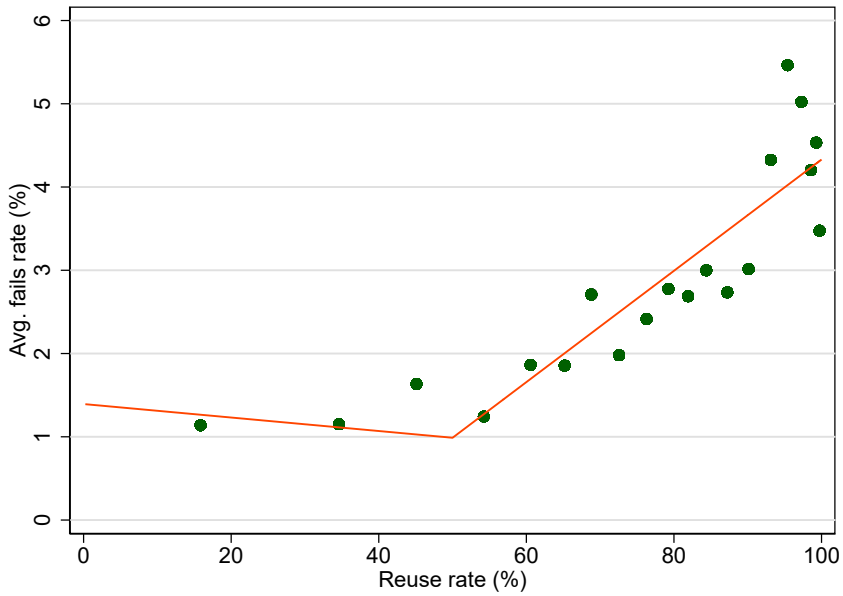
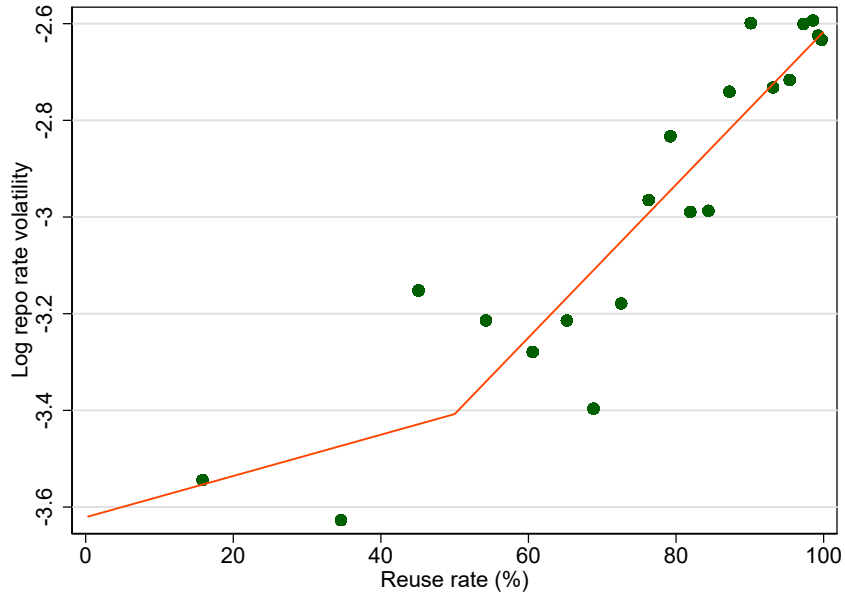
Collateral re-use and (repo) market functioning

High levels of re-use $\Rightarrow$ long collateral chains, increased interconnectedness:

- Risk of delivery failures and higher vol in repo market
- Potential mispricing in cash bond market (Duffie 1996, Jordan&Jordan 1997, D'Amico et al. 2018)





Note: Binned scatter plot of fails rate (LHS) re-use rate and repo rate volatility (RHS) (Bunds, maturity 1-30 years, 2015:M3 - 2017:M12); local mean smoothing with 95% confidence intervals.

