The incentive channel of monetary policy: quasi-experimental evidence from liquidity operations

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Outline

- Motivation, literature overview and preview of the results
- Targeted liquidity operations
  - i. Institutional set-up
  - ii. Identification
- Data and methodology
  - i. Stylized facts
  - ii. The empirical strategy
  - iii. Data used
- Results
  - i. The impact of the program on lending
  - ii. The impact of the program on other variable
  - iii. The incentive channel
  - iv. Heterogeneity
- Conclusions

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Motivation

Targeted liquidity operation are central bank term-loans to banks with attached incentive schemes that aim at ensuring that these funds are "used" by credit intermediaries to finance the real economy thereby contributing to the well-functioning of the monetary transmission mechanism.

Targeted assets: loans to firms and households, excluding housing loans

Adopted by many large central banks (ECB, BoE, BoJ, PBoC)

Motivation

Empirical questions:

i) Were these **operations effective** in stimulating bank lending?

ii) What are the channels through which they operate? Is the **incentive structure** attached to the programme relevant? Or, is it just about the **liquidity** injected?

iii) Are there **spillovers** on non-targeted assets, such as bonds or non-targeted lending segments?

iv) Was the impact of the programme **heterogeneous** across banks?

Motivation

Targeting aspect is important also from a financial stability perspective:

- ✓ It may (over) **amplify the risk-taking channel** as the intended objective of the operation is to induce banks to expand lending to the real sector, namely to riskier segments such as SMEs and consumption credit

- ✓ ...while discouraging banks from (over-)investing in domestic government bonds and **mitigate the sovereign bank nexus**

Literature review and contribution

- Large literature on unconventional monetary policy (Dell'Ariccia, 2018)

- Papers on the bank lending channel of liquidity injections (based on micro data): Garcia-Posada and Marchetti (2014); Albertazzi, Bofondi and Pellegrini (2014); Andrade, Cahn, Fraisse, and Mesonnier (2017); Carpinelli and Crosignani (2018); Jasova, Mendicino and Supera (2018); Andreeva, Georgarakos (2018); Benetton and Fantino (2018)

Literature review and contribution

Defining features of **this paper**

1. we study of the impact on banks of **targeted**-liquidity operations on lending activity

2. we analyze the role of the **incentive scheme** embedded in such operations

3. we exploit the **targeting feature also for identification** purposes (regression kink design)

4. we explore a large number of **outcome variables**, assessing
   - intensity of **risk-taking**
   - implications for bank **funding** and **profitability**

5. we assess **spill-overs** on non targeted assets (bonds, housing loans)

6. we adopt a **multi-country** perspective (euro area banks)

Preview of the results

- Lending
  - ✓ Increase in loan supply and decrease in lending rate
  - ✓ Rebalancing toward riskier loans, increase in PDs and risk tolerance
- Incentive channel
  - ✓ Impact of the programme on eligible but not on non-eligible loans
  - ✓ Incentive channel quantitatively relevant
  - ✓ Asset reallocation from sovereign bonds to loans
- Liabilities
  - ✓ Funding cost relief driven by liability substitution and decreased cost of bond issuance
- Profitability
  - ✓ Overall the measure led to an increase in profitability

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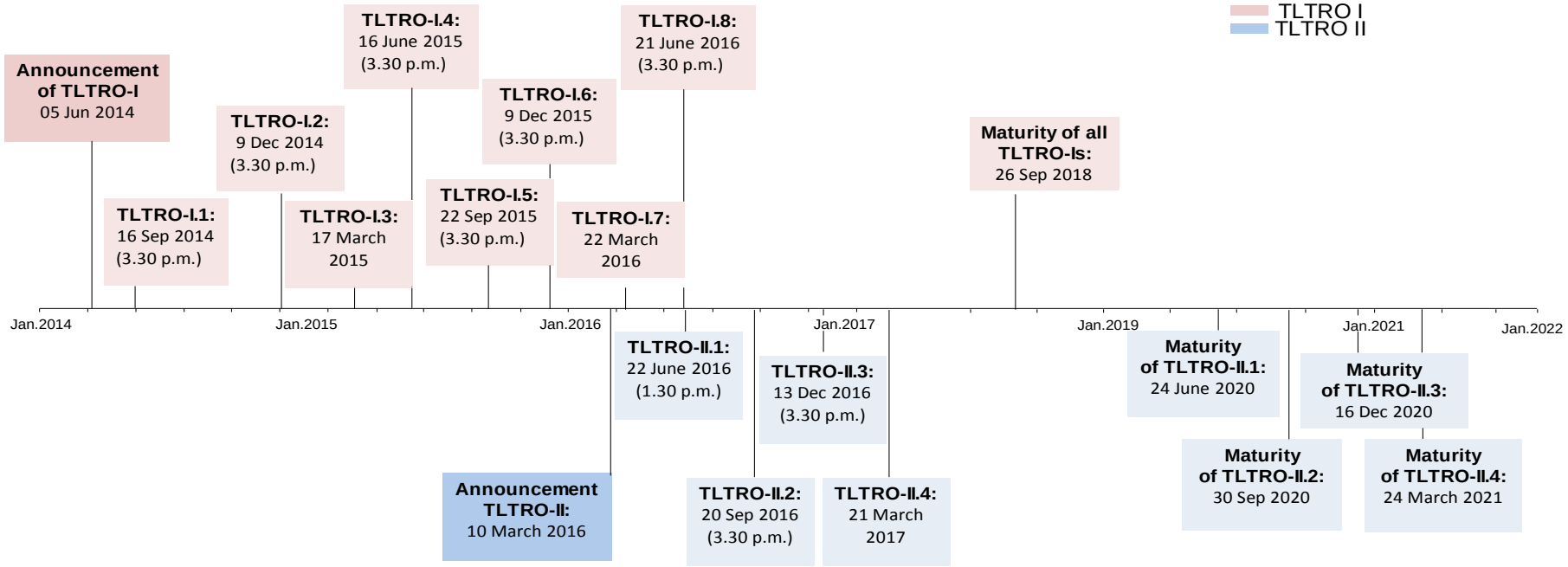
Institutional set-up

