Do Banks Have an Internal Market for Equity?

Implications for Cross-Border Spillovers of Policy Measures

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PRELIMINARY

European Central Bank

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Motivation and literature review

Motivation

- Banking groups allocate capital across entities in the group. The criteria informing this allocation (the "internal market for equity") depend banks' strategies and in turn affect their lending policies.

- Macroprudential policy can generate unintended negative cross-border spillovers, both owing to regulatory arbitrage and risk management decisions by banking groups. Therefore banking groups that operate across countries might be subject to ring-fencing by host authorities who fear that if it were transferred abroad this would impact negatively the local supply of credit.

Motivation

- However, since supervisory measures are expressed in ratios, banks can at least to an extent circumvent such ring-fencing by adapting the denominator of such ratios, for example by reducing lending locally or reallocating it to portfolios with lower risk-weights, thus freeing up capital at the consolidated level and re-allocating it.

- In this paper we investigate whether banks engage in such behaviour and draw some first policy implications.

Research question

- From a perspective of a banking group, are there spillovers effects on affiliated banks' lending and/or risk-taking?
- Is the impact of the capital buffers heterogeneous across subsidiaries and banking groups?

- Relevance from a financial stability perspective:
  1. It may reduce lending (and risk-taking channel)
  2. ...and/or shift its allocation across sectors

Literature review

- Papers on internal capital markets and propagation of shocks of global banks and factors influencing the capital of banks' subsidiaries: Campello, M. (2002); Mili, M. et al (2014); Cetorelli, N. and Goldberg, L. (2012) and Houston, J. and James, C. (1998).

- Literature on measuring the effects of macroprudential measures on banks' risk taking and credit supply: Buch, C. and Goldberg, L. (2017); Aiyar, S. et al (2014); Mosk, T. et al. (2016) and Gropp, R. et al. (2016).

- Literature on the impact of unconventional monetary policy on banks' risk taking and credit supply: (Dell'Ariccia, 2018).

Contribution to the literature

1. Explore some relevant outcome variables, assessing:
   - intensity of risk-taking and credit supply
   - implications for banking groups internal capital markets and profitability (forthcoming)
2. Study of the impact of higher capital buffers, namely of O-SII buffers, on affiliated banks' risk-taking and credit supply
3. Assess the incentive scheme embedded in macroprudential buffers
4. Exploit the feature of the O-SIIs framework also for identification purposes (Diff-in-Disc and DiD)
5. Assess, from the perspective of a banking group, the spillovers effects on affiliated banks' lending and/or risk-taking
6. Adopt a multi-country perspective (Euro Area banks)

Setting

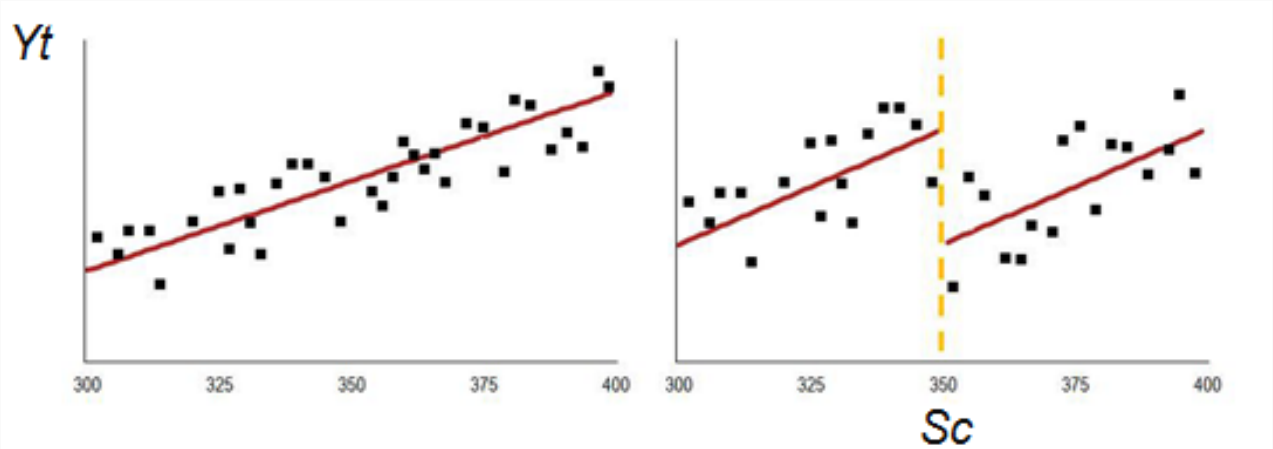
Institutional set-up

- Since 2015, more than 107 entities were identified as O-SIIs and subject to additional requirements concerning the amount of Common Equity Tier 1 (CET1).
- Although the policy was implemented with different methodologies and different phase-in arrangements, the protocol for the identification of the O-SIIs has been established in the EBA guidelines for all countries.
    - Based on some mandatory indicators – size, importance, complexity/cross-border, interconnectedness – each bank receives a score, which should reflect its systemic importance, and banks with a score above a certain threshold are automatically designated as O-SIIs.