Collateral re-use and (repo) market functioning (cont'd)

How does re-use affect delivery fails and volatility in the repo market?

$$
\begin{aligned}
y_{i,t} \quad = \quad & \beta_0 + \beta_1 \textit{PSPP}_{i,t-1} + \beta_2 \textit{Re-use}_{i,t-1} \\
& + \beta_3 \textit{PSPP}_{i,t-1} \times \textit{Re-use}_{i,t-1} + \gamma' \text{Controls}_{i,t-1} \\
& + \alpha_i + \alpha_t + \varepsilon_{i,t},
\end{aligned}
$$

- $y_{i,t}$:
  - $\log(\textit{avg fails rate})_{i,t}$: percentage share of cleared collateral that failed to deliver in month t
  - $\log(\textit{repo rate volatility})_{i,t}$: log of realized volatility of the repo rate of bond i in month t

Again focus on Bunds due to better market coverage of German banks.

Collateral re-use and fails-to-deliver

Dependent variable:	Avg. Fails Rate$_t$(%)			
PSPP$_{t-1}$ (%)	0.04	0.04	-0.23	0.23
	(0.73)	(0.75)	(-1.64)	(1.46)
Reuse rate$_{t-1}$	1.11**		0.80	
	(2.02)		(1.41)	
Reuse rate$_{t-1}$ if in $[0, 0.5)$		-1.51		-0.86
		(-1.23)		(-0.75)
Reuse rate$_{t-1}$ if in $[0.5, 1]$		2.25**		1.65*
		(2.54)		(1.84)
Reuse rate$_{t-1}$ $\times$ PSPP$_{t-1}$ (%)			0.34*	
			(1.69)	
Reuse rate$_{t-1}$ if in $[0, 0.5)$ $\times$ PSPP$_{t-1}$ (%)				-0.78*
				(-1.81)
Reuse rate$_{t-1}$ if in $[0.5, 1]$ $\times$ PSPP$_{t-1}$ (%)				0.63*
				(1.94)
Time fixed effects:	yes	yes	yes	yes
Bond-level controls:	yes	yes	yes	yes
R^2	0.43	0.43	0.43	0.43
N	1,621	1,621	1,621	1,621

Collateral re-use and repo market volatility

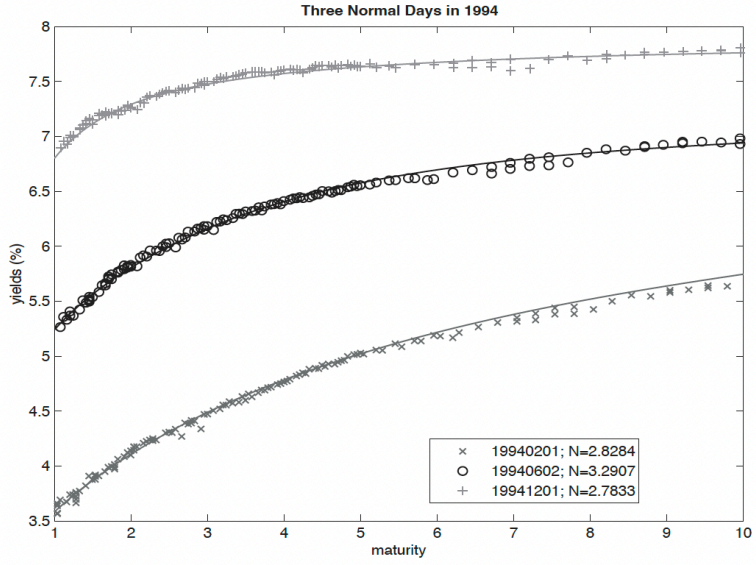
	(1)	(2)	(3)	(4)
Dependent variable:	$\log(\text{Repo Rate Volatility})_t$			
PSPP_{t-1} (%)	0.02*	0.02*	0.02	0.02
	(1.78)	(1.79)	(0.82)	(0.42)
Reuse rate$_{t-1}$	0.24***		0.24***	
	(4.07)		(3.76)	
Reuse rate$_{t-1}$ if in $[0, 0.5)$		0.06		0.05
		(0.47)		(0.43)
Reuse rate$_{t-1}$ if in $[0.5, 1]$		0.32***		0.32***
		(3.54)		(3.17)
Reuse rate$_{t-1}$ $\times$ PSPP_{t-1} (%)			-0.00	
			(-0.10)	
Reuse rate$_{t-1}$ if in $[0, 0.5)$ $\times$ PSPP_{t-1} (%)				0.00
				(0.05)
Reuse rate$_{t-1}$ if in $[0.5, 1]$ $\times$ PSPP_{t-1} (%)				-0.01
				(-0.18)
Time fixed effects:	yes	yes	yes	yes
Bond-level controls:	yes	yes	yes	yes
R^2	0.87	0.87	0.87	0.87
N	1,621	1,621	1,621	1,621

