

# Limits to Arbitrage: Empirical Evidence from Euro Area Sovereign Bond Markets

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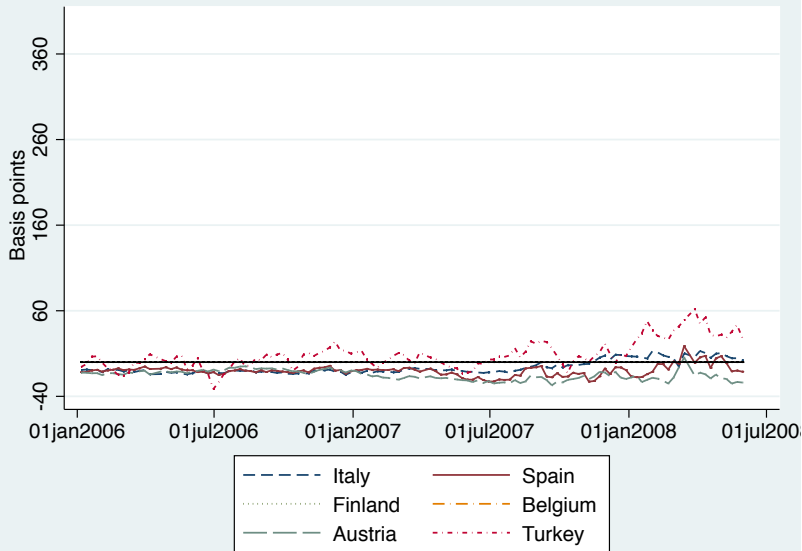
# Context

- ▶ June 2008 - February 2013 USD-denominated bonds were "cheaper" on average than comparable EUR-denominated bonds issued by the same euro zone country
  - ▶ **Countries** - Austria, Belgium, Finland, Italy, and Spain
  - ▶ **Pairs of bonds** - For each USD-denominated bond we find a comparable bond denominated in Euro

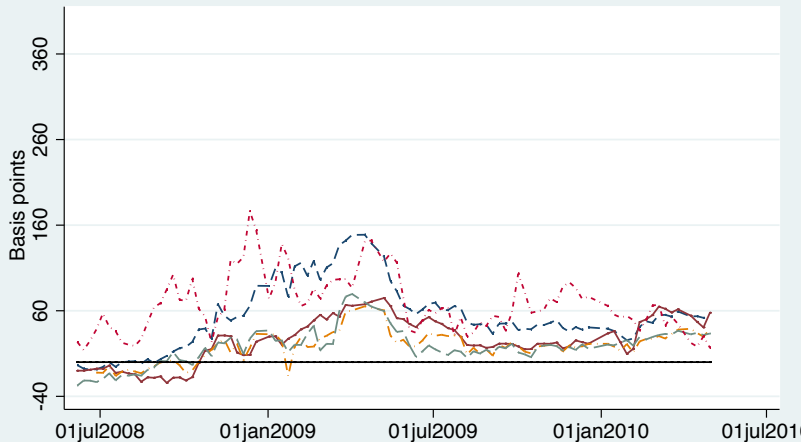
$$Basis_{i,t} = YTM_{m,j,t}^{USD \rightarrow EUR} - YTM_{n,j,t}^{EUR} > 0$$

- $YTM^{USD \rightarrow EUR}$  yield-to-maturity of synthetic (from USD to EUR using currency swap) bond  $m$  issued by country  $j$
- $YTM^{EUR}$  yield-to-maturity of EUR-denominated bond  $n$  issued by country  $j$
- net of total bid-ask spreads

