

Regulatory Effects on Short-Term Interest Rates

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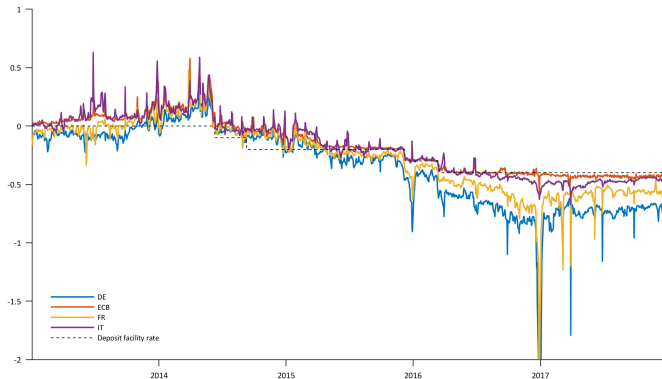
Why do we study this?

- ▶ Central clearing counterparties (CCPs) are at the heart of the reform of the financial system.

*"CCPs act as **major repo counterparties when reinvesting the large amounts of collateral they collect.** Disruptions affecting, or caused by, a CCP can have ripple **effects through the euro repo market,** which may affect the conduct of monetary policy."*

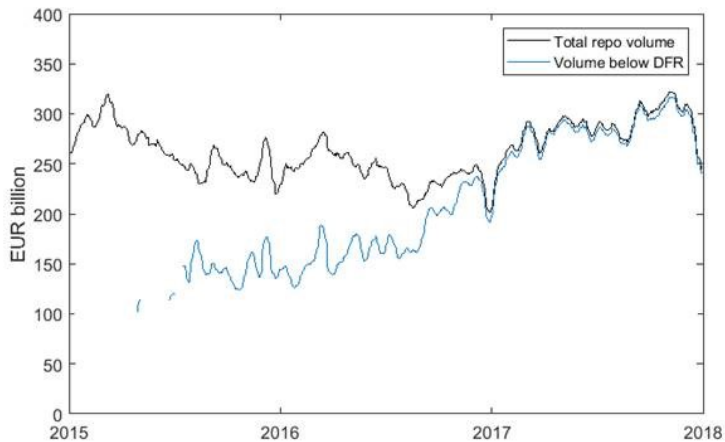
Benoît Coeuré (2019)

Motivation



- ▶ Since 2015, repo rates dropped below the interest rate corridor.
- ▶ Strong rate drops on reporting days.
- ▶ Increasing rate dispersion.

Motivation



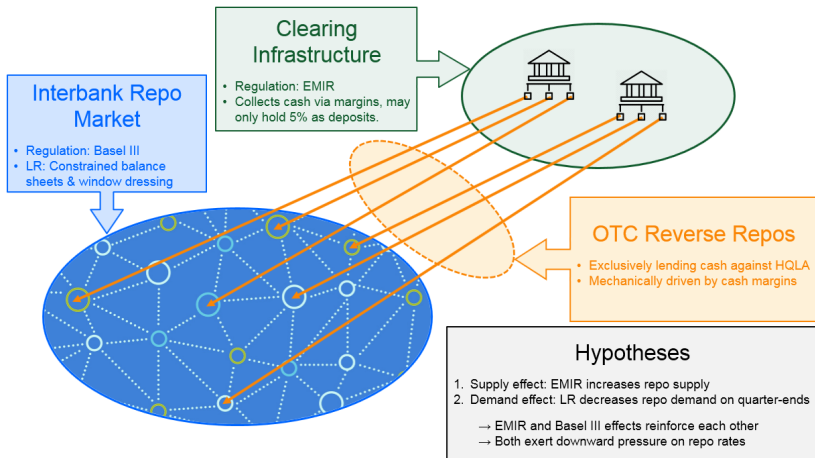
We uncover how new regulation drags down short-term rates:

- ▶ **EMIR**: Central clearing infrastructure increases repo **supply**.
- ▶ **Basel III**: Leverage ratio rule disincentivizes repo **demand**.

Contributions to literature:

- ▶ **Intermediary asset pricing**: Regulatory reforms constrain intermediation with adverse effects on funding liquidity and monetary policy transmission.
- ▶ **Central clearing**: CCPs as major market players with regulatory driven supply of cash and demand for safe assets.
- ▶ **Repo market**: Explanation for repo rates below the central bank deposit rate, their seasonalities, and cross-sectional dispersion.