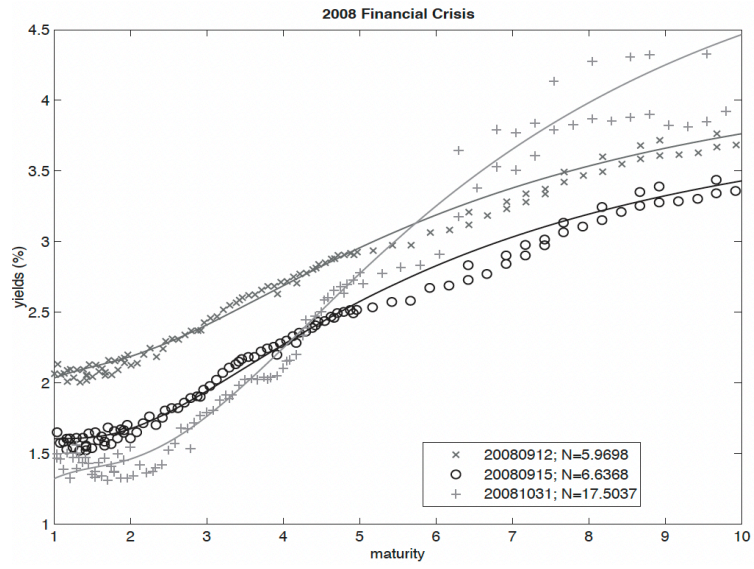
Collateral re-use and mispricing in the cash market

Purchase-induced scarcity in repo market can spill over to cash bond market (D'Amico et al. 2018, Schlepper et al. 2018)

Does collateral re-use mitigate such spillovers?

Use deviations from smooth zero-coupon yield curve as measure of mispricing (e.g. Hu et al. 2013)





Collateral re-use and mispricing in the cash market - ctd.

	(1)	(2)	(3)	(4)
Dependent variable:		Yield Fitting Error$_t$(%)		
			Re-use low	Re-use high
Specialness	-0.11***	-0.10***	-0.24***	-0.05
	(-3.82)	(-3.34)	(-3.13)	(-1.38)
PSPP		-0.10***	-0.09**	-0.09**
		(-2.82)	(-2.00)	(-2.38)
Specialness × PSPP		-0.18*	-0.09	-0.24*
		(-1.71)	(-1.02)	(-1.73)
Bond-level Controls	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Bond fixed effects	Yes	Yes	Yes	Yes
R^2	0.18	0.18	0.21	0.21
N	36,337	36,337	17,372	18,964