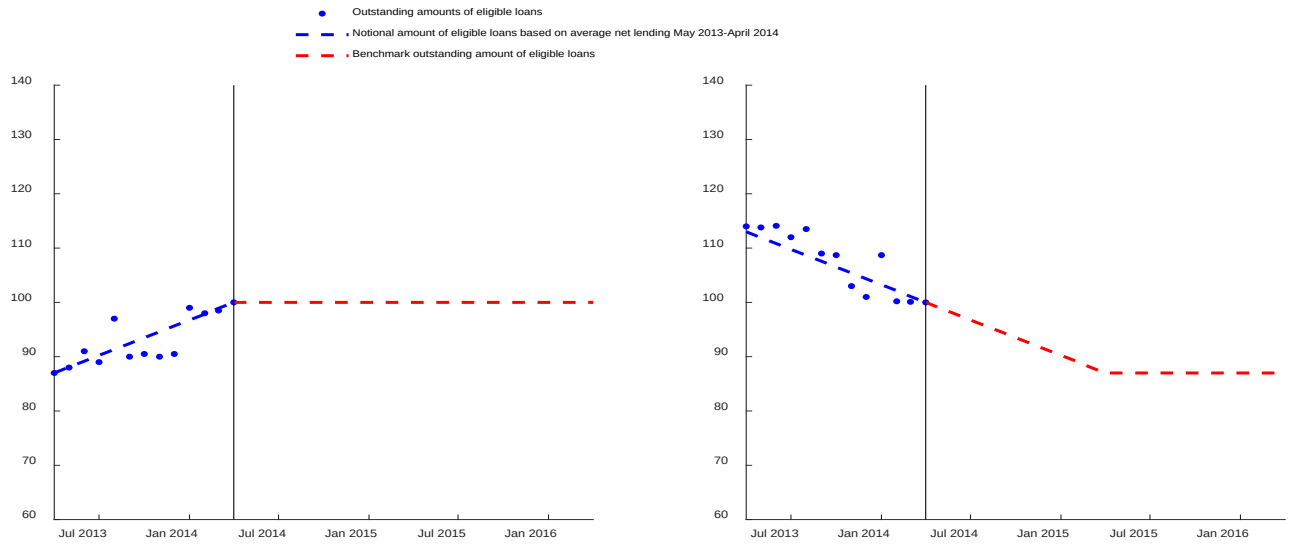


- TLTRO I announced in Jun 14: 8 quarterly operations, starting in Sep 14
- Maturity: Sep 2018
- Rate: official policy rate "MRO" (+10 bps for op. 1 and 2)
- Amount: chosen by banks subject to
  - provision of (Eurosystem eligible) collateral and
  - "borrowing allowances" (to be illustrated)
- Followed by a second series of 4 quarterly operations (TLTRO-II) with slightly different characteristics (we will ignore TLTRO-II in this presentation)

