

# SYSTEMIC RISK IN CLEARING HOUSES: EVIDENCE FROM THE EUROPEAN REPO MARKET

BOISSEL, DERRIEN, ORS, THESMAR (HEC Paris)

# Motivation

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- **We ask: Are CCPs resilient in time of market stress?**
  
- Central Counterparties (CCPs), i.e. clearing houses, eliminate counterparty risk by inserting themselves between the two sides of a trade
  
- CCPs are at the center of policy makers attention:
  - EMIR and title VII of Dodd Frank Act

# Motivation

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- Coeuré (ECB board member, 2014): “The success of CCPs [...] depends on the ability of CCPs to handle the risk they are concentrating”
  
- **What we find is consistent with:**
  - In times of moderate stress CCPs work well
  - But they appear to be less effective at the peak of the EZ crisis

# What do we look at?

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- We look at anonymous General Collateral (GC) CCP cleared repo transactions :
  - Collateral from a basket of Eurozone sovereign bonds
    - Cash lender only knows country of the bond
    - Not the maturity, not the coupon
  - Borrower gives collateral to CCP and gets cash from CCP
  - Cash lender lends to CCP against a predetermined country sovereign bonds
  - Each transaction is over-collateralized by a factor (the haircut) determined by the CCP
  - Price of borrowing = Repo rate
- Baseline: Very safe transactions as counterparty default insured by collateral + CCP default fund

# EZ vs US Repo Market

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- Represents around 90% of EZ interbank market:
  - Of which 50% are CCP Cleared
  - Key to the management of the ECB monetary policies
- Main differences with the US:
  - **Much minor role of tri party repo** where only settlement but not counterparty risk is managed by the CCP (Try party repo in the US ~ 50%; Europe 10%)
  - **Participants** (mainly banks in the EZ)
  - Type of collateral (mainly Sovereign bonds in the EZ)

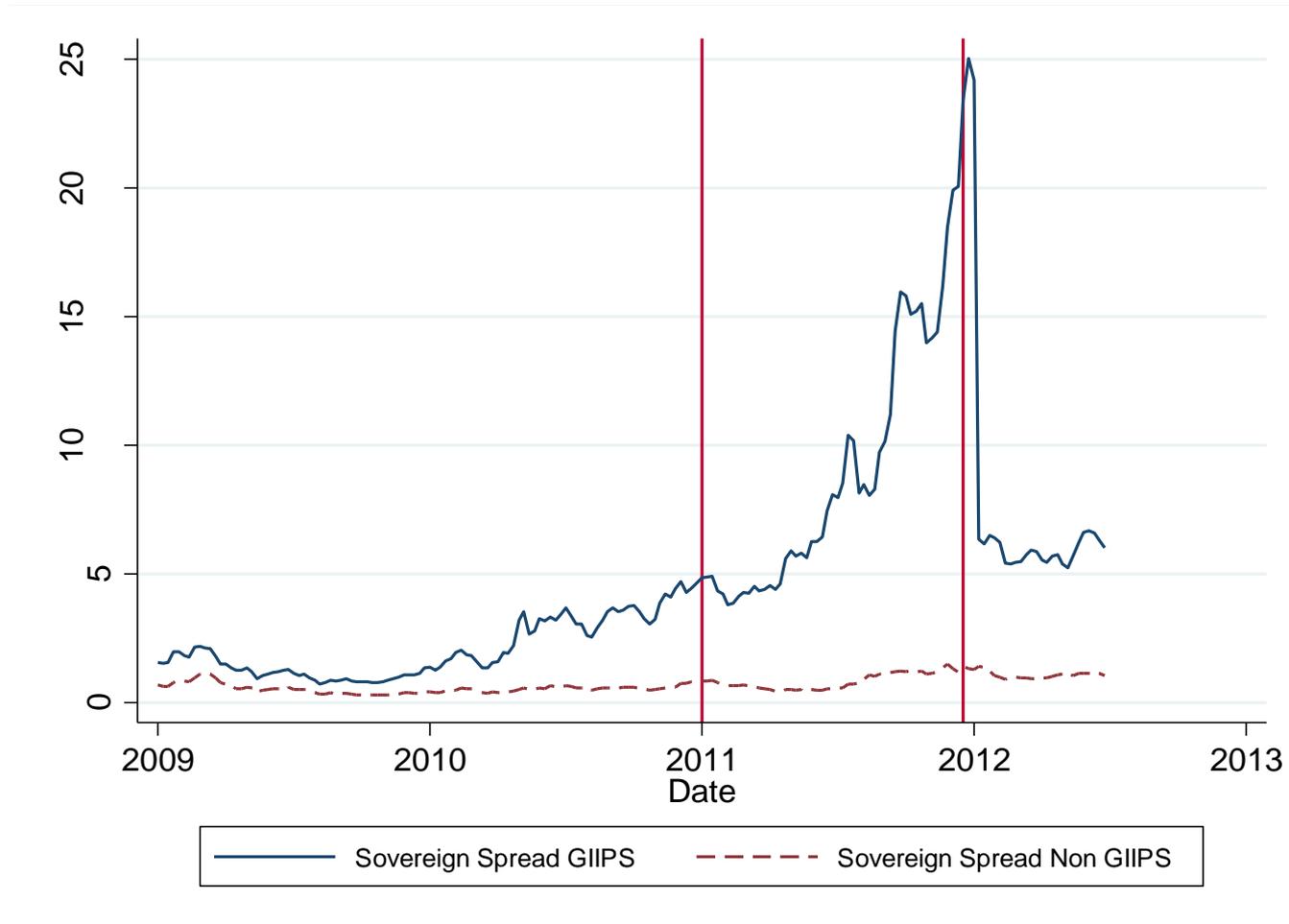
# What do we test empirically?