Main Mechanism



CCPs accumulate cash through margin calls and default fund contributions. EMIR sets strict guidelines how to invest it.

EMIR 47 & Commission Delegated Regulation (EU) No 153/2013:

[...] where cash is maintained overnight [...] not less than 95% of such cash, calculated over an average period of one calendar month, shall be deposited through arrangements that ensure the collateralisation of the cash with highly liquid financial instruments [...].

To comply, CCPs might have these options:

- ▶ **Reverse repo** to get safe assets; **exogenous** to the interbank market as regulatory driven and performed in the OTC segment
- ▶ Outright purchase of government bonds
- ▶ Central bank deposits

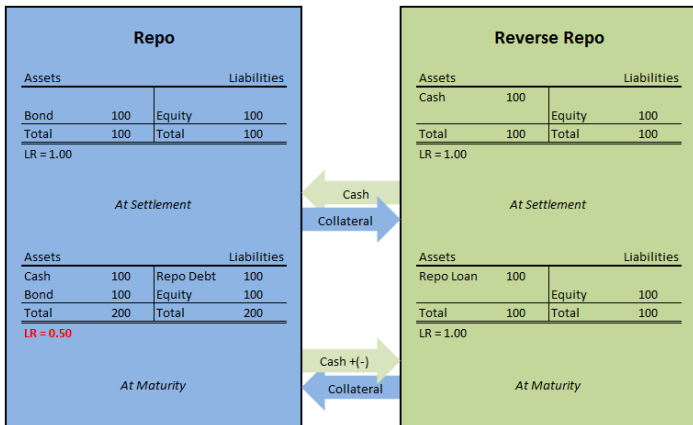
Supply Hypothesis: *CCP repo supply lowers interbank repo rates.*

- ▶ To comply with EMIR, CCPs lend large amounts of cash to obtain safe assets in the OTC segment (no need to borrow).
- ▶ CCPs' counterparties offload cash surplus in the interbank market.
- ▶ Downward pressure on interbank repo rates.

EMIR / central clearing is **not market neutral** but lowers short-term interest rates.

Basel III / Demand Hypothesis

Basel III requires banks to hold the leverage ratio above 3% (more for G-SIBs). Repo trading affects the leverage ratio:



- ⇒ LR is affected by repo borrowing, but not by repo lending.
- ⇒ Repo borrowing is limited by balance sheet space.

Demand Hypothesis: *Leverage ratio (LR) rule lowers repo demand.*

- ▶ LR weakens repo demand but not repo supply thus decreasing rates.
- ▶ LR constraint only arises during LR disclosure days.
- ▶ Lower rates for repos that end up on the balance sheet during disclosure days.

Basel III / LR lowers short-term interest rates on reporting days.

Data / Interbank Repo Market

- ▶ All transactions from the 3 major electronic platforms.
- ▶ Central clearing, anonymous trading, and CLOB excludes many confounding factors.
- ▶ We compute daily average rates and order flows.
- ▶ We select 21 liquid and representative segments, with 6 collateral countries and 4 tenors (ON, TN, SN, S1W).

	Transactions (in mn)	Volume (in EUR tn)	Transactions (share in %)	Volume (share in %)
Total	13.24	326.3	100.0	100.0
BrokerTec	8.76	189.7	66.1	58.1
Eurex Repo	0.33	36.9	2.5	11.3
MTS	4.16	99.7	31.4	30.6
CCP	12.86	317.1	97.1	97.2
Bilateral	0.38	9.2	2.9	2.8
Euro	12.23	296.9	92.3	91.0
Sterling	1.01	29.4	7.7	9.0
DE	2.90	74.4	21.9	22.8
ES	1.14	21.2	8.6	6.5
FR	1.36	31.0	10.3	9.5
GB	1.01	29.4	7.7	9.0
IT	4.08	97.8	30.8	30.0
NL	0.64	12.3	4.9	3.8
Other	2.09	60.3	15.8	18.5
1-day	12.99	313.6	98.1	96.1
>1-day	0.25	12.7	1.9	3.9

- ▶ Daily investment positions from EMIR-regulated clearing infrastructures. From November 2013 to December 2017.
- ▶ Confidential data: Representative for CCP infrastructure; But not allowed to disclose which clearing houses/services are included. All investment volumes are standardized.
- ▶ Investment volumes divided by type (reverse repo/bonds) and collateral country.
- ▶ CCPs invest over-the-counter, but most counterparties are participants in the interbank market.