Benchmarks and borrowing allowances

(a) Benchmark for **positive** ex ante net lending banks

(b) Benchmark for **negative** ex ante net lending banks



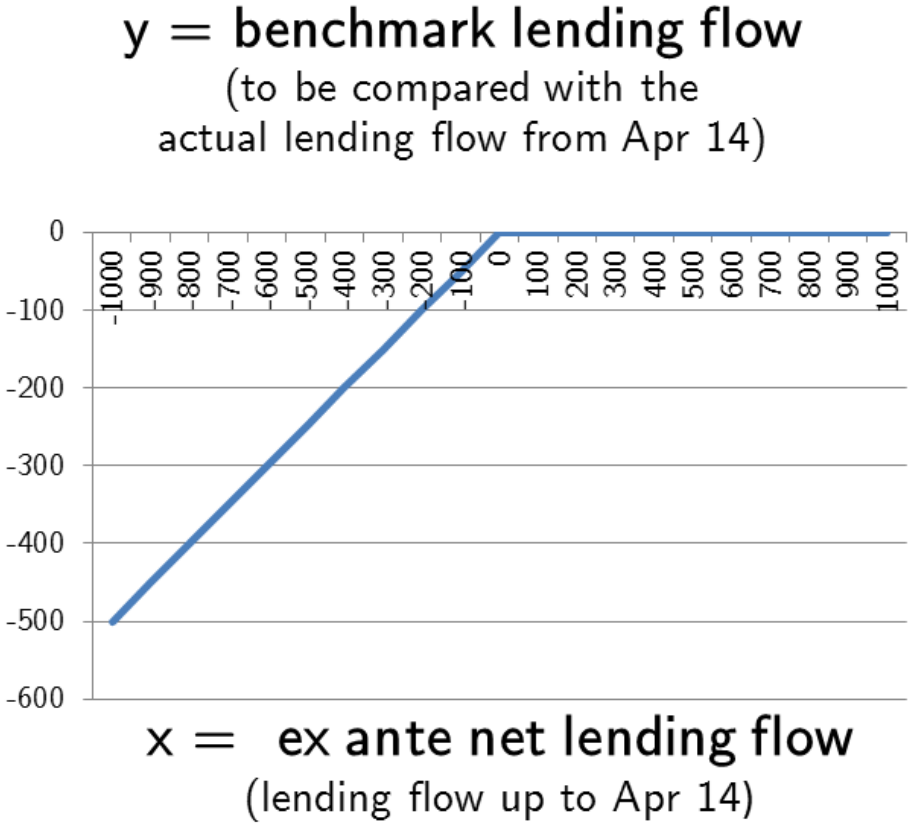
Each bank is assigned a **benchmark loan stock,** depending on its ex ante lending (yearly loan growth in Apr 14, i.e. prior to announcement)

- Chart (a): if ex ante lending is positive => constant benchmark
- Chart (b): otherwise => benchmark decreasing (it declines at the same pace for two quarters and then stable)

Borrowing allowance: Borrowing< 3* lending in excess of benchmark

Eligible loans: loans to non-financial private sector, excluding housing loans

Benchmarks and kinks



The relationship between **benchmark lending** (flow) and **ex ante lending** (flow) displays a change in slope at 0 (kink)

Differences in benchmarks reflect **differences in accessibility of TLTRO funds** (the easier the benchmark the less stringent the borrowing allowance)

The role of the kink in the identification strategy

Kink regression design: we exploit the kink in the definition of the benchmark to assess the impact of TLTRO funds on banks i.e. **we test if the relationship between the outcome variable considered and ex ante lending presents a kink around 0**

- running variable (instrument) = ex ante lending
- treatment = TLTRO borrowing
- outcome variable = ex post lending, rates...

a. Focus is on the change in slope at 0 (the kink) of relationship between outcome variable (e.g. ex post lending) and ex ante lending

b. The slope itself is not informative as it may also reflect differences in confounding factors (namely loan demand, which is likely to be persistent)

The "liquidity" and the "incentive" channels

Banks **may respond by lending more** so to relax their borrowing allowance constraint

The **overall impact** captured by the kink reflects both

- "**liquidity channel**": differences in TLTRO fund accessibility
- "**incentive channel**": the intended response of banks that try to increase their borrowing allowance by extending more eligible loans

We isolate the incentive channel with two approaches

a. by distinguishing between **eligible vs non-eligible lending**. The incentive channels only applies to eligible lending

b. by **controlling for the amount of take up** which should switch off the "liquidity channel" (at least under the assumption that the direct impact of liquidity injections on lending supply materializes only after banks access such funds)

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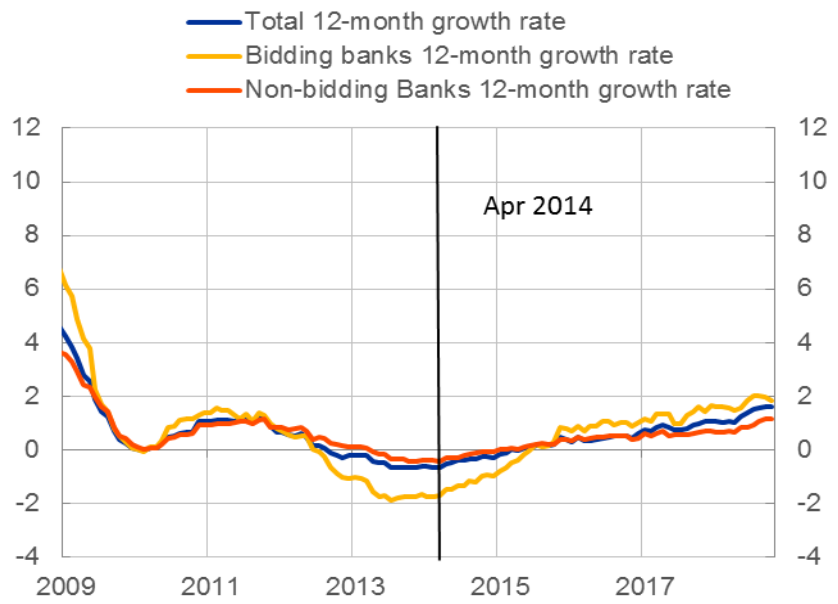
Data

