

ECB Interventions in Distressed Sovereign Debt Markets: The Case of Greek Bonds

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Motivation

Since 2010, several central banks have implemented large-scale bond purchases (“Quantitative Easing”).

We know these programmes were effective in lowering bond yields in more or less “normal” times (asset markets not distressed):

- Gagnon et al. (2011), Krishnamurthy and Vissing-Jorgensen (2011), Bauer and Rudebusch (2012), Hamilton and Hu (2012), D’Amico et al. (2012), D’Amico/King (2013), Cahill et al. (2013); Joyce et al. (2010), Breedon et al. (2012); survey by IMF (2013)
- Cumulative effect in US and UK: -50 to -200 bp.

But are they also effective in (very serious) crisis times?

- Lack of liquidity/higher risk aversion could enhance effects of purchases ... but also make them more “local”
- Furthermore, very noisy environment, attempt to “lean against” market pressures: could make intervention less effective and/or harder to detect.

This paper

- Focuses on ECB's (2010-12) Securities Markets Program (SMP) used to purchase government bonds during Euro area crisis;
- Focuses on Greece – the worst of the Euro area crises.
- Two main contributions:
 1. Identifies and characterises ECB purchases at the bond level, exploiting the fact that ECB's Greek bond holdings were (involuntarily) revealed just ahead of February 2012 restructuring (“silent swap”)
 2. Shows effects of bond purchases using an identification approach that side-steps some of the problems of the time-series literature.

Related literature on SMP: De Pooter et al. (2013), Doran et al. (2014), Eser and Schwaab (2016), Ghysels et al. (2016), Krishnamurthy et al. (2014).

Plan

1. Briefly describe SMP
2. Show why effects of SMP are so hard to identify in time series data
3. Offer an alternative (cross-sectional) approach that side-steps this problem
4. Summarise results on implicit criteria for intervention
5. Show results on effects of intervention (mostly in charts, two regression tables).
6. Conclude

ECB Securities Market Programme

- Announced May 9th, first purchases on May 10th 2010
- Two main phases:
 1. May - July 2010 (~ €80 bn): Mostly Greece, Ireland, Portugal
 2. Aug. 2011- Jan. 2012 (~ €150 bn): Mostly Italy and Spain
- Terminated in Sept. 2012, when OMT was introduced
- Main differences to US, UK and current ECB programs
 1. Objective: Contain debt crisis, target dysfunctional markets
 2. Communication: far fewer details, no amounts, open-ended
 3. No sales: bonds held to maturity; stock = cumulative flow
 4. In Greece: purchases very concentrated: ECB bought >10% of total stock of Greek bonds within 8 weeks in May and June 2010 (Barclays estimates, press reports)

Why the effects of the SMP are hard to identify

Standard approach: a time-series regression of the type:

$$\Delta y_t = \alpha + \gamma q_t + \theta x_t + \varepsilon_t , \text{ where}$$

Δy_t is change in bond yield or price during intervention period
(e.g. within a day)

q_t is purchase amount of bond during that period

x_t denotes control variables

Two main problems:

- Intervention q_t may have been anticipated
- q_t may be reaction to pressures in bond market within the intervention period (endogenous or “passive” intervention)

Possible remedy: look at extremely short intervention periods

Example: SMP intervention in Portuguese sovereign debt market

Source: Doran, Dunne, Monks and O'Reilly (2014)

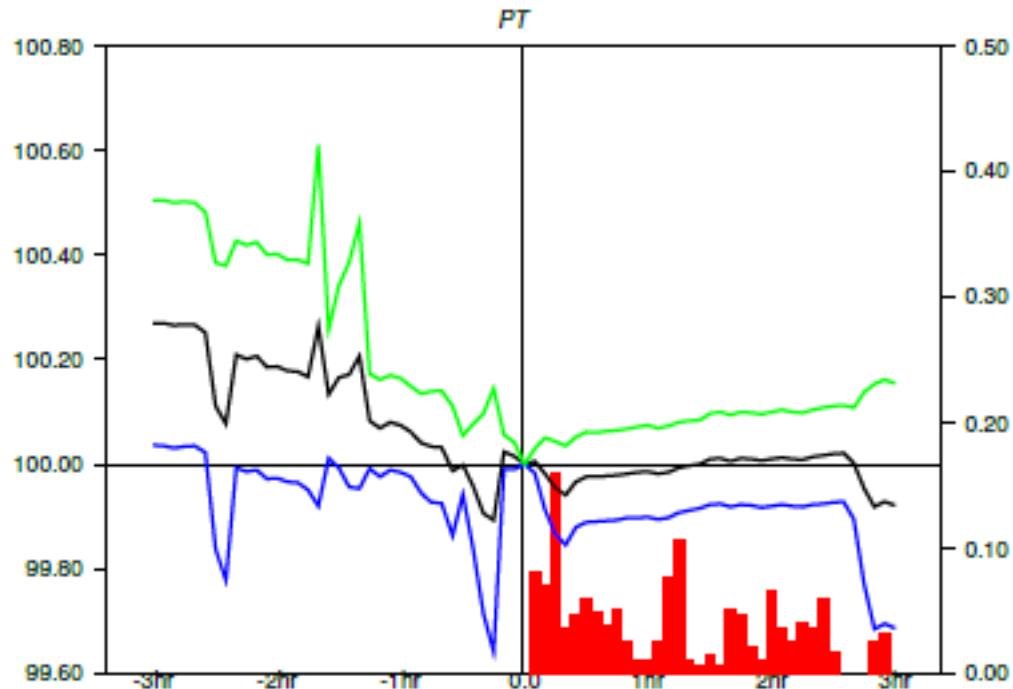
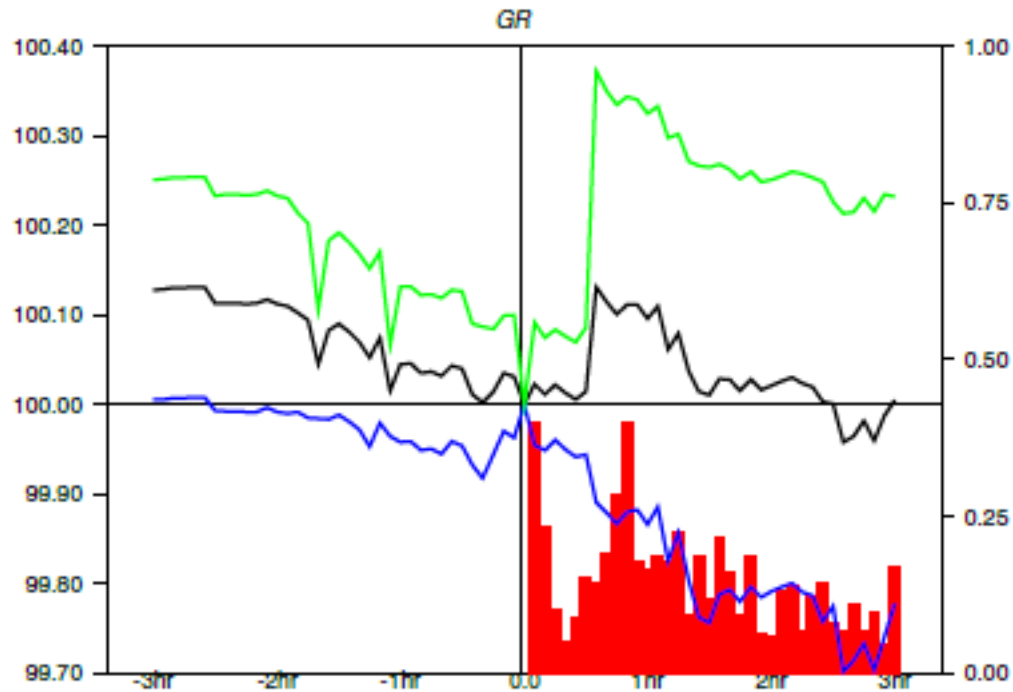


Figure displays an index of bond prices for short-maturity bonds with mid-sized coupons at 5 minute intervals to 3 hours before and after start of SMP intervention. 95% confidence bounds shown in blue and green, intervention quantities across all event days shown in red (in €bn).

Same chart for Greece

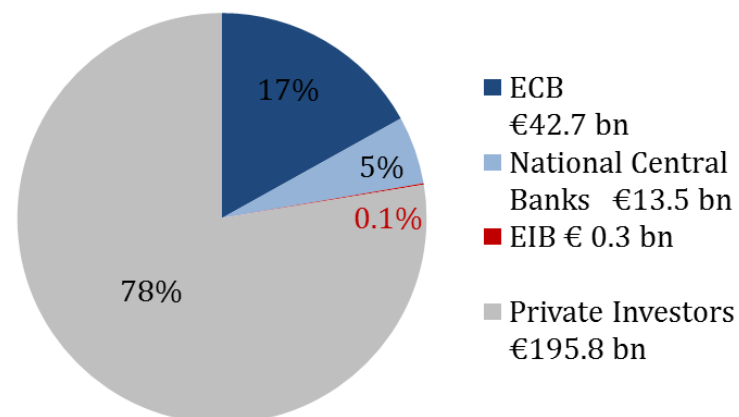
Source: Doran, Dunne, Monks and O'Reilly (2014)



- Hard to say much even using intraday data: effects appear temporary, confidence bands very wide
- 2 out of 3 papers written in parallel with ours do not find significant effects of SMP purchases for Greece.

Our approach

1. Infer bond-by-bond ECB holdings of Greek bonds from the fact that ECB did **not** participate in Greek debt restructuring (“Silent swap” in February 2012, published in little-known Greek government gazette).
2. Given buy- and hold strategy, and maturity range of intervention, can assume that these are bonds were bought via the SMP.
3. Characterise implicit ECB bond purchase criteria
4. **Compare yield changes of bonds bought and not bought** over main intervention period (first 8 weeks of SMP, based on market estimates and weekly aggregate data published by ECB).