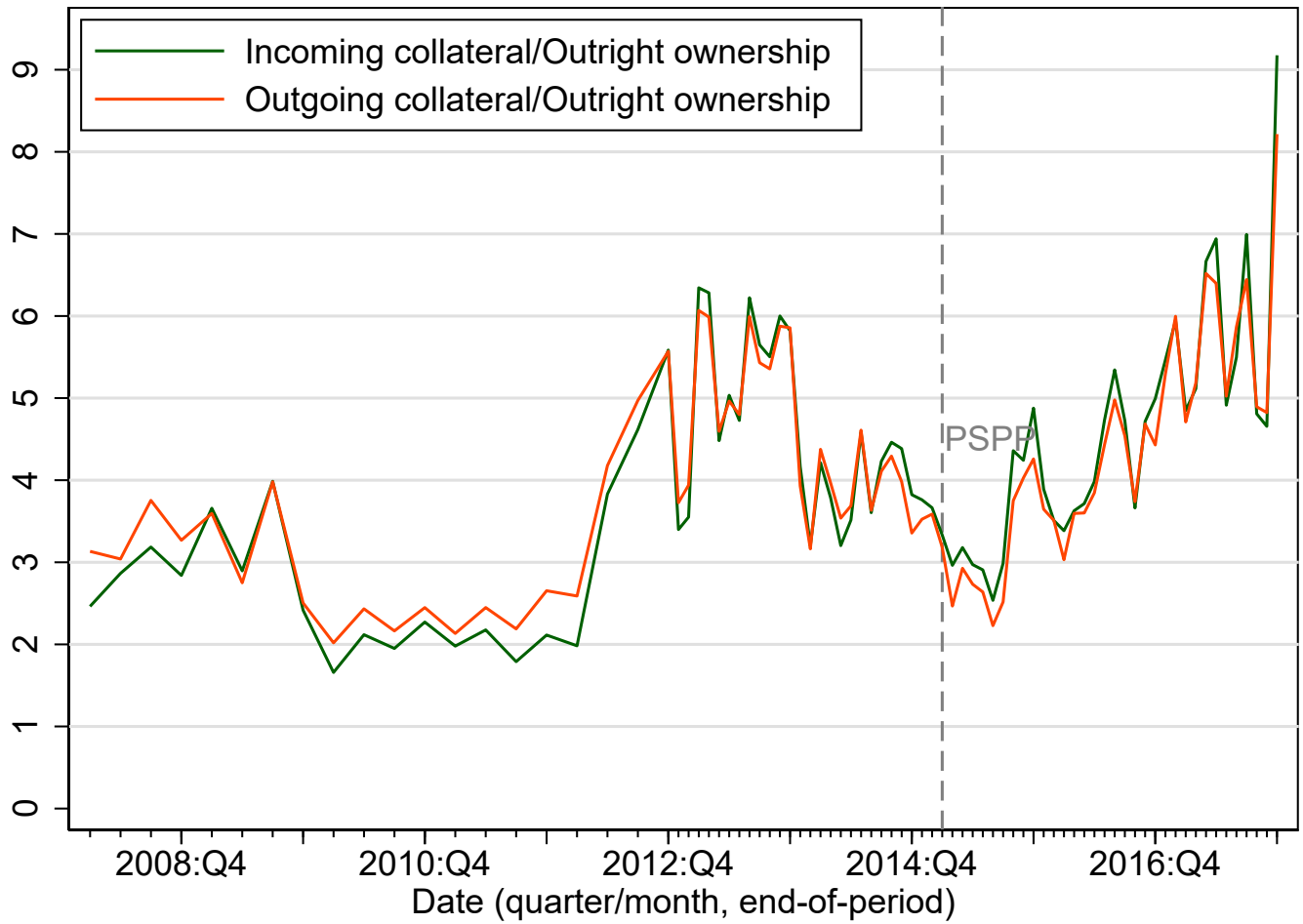
Summary and Conclusion

- Banks adjust to QE-induced safe asset scarcity by increasing collateral re-use.
- Re-use mitigates exogenous supply reduction, which is reflected in a lower scarcity premium.
- Non-linear effects of scarcity on market functioning. High levels of collateral re-use associated with:
  - More fails to deliver and high volatility of repo rates.
  - Larger mispricing in cash bond market.

Re-use as *self-healing* feature of collateral market, but with limits!

Additional Results and References

Collateral received and posted over time



Note: Aggregate over euro area sovereign bonds (maturity 1-30 years) of German dealers.

Substitutability of collateral

Do dealers re-use similar bonds in response to purchase-induced scarcity?

Issuer country:	all		not Germany	Germany
	Dependent variable: ΔRe-use Rate$_t$			
Asset purchases$_t$ (%)	0.64**	0.59**	0.78**	0.76*
	(2.25)	(2.09)	(2.10)	(1.70)
Asset purchases$_t$ (same country and maturity bucket, %)	-0.84*	-0.92*	0.04	-2.14***
	(-1.73)	(-1.93)	(0.06)	(-2.66)
Asset purchases$_t$ (same rating group and maturity bucket, %)	0.47			
	(0.76)			
Asset purchases$_t$ (same rating notch and maturity bucket, %)		1.01**	1.81***	-0.76
		(2.01)	(3.11)	(-0.72)
R^2	.1084	.1085	.1174	.1569
N	35,093	35,093	24,961	10,063
Fixed effects:		dealer×time + dealer×bond		

t-statistics based on clustered standard errors (bond×time) are provided in parentheses.
*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