- This characteristic of the O-SII institutional framework provides us with an ideal ground to assess the impact of higher capital requirements on banking groups and on affiliated banks' lending and/or risk-taking behaviour.

Identification strategy

- According to the EBA framework, the identification of a credit institution is based on an automatic selection rule based on the overall O-SII score and the possible application of supervisory judgment. The automatic selection rules implies that banks, whose score is above the threshold (e.g. 350 bps), are identified as O-SII and potentially required to hold additional capital (CET1).
- The empirical strategy for causally identifying the effect of the regulatory shock is to compare the change in the outcomes of interest for banks just above and below the cutoff, ie. before/after the additional capital surcharge.
- This scoring process allows us to use both a Fuzzy RDD and a DiD design, which exploit both the policy change and the discontinuity induced by the O-SIIs identification.



Empirical strategy

- Since there are two sources of variation in place:
  1. Policy change: before/after the notification date
  2. Threshold: below/above the cut-off point induced by the O-SIIs identification process

We implement a "Difference-in-discontinuities - Diff-in-Disc" design (Grembi et al. (2016) and Leonardi and Pica (2013)).The "difference-in-differences" estimation is used to validate the results.

- Diff-in-Disc regression design: we exploit the discontinuity to assess the impact of a parent being O-SII on affiliated banks' lending and/or risk-taking (capital markets and profitability to be included)
  1. Treatment: banking group parents identified as O-SIIs
  2. Outcome variable: lending, risk-taking...

Focus is on the change in the discontinuity in relation to the outcome variable (e.g. risk taking and lending).

Data Set

Two unique data sets:

1. Internal dataset on O-SIIs:
   - SSM countries decision on the identification and calibration of the O-SII according to the provisions of Art. 131 CRD IV and in the EBA Guidelines on criteria to assess O-SIIs.
   - Data to compute the underlying score of banks and to control the results for banks' characteristics - based on four mandatory indicators: size, importance, complexity/cross-border activity and interconnectedness.

2. Granular supervisory data:
   - Quarterly reports for Euro Area banks, which include information on volumes of exposures, risk-weighted assets, impairments or expected losses, as well as indicators of capital, such as CET1.
   - Almost 400 banks (of which 107 O-SIIs) from 17 Euro Area countries.
   - Data spanning from Q4 2014 till Q4 2017.

Methodology - Differences in discontinuities

$$Y_{itc} = \beta_0 + \beta_1 OSII_{itc} + \beta_2 (OSII_{itc} \cdot Post_{tc}) + \gamma_0 (S_{itc} - S_c) + \gamma_1 (S_{itc} - S_c) D_{itc} + \gamma \cdot X_{itc} + \eta_{tc} + \varepsilon_{itc}$$

$$OSII_{itc} = \delta_0 + \delta_1 D_{itc} + \delta_2 (D_{itc} \cdot Post_{tc}) + \delta_3 (S_{itc} - S_c) + \delta_4 (S_{itc} - S_c) D_{itc} + \gamma \cdot X_{itc} + \eta_{tc} + \varepsilon_{itc}$$

$$OSII_{itc} \cdot Post_{tc} = \zeta_0 + \zeta_1 D_{itc} + \zeta_2 (D_{itc} \cdot Post_{tc}) + \zeta_3 (S_{itc} - S_c) + \zeta_4 (S_{itc} + S_c) D_{itc} + \gamma \cdot X_{itc} + \eta_{tc} + \varepsilon_{itc}$$

where:

- Y_{itc} is the outcome variable - lending, risk-taking...
- $OSII_{itc}$ is a dummy that takes value 1 if bank *i*'s parent has been identified as OSII and 0 otherwise.
- $S_{itc} - S_c$ is the bank's normalized score.
- $Post_{tc}$ is a dummy that equals 1 after the notification of the capital buffer.
- ε_{itc} is the individual error term.
- X_{itc} is a vector of control variables, namely the CET1 (for both parent and subsidiary) and the country's unemployment rate.
- η_{tc} is a vector of fixed effects (quarter and country f.e.)
- β_2 is the coefficient on the interaction term ($OSII_{itc} \cdot Post_{tc}$) i.e. the diff-in-disc estimator which identifies the effect of being designated as O-SII on the outcome of interest, Y_{itc}.