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- Test whether or not GC CCP cleared repo rates were affected by the fluctuations in sovereign risk
  
- As CCPs assume counterparty risk:
  - It should not be the case as long as CCPs default risk is perceived as low
  
  - If yes, it means that CCPs are perceived as risky by lenders

# The EZ Crisis

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# literature

- Interbank market
  - ▣ US: fed funds market (unsecured): Afonso&al (2011)
  - ▣ ECB policy interventions: Cassola&al (2011)
  - ▣ Our paper: secured segment of IB market
- repo market
  - ▣ US repo market (private ABS)
    - Gorton-Metrick, 2013 ; Krishnamurthy&al, 2013
    - For shadow banks mostly; no CCP
- Most close to our paper but highlights different features
  - ▣ Mancini & al, 2013

# Our data

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- Two leading european repo platforms: Icap + MTS
- Data on all GC CCP Cleared Repo transactions:
  - 11 nationality of sovereign bonds
    - GIIPS: Greece, Ireland, Italy, Portugal, Spain
    - Non-GIIPS: Austria, Belgium, Finland, France, Germany, Netherlands
  - Daily data on volumes and repo rates
  - Average of 50 bn of daily volume. EZ IB market=400 bn
- Haircuts: One haircut per country imposed by CCP (LCH Clearnet)
- Sovereign risk
  - We use CDS spreads on 5-year sovereign bonds

# A simple framework

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- Assume risk neutral arbitrageur
  - Option #1: lends to the ECB
    - Rate =  $r^{\text{ecb}}$
  - Option #2: lends against government bond of country c
    - Rate =  $r_c^{\text{repo}}$
    - Risk free unless Government fails as well as the counterparty and the CCP
  
- Implicit assumption that when both counterparty and CCP default, lender ends up with the bond
  
- Bold assumption as CCP resolution not well defined but seems reasonable

# A simple framework

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## □ No-arbitrage condition

$$r^{ecb} = (1 - p\lambda\pi)r^{repo} - p\lambda\pi.LGD(h) \quad (1)$$

$\pi = P(\text{sovereign bond default})$

$p = P(\text{counterparty default} \mid \text{sovereign bond default})$

$\lambda = P(\text{CCP defaults} \mid \text{sovereign \& counterparty default})$

$LGD(h)$ : LGD conditional on haircut  $h$

## □ Rewriting (1)

$$r^{repo} - r^{ecb} = \left( p\lambda \frac{LGD(h)}{LGD(0)} \right) \cdot (\pi LGD(0))$$

# Empirical framework

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$$R_{c,t}^{\text{repo}} - R_t^{\text{ecb}} = a + b \cdot \text{CDS}_{c,t} + \gamma_t + \delta_{c,m} + \varepsilon_{c,t}$$

- $\gamma_t$  = day fixed effect (common factor exposure)
- $\delta_{c,m}$  = country-month FE (slow moving country factor)
- $\varepsilon_{c,t}$  are clustered across days
  