From **CPMI-IOSCO quantitative disclosures**

Euro cash holdings (margin & default fund) and investment type:

CCP	2016 Q2			2018 Q2		
	EUR bn	repo	cb	EUR bn	repo	cb
LCH Ltd.	5.46	61.1%	5.4%	5.12	60.7%	17.9%
LCH SA	16.99	3.9%	66.8%	29.18	0%	99.7%
Eurex	22.49	2.3%	97.6%	25.22	3.1%	96.8%
CC&G	16.96	43.7%	52.0%	19.17	2.6%	97.3%
EuroCCP	0.61	100.0%	0%	0.60	100.0%	0%
ICE	5.62	71.4%	0%	3.96	76.5%	11.6%

Repo interbank turnover: 300 EUR bn/day

Panel regression of interbank repo rates (minus the central bank deposit rate) on CCP reverse repo investments. The cross-section i denotes country-tenor pairs.

$$Rate_{i,t} = FE(i) + \lambda \cdot Reverse_{i,t} + \beta^T \mathbf{X}_{i,t} + \epsilon_{i,t}$$

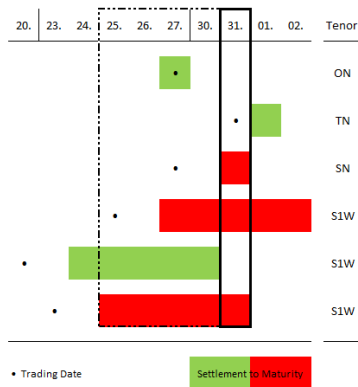
$\mathbf{X}_{i,t}$ includes **interbank order flow** capturing the interbank net demand and controls for

- ▶ Past repo rates (rates exhibit some persistence)
- ▶ CCP bond purchases (affects specialness).
- ▶ CIP violations (affects “cheapest-to-deliver” collateral).
- ▶ Past VIX (affects size of margin calls).

	<i>Rate_{i,t}</i>		
	(a)	(b)	(c)
<i>Reverse_{i,t}</i>	-4.525*** (1.297)	-4.491*** (1.283)	-1.530*** (0.587)
<i>Orderflow_{i,t}</i>	0.163** (0.078)	0.163** (0.079)	0.192*** (0.033)
<i>Bonds_{i,t}</i>		0.065 (0.801)	-0.192 (0.333)
<i>CIP_{i,t}</i>			158.547*** (55.276)
<i>VSTOXX_{t-1}</i>			0.085*** (0.023)
<i>Rate_{i,t-1}</i>	0.502*** (0.063)	0.502*** (0.063)	0.802*** (0.020)
Fixed Effects	Segment	Segment	Segment
Observations	13193	13193	12709
Segments	13	13	13
<i>R</i> ²	0.496	0.497	0.710

Demand Effects

Inspired by the identification strategy in Du, Tepper & Verdelhan (JF,2018), we test whether repos ending up on the balance sheet during LR disclosure days are more affected by the CCP supply variation than those maturing before.



Diff-in-diff setup:

- ▶ “Treated group”: Repos affecting LR (1-week tenors)
- ▶ “Control group”: Repos maturing before EoQ (1-day tenors)
- ▶ “After treatment”: 1-4 days before EoQ
- ▶ “Before treatment”: All other days (except EoQ)

Interaction of a 1-week tenor dummy $1W_i$ (treated group) with a time dummy $BeforeEoQ_t$ (after treatment period):

$$\begin{aligned}Rate_{i,t} = & \lambda_1 \cdot Reverse_{i,t} + \lambda_2 \cdot 1W_i \cdot Reverse_{i,t} \\ & + \lambda_3 \cdot BeforeEoQ_t \cdot Reverse_{i,t} \\ & + \lambda_4 \cdot 1W_i \cdot BeforeEoQ_t \cdot Reverse_{i,t} + \eta \cdot BeforeEoQ_t + \dots\end{aligned}$$

If LR rule decreases demand, λ_4 to should be significantly negative (i.e. stronger impact of CCP supply).