Methodology - Difference-in-difference

$$Y_{itc} = \beta_0 + \beta_1 OSII_{itc} + \beta_2 Post_{tc} + \beta_3 (OSII_{itc} \cdot Post_{tc}) + \gamma \cdot X_{itc} + \eta_{tc} + \varepsilon_{itc}$$

where:

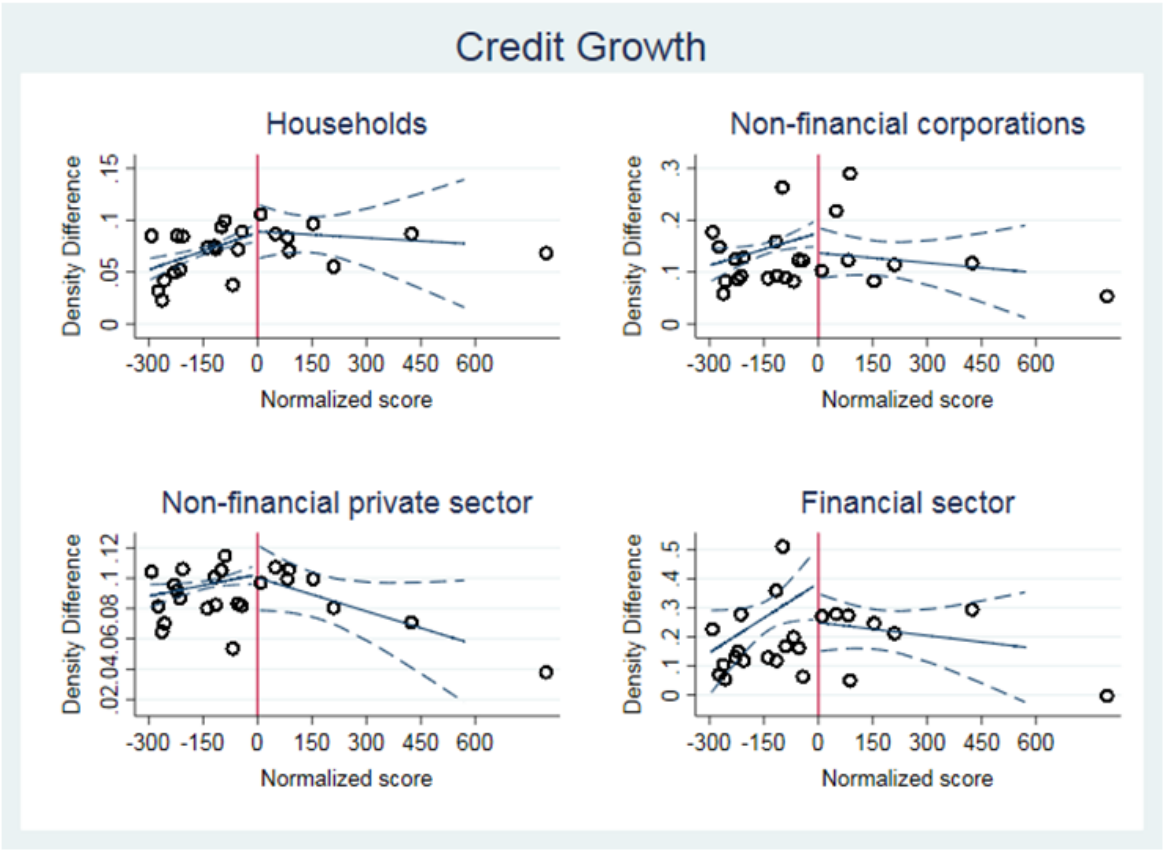
- Y_{itc} is the outcome variable - lending, risk-taking...
- $OSII_{itc}$ is a dummy that takes value 1 if bank *i* in country *c* has been identified as OSII and 0 otherwise.
- $Post_{tc}$ is a dummy that equals 1 after the notification of the capital buffer.
- ε_{itc} is the individual error term.
- X_{itc} is a vector of control variables, namely the CET1 (for both parent and subsidiary) and the country's unemployment rate.
- η_{tc} is a vector of fixed effects (quarter and country f.e.)
- β_3 is the coefficient on the interaction term ($OSII_{itc} \cdot Post_{tc}$) ie the diff-in-diff estimator which identifies the effect of being designated as O-SII on the outcome of interest, Y_{itc}.

  The panel with multi-country dimension allows to have #country x time fixed effects, which absorb all possible variation related to country-level macroeconomic conditions (Gambacorta et all)

Results

Results lending: All subsidiaries (Diff-in-Disc plot)

Average effect on affiliated banks' lending



Notes: Diff-in-disc design graph for credit growth. The vertical axis displays the dependent variable value post-notification. The horizontal axis measures the score distance from the threshold. The central line plots fitted values of the regression of the dependent variable on a second-order polynomial in score distance from the threshold, estimated separately on each side of the cutoff; the lateral lines represent the 95 percent confidence interval.
Data aggregated in 4 segments: HH; NFC; NFPS; FS

Results risk-taking: All subsidiaries (Diff-in-Disc design)

Average effect on affiliated banks' lending

	Households		Non-financial corporations		Non-financial private sector		Financial sector	
Bandwidth Method	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Δ% Credit								
Coefficient	0.048*	0.074	-0.129*	-0.154	0.014	0.017	-0.062	-0.054
	(0.021)	(0.055)	(0.056)	(0.165)	(0.019)	(0.050)	(0.076)	(0.101)
Observations	1372	433	1417	468	1441	478	2060	1253
First-stage F-statistic	87.46	20.47	85.46	21.46	78.66	20.70	191.23	67.01
Sanderson-Windmeijer F-statistic	167.44	16.47	167.44	23.61	121.74	20.32	391.57	125.09
Left-side Bandwidth	148.92	111.59	150.67	112.50	143.82	107.32	194.84	145.37
Right-side Bandwidth	1053.48	789.41	708.84	529.25	686.99	512.64	1881.47	1403.76