- Model says:  $b = \frac{\text{LGD}(h)}{\text{LGD}(0)} \times p \times \lambda$

# Repo rate sensitivity to sov. CDS

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## □ Table 2, Panel B

	(1)	(2)	(3)	(4)	(5)
	2008-2012 S1	2008-Lehman	2009-2010	2011	2012 S1
Sovereign CDS	0.00933	-0.0576	-0.00441	<b>0.0765**</b>	0.0102
	(0.81)	(-0.61)	(-0.49)	<b>(2.36)</b>	(0.77)
Day FE	Yes	Yes	Yes	Yes	Yes
Country FE	No	No	No	No	No
Country-month FE	Yes	Yes	Yes	Yes	Yes
Number of observations	9115	1169	4520	1892	879
R <sup>2</sup>	0.981	0.841	0.947	0.950	0.947

# GIIPS vs non-GIIPS

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## □ Table 3, Panel B

	(1) 2008-2012 S1	(2) 2008-Lehman	(3) 2009-2010	(5) 2011	(6) 2012 S1
Sovereign CDS	-0.0430** (-2.42)	0.0593 (0.34)	-0.00436 (-0.16)	<b>-0.107***</b> <b>(-3.45)</b>	0.0200 (1.47)
GIIPS×Sovereign CDS	0.0525*** (2.58)	-0.111 (-0.74)	-0.0000487 (-0.00)	<b>0.208***</b> <b>(5.01)</b>	-0.0105 (-0.59)
Day FE	Yes	Yes	Yes	Yes	Yes
Country FE	No	No	No	No	No
Country-month FE	Yes	Yes	Yes	Yes	Yes
Number of observations	9115	1169	4520	1892	879
R <sup>2</sup>	0.981	0.841	0.947	0.951	0.947

*CDS spread increases by 100bp  
→ Repo rate increases by 20bp*

## □ Similar effect on volume, albeit less robust

# What explains evolution of stress?

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- repo to CDS sensitivity =  $p \cdot \lambda \cdot \frac{LGD(h)}{LGD(0)}$  increased in 2011
  
- Try to disentangle between:
  - ▣ Change in  $\frac{LGD(h)}{LGD(0)}$  : did haircuts decrease in 2011?
  - ▣  $p$  : change in counterparty risk? Did it increase?
  - ▣  $\lambda$  : **Or is it due to a change in CCP default risk?**

# Haircuts were unable to reduce stress

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- Haircuts increased by CCP, by type of GC



# Change in counterparty risk p

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- Run regression

$$\Delta\text{CDS}_{c,t}^{\text{bank}} = a + b \cdot \Delta\text{CDS}_{c,t}^{\text{sov}} + \varepsilon_{c,t}$$

- Under reasonable assumptions interpret b as a lower bound for p

# Change in counterparty risk p

$$\Delta\text{CDS}_{c,t}^{\text{bank}} = a + b \cdot \Delta\text{CDS}_{c,t}^{\text{sov}} + \varepsilon_{c,t}$$

## □ GIIPS countries

	(1) 2008-2012 S1	(2) 2008-Lehman	(3) 2009-2010	(4) 2011	(6) 2012 S1
Change in Sovereign CDS	0.168*** (3.66)	0.234 (0.61)	0.396*** (4.61)	0.176** (2.28)	0.0255 (0.55)
Day FE	Yes	Yes	Yes	Yes	Yes
Number of observations	4269	487	2008	992	480
R <sup>2</sup>	0.390	0.805	0.512	0.329	0.381

## □ In fact, p went down in 2011

# Interpretation of results

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- Neither counterparty risk nor GIIPS Haircuts can explain the rise in stress
- This suggests that  $\lambda$ ,  $P$  (CCP default | counterparty & sovereign default), increased
  - ▣ Crude calibration exercise implies that is very high

# What ended the repo stress?

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- Using event studies around the 3 years LTRO of 2011, we find that it succeeded in removing the stress from the GC CCP Cleared repo market