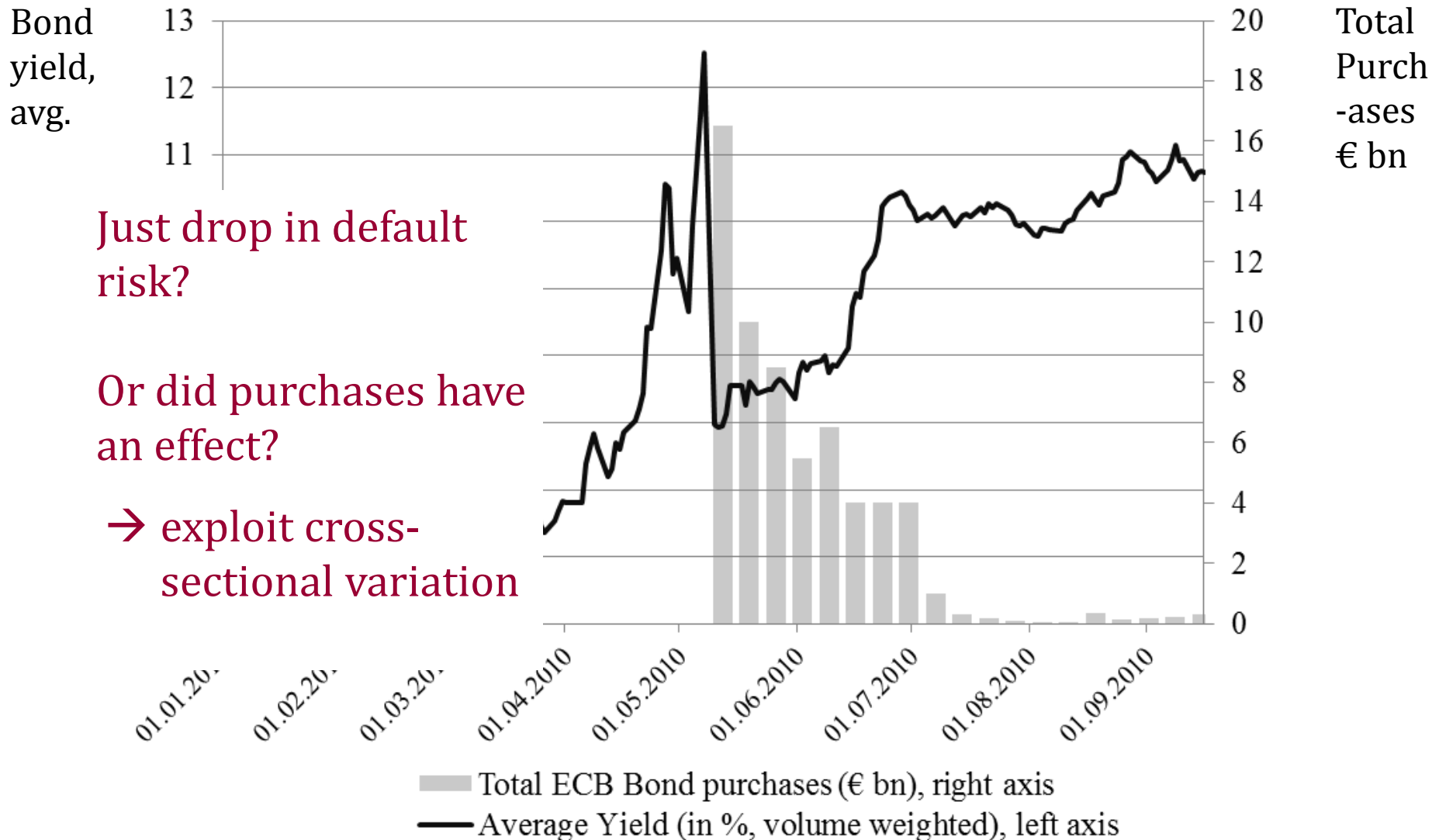
What bonds did the ECB buy?

- 85 Greek sovereign bonds and floating rate notes in May 2010.
- ECB focused on only 31 bonds; rest untouched
- Holdings up to 38% in some bonds, average for target bonds: 18%

ECB had a preference for:

1. Bonds with shorter- and medium term maturities (average 5.4 years, versus 9.1 years in full sample)
2. Benchmark bonds (24 benchmark bonds account for 95% of bonds bought) with regular pricing on Bloomberg
3. Greek-law bonds (as opposed to foreign law)
4. Bonds that had higher yields
 - Bond size and average yield in 4 weeks prior to SMP explain about 70 percent of cross-sectional variation in purchases among bonds bought

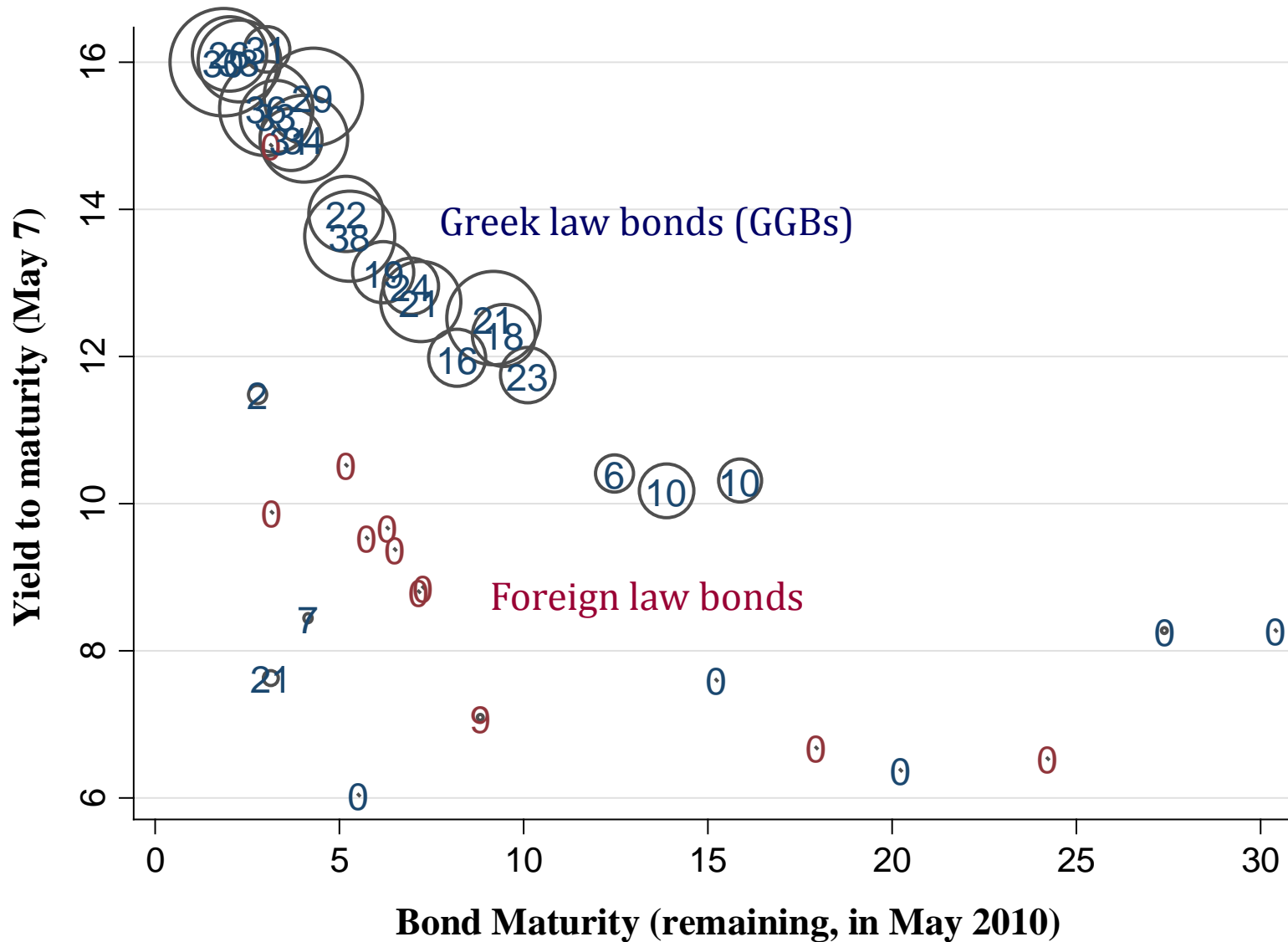
Aggregate reaction to SMP (and EFSF) launch: bond yields drop 550 basis points



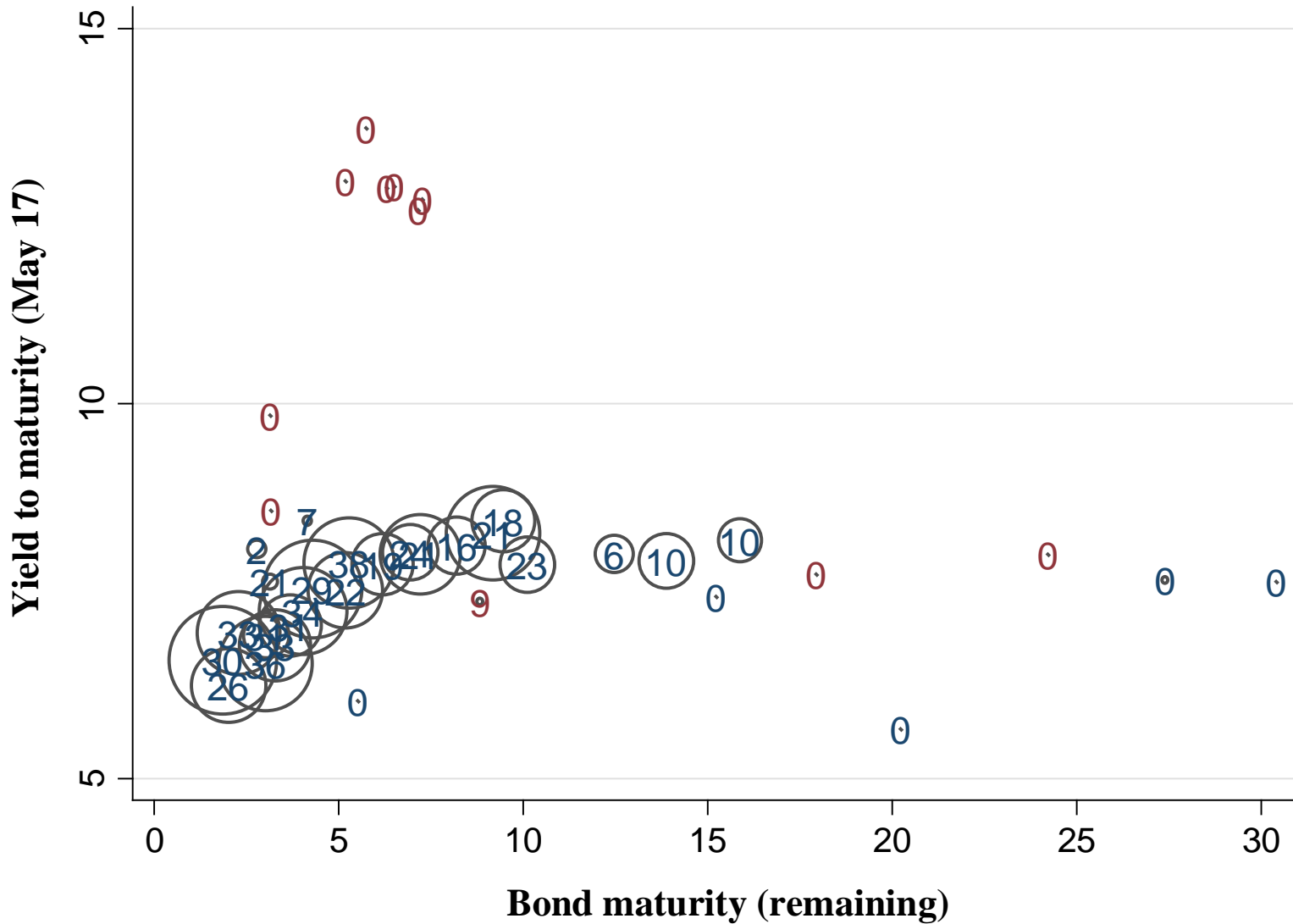
Time Series of Yields: Targets vs Non-Targets