→ Scarcity in other countries' bonds with same rating notch increases re-use, but not for Bunds

→ In line with some fragmentation in European collateral markets

Economic significance

$$\begin{aligned} \textit{effective amount} &= \textit{base amount} \times \sum_{n=0}^{\infty} \textit{Re-use rate}^{n} \\ &= \frac{\textit{base amount}}{1 - \textit{re-use rate}} \end{aligned}$$

- Assume: re-use rate 62.1% (panel median)
  $\Rightarrow$ *effective amount* $= 2.64 \times$ *base amount*
- Reduction of base amount by 1%:
  $\Rightarrow$ re-use rate needs to increase to 62.5% to stabilize effective amount
- Predicted 0.4 pp increase $<$ estimated 0.89 pp.

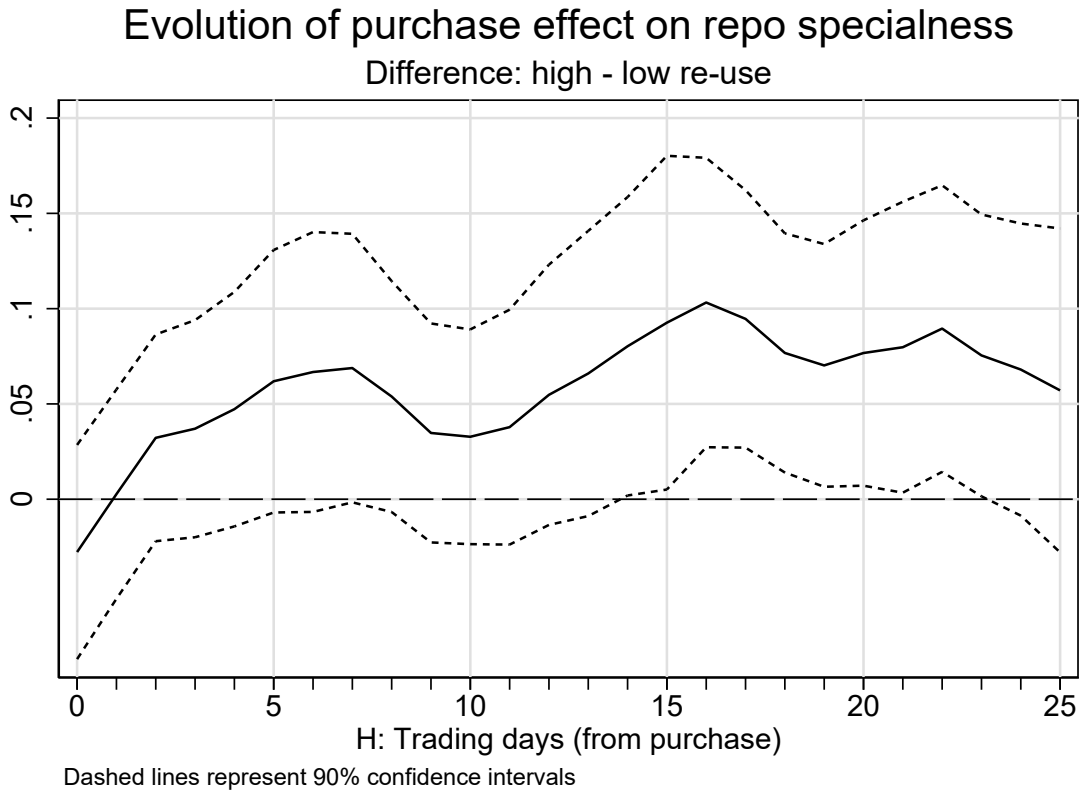
$\Rightarrow$ Dealers seem to overcompensate scarcity through reuse. Why?

- Eurosystem buys disproportionately from holders that tend to supply assets as collateral (Koijen, Koulischer, Nguyen, and Yogo, 2021)

$\Rightarrow$ Purchase of 1% $\equiv >$ 1% reduction in effective amount of collateral

Asymmetric persistence of purchases on specialness

Effect stronger before BuBa started SecLending against Cash Collateral



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