# What ended the repo stress?

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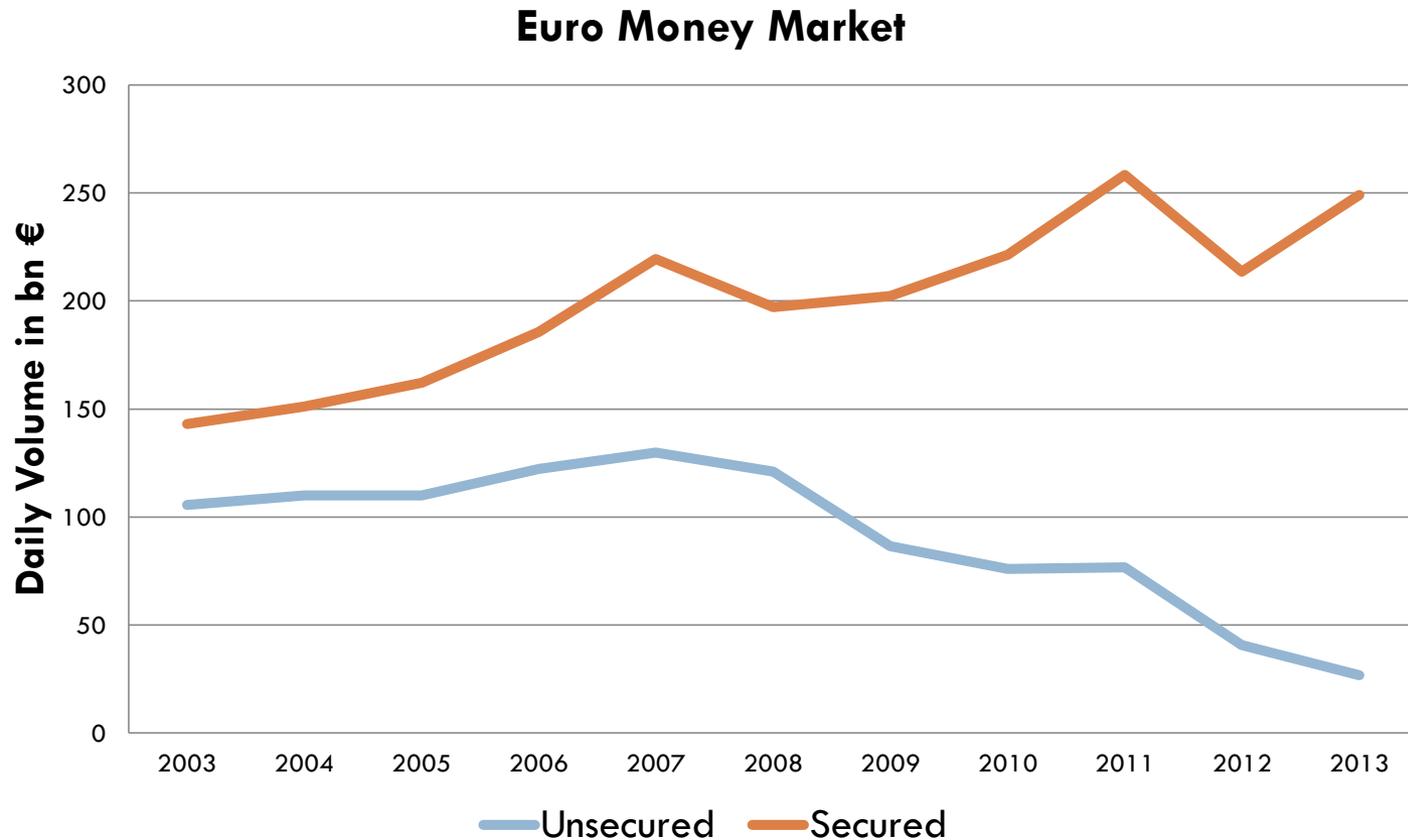
	(1)	(2)	(3)	(4)
	1Y LTRO DEC 2009	1Y LTRO OCT 2011	3Y LTRO DEC 2011	3Y LTRO FEB 2012
Sovereign CDS	0.0873 (0.13)	-0.0765* (-1.98)	-0.130** (-2.17)	0.0216 (0.99)
POST×Sovereign CDS	-0.106 (-0.16)	0.162*** (2.86)	0.0524 (0.71)	-0.0625 (-1.30)
GIIPS× Sovereign CDS	-0.0336 (-0.05)	0.408*** (5.71)	0.415*** (7.60)	0.0735* (1.78)
POST×GIIPS× Sovereign CDS	-0.0254 (-0.04)	-0.167 (-1.32)	-0.743*** (-6.40)	0.0481 (0.69)