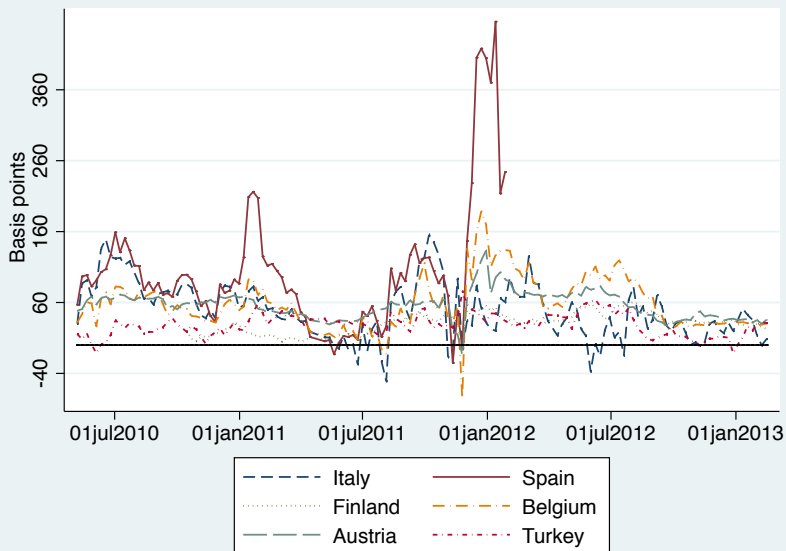
# Law of one price in action



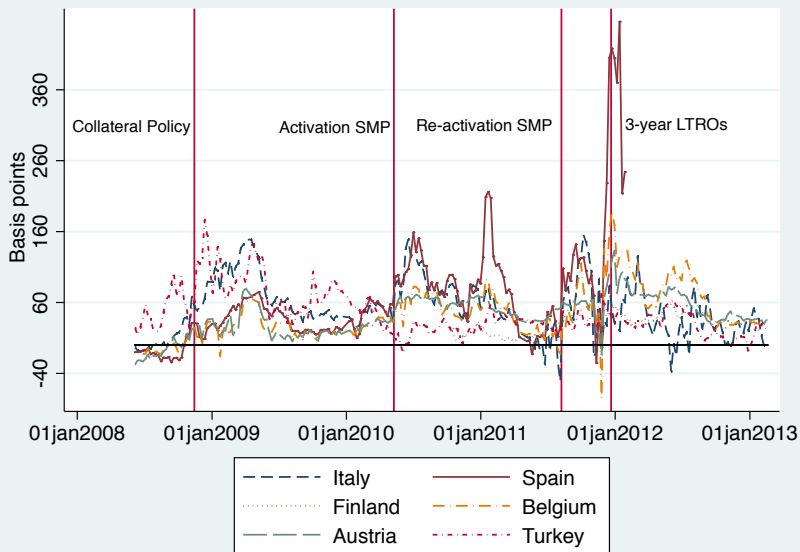
# Pricing anomaly - The Financial crisis starts



# Pricing anomaly - The Euro debt crisis starts



# Pricing anomaly - ECB non-standard measures



# Overview

- ▶ The paper provides evidence that frictions and market segmentation matters for asset pricing
- ▶ The basis is related to
  - ▶ **ECB fixed-rate full allotment policy**
    - ▶ Counterparties can control the amount of liquidity they demand pledging adequate collateral
  - ▶ **ECB haircuts** being lower for EUR-denominated bonds
  - ▶ The **amount of bonds pledged to ECB** when
    - ▶ country CDS spike
    - ▶ 3-year LTROs are implemented
  - ▶ **Securities Market Programme** targeting exclusively EUR-denominated bonds

# Outline

1. **Basis**
2. **Data & Methodology**
3. **ECB Collateral and Liquidity Policy**
4. **Alternative basis**



# Basis

- ▶ We select fixed-rate coupon bonds from the same issuer
- ▶ Every USD-denominated bond is matched to a EUR-denominated bond ( issuance and maturity date)
- ▶ For every matched-pair bond  $i$  the basis at time  $t$  is:

$$Basis_{i,j,t} = YTM_{m,j,t}^{USD \rightarrow EUR} - YTM_{n,j,t}^{EUR}$$

- $YTM_{m,j,t}^{USD \rightarrow EUR}$  yield-to-maturity of the synthetic (from USD to Euro) bond  $m$  issued by country  $j$
- $YTM_{n,j,t}^{EUR}$  yield-to-maturity of the EUR-denominated bond  $n$  issued by country  $j$
- ▶  $Basis_{i,j,t}$  net of total bid-ask spreads