	<i>Rate_{i,t}</i>		
	(d)	(e)	(f)
<i>Reverse_{i,t}</i>	-3.297*** (1.127)	-3.318*** (1.129)	-0.848** (0.384)
<i>Reverse_{i,t} · 1W_i</i>	-13.464*** (4.908)	-13.477*** (4.878)	-7.944** (3.152)
<i>Reverse_{i,t} · BeforeEoQ_t</i>	0.512 (0.835)	0.511 (0.835)	0.191 (0.492)
<i>Reverse_{i,t} · BeforeEoQ_t · 1W_i</i>	-27.933** (13.515)	-27.941** (13.516)	-26.782** (13.346)
<i>BeforeEoQ_t</i>	-2.745 (2.904)	-2.746 (2.903)	-2.083 (1.689)
<i>BeforeEoQ_t · 1W_i</i>	-101.073** (48.681)	-101.097** (48.686)	-94.397** (47.037)
<i>Orderflow_{i,t}</i>	0.173** (0.080)	0.172** (0.080)	0.197*** (0.033)
<i>Bonds_{i,t}</i>		-0.042 (0.810)	-0.270 (0.355)
<i>CIP_{i,t}</i>			128.024*** (34.392)
<i>VSTOXX_{t-1}</i>			0.078*** (0.022)
<i>Rate_{i,t-1}</i>	0.495*** (0.062)	0.495*** (0.062)	0.795*** (0.021)
Fixed Effects	Segment	Segment	Segment
Observations	13193	13193	12709
Segments	13	13	13
<i>R</i> ²	0.096	0.096	0.422

Rate dispersion: Spreads between countries increase with CCP investments (3.6 bp/std). The effect is much stronger on LR disclosure days (21.3 bp/std) and for safer collateral.

Trader-level order flows: Banks that are OTC repo counterparties of CCPs decrease (increase) interbank borrowing (lending).

Robustness: Various robustness checks and controls including *Quantitative Easing*, i.e. ECB's PSPP and Excess Liquidity.

Rate Dispersion

	<i>Spread_{i,t}</i>				
	(g)	(h)	(i)	(j)	(k)
<i>BaseReverse_{i,t}</i>	7.269*** (0.587)				
<i>QuoteReverse_{i,t}</i>	0.377 (1.344)				
<i>TotalReverse_t</i>		4.832*** (0.393)	3.508*** (0.317)	5.122*** (0.342)	3.764*** (0.213)
<i>TotalReverse_t · 1W_i</i>				-2.734*** (0.797)	-2.172*** (0.608)
<i>TotalReverse_t · BeforeEoQ_t</i>				-2.141** (1.012)	-2.005** (0.742)
<i>TotalReverse_t · BeforeEoQ_t · 1W_i</i>				21.548*** (7.948)	21.346** (8.301)
<i>BeforeEoQ_t</i>				4.299*** (0.878)	3.134*** (0.677)
<i>BeforeEoQ_t · 1W_i</i>				3.957 (2.750)	3.833 (2.479)
<i>BaseOrderflow_{i,t}</i>	-0.089*** (0.024)	-0.062*** (0.022)	-0.080*** (0.019)	-0.061*** (0.022)	-0.080*** (0.019)
<i>QuoteOrderflow_{i,t}</i>	0.172*** (0.029)	0.146*** (0.027)	0.112*** (0.022)	0.147*** (0.026)	0.114*** (0.021)
<i>BaseBonds_{i,t}</i>	-2.170*** (0.313)	-0.375 (0.395)	-0.258 (0.308)	-0.515 (0.360)	-0.377 (0.273)
<i>QuoteBonds_{i,t}</i>	-0.056 (0.447)	-0.587 (0.381)	-0.090 (0.297)	-0.711* (0.365)	-0.188 (0.285)
<i>CIP_{i,t}</i>			-100.411*** (37.775)		-46.757*** (13.765)
<i>VSTOXX_{t-1}</i>			-0.089*** (0.017)		-0.088*** (0.018)
<i>Spread_{i,t-1}</i>	0.430*** (0.029)	0.407*** (0.027)	0.542*** (0.027)	0.401*** (0.027)	0.534*** (0.028)
Fixed Effects	Segment	Segment	Segment	Segment	Segment
Observations	14419	14419	13867	14419	13867
Segments	15	15	15	15	15
R ²	0.436	0.428	0.485	0.441	0.499

Transmission channel:

1. Rebalancing: A dealer offloads excess cash borrowed from CCPs into interbank market submitting **more lending orders**.
2. Constrained balance sheet: The same dealer provides less liquidity and interbank intermediation submitting **less borrowing orders**

⇒ Its order flow becomes more negative driving down rates.