# Conclusion

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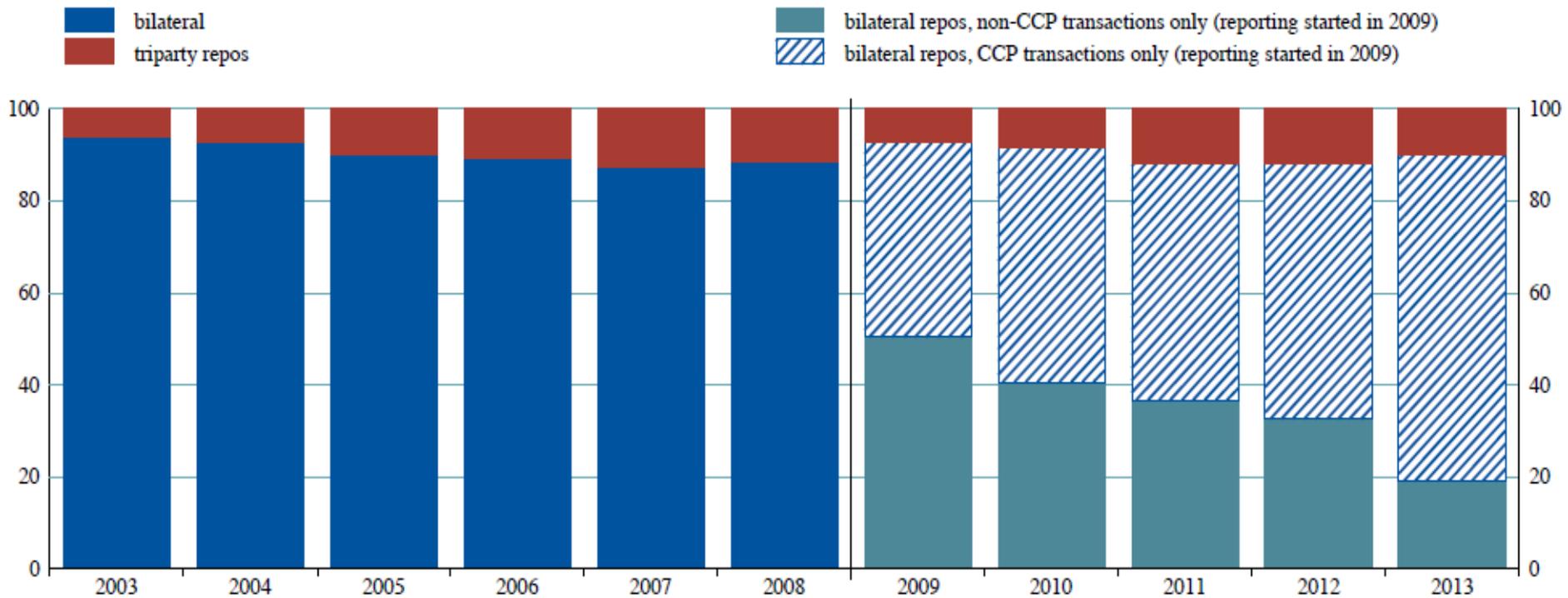
- CCP worked well in 2009-2010
  - ▣ Haircut high enough / conditional  $P(\text{CCP default}) \approx 0$
  
- CCP offered little protection in 2011
  - ▣ Haircut increases did not work
  - ▣  $P(\text{CCP default})$  very high
  