# Basis & Currency Swap Spread

Currency hedge using a cross-currency asset swap:

- ▶ **Asset swap:** exchange the fixed coupons of the USD-denominated into floating cash flows linked to the Libor rates (premium or discount)
- ▶ **Cross currency swap:** exchange the Libor linked cash flows with Euribor linked cash flows plus the cross currency spread (CCS)
- ▶ **Swap:** exchange the Euribor linked cash flows with fixed cash flows using EUR swap rates

The CCS is a key driver of the basis

- ▶ affects the yield-to-maturity of the synthetic bond
- ▶ depends on demand for dollar funding (Ivashina, Scharfstein and Stein (2012))

# Basis & Theory

The basis should be close to zero, when the following frictions are not in place (Buraschi & al. (2014))

- ▶ Liquidity and fungibility
- ▶ Short-selling and constraints
- ▶ Funding constraints and FX Markets
- ▶ *Pari Passu* (same recovery rate in case of default)
- ▶ Early default and FX risk

The paper stresses the role of central banks interventions

- ▶ Collateral policy: different haircuts imply different prices
  - > **monetary funding premium** (Garleanu&Pedersen (2011))
- ▶ Asset purchases when explicitly targeting specific securities
  - > **segmentation** (Greenwood&Vayanos (2011))

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- ▶ **Bond pairs:**
  - ▶ 19 pairs: Italy (9), Spain (4), Austria (2), Belgium (2) and Finland (2).
  - ▶ daily bid and ask prices (Bloomberg BGN)
- ▶ **Bond factors:** lending activity, governing law and additional clauses
- ▶ **Market factors:** Quanto CDS, Eurepo - OIS spread and VIX
- ▶ **ECB data:**
  - ▶ Collateral and liquidity (bond and bank level)
  - ▶ SMP purchases (bond level)

# Empirical Strategy

- ▶ **Unbalanced panel regressions** - Prais-Winsten regression specification with country fixed-effects:

$$\begin{aligned} \text{Basis}_{i,j,t} = & \alpha + \delta_j + \beta \times \text{Bond Information}_{i,j,t} \\ & + v \times \text{Market Factors} \\ & + \pi \times \text{ECB} + \varepsilon_{i,j,t}, \end{aligned}$$

- $i$  bonds pair
- $j$  country
- $t$  time

- ▶ **Event study (Diff-in-diff)** analysis

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# Change collateral policy

- ▶ 15 October 2008: Fixed-rate full allotment policy
- ▶ 14 Nov. 2008 - 31 Dec. 2009: temporary expansion of the collateral (announcement on 22 Oct. 2008)
  - ▶ ECB admits bonds in USD, pounds sterling and Japanese yen when they are eligible
  - ▶ If USD-denominated bond is **eligible**, it is subject to an **additional** haircut (mark-down)
  - ▶ Our sample: 6 (2) USD-denominated bonds issued by Italy (Spain) are no eligible
  - ▶ **Why?** The bonds are not settled in the European Economic Area (EEA)
  - ▶ ECB publishes the list of eligible assets on 14 Nov. 2008
- ▶ from 9 Nov. 2012: same expansion of the collateral (announcement on 6 Sep. 2012)



# Change collateral policy - Basis

- ▶ **Illustrative example for a pair:**

- ▶ EUR-den. bond is subject to a 3% haircut

$$€100 \times (1 - 3\%) = €97$$

- ▶ Eligible USD-den. bond is subject to an additional 8% haircut

$$\$100 \times (1 - 3\%) \times (1 - 8\%) = \$89.24 \rightarrow \text{overall haircut of } 10.76\%$$