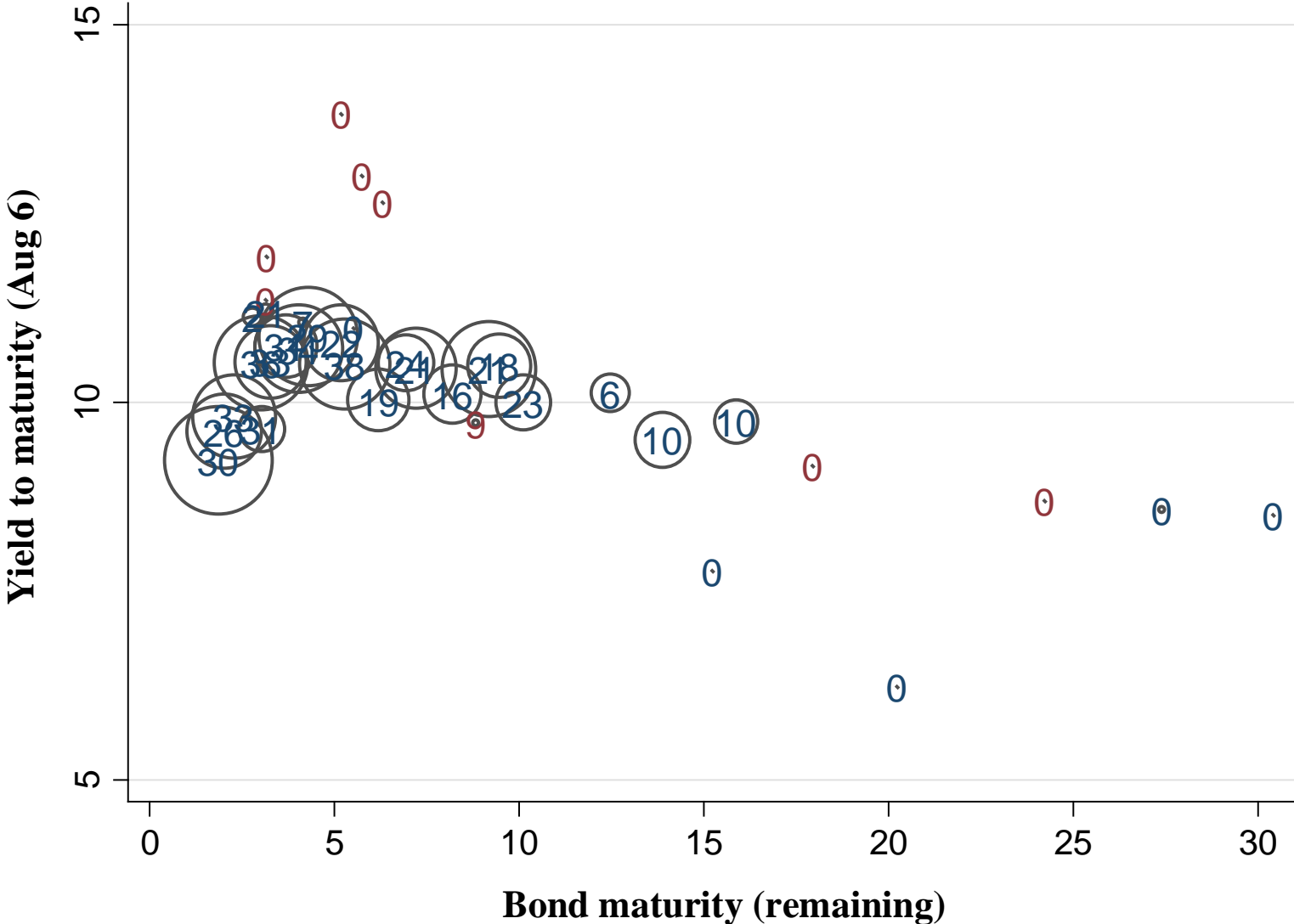
Yield Curve – May 7 (Pre SMP)



Yield Curve – May 17 (1 week later)

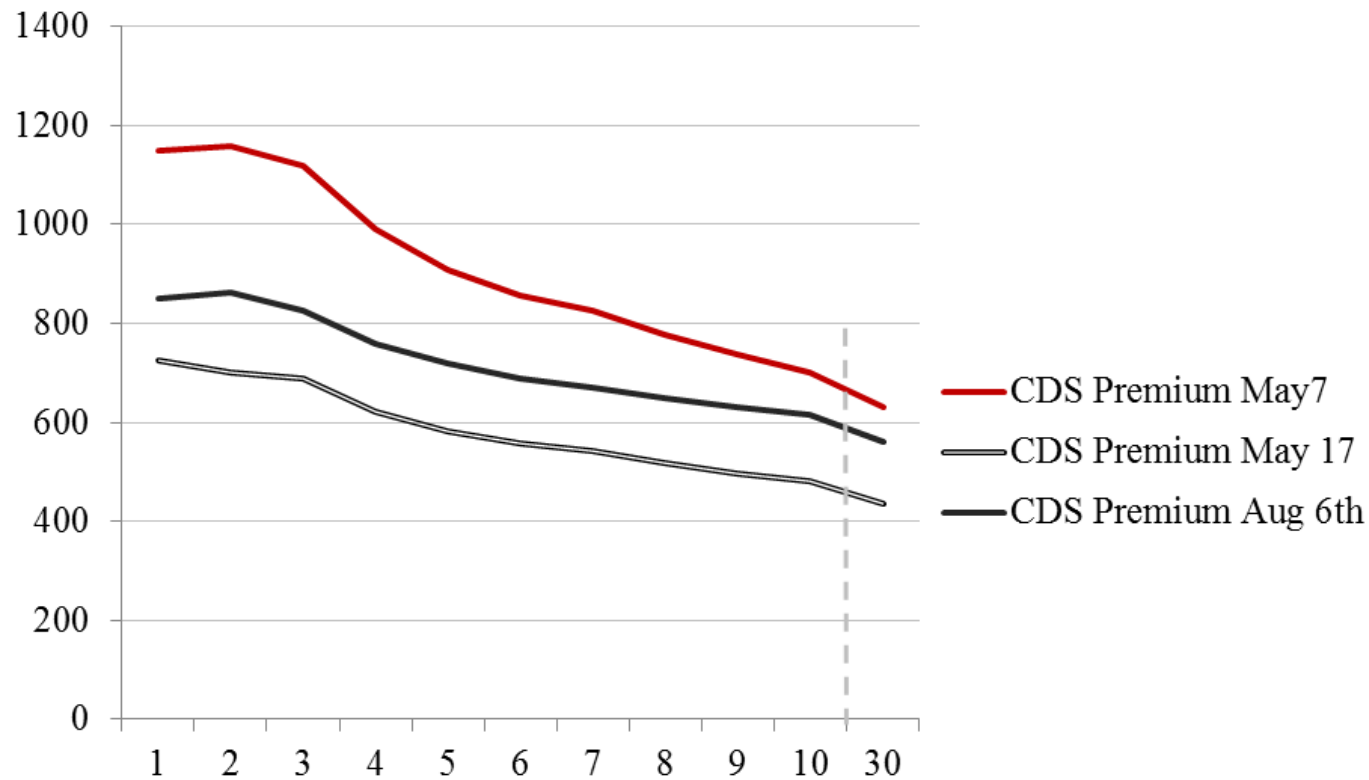


Yield Curve – Aug 6th (3 months later)



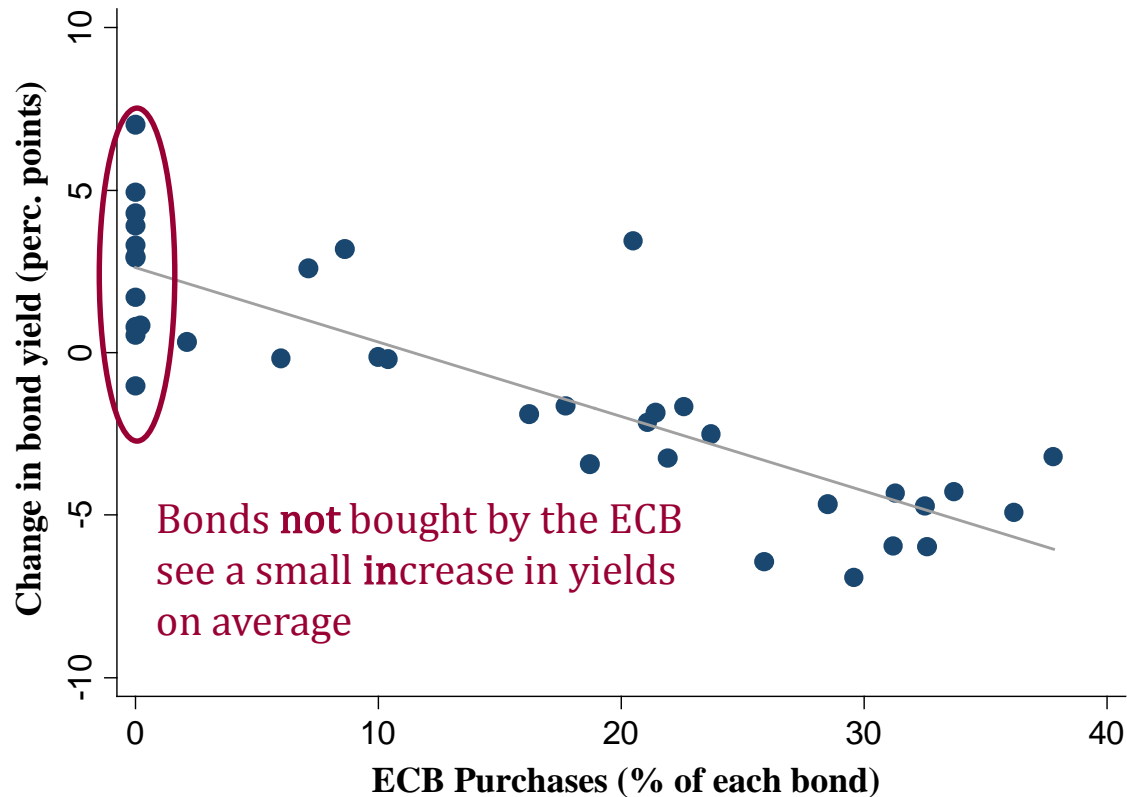
“Twist” in bond yield curve cannot be explained by program/default risk effect

Greek CDS Curve (risk premia in basis points, x-axis shows maturity in years)



Source: JP Morgan

Cross-Section: Yield Change May 7 to July 5



Why do we need to still run a regression?

- Helps identify size of „purchase effect“ (constant, controls)
- Deal with endogeneity through selection of purchased bonds

Identification: basic strategy

Basic idea: run a **cross-sectional** regression of the type:

$$\Delta y_i = \alpha + \gamma q_i + \Phi(\tau_i) + \varepsilon_i , \text{ where}$$

Δy_i is change in yield of bond i over intervention period (8 weeks)

q_i is purchase amount of bond i as a share of outstanding amount

$\Phi(\tau_i)$ is nonlinear function of maturity

- Common effects of announcement absorbed by constant α
- Coefficient γ should identify purchase effects.