Bank-level panel regression:

$$Share_{t,i}^o = \lambda_0 \cdot Reverse_t + \lambda_1 \cdot Reverse_t \cdot CCPCounterparty_i + \dots$$

- ▶ o : 4 types of orders. Lend/borrow and market/limit order.
- ▶ $Share_i^o$: The share of order o of trader i 's total volume.
- ▶ $CCPCounterparty_i$: Dummy variable for a CCP counterparty.

	<i>MarketBorrow_{i,t}</i>	<i>LimitBorrow_{i,t}</i>	<i>MarketLend_{i,t}</i>	<i>LimitLend_{i,t}</i>
	(l)	(m)	(n)	(o)
<i>Reverse_t</i>	0.002 40* (0.0014)	0.001 72 (0.001 55)	-0.004 14*** (0.001 58)	0.000 18 (0.001 38)
<i>Reverse_t · Counterparty_i</i>	-0.003 23** (0.001 66)	-0.004 65*** (0.001 83)	0.007 40*** (0.002 04)	0.000 58 (0.001 76)
<i>Bonds_t</i>	-0.001 83 (0.001 41)	0.000 29 (0.001 56)	0.000 79 (0.001 71)	0.000 42 (0.001 42)
<i>OrderShare_{i,t}</i>	0.137 82*** (0.008 30)	-0.134 06*** (0.009 20)	-0.150 38*** (0.009 98)	0.169 34*** (0.009 02)
$\Delta Rate_t$	0.016 32 (0.009 95)	-0.005 30 (0.012 85)	-0.002 02 (0.013 88)	-0.006 24 (0.011 83)
$\log(\text{Volume}_t)$	-0.009 01 (0.009 83)	0.033 68*** (0.010 79)	-0.009 84 (0.011 91)	-0.014 42 (0.010 59)
<i>EffectiveSpread_t</i>	-0.000 39 (0.000 43)	0.000 27 (0.000 47)	0.000 09 (0.000 47)	0.000 04 (0.000 45)
<i>Volatility_t</i>	0.000 37 (0.000 47)	-0.000 37 (0.000 51)	-0.000 29 (0.000 52)	0.000 21 (0.000 49)
<i>CIP_t</i>	0.229 25** (0.099 03)	-0.142 61 (0.102 39)	-0.269 34** (0.123 06)	0.158 51 (0.112 95)
<i>VIX_{t-1}</i>	-0.000 10 (0.000 29)	-0.000 52* (0.000 29)	0.000 91*** (0.000 32)	-0.000 33 (0.000 27)
<i>MarketBorrow_{i,t-1}</i>	0.344 71*** (0.009 55)			
<i>LimitBorrow_{i,t-1}</i>		0.471 29*** (0.009 82)		
<i>MarketLend_{i,t-1}</i>			0.445 45*** (0.009 47)	
<i>LimitLend_{i,t-1}</i>				0.352 77*** (0.010 01)
Fixed Effects	Bank & Month	Bank & Month	Bank & Month	Bank & Month
Observations	67386	67386	67386	67386
Banks	226	226	226	226
R ²	0.367	0.570	0.494	0.388

Main Findings:

- ▶ Increased repo supply due to EMIR lowers repo rates.
- ▶ When the leverage ratio must be disclosed, EMIR repo supply lowers repo rates even more.
- ▶ EMIR repo supply affects more high-quality assets creating larger rate dispersion and (interbank) order flow imbalance.
- ▶ New regulation on central clearing infrastructure and leverage ratio is not market neutral.

How to mitigate these unintended consequences:

- ▶ Consider the joint effects of existing and new regulation.
- ▶ Make LR binding equally on all days to mitigate window-dressing seasonalities.
- ▶ Use constrained dealers balance sheet space more efficiently: De-intermediation by giving non-financials access to the centrally cleared repo market and more efficient netting through CCP interoperability and compression services could alleviate pressure.
- ▶ Give alternative options to CCPs how to hold safe assets. Grant full access to central bank deposits.