- Get further data for further robustness checks

# IB market: Mostly secured now

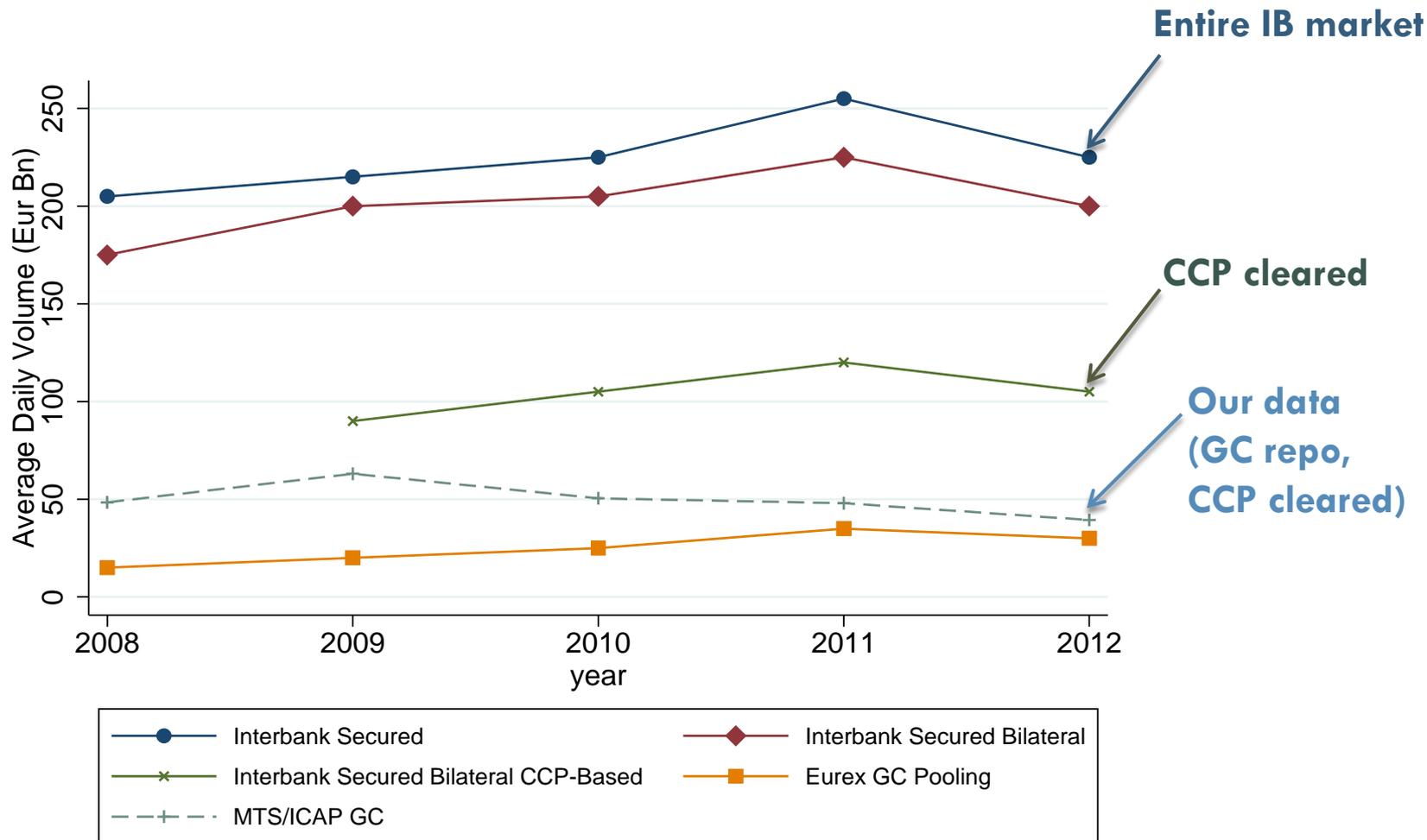


Source: ECB survey on 161 largest banks in Europe

# CCP cleared: Increasingly prevalent



# How big/representative are our data?