However, need to deal with several complications that might create a correlation between ε_i and q_i

Identification: dealing with the complications

1. News during intervention period might be correlated with q_i
 - E.g. SMP/EFSF announcement could have benefited short bonds more
2. Selection bias: ECB targeted higher-yield bonds. Maybe yields of bonds targeted would have declined anyway?
3. Changing expectations on future interest rates, inflation, growth
 - Though far less likely than for QE (interventions sterilised – not mon. policy).
4. Measurement error (stock is imperfect proxy for flow)

Approach:

- i. Additional controls: pre-SMP yields; maturity-specific CDS, Euro-area interest swap rates ...
- ii. 2-stage-least-squares (instruments: size, benchmark, coupon)
- iii. Diff-in-Diff-type regressions using dates after May 9, 2010 as “post-treatment” period (allows bond fixed effects)
- iv. Robustness with opening prices on first day (May 10th, 09:00), spreads.

Short-term Effects – Cross-Section (Yield Change)

Dependent Variable: **Yield change after May 7 ... (in perc. points)**

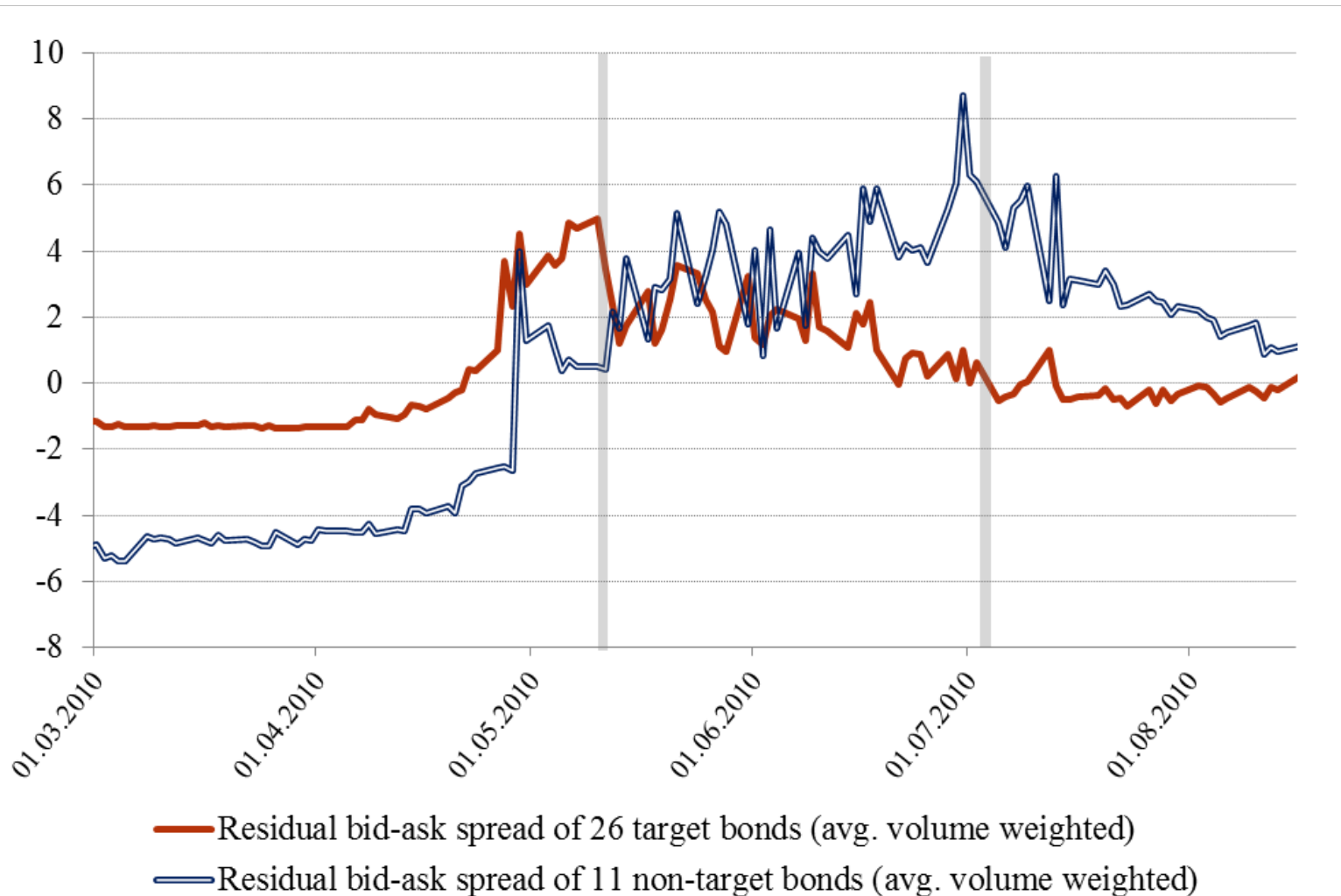
	8 week (May 7 vs July 5)			1 day	1 week	4 week	End of 2010
	OLS	OLS	2SLS	OLS	OLS		
	(1)	(2)	(3)	(4)	(5)		
ECB Purchases (share of bond, in %)	-0.20*** (0.03)	-0.11*** (0.03)	-0.12*** (0.04)	-0.09*** (0.02)	-0.11** (0.05)		
Remaining Maturity (in years)	-0.15*** (0.05)	-0.17*** (0.05)	-0.18*** (0.04)	-0.05 (0.03)	-0.15** (0.07)		
Greek Law Bond (Dummy)	-1.59* (0.91)	-1.29 (0.79)	-1.13* (0.68)	-0.61 (0.58)	-2.05** (0.94)		
Change in CDS Premia (in %, by maturity)	-2.30*** (0.86)	-0.38 (0.59)	-0.42 (0.49)	0.00 (0.48)	-0.91* (0.48)		
Yield pre-SMP (increase from April 12 to May 7)		-0.77*** (0.15)	-0.74*** (0.11)	-0.76*** (0.14)	-0.71*** (0.24)		
Constant	5.58*** (1.09)	7.49*** (1.10)	7.48*** (0.86)	2.06 (1.41)	7.76*** (1.84)		
Observations	37	37	37	40	40		
R ² (adjusted)	0.758	0.924	0.923	0.948	0.912		

Large effects:

- **10% increase in ECB holdings: yield drops 110 bps**
- **€1 bn extra: yield drops 173 bps**
- **If total purchases of €41 bn in May-July are equally spread out: Total yield impact of 193 basis points (1.108 *166)**

- Instruments in 2SLS: coupon size, benchmark bond

Time Series of Liquidity (residual bid-ask spread)



Effects on bond liquidity/close substitutes

Cross section (changes May 7 to July 5)

	With close substitutes	Effects on bid-ask spreads	Effects on CDS-bond basis
Dependent variable:	Change in yields	Change in bid-ask spr.	Change in CDS-bond bs.
	(1)	(2)	(3)
ECB purchases (share of bond, in %)	-0.20*** (0.04)	-0.16* (0.09)	0.09*** (0.03)
Remaining maturity (in years)	0.02 (0.08)	0.04 (0.17)	0.02 (0.04)
Greek law bond (Dummy)	-1.81* (1.04)	1.56 (2.56)	1.78** (0.72)
Change in CDS premia (in %, by maturity)	3.48** (1.74)	0.18 (2.42)	
ECB purchases of close substitutes	0.05 (0.05)		
Constant	5.14*** (1.75)	0.63 (3.80)	-4.46*** (0.79)
Observations	37	34	37
Number of bonds	37	34	37
Adjusted R2	0.745	0.338	0.880

Controlling for “own bond” purchases, purchases of close substitute bonds (defined as bonds of similar maturity plus or minus one year) have no impact on yield

Conclusion

Main result: interventions had large “local” impact of bond buying on bond yields, but not on bond liquidity

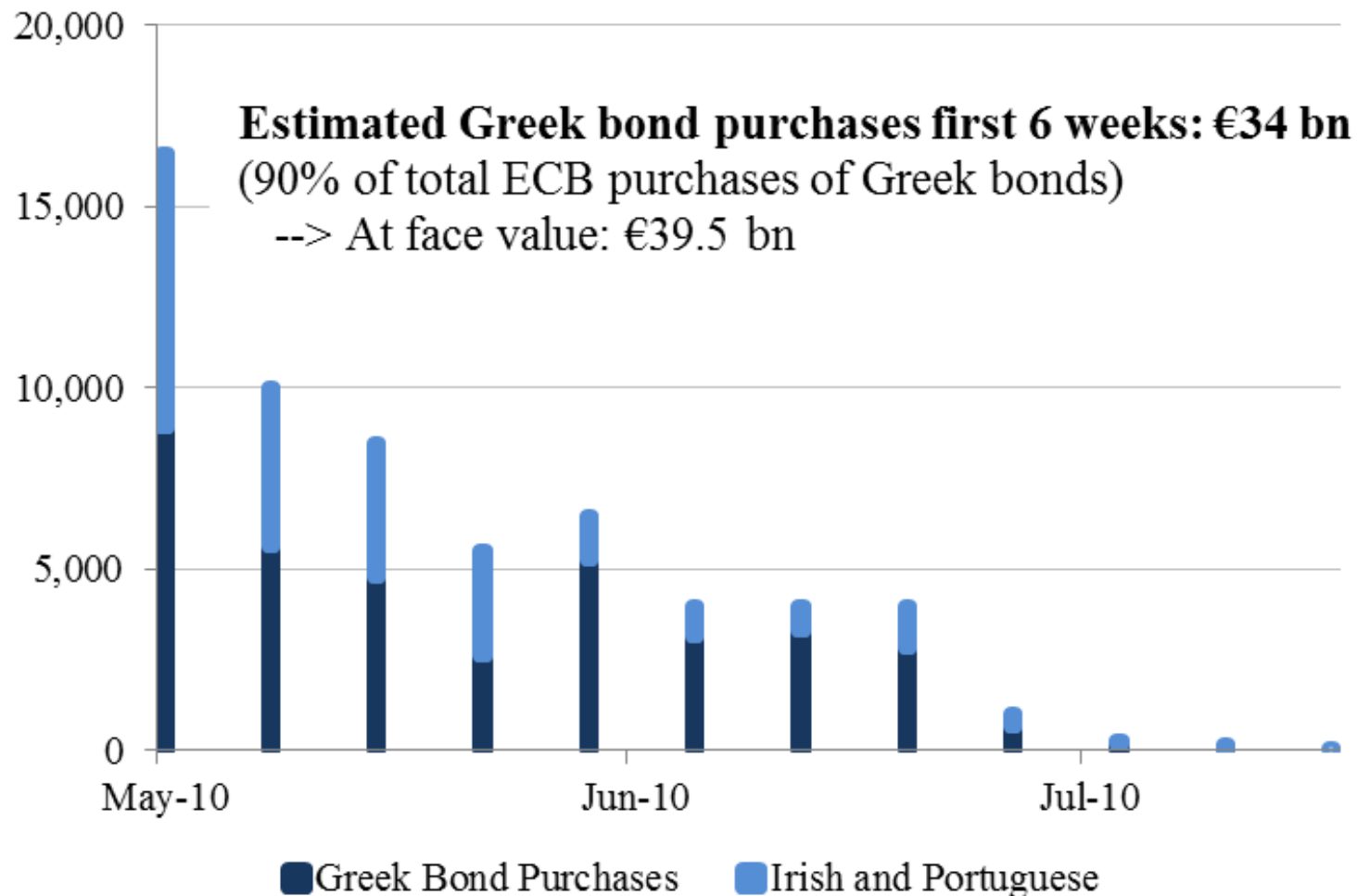
- Consistent with theories of segmented markets
- Lack of effects even in close substitute bonds may help rationalise why it is hard to find results using bond indices.