Two unique confidential datasets:

- Official reporting for take-up in liquidity operations (TLTRO template)
  - ✓ Borrowing allowances, take-up and ex ante and ex post lending to the eligible sector
  - ✓ 565 banks
- IRB sample
  - ✓ TLTRO borrowing allowances and take-up
  - ✓ Loan flows to different sectors (iBSI)
  - ✓ Lending and deposit rates (iMIR)
  - ✓ Capital ratios and PDs (supervisory reports)
  - ✓ Risk appetite (individual replies to the Bank Lending Survey)
  - ✓ 65 banks

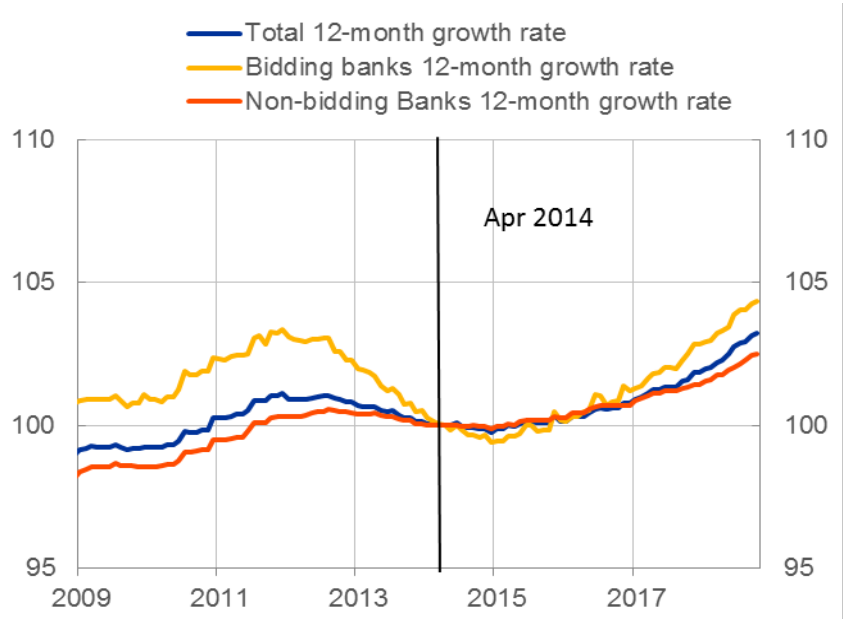
Stylized facts

Lending to the eligible sectors *(12-month growth rates, percentage points, medians)*



Sources: ECB.
Notes: Bidders are banks with positive Takeup in at least 1 of the 8 TLTRO-I operations.

Lending to the eligible sectors *(index of notional stock: Apr. 2014=100, medians)*



Sources: ECB.
Notes: Bidders are banks with positive Takeup in at least 1 of the 8 TLTRO-I operations.

Banks borrowing at TLTRO operations display a stronger improvement of (eligible) lending after such funds became available

Methodology

$$y_{i,t} = \alpha + \gamma Exante\ Lending_i + \beta\left(Exante\ Lending_i \times D_i\right) + \Omega X_{i,t} + \epsilon_{i,t}$$

y = outcome variable (take-up, ex-post lending, lending rates, probability of default, funding costs, bank profitability, bond holdings...)

i = all banks submitting the "TLTRO template" (or all IRB banks)
t= 3,4,5,6,7,8 (6 quarters, corresponding to TLTRO-I op. from 3 to 8)

Exante Lending = ex ante (eligible) lending flow, expressed as a ratio of the stock of (eligible) loans

$X_{i,t}$= vector of controls (including fixed effects)

$$D_i = \begin{cases} 0 \text{ if Ex-ante Lending} \leq 0 \text{ (left of the kink)} \\ 1 \text{ if Ex-ante Lending}>0 \text{ (right of the kink)} \end{cases}$$

Identification of impact of the programme relies on change in the slope of the relationship between the outcome variable and the running variable (ex ante lending), as captured by the coefficient β

Methodology

Focus on kink => controlling for unobserved heterogeneity in demand conditions is not as crucial as with alternative approaches

Nonetheless, the multi-country dimension of our bank panels allows to have country*time f.e. absorbing all possible variation related to country level macroeoconomic conditions

Baseline model extended with additional (triple) interactions terms in order to explore

- ❑ Differences across lending segments (eligible vs non eligible)
- ❑ Differences across banks