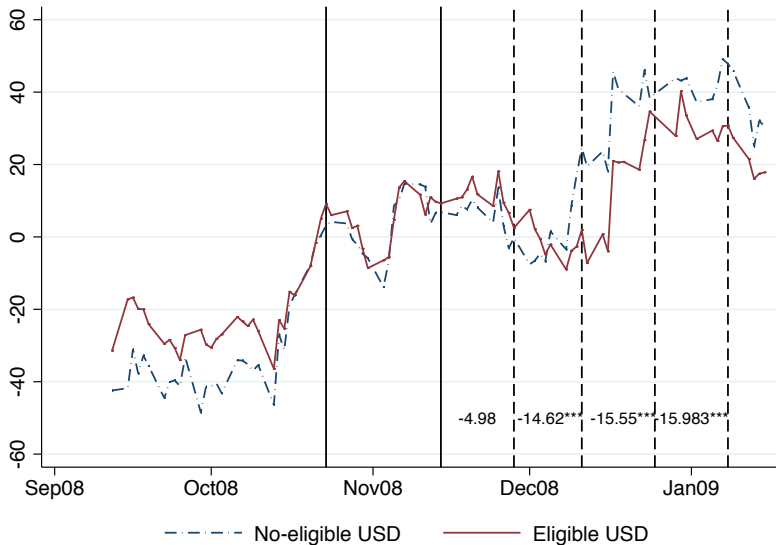
- ▶ No Eligible USD-den. bond: 100% haircut

- ▶ **Our estimates:**

- ▶ Reduction of the basis by over 15 basis points for bond pairs including eligible USD-denominated bonds

- ▶ **Monetary funding premium:** the YTM of the USD-denominated bond lowers by 15 bps decreasing haircuts from 100% to 10.76%

# Change collateral policy - Event study



# Change collateral policy - Event study

	(1)	(2)	(3)
	14 - 11 - 2008	9 - 11 - 2012	31 - 12 - 2009
D. After 1w-2w <sub>t</sub>	14.924*** (2.974)	-7.454*** (2.249)	8.209* (4.732)
D. After 3w-4w <sub>t</sub>	26.900*** (3.316)	3.381 (2.394)	29.234*** (4.692)
D. After 5w-6w <sub>t</sub>	36.502*** (3.598)	0.975 (2.418)	14.967*** (4.692)
D. After 7w-8w <sub>t</sub>	53.112*** (4.073)	2.102 (2.356)	1.184 (4.692)
D. After 1w-2w <sub>t</sub> × Elig. Pair <sub>i,j</sub>	-4.987 (4.000)	3.303 (2.754)	3.296 (7.793)
D. After 3w-4w <sub>t</sub> × Elig. Pair <sub>i,j</sub>	-14.620*** (4.468)	-7.838*** (2.934)	-15.066* (7.726)
D. After 5w-6w <sub>t</sub> × Elig. Pair <sub>i,j</sub>	-15.551*** (4.876)	-7.032** (2.952)	-9.413 (7.418)
D. After 7w-8w <sub>t</sub> × Elig. Pair <sub>i,j</sub>	-15.983*** (5.508)	-7.845*** (2.894)	-5.250 (6.758)
Eligible Pair <sub>i,j</sub>	39.787*** (4.666)	73.066*** (4.878)	69.454*** (9.894)
Constant	-37.782*** (4.923)	-16.766*** (4.786)	-14.323 (9.922)
Country FE	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes
$\rho$	0.780	0.688	0.903
Num. Obs.	993	695	1294
R <sup>2</sup>	0.550	0.801	0.511

# Sovereign Debt Pledged to the ECB

- ▶ We focus on the impact of the sovereign debt collateral pledged at the ECB in exchange of liquidity by including  $Sov. Collateral_{j,t}$  to  $Tot. Sov. Debt_{j,t}$
- ▶ We find the amount of sovereign pledged to the ECB
  1. during market distress is significantly related to the basis (sovereign CDS above the 90<sup>th</sup> percentile of its distribution over the full-sample period, similar to Pelizzon&al. (2014) )
  2. during the 3-year LTROs is significantly related to the basis
- ▶ In both cases only EUR-denominated bonds were eligible