Policy lessons:

- Useful complement to conditional lending – if conditionality eventually works (effects of SMP in Greece temporary, as program failed to stabilize economy)
- Most effective at shorter maturities
- In a crisis setting, beware that effects may become highly “local” – strong effects only on bonds that you actually buy.

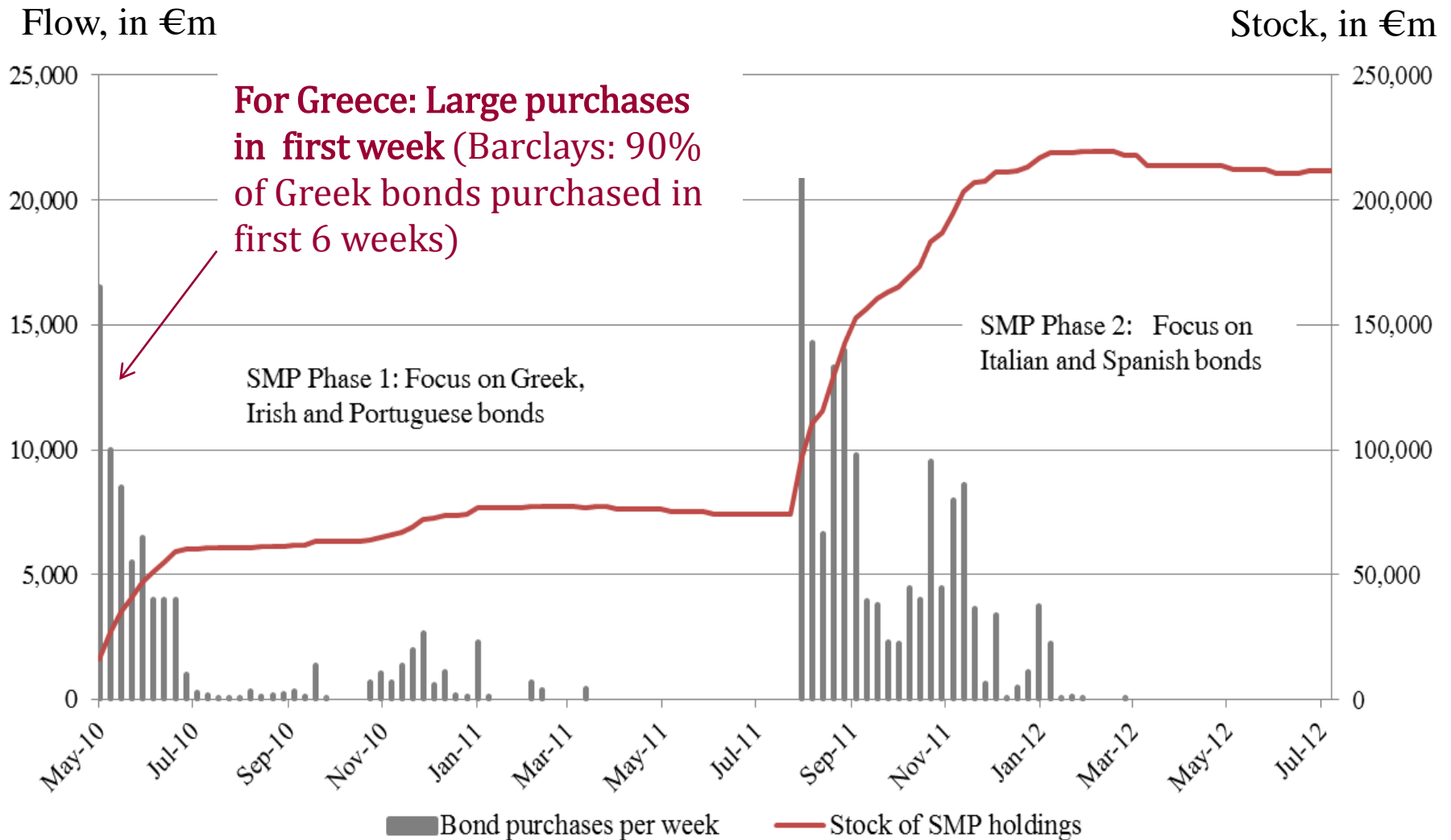
Appendix

SMP Purchases in mid-2010 (Barclays Guesstimates)



Source: Barclays Capital

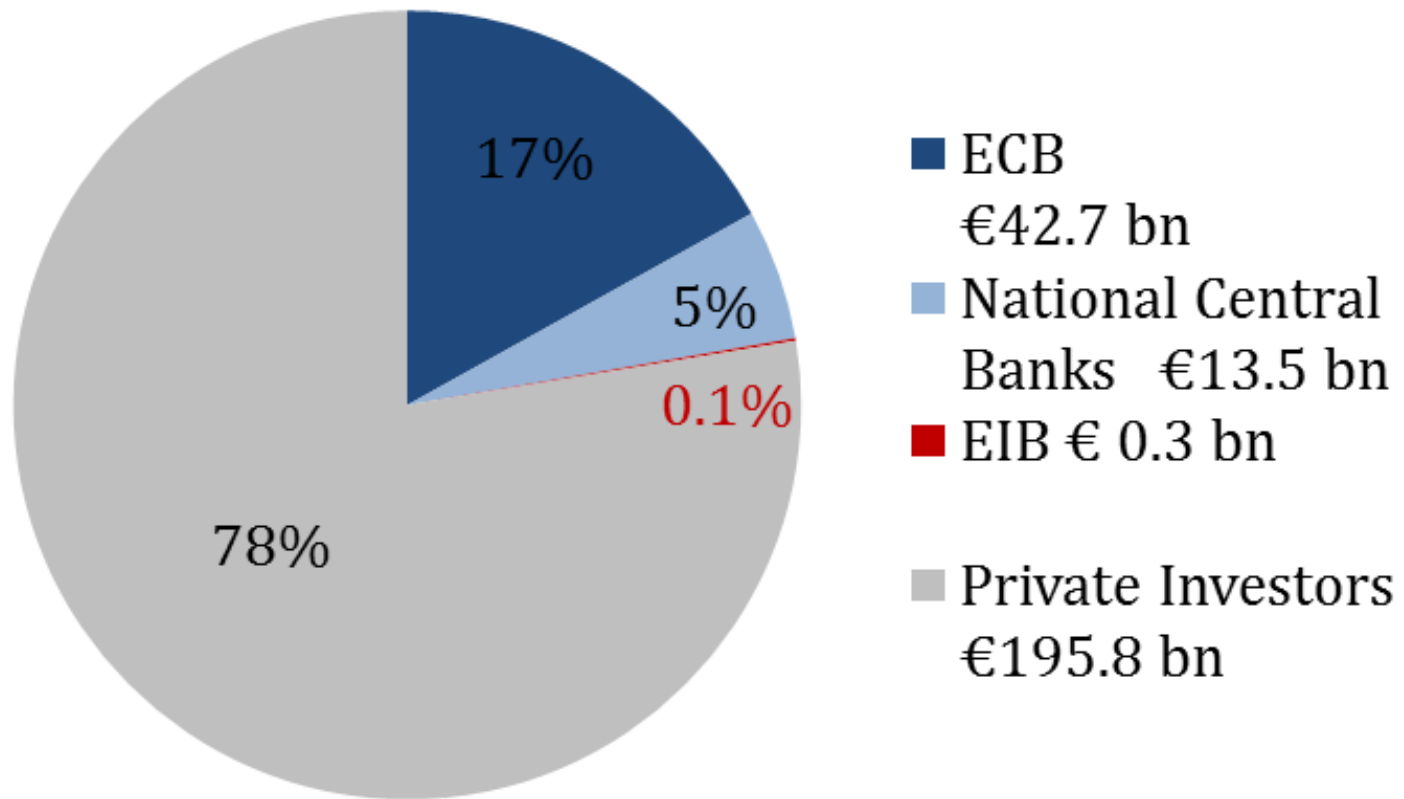
ECB Securities Market Programme



Source: ECB

Holdings of Greek bonds (February 2012)

Total Greek Bonds: €252.5 bn (81 bonds)



Source: Greek Government Gazette, July 2012

Summary statistics of Greek government bonds

	Average of ECB purchases	Average of all outstanding bonds
Remaining maturity /1	5.4 years	9.1 years
Coupon	5.0%	4.5%
Time since issued /2	3.8 years	4.0 years
% Greek-law bonds	99.9%	92.6%
% Benchmark bonds	94.7%	74.5%
% Priced on Bloomberg	100.0%	93.5%
Yield average (pre-SMP) /3	10.0%	9.0%

Sample averages for Greek bonds bought by the ECB and full sample of bonds (all outstanding securities). All figures are Euro-weighted means.

/1 Remaining maturity as of May 10, 2010 (start of SMP)

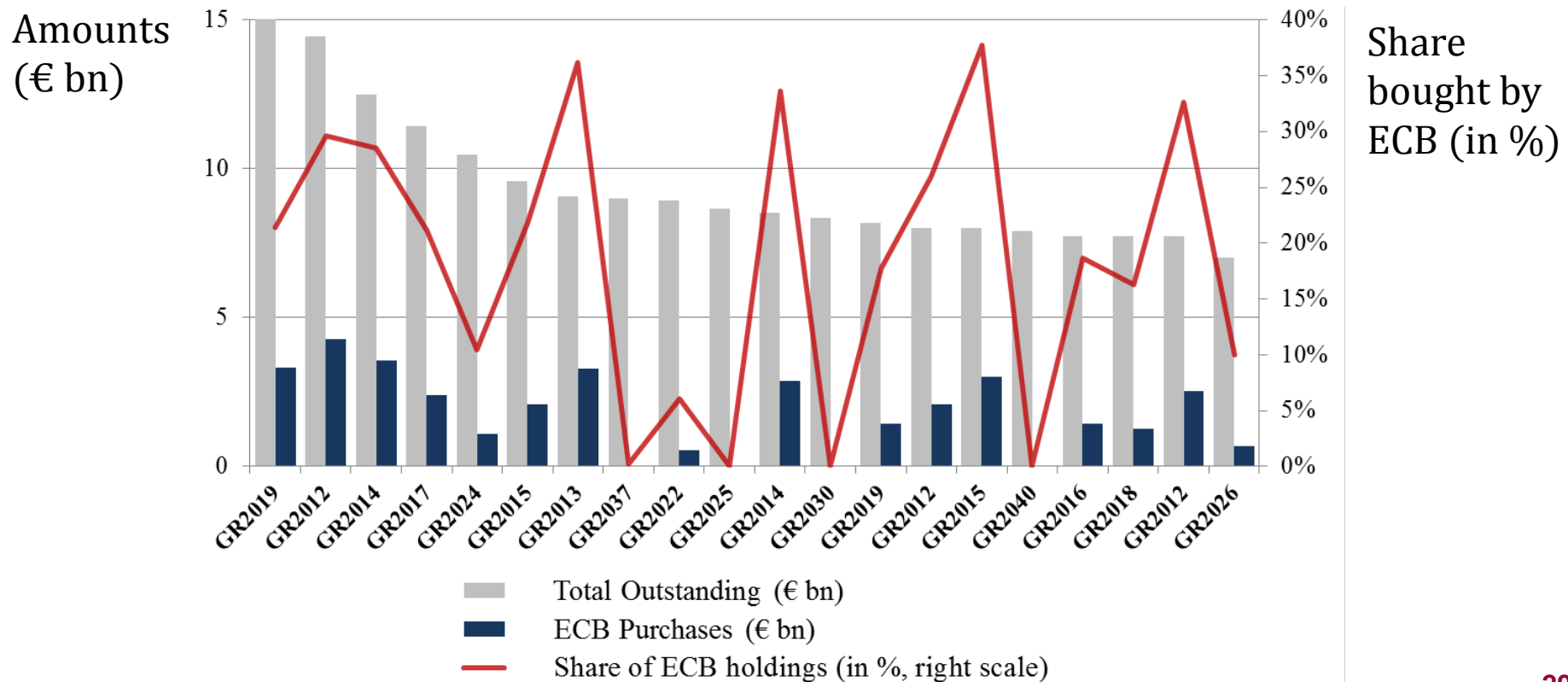
/2 Age of the bond as of May 10, 2010 (start of SMP)