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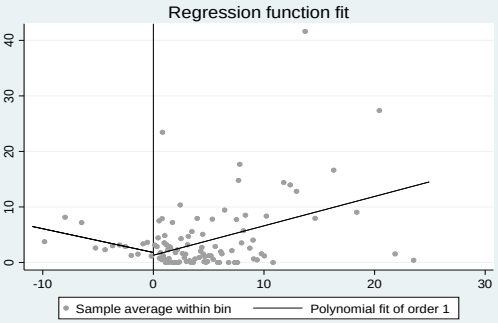
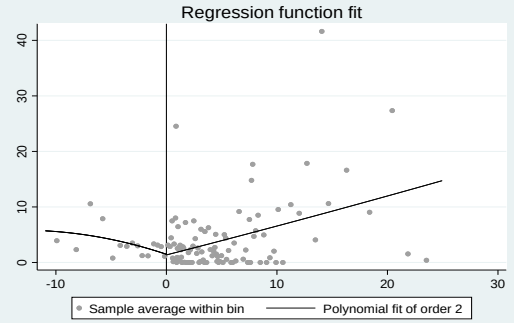
Template: First stage (TLTRO borrowing vs and ex-ante lending)

Average TLTRO borrowing (y), by bins of ex ante lending (x)

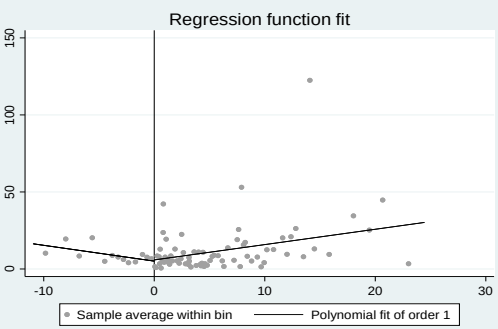
Baseline



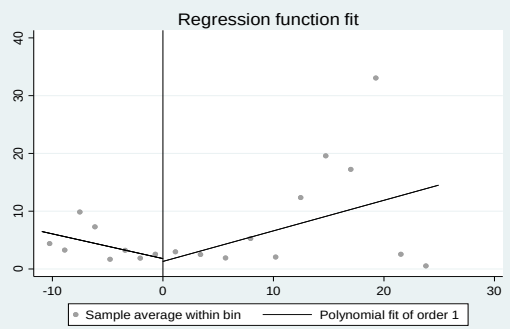
Quadratic



Only Bidders



Equally Spaced Bins



- relationship displays a change in slope around 0 (as expected)
- no material jumps in level (as expected)
- convex kink (as expected)
- lower dispersion for subsample without banks not borrowing (bidders only)
- robust across methodologies (n. of bins , degree of polynomial,...)

Template: First stage (TLTRO borrowing on and ex-ante lending)

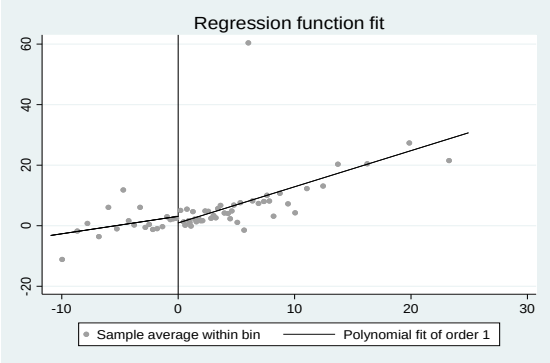
	(1)	(2)	(3)	(4)
Ex-ante lending # D	0.476***	0.475***	0.514***	0.514***
	[4.71]	[4.72]	[5.04]	[5.01]
Ex-ante lending	-0.245***	-0.245***	-0.169***	-0.170***
	[-4.59]	[-4.59]	[-2.98]	[-2.97]
D	-0.232	-0.232	-0.439	-0.436
	[-0.85]	[-0.85]	[-1.64]	[-1.62]
Time fixed effects	-	Yes	-	-
Country fixed effects	-	-	Yes	-
Country-time fixed effects	-	-	-	Yes
N	2961	2961	2961	2951
R^2	0.012	0.017	0.101	0.101

- Charts findings confirmed by regressions
- different f.e. have no material impact on coefficient
- quantitative relevance: s.d.(exante lending) * $\beta = 6.4 * .51 = 3.2$ =two thirds of the s.d. of TLTRO borrowing (4.8)

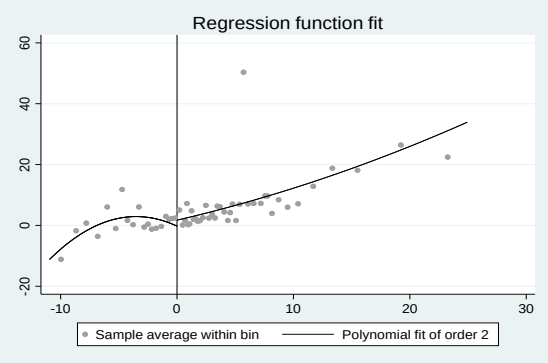
Template: "Reduced form" (ex-post lending vs and ex-ante lending)

Average (ex post) lending (y), by bins of ex ante lending (x)