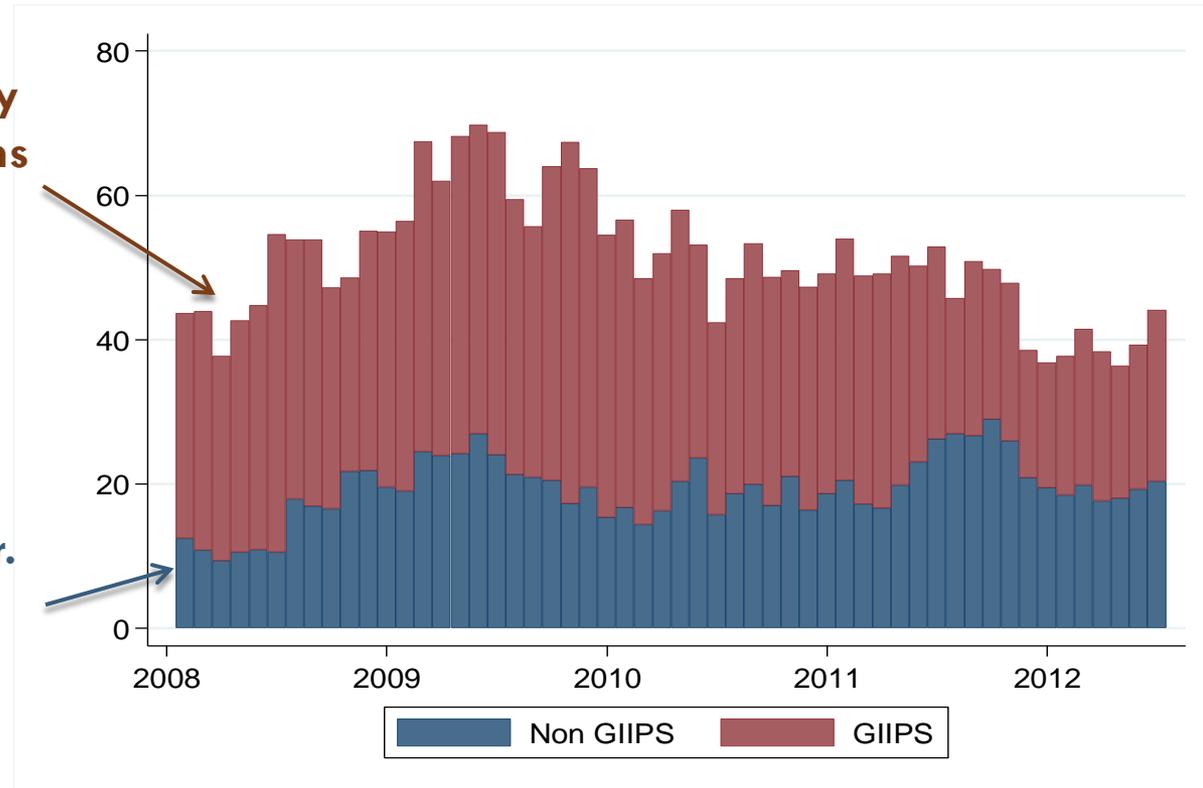


# Repo volume by country of collateral

- GIIPS collateral-backed lending stressed, not frozen

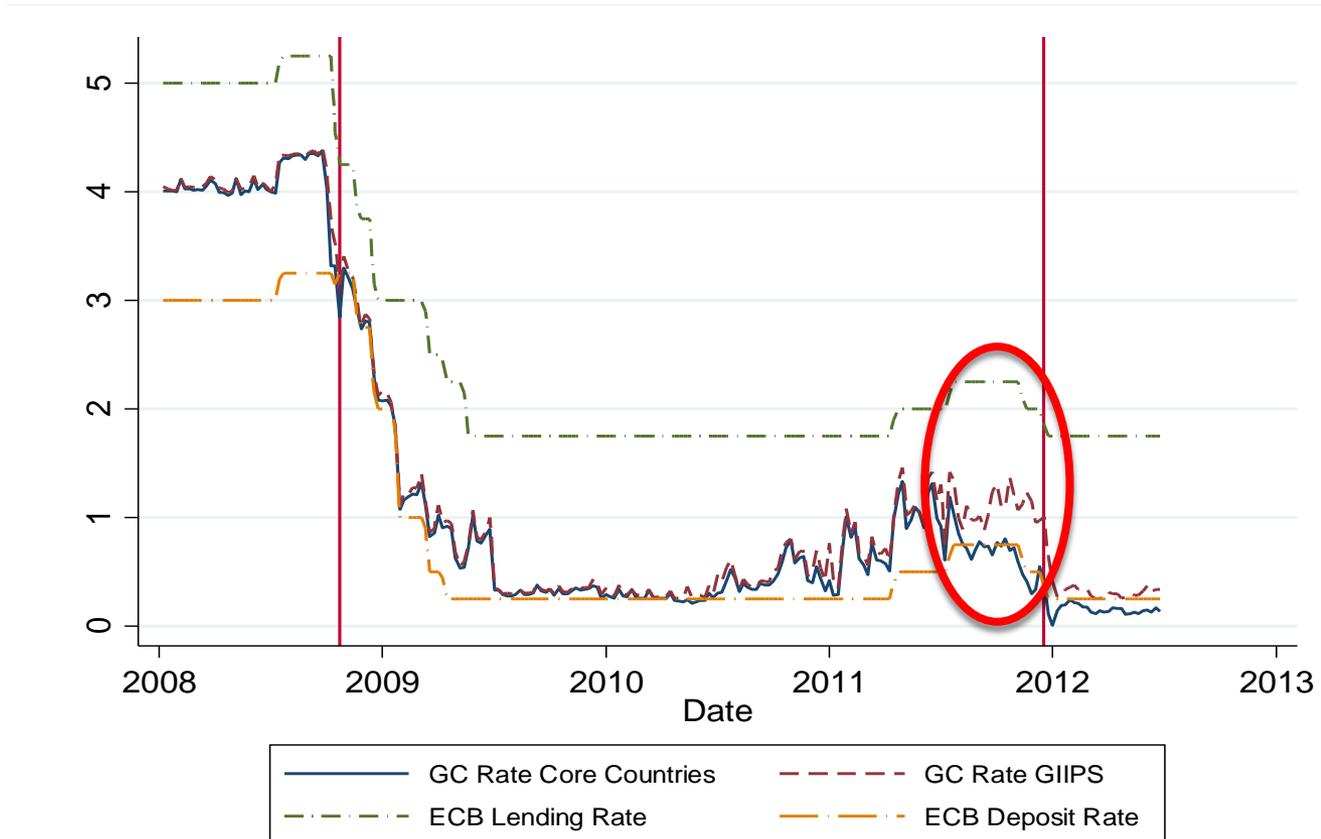
**Volume mostly from Italy  
but rates and transactions  
for all GIIPS**