Notes: Diff-in-disc estimates for the effect of the ultimate parent's O-SII identification on affiliated banks' credit growth. The dependent variable is the quarterly growth rate of credit. We perform local linear regressions with a triangular kernel using both the mean squared error optimal (MSE)-optimal (1) and coverage error rate (CER)-optimal (2) bandwidths. All regressions include quarter fixed effects, country fixed effects and a polynomial of degree one in the score distance from the threshold. We include the country's unemployment level and the CET1 level of both the subsidiary and the parent institution as control variables. Standard errors are clustered at the bank level. ***, **, and * denote significance at the 1, 5 and 10 percent level.
$\beta 2$ is presented for both MSE optimal and CER optimal bandwidths (developed by Calonico et al (2016)).

- For specification ((1) mean squared error optimal (MSE)) affiliated banks with Parents identified as an O-SII tend to reduce their lending to risky counterparts in the non-financial private sector, in particular in the non-financial corporations sector.
- … while, lending to households increases.

Results lending: All subsidiaries (DiD)

Average effect on affiliated banks' lending

	Households		Non-financial corporations		Non-financial private sector		Financial sector		Public sector	
Δ(%) Credit Growth	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Dummy O-SII	-0.014	-0.003	0.035*	0.049***	-0.000	-0.001	-0.026	-0.009	0.025	0.040
	(0.012)	(0.009)	(0.019)	(0.015)	(0.007)	(0.009)	(0.034)	(0.037)	(0.032)	(0.031)
Dummy Post	-0.068	0.003	0.039	0.053***	-0.029	-0.004	0.195**	0.028	0.151**	0.102**
	(0.046)	(0.012)	(0.033)	(0.015)	(0.031)	(0.009)	(0.091)	(0.193)	(0.066)	(0.044)
Dummy O-SIIs & Post	0.032**	0.016*	-0.056***	-0.074***	0.002	0.003	-0.022	-0.040	-0.062	-0.084**
	(0.008)	(0.008)	(0.021)	(0.014)	(0.009)	(0.006)	(0.050)	(0.050)	(0.041)	(0.039)
Country-Time fixed-effects	Interacted	Solo	Interacted	Solo	Interacted	Solo	Interacted	Solo	Interacted	Solo
Observations	3,207		3,354		3,431		3,152		3,291	
R-Squared	0.146	0.043	0.100	0.039	0.136	0.040	0.084	0.033	0.113	0.042

Notes: Diff-in-diff estimates for the effect of the ultimate parent's O-SII identification on affiliated banks' lending. The dependent variable is the quarterly growth rate of credit. All regressions include fixed effects, i.e., by quarter and country, interacted or individually, an intercept and the CET1 level as control variable. Standard errors are clustered at the bank level. ***, **, and * denote significance at the 1, 5 and 10 percent level, respectively.

(previous results are confirmed)

- For both specifications (1) (2) affiliated banks with Parents identified as an O-SII tend to shift their credit supply to less risky counterparts, in particular in the non-financial corporations sector.
  ... while, lending to households increases.

- Different fixed effects have no material impact in the coefficients.

Results lending: Cross-border subsidiaries (DiD)