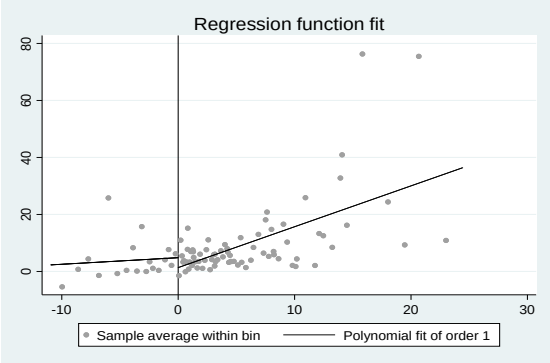
Baseline



Quadratic



Only Bidders



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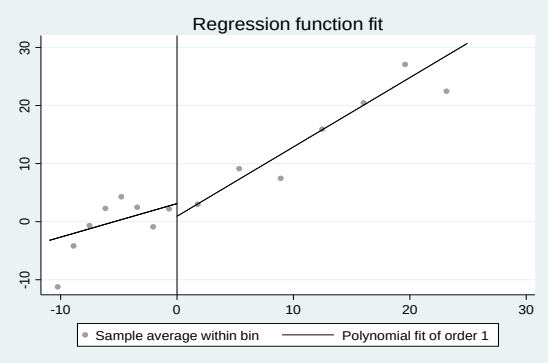

- relationship displays a change in slope around 0 (as expected)
- no material jumps in level (as expected)
- convex kink (as expected)
- lower dispersion compared to 1st stage
- robust across methodologies (n. of bins , degree of polynomial,...)

Template: "Reduced form" (ex-post lending vs and ex-ante lending)

	(1)	(2)	(3)	(4)
Ex-ante lending # D	0.895***	0.892***	0.778***	0.765***
	[4.51]	[4.48]	[3.79]	[3.68]
Ex-ante lending	0.121	0.124	0.261***	0.267***
	[1.27]	[1.30]	[2.64]	[2.68]
D	-0.307	-0.302	-0.950**	-0.939**
	[-0.81]	[-0.80]	[-2.50]	[-2.44]
Time fixed effects	-	Yes	-	-
Country fixed effects	-	-	Yes	-
Country-time fixed effects	-	-	-	Yes
N	2465	2465	2465	2453
R^2	0.218	0.220	0.267	0.280

- Charts findings confirmed by regressions
- no large influence of f.e. on coefficient
- quantitative relevance: s.d.(exante lending) * $\beta = 6.4 * .77 = 4.9$ = three quarters of s.d. of eligible ex-post lending in the period TLTRO borrowing (6.5)

Quantification

Estimated causal impact of TLTRO liquidity injection equal to 1% of outstanding (eligible) loans on subsequent (eligible) loan growth is:

$$\text{“Reduced form elasticity”} \,/\, \text{“1}^{\text{st}}\text{ stage elasticity”} = 0.77/0.51 = 1.4\%$$

Sizable, considering that the average take-up is 3.0%, median 1.6%

IRB sample: Impact on lending volumes, lending rates and risk-taking

	Lending		Margins		PD	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Ex-ante lending # D	1.064***	1.232***	0.0185	-0.0559**	0.0522	0.0730**
	[3.84]	[4.00]	[0.67]	[-2.05]	[1.06]	[2.16]
Ex-ante lending	0.246***	0.123	0.0000782	0.0667***	-0.00426	0.0447
	[2.70]	[1.13]	[0.01]	[5.48]	[-0.18]	[1.43]
D	1.496	0.112	-0.468**	-0.422***	-0.270	-0.676***
	[1.11]	[0.07]	[-2.52]	[-3.76]	[-1.20]	[-3.27]
Country-time fixed effects	-	Yes	-	Yes	-	Yes
N	338	326	289	279	319	304
R^2	0.333	0.550	0.044	0.766	0.007	0.375

- Impact on (eligible) lending also in IRB sample
- (Negative) impact also on lending margins (corroborate identification)
- Impact on PD: lending supply expansion towards marginally riskier loans

Risk appetite and funding costs

	Risk appetite		Funding cost	
	(1)	**(2)**	**(3)**	**(4)**
Ex-ante lending # D	0.0310**	0.0552***	-0.0801***	-0.0219*
	[2.36]	[2.78]	[-8.13]	[-2.09]
Ex-ante lending	-0.0162**	-0.0139*	0.0404***	0.00717
	[-1.99]	[-1.88]	[11.10]	[1.78]
D	-0.261*	0.0224	-0.0699**	0.0746**
	[-1.88]	[0.23]	[-3.64]	[3.99]
Country-time fixed effects	-	Yes	-	Yes
N	340	328	312	300
R^2	0.030	0.345	0.103	0.536

- Increase in risk taking also confirmed by findings on self-reported risk tolerance
- Negative impact on bank funding cost (wholesale market funding; it excludes central bank funding)