# Sovereign Debt Pledged to the ECB - Results

	(1) Panel Analysis	(2) Event Study 8 – 12 – 2011
Sov. Coll. to Tot. Sov. Debt $_{j,t}$	17.294 (74.930)	
Sov. Coll. to Tot. Sov. Debt $_{j,t}$ × D. High CDS $_{j,t}$	461.256*** (136.834)	
Sov. Coll. to Tot. Sov. Debt $_{j,t}$ × D. 3y-LTROs $_{j,t}$	325.812** (146.123)	
D. 3y-LTROs $_{j,t}$	0.753 (5.621)	
D. High CDS $_{j,t}$	-44.384*** (7.113)	
D. After 1w-2w $_t$		20.475*** (5.825)
D. After 3w-4w $_t$		40.280*** (6.567)
D. After 5w-6w $_t$		26.040*** (6.637)
D. After 7w-8w $_t$		34.271*** (7.071)
Constant	6.489 (11.202)	55.348*** (5.327)
Other Control Variables	Yes	No
Country FE	Yes	Yes
Pair FE	No	Yes
$\rho$	0.837	0.789
Num. Obs.	3271	1077
$R^2$	0.098	0.439

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# Strategy

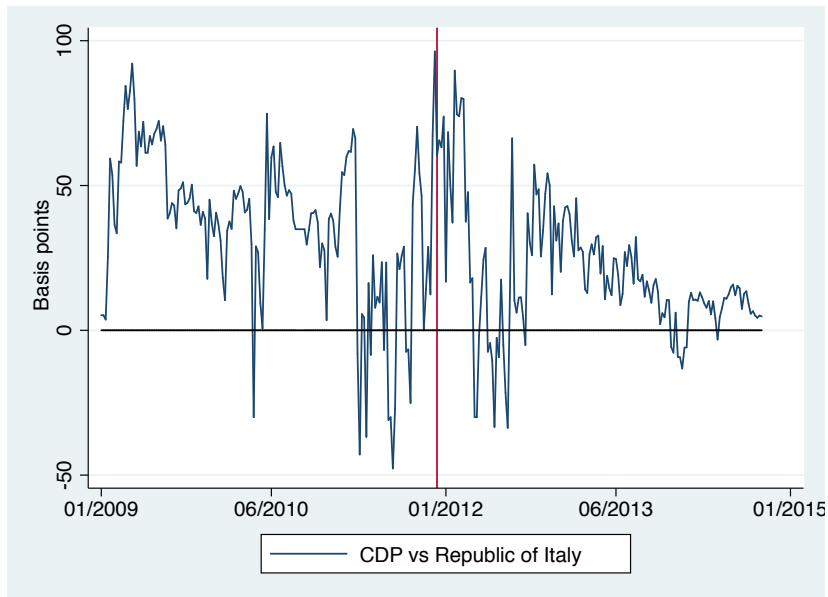
- ▶ Strategy: identify EUR-denominated bonds that are **similar** but are subject to different haircuts in ECB liquidity operations
- ▶ Two examples
  - ▶ Fixed vs floating rate bond issued by Italy
  - ▶ Fixed rate bonds issued by Cassa Depositi e Prestiti, Italian state-owned bank

# Cassa Depositi e Prestiti (I)

- ▶ Cassa Depositi and Prestiti (CDP) is an Italian state-owned bank
- ▶ The Republic of Italy is legally required
  - ▶ to hold majority ownership in CDP (80.2% equity)
  - ▶ to unconditionally guarantee postal savings products
- ▶ Rating agencies typically assign the CDP and the Republic of Italy the same credit worthiness
- ▶ ECB haircuts on June 2011:
  - ▶ a fixed-rate bond issued by CDP and expiring in September 2016 is subject to a haircut of 24.5%
  - ▶ a comparable Italian sovereign fixed-rate coupon bond expiring in August 2016 is subject to a haircut of 10%
- ▶ During 3-year LTROs the basis is of 64 basis points



# Cassa Depositi e Prestiti (II)



# Conclusions

- ▶ We provide evidence that a monetary funding premium is embedded in the EUR- denominated bonds because these bonds could be used as collateral for liquidity operations with the ECB at lower haircuts.
- ▶ This monetary funding premium is time varying
  - ▶ changes in collateral policy
  - ▶ loans at longer maturities than available in the market
  - ▶ sovereign issuer experiencing market stress