Average effect on affiliated banks' lending

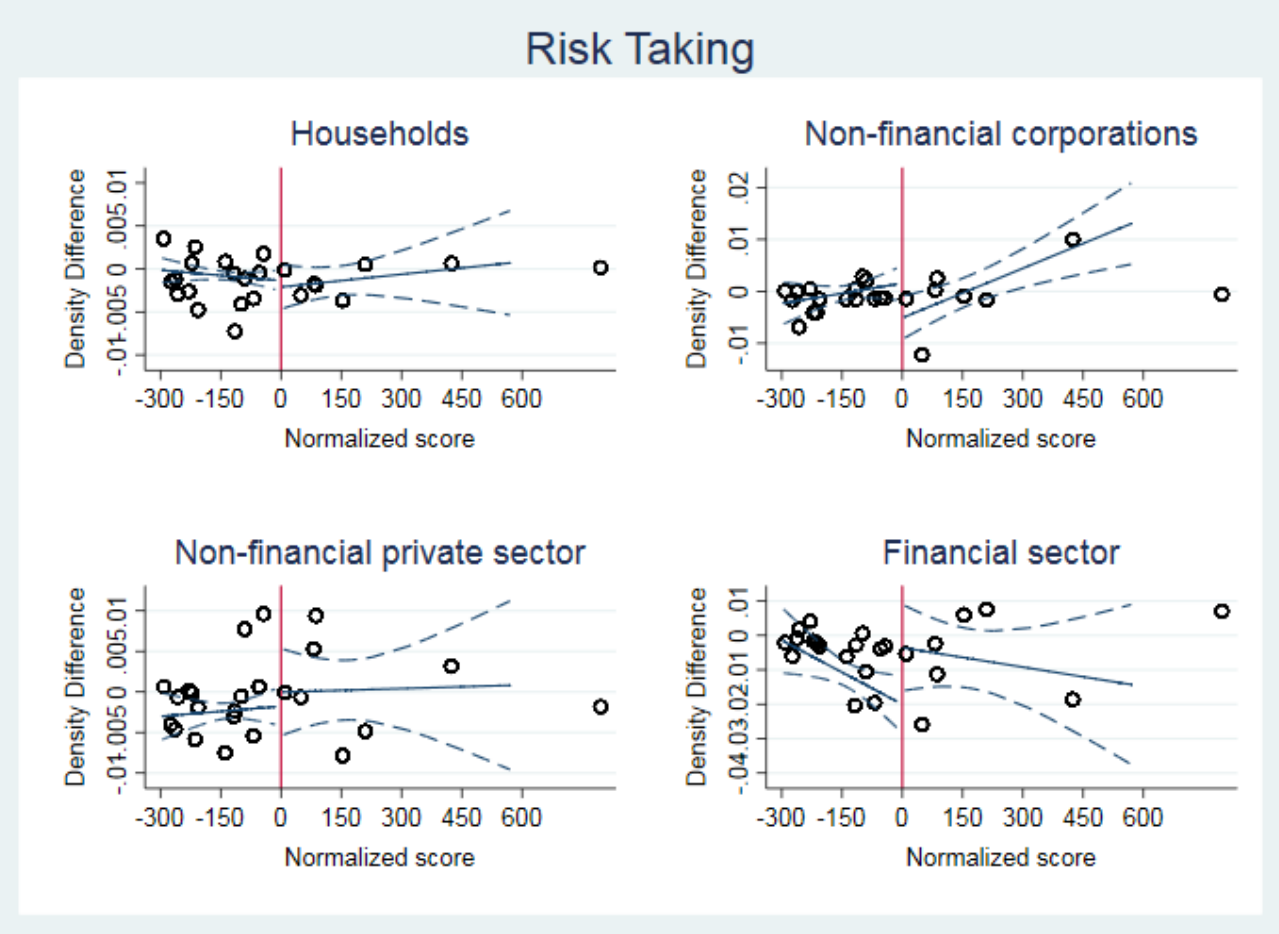
	Households		Non-financial corporations		Non-financial private sector		Financial sector		Public sector	
Δ(%) Credit Growth	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Dummy O-SII	-0.023	-0.018	0.091*	0.099**	0.036*	0.041**	0.053	0.027	0.074	-0.011
	(0.033)	(0.028)	(0.046)	(0.039)	(0.019)	(0.018)	(0.053)	(0.054)	(0.077)	(0.102)
Dummy Post	-0.147*	-0.087	0.039	0.066	-0.042	-0.004	0.401**	0.154	0.215*	0.280**
	(0.085)	(0.055)	(0.057)	(0.043)	(0.058)	(0.040)	(0.188)	(0.103)	(0.115)	(0.132)
Dummy O-SIIs & Post	0.080**	0.073**	-0.077	-0.091**	-0.017	-0.027	-0.145*	-0.100	-0.142	-0.030
	(0.039)	(0.035)	(0.048)	(0.044)	(0.024)	(0.022)	(0.075)	(0.075)	(0.112)	(0.139)
Country-Time fixed-effects	Interacted	Solo	Interacted	Solo	Interacted	Solo	Interacted	Solo	Interacted	Solo
Observations	619		757		754		783		751	
R-Squared	0.320	0.101	0.247	0.079	0.258	0.086	0.211	0.036	0.330	0.062

Notes: Diff-in-diff estimates for the effect of the ultimate parent's O-SII identification on affiliated banks' lending. The dependent variable is the quarterly growth rate of credit. All regressions include fixed effects, i.e., by quarter and country, interacted or individually, an intercept and the CET1 level as control variable. Standard errors are clustered at the bank level. ***, **, and * denote significance at the 1, 5 and 10 percent level, respectively.

- If considering just cross-border subsidiaries, for both specifications (1) (2) previous results are confirmed (the same as for all subsidiaries).
- Different fixed effects have no material impact in the coefficients.