Spillovers to other assets

	Non-eligible loans		Sovereign bond holdings	
	(1)	**(2)**	**(3)**	**(4)**
Ex-ante lending # D	-0.277	-0.215	-0.385***	-0.579***
	[-0.74]	[-0.70]	[-2.76]	[-5.26]
Ex-ante lending	-0.100	-0.175	-0.0412	0.217***
	[-0.94]	[-1.50]	[-0.60]	[2.85]
D	8.432***	4.169**	1.219	-1.817**
	[5.03]	[2.56]	[1.30]	[-2.36]
Country-time fixed effects	-	Yes	-	Yes
N	320	308	340	328
R^2	0.175	0.555	0.020	0.579

- No impact on non-eligible loans (if anything some crowding out)
- Negative impact on sovereign bond holdings (interaction with APP)
- Both findings suggests prominence of incentive channel (more formally tested below)

Impact on bank profitability

	(1)	(2)	(3)	(4)
Ex-ante lending # D	0.000452***	0.000443***	0.000302**	0.000278**
	[5.03]	[5.93]	[2.42]	[2.56]
Ex-ante lending	-0.0000989**	-0.0000954***	-0.0000547	-0.0000520
	[-2.45]	[-2.77]	[-1.04]	[-1.14]
D	0.00115**	0.00115**	-0.000410	-0.000338
	[2.31]	[2.43]	[-0.96]	[-0.86]
Time fixed effects	-	Yes	-	-
Country fixed effects	-	-	Yes	-
Country-time fixed effects	-	-	-	Yes
N	281	281	281	263
R^2	0.071	0.109	0.467	0.755

- Positive impact on profitability
- 3 bps/.51 (1ststage coeff) =6bps per p.p. of borrowing. Average borrowing is 3%, so average effect on ROA is 18 bps (average ROA equal to 20 bps, 100 bps in pre-crisis)

Identification of incentive channel 1

$$y_{i,s,t} = \alpha + \gamma Exante\ Lending_i + \beta\left(Exante\ Lending_i \times D_i\right) + \theta\left(Exante\ Lending_i \times D_i \times Eligible_s\right) + \cdots + \Omega X_{i,t} + \epsilon_{i,t}$$

$y =$ outcome variable

$Exante\ Lending_i =$ ex-ante (eligible) lending flow, expressed as a ratio of the stock of (eligible) loans

$Eligible_s =$ dummy for eligible lending

$X_{i,t} =$ vector of controls (including f.e.)

$$D_i = \begin{cases} 0 \text{ if Exante (eligible) Lending} \leq 0 \text{ (left of the kink)} \\ 1 \text{ if Exante (eligible) Lending}>0 \text{ (right of the kink)} \end{cases}$$

Incentive channel on lending

	(1)	(2)	(3)	(4)
Ex-ante lending # D # Eligible	1.311**	1.491***	1.346**	1.492***
	[2.34]	[2.94]	[2.56]	[2.74]
Ex-ante lending # D	-0.176		-0.277	
	[-0.50]		[-0.73]	
Eligible # D	-6.762***	-7.375***	-6.922***	-7.366***
	[-2.79]	[-3.37]	[-3.02]	[-3.13]
Ex-ante lending # Eligible	0.370**	0.297**	0.343**	0.297**
	[2.57]	[2.34]	[2.58]	[2.18]
Ex-ante lending	-0.209*		-0.1000	
	[-1.86]		[-0.93]	
D	5.874***		8.415***	
	[3.55]		[4.98]	
Eligible	0.796	0.748		
	[0.89]	[0.91]		
Country-time fixed effects	Yes	-	-	Yes
Bank-time fixed effects	-	Yes	-	Yes
Sector-time fixed effects	-	-	Yes	Yes
N	658	640	658	640
R^2	0.445	0.667	0.260	0.669

- Sign coeff for triple interaction corroborates presence of an incentive channel
- Coeff larger than average one suggests prominence of incentive channel
- Holds also in fully saturated specification

Identification of incentive channel 2

$$y_{i,t} = \alpha + \gamma Exante\ Lending_i + \beta\left(Exante\ Lending_i \times D_i\right) + \delta Takeup_i + \\ + \Omega X_{i,t} + \epsilon_{i,t}$$

y = outcome variable

Exante Lending = ex ante (eligible) lending flow, expressed as a ratio of the stock of (eligible) loans

Takeup = Shutting down the liquidity channel by controlling for each bank's takeup

$X_{i,t}$ = vector of controls

$$D_i = \begin{cases} 0 \text{ if Exante Lending} \leq 0 \text{ (left of the kink)} \\ 1 \text{ if Exante Lending} > 0 \text{ (right of the kink)} \end{cases}$$