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5. **Additional slides**

# Eligibility criteria - marketable assets

## General framework for eligibility of marketable assets

1. Type of asset
2. Credit standards
3. Place of issue: European Economic Area (EEA)
4. Settlement: Euro area
5. Type of issuer (EEA or non EEA G10 countries) / Debtor (EEA) / Guarantor (EEA)
6. Acceptable markets
7. Currency: Euro

# Alternative basis - Fixed vs floating rate bond (I)

## ▶ **Fixed-rate coupon bond**

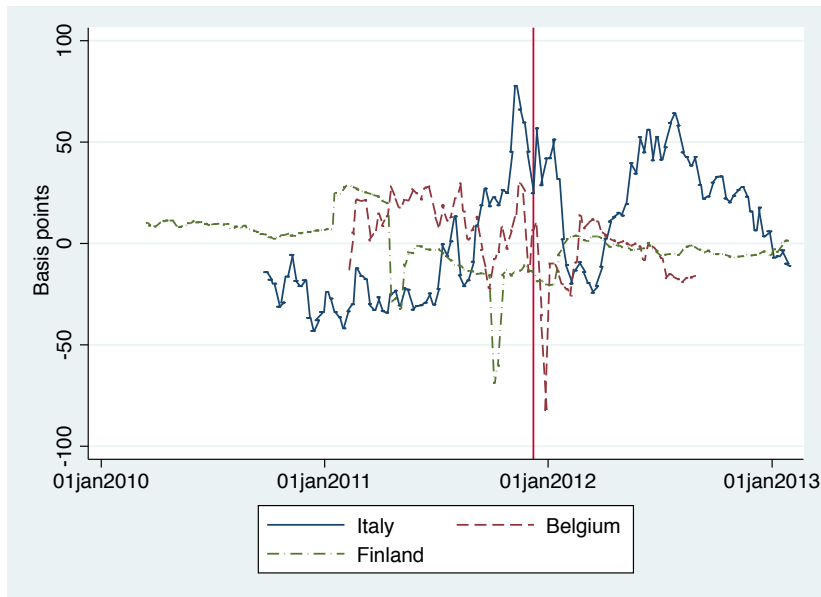
- ▶ The haircut applied depends on i) the sovereign issuer rating and ii) the time-to-maturity (maturity buckets)
- ▶ The longer the time-to-maturity, the higher the haircut is applied to the fixed-rate coupon bond.

## ▶ **Floating-rate coupon bond**

- ▶ The haircut applied is the one applied to the zero-to-one-year maturity bucket for fixed coupon instruments.

- ▶ **Intuition:** Expect a basis between a long term fixed-rate coupon bond and its synthetic counterpart - a swapped floating rate bond, issued by the same euro area country

# Alternative basis - Fixed vs floating rate bond (II)



# SMP

	(1) Panel Analysis	(2) Event Study 10 May 2010	(3) Event Study 11 Aug. 2011
$SMP_{j,t}$	2.588*** (0.339)		
D. After 1w-2w <sub>t</sub>		30.794*** (3.009)	14.239*** (3.164)
D. After 3w-4w <sub>t</sub>		22.634*** (3.060)	19.592*** (3.207)
D. After 5w-6w <sub>t</sub>		49.083*** (3.034)	19.637*** (3.164)
D. After 7w-8w <sub>t</sub>		58.757*** (2.969)	37.938*** (3.164)
D. After 1w-2w <sub>t</sub> × Target Coun. <sub>j,t</sub>			43.046*** (6.964)
D. After 3w-4w <sub>t</sub> × Target Coun. <sub>j,t</sub>			43.847*** (7.060)
D. After 5w-6w <sub>t</sub> × Target Coun. <sub>j,t</sub>			14.063** (6.964)
D. After 7w-8w <sub>t</sub> × Target Coun. <sub>j,t</sub>			53.840*** (7.302)
Target Countries <sub>j,t</sub>			-78.899*** (7.097)
Other Control Variables	Yes	No	No
Country FE	Yes	Yes	Yes
Pair FE	No	Yes	Yes
$\rho$	0.847	0.780	0.832
Num. Obs.	3271	1237	1252
R <sup>2</sup>	0.089	0.628	0.551

# Reactivation SMP