Results risk-taking: All subsidiaries (Diff-in-Disc plot)

Average effect on affiliated banks' risk-taking



Notes: Diff-in-disc design graph for risk-taking. The vertical axis displays the dependent variable value post-notification. The horizontal axis measures the score distance from the threshold. The central line plots fitted values of the regression of the dependent variable on a second-order polynomial in score distance from the threshold, estimated separately on each side of the cutoff; the lateral lines represent the 95 percent confidence interval.
Data aggregated in 4 segments: HH; NFC; NFPS; FS

Results risk-taking: All subsidiaries (Diff-in-Disc design)

Average effect on affiliated banks' risk-taking

	Households		Non-financial corporations		Non-financial private sector		Financial sector	
Bandwidth Method	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Panel A: Δ Avg. Risk-Weights								
Coefficient	-0.001	-0.001	-0.006	-0.005	-0.002	-0.003	-0.029*	-0.030*
	(0.002)	(0.002)	(0.003)	(0.003)	(0.005)	(0.005)	(0.012)	(0.013)
Observations	1408	1358	1583	1413	1584	1470	1133	1036
First-stage F-statistic	67.11	51.65	135.38	113.33	93.58	83.33	82.57	72.22
Sanderson-Windmeijer F-statistic	148.26	87.02	273.57	226.69	155.79	128.87	157.47	136.89
Left-side Bandwidth	167.51	125.49	249.57	186.34	222.95	166.30	221.26	165.15
Right-side Bandwidth	1240.72	929.42	664.86	496.41	1128.65	841.84	885.44	660.91
Panel b: Δ Avg. Global Charge								
Coefficient	-0.000	-0.004	0.008	0.004	-0.005	-0.003	-0.021*	-0.026*
	(0.006)	(0.007)	(0.011)	(0.012)	(0.025)	(0.025)	(0.009)	(0.011)
Observations	1351	1303	1551	1406	1455	1414	1999	1253
First-stage F-statistic	67.72	51.03	104.66	88.64	99.98	84.93	157.84	59.44
Sanderson-Windmeijer F-statistic	133.33	71.95	200.11	161.63	163.89	133.64	321.90	114.30
Left-side Bandwidth	162.15	121.50	237.63	177.42	178.58	133.26	191.78	143.07
Right-side Bandwidth	1095.56	820.94	1120.73	836.78	608.04	453.72	1716.05	1280.16

Notes: Diff-in-disc estimates for the effect of the ultimate parent's O-SII identification on affiliated banks' risk taking. The dependent variable is the quarterly change in the average risk-weights and global charge. We perform local linear regressions with a triangular kernel using both the mean squared error optimal (MSE)-optimal (1) and coverage error rate (CER)-optimal (2) bandwidths. All regressions include quarter fixed effects, country fixed effects and a polynomial of degree one in the score distance from the threshold. We include the country's unemployment level and the CET1 level of both the subsidiary and the parent institution as control variables. Standard errors are clustered at the bank level. ***, **, and * denote significance at the 1, 5 and 10 percent level. $\beta 2$ is presented for both MSE optimal and CER optimal bandwidths (developed by Calonico et al (2016)).

- Affiliated banks with Parents identified as an O-SII tend to shift their lending to less risky counterparts.

Results risk-taking: All subsidiaries (DiD)

Average effect on affiliated banks' risk-taking

	Households		Non-financial corporations		Non-financial private sector		Financial sector	
Panel A: Δ Avg. Risk-Weights	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Dummy O-SII	0.001	0.002***	-0.000	0.002	0.002	0.004**	0.008*	0.011**
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)
Dummy Post	0.003	0.004***	0.005	0.006***	0.013***	0.007***	0.011	0.009
	(0.002)	(0.001)	(0.005)	(0.003)	(0.005)	(0.002)	(0.017)	(0.007)
Dummy O-SIIs & Post	-0.002*	-0.003***	-0.000	-0.004**	-0.003	-0.005***	-0.003	-0.008
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)
Country-Time fixed-effects	Interacted	Solo	Interacted	Solo	Interacted	Solo	Interacted	Solo
Observations	3,231		3,388		3,436		2,996	
R-Squared	0.192	0.060	0.134	0.035	0.113	0.031	0.174	0.033
Panel B: Δ Avg. Global Charge								
Dummy O-SII	0.001	-0.001	0.005	0.001	0.026***	0.021***	0.004	0.007
	(0.002)	(0.003)	(0.007)	(0.006)	(0.009)	(0.007)	(0.006)	(0.006)
Dummy Post	0.008	0.011***	-0.019	-0.002	0.052*	0.025**	0.036	0.016*
	(0.006)	(0.004)	(0.024)	(0.008)	(0.029)	(0.012)	(0.028)	(0.009)
Dummy O-SIIs & Post	-0.004	-0.000	-0.002	0.001	-0.030***	-0.024***	-0.005	-0.008
	(0.003)	(0.003)	(0.008)	(0.006)	(0.011)	(0.007)	(0.007)	(0.005)
Country-Time fixed-effects	Interacted	Solo	Interacted	Solo	Interacted	Solo	Interacted	Solo
Observations	3,198		3,330		3,438		3,185	
R-Squared	0.258	0.068	0.158	0.040	0.160	0.050	0.136	0.026

Notes: Diff-in-diff estimates for the effect of the ultimate parent's O-SII identification on affiliated banks' risk-taking. The dependent variable in Panel A is the quarterly change in the average risk-weight and Panel B the quarterly change in the average global charge. All regressions include fixed effects, i.e., by quarter and country, interacted or individually, an intercept and the CET1 level as control variable. Standard errors are clustered at bank level. ***, **, and * denote significance at the 1, 5 and 10 percent level, respectively.