Incentive channel: controlling for take-up

	Lending		Margins		PD	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Ex-ante lending # D	0.992***	1.131***	0.0148	-0.0524*	0.0534	0.0797**
	[3.69]	[3.85]	[0.51]	[-1.91]	[1.06]	[2.26]
Ex-ante lending	0.305***	0.196*	0.00256	0.0647***	-0.00530	0.0399
	[3.10]	[1.81]	[0.19]	[5.36]	[-0.21]	[1.26]
D	1.355	-0.166	-0.471**	-0.419***	-0.268	-0.660***
	[1.05]	[-0.10]	[-2.54]	[-3.74]	[-1.19]	[-3.19]
Take-up	0.439***	0.540***	0.0187	-0.0147	-0.00753	-0.0366
	[2.86]	[2.94]	[0.91]	[-1.18]	[-0.32]	[-1.29]
Country-time fixed effects	-	Yes	-	Yes	-	Yes
N	338	326	289	279	319	304
R^2	0.352	0.571	0.047	0.767	0.007	0.379

- Coefficient for double interaction remains sign
- Comparable in size to specification without takeup as controls => corroborates prominence of incentive channel
- Coeff for takeup not necessarily interpretable as quantification of liquidity channel. Prominence of incentive channel anyway confirmed (even for lending)

Impact across countries

	Loan growth		Lending rates	
	(1)	(2)	(3)	(4)
Ex-ante lending # D	1.546***	1.318***	0.0273	0.0309
	[3.49]	[3.10]	[1.16]	[1.29]
Vuln. Country # Ex-ante lending # D	-0.763	-0.498	-0.176***	-0.187***
	[-1.48]	[-0.98]	[-4.36]	[-4.55]
Ex-ante lending	-0.0490	0.0990	-0.00574	-0.00810
	[-0.22]	[0.43]	[-0.34]	[-0.47]
D	0.0700	-0.655	0.0269	0.0382
	[0.03]	[-0.28]	[0.17]	[0.24]
Vuln. Country # D	0.976	1.686	-0.559**	-0.567**
	[0.32]	[0.59]	[-2.36]	[-2.41]
Vuln. Country # Ex-ante lending	0.244	0.116	0.103***	0.102***
	[0.96]	[0.45]	[4.53]	[4.51]
Takeup_ol		0.823***		-0.0131
		[3.08]		[-0.99]
Vuln. Country # Takeup_ol		-0.569*		-0.0351
		[-1.65]		[-1.37]
N	326	326	303	303
R^2	0.553	0.580	0.768	0.774

Impact across banks

	Loan growth		Lending rates	
	(1)	(2)	(3)	(4)
Ex-ante lending # D	1.006***	0.895***	-0.0316	-0.0260
	[2.81]	[2.62]	[-1.50]	[-1.21]
T1 Cap. Ratio # Ex-ante lending # D	1.542***	1.652***	-0.128***	-0.134***
	[2.80]	[3.00]	[-2.83]	[-2.93]
Ex-ante lending	0.125	0.198*	0.0595***	0.0558***
	[1.06]	[1.71]	[5.24]	[5.15]
D	2.918	2.468	-0.350***	-0.327**
	[1.41]	[1.26]	[-2.66]	[-2.48]
T1 Cap. Ratio	-1.217	-1.058	0.188	0.179
	[-0.96]	[-0.82]	[1.26]	[1.20]
T1 Cap. Ratio # D	-7.796***	-7.297**	0.137	0.111
	[-2.65]	[-2.52]	[0.50]	[0.40]
T1 Cap. Ratio # Ex-ante lending	-0.481***	-0.545***	0.0382**	0.0415**
	[-3.32]	[-3.82]	[2.24]	[2.33]
Takeup_ol		0.498***		-0.0253**
		[2.97]		[-2.03]
T1 Cap. Ratio # Takeup_ol		-0.208		0.0115
		[-0.59]		[0.23]
N	326	326	303	303
R^2	0.589	0.606	0.753	0.756

Outline

- Motivation, literature overview and preview of the results
- Targeted liquidity operations
  - i. Institutional set-up
  - ii. Identification
- Data and methodology
  - i. Stylized facts
  - ii. The empirical strategy
  - iii. Data used
- Results
  - i. The impact of the program on lending
  - ii. The impact of the program on other variable
  - iii. The incentive channel
  - iv. Heterogeneity
- Conclusions

Conclusions

- Results
  - ✓ Increase in loan supply (effect on volumes and rates)
  - ✓ Risk-taking (increase in PD and risk tolerance)
  - ✓ No spillover on non-eligible loans
  - ✓ (Negative) spillover on bond holdings
  - ✓ Prominence of the incentive channel
  - ✓ Positive impact on profitability
  - ✓ Some heterogeneity across countries and banks

- Assessment
  - ✓ Effective programme on targeted assets
  - ✓ with some "beneficial" spillover non-targeted assets (crowding out of bond holdings)
  - ✓ operating through peculiar modalities (banks extend loans to get the liquidity)
  - ✓ Financial stability implications
    - ✓ Effective in stimulating only targeting assets
    - ✓ Even reduces sovereign exposures (nexus)
    - ✓ Extra risk taken not under-priced
    - ✓ Positive implication on bank strength (profitability increases)

Thanks!