/3 Four week average between April 12 and May 7, for all bonds with yield data

Variation in ECB Purchases across Bonds

- Very large variation across 81 Greek sovereign bonds
- ECB bought up to 38% of some bonds, but left 51 bonds untouched

Holdings of 20 largest bonds



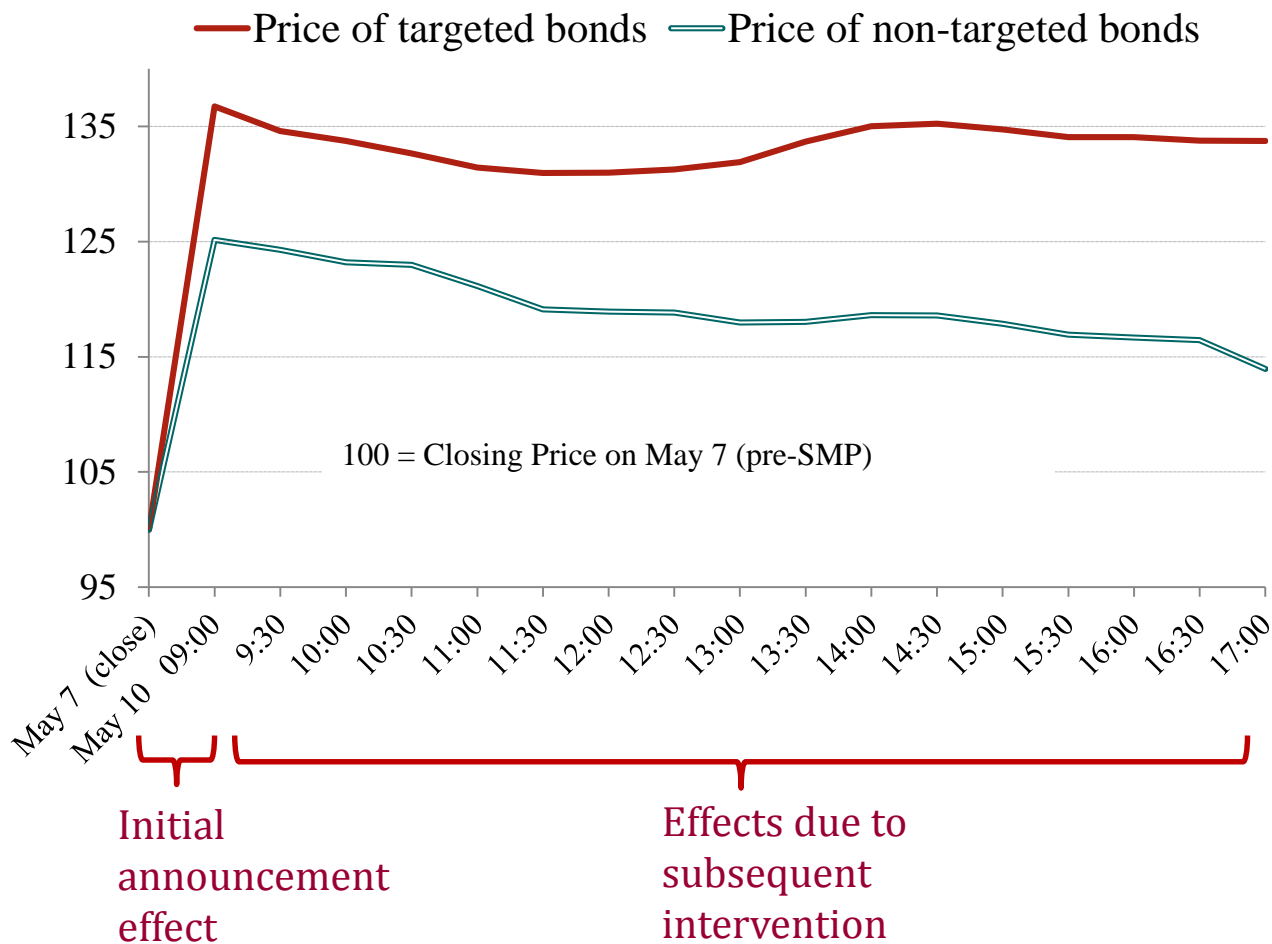
Determinants of ECB holdings

Dependent Var.: Share of ECB holdings (in perc. points)

	Full Sample		Subsample for which yield data is available		
	(1) coef/se	(2) coef/se	(3) coef/se	(4) coef/se	(5) coef/se
Bond size (amount outstanding, €bn)	1.21*** (0.34)		0.59* (0.31)	0.66* (0.36)	0.75 (0.49)
Remaining maturity (years, in May 2010)	-0.46** (0.20)			-0.40** (0.19)	-1.00*** (0.16)
Coupon size (in %)	1.41** (0.61)			1.01 (1.23)	3.25*** (0.96)
Greek law bond (Dummy)	-0.60 (1.48)				
Benchmark bond (Dummy)	7.82** (3.91)			3.68 (3.00)	6.65** (3.11)
Yield pre-SMP, in % (4-week average)		8.70*** (1.00)	7.84*** (1.13)	5.44*** (1.94)	
Bid-ask pre-SMP, in % (4-week average)					1.51 (1.26)
Constant	-0.64 (2.53)	-58.29*** (8.29)	-54.50*** (8.05)	-38.59*** (12.35)	-5.55 (5.30)
Observations	81	40	40	40	40
R ² (adjusted)	0.629	0.693	0.719	0.723	0.671

- Two variables can explain over 70% of variation in ECB purchases
- ECB seems to have applied simple “Rule of Thumb”

Evolution of Greek yields on first day of SMP (May 10, 2010)



Regressions excluding announcement effect

Dependent variable: **Yield change**
after May 10, 9:00 am (opening prices),....
 (post-announcement but pre-purchase yields)

	1 week (May 10 vs May 17)	4 week (May 10 vs June 7)	8 week (May 10 vs July 5)	8 week (May 10 vs July 5)
	OLS	OLS	OLS	2SLS
	(5)	(6)	(7)	(8)
ECB purchases (share of bond, in %)	-0.06*** (0.02)	-0.05** (0.02)	-0.05** (0.02)	-0.09** (0.04)
Remaining maturity (in years)	-0.04 (0.03)	-0.03 (0.03)	-0.07* (0.04)	
Greek law bond (Dummy)	0.59*** (0.19)	0.53** (0.23)	0.65*** (0.25)	
Constant	1.38** (0.60)	1.54*** (0.58)	3.72*** (0.66)	
Observations	25	25	25	25
R ² (adjusted)	0.428	0.421	0.154	

Short-term Effects – Diff-in-Diff (Yield Levels)

Dependent Variable: Daily yields in levels, for all 40 bonds

Panel with bond and day fixed effects, errors clustered on bond

	ECB intervention: target dummy				ECB intervention: % of holdings	
	8-week		1-week	4-week	8-week	
	(1)	(2)	(3)	(4)	(5)	(6)
Post-SMP indicator	1.80*** (0.63)	2.97*** (0.74)		-1.51 (0.94)	2.20*** (0.68)	2.20*** (0.68)
ECB intervention x post-SMP indicator /1	-2.73*** (0.40)	-2.03*** (0.50)	-2.45*** (0.59)	-2.72*** (0.52)	-0.11*** (0.01)	-0.11*** (0.02)
CDS premia (in %, by maturity)	1.49*** (0.14)	1.71*** (0.16)	1.09*** (0.34)	2.04*** (0.18)	1.75*** (0.16)	1.74*** (0.16)
Yield increase pre-SMP x post-SMP indicator		-0.21*** (0.07)	-0.41*** (0.11)	-0.23*** (0.07)		0.00 (0.07)
Constant	-0.89 (1.40)	-3.13* (1.62)	3.58 (3.70)	-1.51** (0.71)	-3.77** (1.53)	-3.77** (1.55)
Bond fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,009	3,009	407	1,531	3,009	3,009
Number of bonds	40	40	40	40	40	40
Adjusted R ²	0.847	0.861	0.875	0.802	0.875	0.875

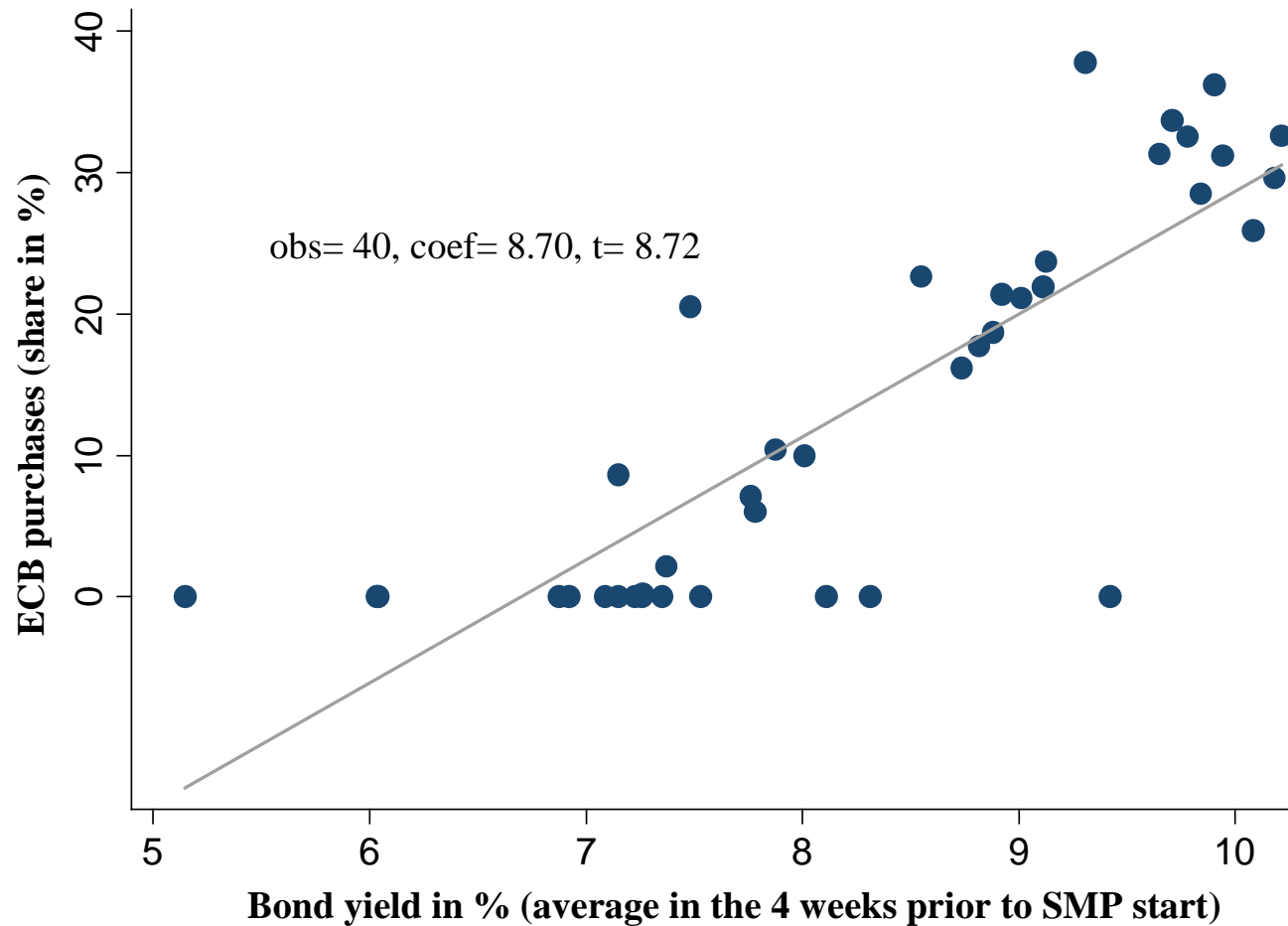
- Size of effects: (i) 10% increase: -110 bps; (ii) €1 bn increase: -187 bps (-200 total)
- Robustness: Holds in 2-period Diff-in-Diff (average yields pre- and post-treatment)