- For both specifications (1) (2) results show that affiliated banks with Parents identified as an O-SII tend to shift their lending to less risky counterparts in the non-financial private sector, in particular in the non-financial corporations and household sectors.
- Different fixed effects have no material impact in the coefficients.

Results risk-taking: Cross-border subsidiaries (DiD)

Average effect on affiliated banks' risk-taking

	Households		Non-financial corporations		Non-financial private sector		Financial sector	
Panel A: Δ Avg. Risk-Weights	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Dummy O-SII	-0.000	0.001	0.002	0.002	0.007	0.005	-0.019	-0.015
	(0.003)	(0.003)	(0.008)	(0.005)	(0.007)	(0.006)	(0.013)	(0.011)
Dummy Post	-0.001	0.003	0.005	0.008	0.022**	0.023**	0.033	0.035
	(0.003)	(0.003)	(0.010)	(0.009)	(0.009)	(0.009)	(0.027)	(0.023)
Dummy O-SIIs & Post	0.001	-0.001	-0.005	-0.005	-0.009	-0.008	0.017	0.013
	(0.004)	(0.003)	(0.008)	(0.006)	(0.008)	(0.006)	(0.012)	(0.010)
Country-Time fixed-effects	Interacted	Solo	Interacted	Solo	Interacted	Solo	Interacted	Solo
Observations	615		764		754		771	
R-Squared	0.284	0.034	0.333	0.094	0.255	0.053	0.321	0.055
Panel B: Δ Avg. Global Charge								
Dummy O-SII	-0.008	0.003	0.003	0.014	0.051**	0.048**	-0.021	-0.018
	(0.006)	(0.008)	(0.016)	(0.016)	(0.022)	(0.019)	(0.014)	(0.011)
Dummy Post	0.003	0.005	-0.023	0.003	0.033	0.049	0.084*	0.061
	(0.013)	(0.008)	(0.031)	(0.017)	(0.060)	(0.058)	(0.049)	(0.041)
Dummy O-SIIs & Post	0.003	-0.012	0.005	-0.009	-0.057**	-0.052**	0.011	0.011
	(0.007)	(0.011)	(0.016)	(0.014)	(0.028)	(0.023)	(0.013)	(0.012)
Country-Time fixed-effects	Interacted	Solo	Interacted	Solo	Interacted	Solo	Interacted	Solo
Observations	630		766		756		767	
R-Squared	0.234	0.049	0.246	0.066	0.317	0.085	0.335	0.054

Notes: Diff-in-diff estimates for the effect of the ultimate parent's O-SII identification on affiliated banks' risk-taking. The dependent variable in Panel A is the quarterly change in the average risk-weight and Panel B the quarterly change in the average global charge. All regressions include fixed effects, i.e., by quarter and country, interacted or individually, an intercept and the CET1 level as control variable. Standard errors are clustered at bank level. ***, **, and * denote significance at the 1, 5 and 10 percent level, respectively.

- If considering just cross-border subsidiaries, for both specifications (1) (2) the Global Charge (which includes expected losses) confirms the decrease in risk-taking (NFPS)

Conclusions

Conclusions

Results

- Impact on non-financial private sector: Decrease both in loan supply and riskier loans, in particular in the non-financial corporations sector.

- Impact on households: lending supply expansion towards marginally less risky loans.

Conclusions

Policy implications

An increase of capital requirements at the consolidated level translates into the following effects at the subsidiary level:

- Negative spillover effects on the credit supply for both domestic and cross-border subsidiaries (via less credit supply to the non-financial corporations sector);
- Re-allocation impact on risk-taking given the rebalancing toward less risky loans (to households and non-financial corporations sector).

Banks can circumvent at least to an extent ring-fencing of capital via macroprudential measures.

Conclusions

Financial stability concerns

- The O-SIIs buffers could have potentially a positive disciplining effect by reducing banks' risk-taking (Gersbach and Rochet, 2012 and Repullo, 2003).

- Following the conclusions of Admati et al. (2015), our results suggest that banks tend to comply with higher capital requirements by dampen down their risk-weighted assets -follows the debate on how banks adjust their balance sheets in response to higher capital requirements imposed by policy regulation (see Gropp et al., 2016).

- As suggested by Hanson et al. (2011) and Gropp et al. (2016), targeting the absolute amount of new capital that has to be raised instead the capital ratio could mitigate the problem of some potential optimisation of risk-weighted assets and reduce the adverse impact on the real economy.

Feedback and comments are welcome

Thank you!