**Volume mostly from Fr. & Ger.  
but rates and transactions  
for all others**



# Rates

- Stress
- GIIPS/non-GIIPS disconnect in 2011



# Rates

Daily volume = 50bn€

Europe's money market = daily volume 400bn€

Repo = 250bn€

CCP cleared repo = 120bn€

# Motivation 2

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- Were CCP (Central Counterparty) cleared repo transactions affected by the EZ sovereign crisis?
- **We show that at the peak of the crisis CCP it was indeed the case**
  - ▣ More specifically, repo rates were strongly affected by sovereign CDS for GIIPS collateral in 2011
- And ask: why?
  - ▣ EZ CCP Cleared Repo transactions supposed to be very safe:
    - Overnight transactions, Collateralized by sovereign bonds, haircuts and CCP's default funds
  - ▣ But it appears that CCP default risk was factored in at the peak of the crisis: **CCP is no panacea**

# EZ vs US Repo Market

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- Represents around 90% of EZ interbank market:
  - Of which 50% are CCP Cleared
  - Collateral is mainly EZ government bonds
  
- Main differences with the US:
  - Much minor role of tri party repo where only settlement but not counterparty risk is managed by the CCP)
  - Participants (mainly banks in the EZ)
  - Type of collateral (mainly Sovereign bonds in the EZ)

# Change in counterparty risk $p$

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- $p = P(\text{counterparty default} \mid \text{sovereign default})$
- $P(\text{CP default}) = p \cdot \pi + \rho \cdot (1 - \pi) = (p - \rho) \cdot \pi + \rho$ 
  - ▣ where  $\rho = P(\text{CP default} \mid \text{sovereign non-default})$
  - ▣  $\pi = P(\text{sovereign default})$
- Run regression

$$\text{CDS}_{c,t}^{\text{bank}} = a + b \cdot \text{CDS}_{c,t}^{\text{sov}} + \varepsilon_{c,t}$$

- ▣ Assuming  $\rho$  stable over time and that banks from country  $c$  hold country  $c$ 's debt
- Interpret  $b = p - \rho$  as a lower bound for  $p$

# Haircuts were unable to reduce stress

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- Haircut change → repo to CDS sensitivity goes down in 2010, not in 2011

	Spain December 2010 HC Change		Spain September 2011 HC Change		Italy November 2011 HC Change	
	(1)	(2)	(3)	(4)	(5)	(6)
	Spain Only	Spain and Others	Spain Only	Spain and Others	Italy Only	Italy and Others
Sovereign CDS	-0.0822 (-1.47)	-0.278*** (-5.78)	-0.305*** (-3.14)	-0.249*** (-6.43)	-0.0873 (-0.92)	-0.106 (-1.46)
POST	0.587*** (2.83)	0.0894** (2.18)	-1.258*** (-3.41)	-0.320*** (-8.51)	-1.313*** (-3.10)	-0.0851* (-1.82)
POST×Sovereign CDS	<b>-0.210**</b> <b>(-2.38)</b>	0.0206 (1.66)	<b>0.446***</b> <b>(3.72)</b>	0.197*** (9.88)	<b>0.359***</b> <b>(3.40)</b>	0.0545** (2.57)
HC Country×Sovereign CDS		0.195*** (4.02)		-0.0569 (-0.72)		0.0190 (0.18)
POST×HC Country		0.498** (2.15)		-0.938*** (-2.71)		-1.208** (-2.35)
POST×HC Country×Sovereign CDS		<b>-0.231**</b> <b>(-2.33)</b>		<b>0.249**</b> <b>(2.32)</b>		<b>0.299**</b> <b>(2.34)</b>