Effects on Bond Liquidity / Market Quality

Cross section (changes May 7 to July 5)

	With close substitutes	Effects on bid-ask spreads	Effects on CDS-bond basis
Dependent variable:	Change in yields	Change in bid-ask spr.	Change in CDS-bond bs.
	(1)	(2)	(3)
ECB purchases	-0.20***	-0.16*	0.09***
(share of bond, in %)	(0.04)	(0.09)	(0.03)
Remaining maturity	0.02	0.04	0.02
(in years)	(0.08)	(0.17)	(0.04)
Greek law bond	-1.81*	1.56	1.78**
(Dummy)	(1.04)	(2.56)	(0.72)
Change in CDS premia	3.48**	0.18	
(in %, by maturity)	(1.74)	(2.42)	
ECB purchases of close substitutes	0.05		
	(0.05)		
Constant	5.14***	0.63	-4.46***
	(1.75)	(3.80)	(0.79)
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ECB Purchases and bond yields pre-SMP



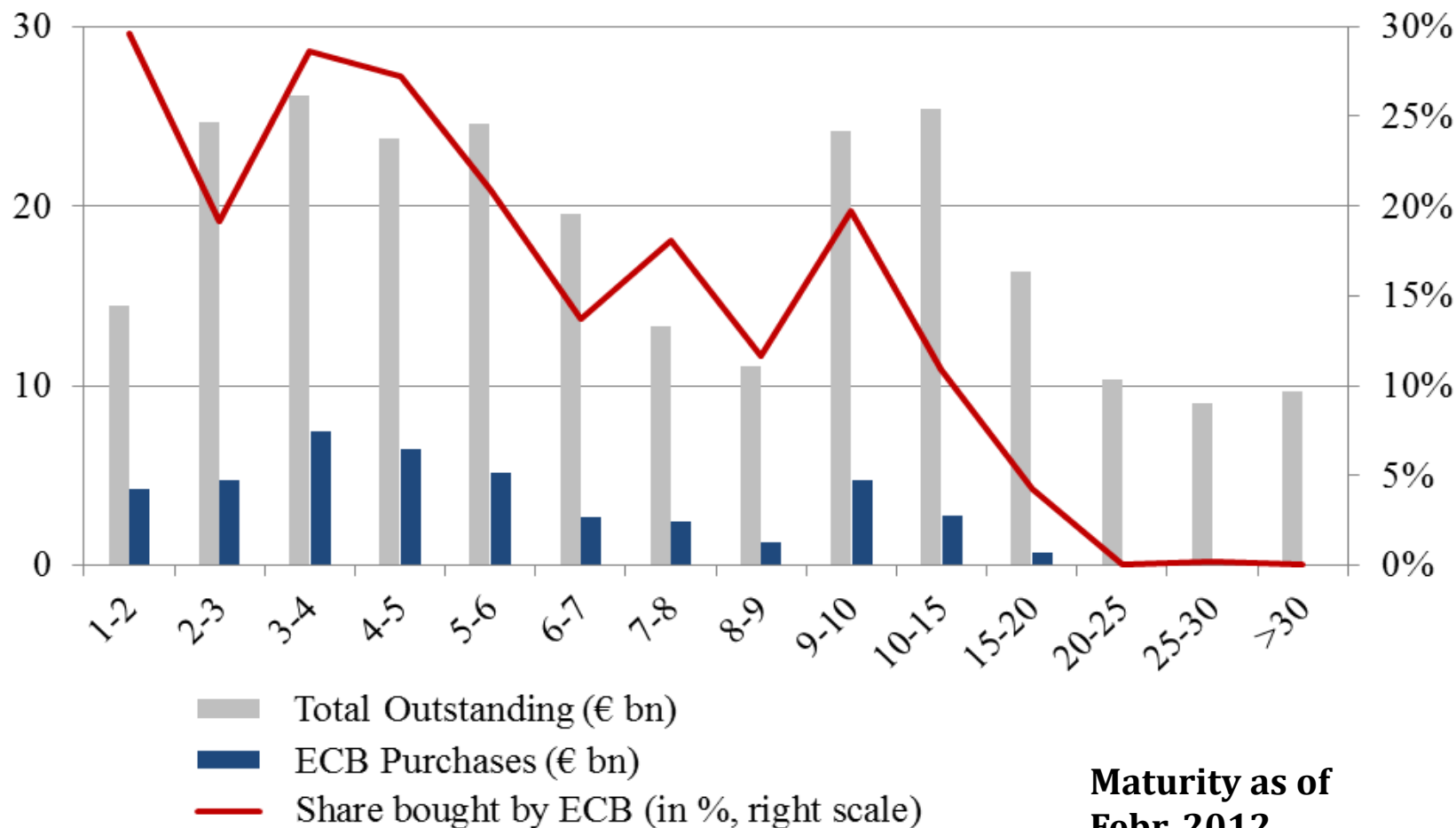
ECB purchase: in % of face value of each bond

Bond yields in the 4 weeks prior to the start of the SMP (between April 12 and May 7)

Maturity Profile of Purchases

Amounts (€ bn)
at face value

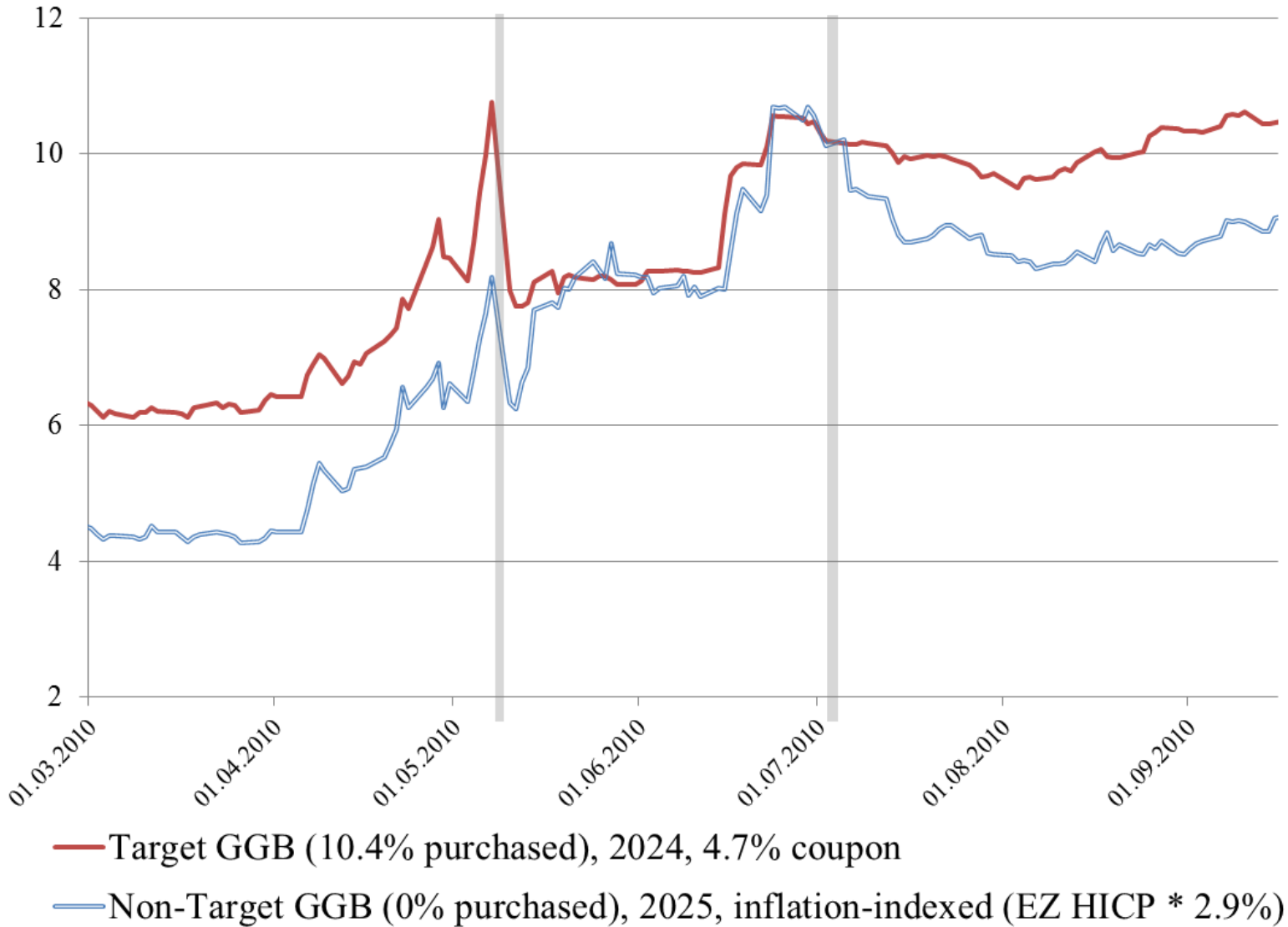
Share bought by
ECB (in %)



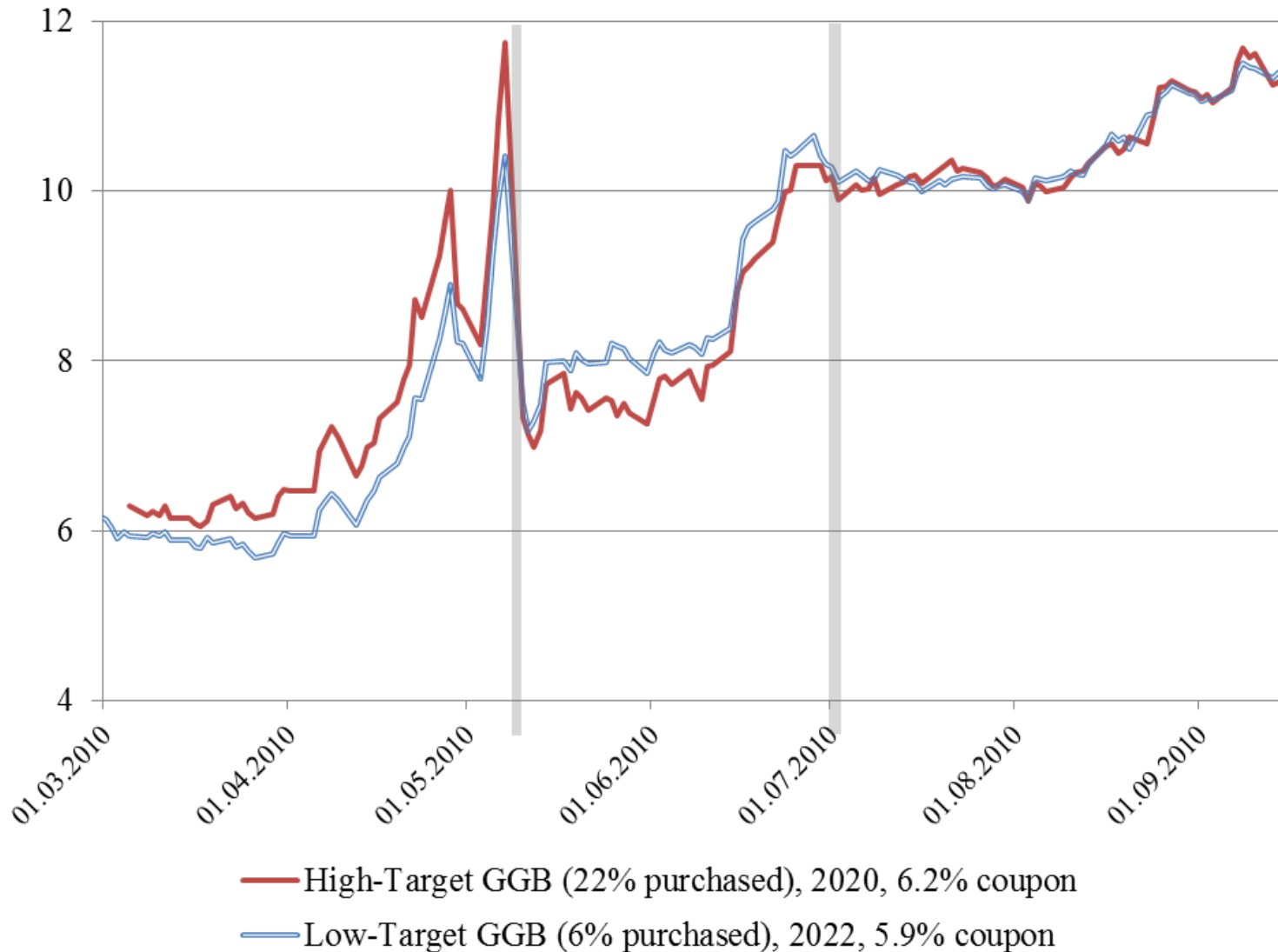
Time Series of Residual Yields



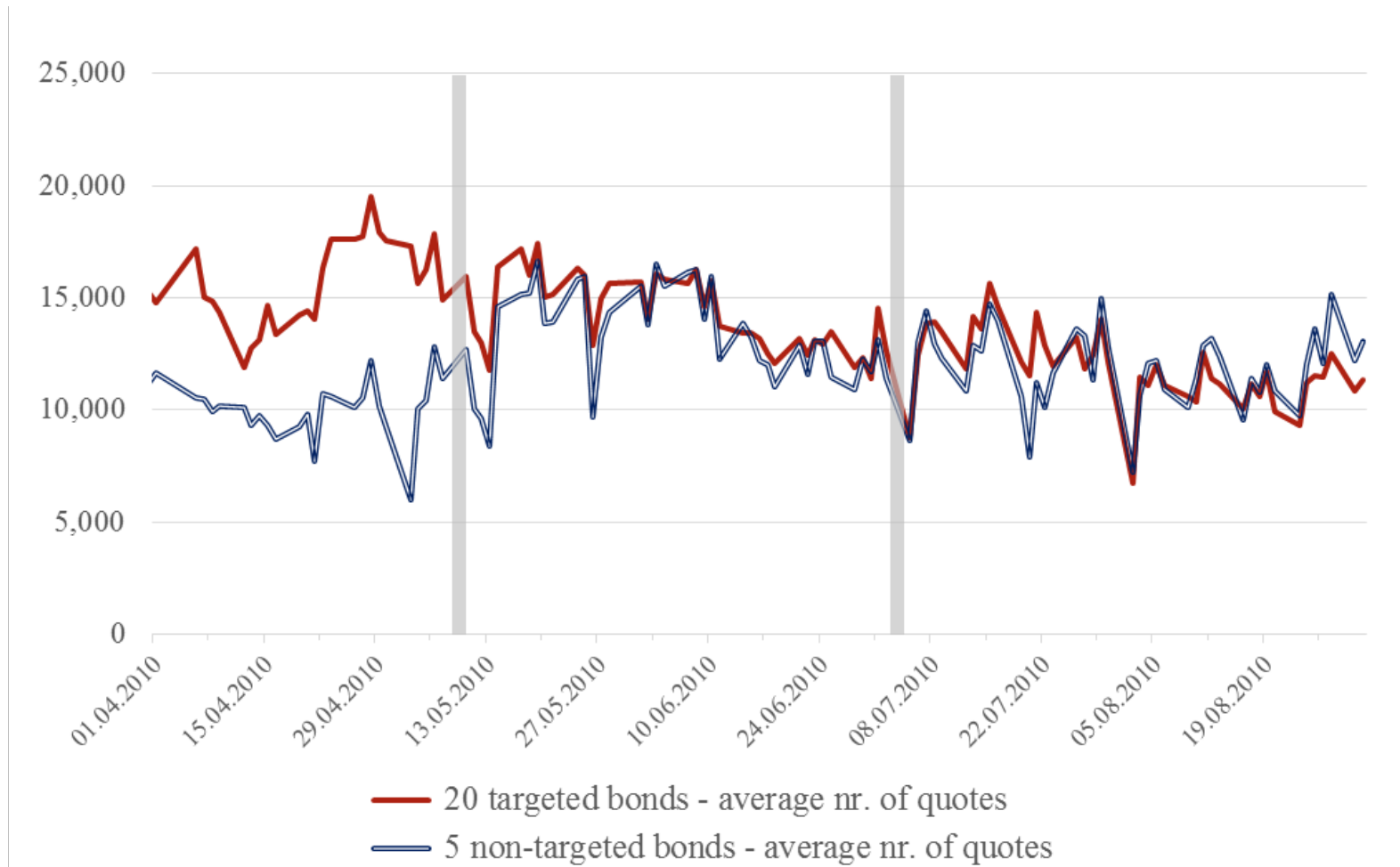
Time Series of Yields: “Twin Bonds”



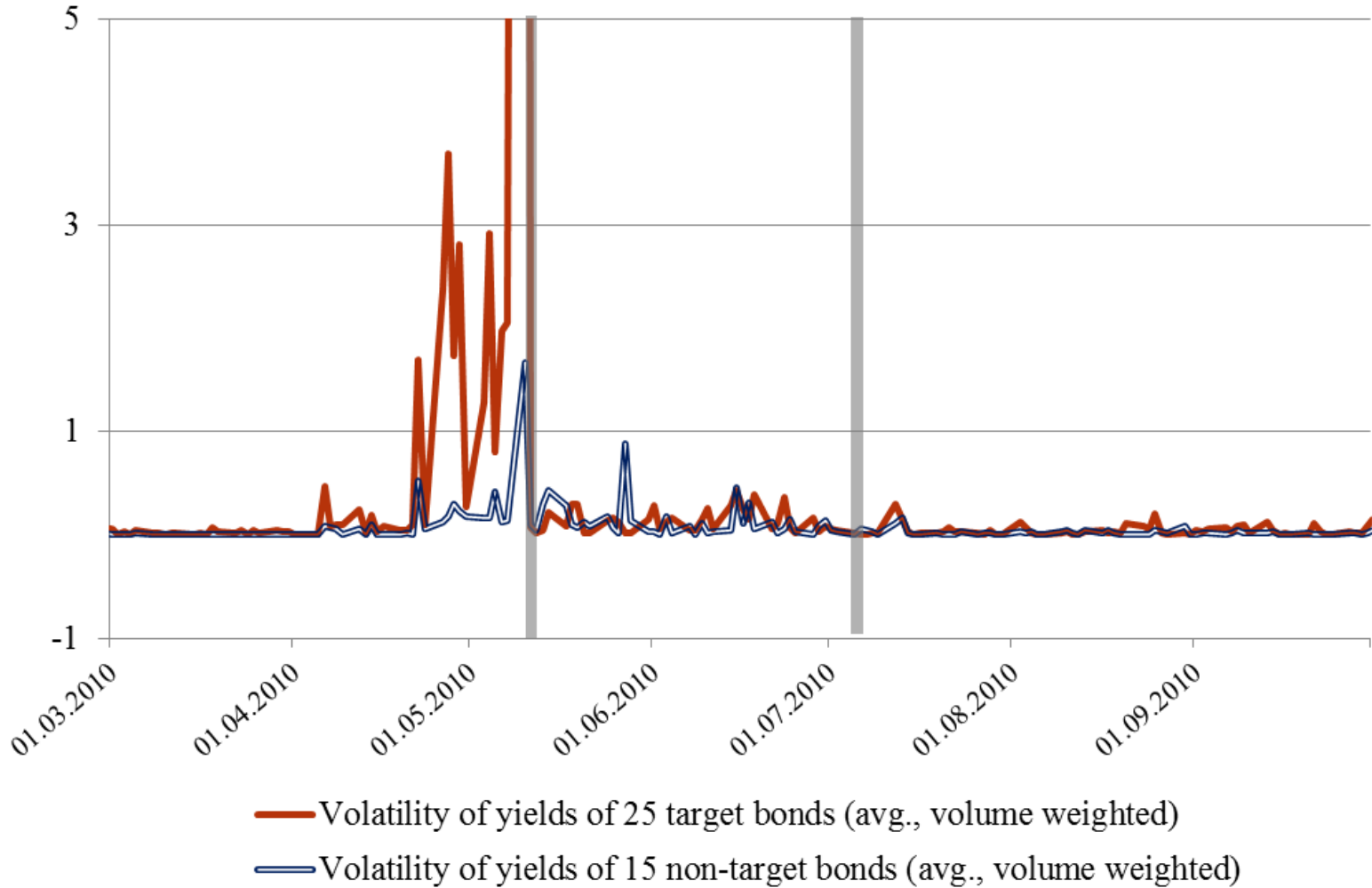
Twin Bonds (Part 2): 2020 vs 2022



Time Series of Bond Quote Frequency (liquidity)



Time Series of Bond Volatility



Time Series of CDS-Bond basis