Methodology - Fuzzy kink regression (copy)

$$Y_{itc} = \beta_0 + \beta_1 OSII_{itc} + \beta_2 (OSII_{itc} \cdot Post_{tc}) + \gamma_0 (S_{itc} - S_c) + \gamma_1 (S_{itc} - S_c) D_{itc} + \gamma \cdot X_{itc} + \varepsilon_{itc}$$

$$OSII_{itc} = \delta_0 + \delta_1 D_{itc} + \delta_2 (D_{itc} \cdot Post_{tc}) + \delta_3 (S_{itc} - S_c) + \delta_4 (S_{itc} - S_c) D_{itc} + \gamma \cdot X_{itc} + \varepsilon_{itc}$$

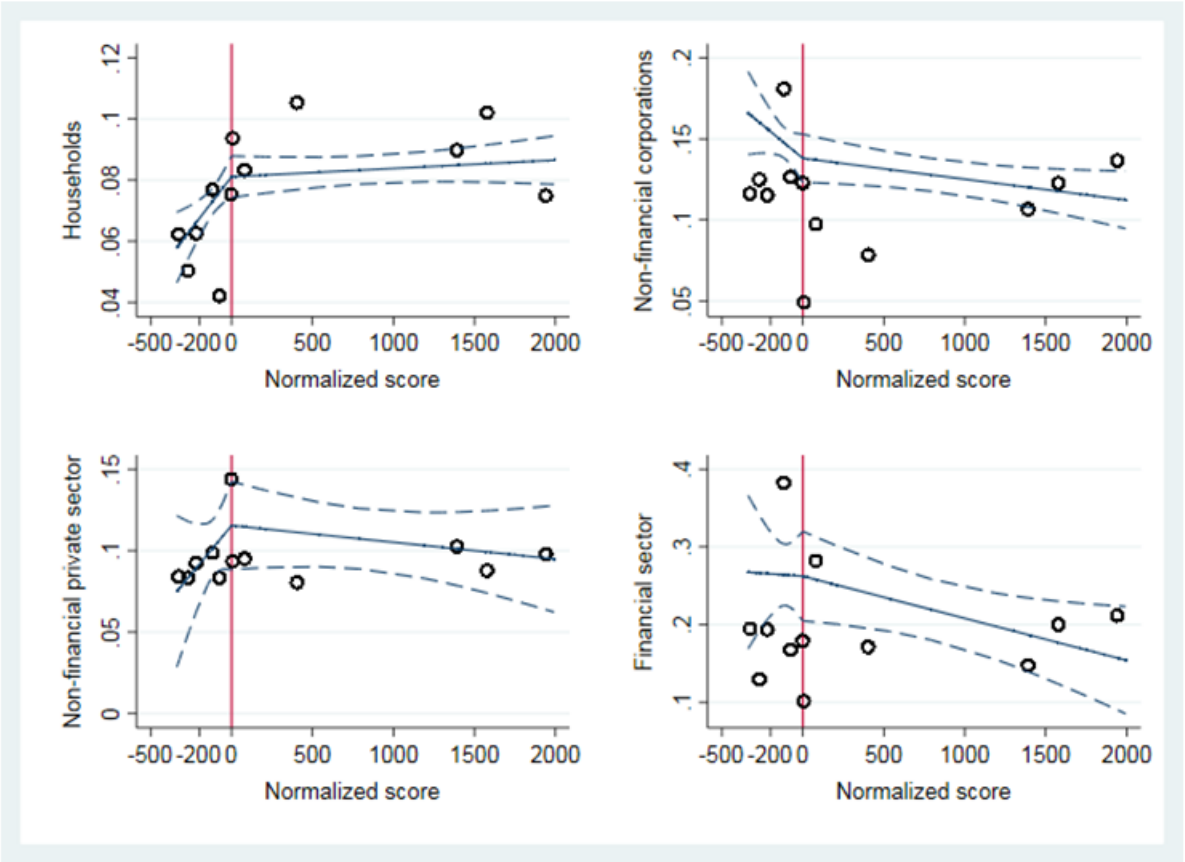
$$OSII_{itc} \cdot Post_{tc} = \zeta_0 + \zeta_1 D_{itc} + \zeta_2 (D_{itc} \cdot Post_{tc}) + \zeta_3 (S_{itc} - S_c) + \zeta_4 (S_{itc} - S_c) D_{itc} + \gamma \cdot X_{itc} + \varepsilon_{itc}$$

where:

- Y_{itc} is the outcome variable - lending, risk-taking...
- $OSII_{itc}$ is a dummy that takes value 1 if bank *i* in country *c* has been identified as OSII and 0 otherwise.
- $S_{itc} - S_c$ is the bank's normalized score.
- $Post_{tc}$ is a dummy that equals 1 after the notification of the capital buffer.
- ε_{itc} is the individual error term.
- X_{itc} is a vector of control variables, namely the CET1 (for both parent and subsidiary) and the country's unemployment rate.
- β_2 is the coefficient on the interaction term ($OSII_{itc} \cdot Post_{tc}$) ie thefuzzy kink estimator which identifies the effect of being designated as O-SII on the outcome of interest, Y_{itc}.

Results lending: All subsidiaries (RKDplot)

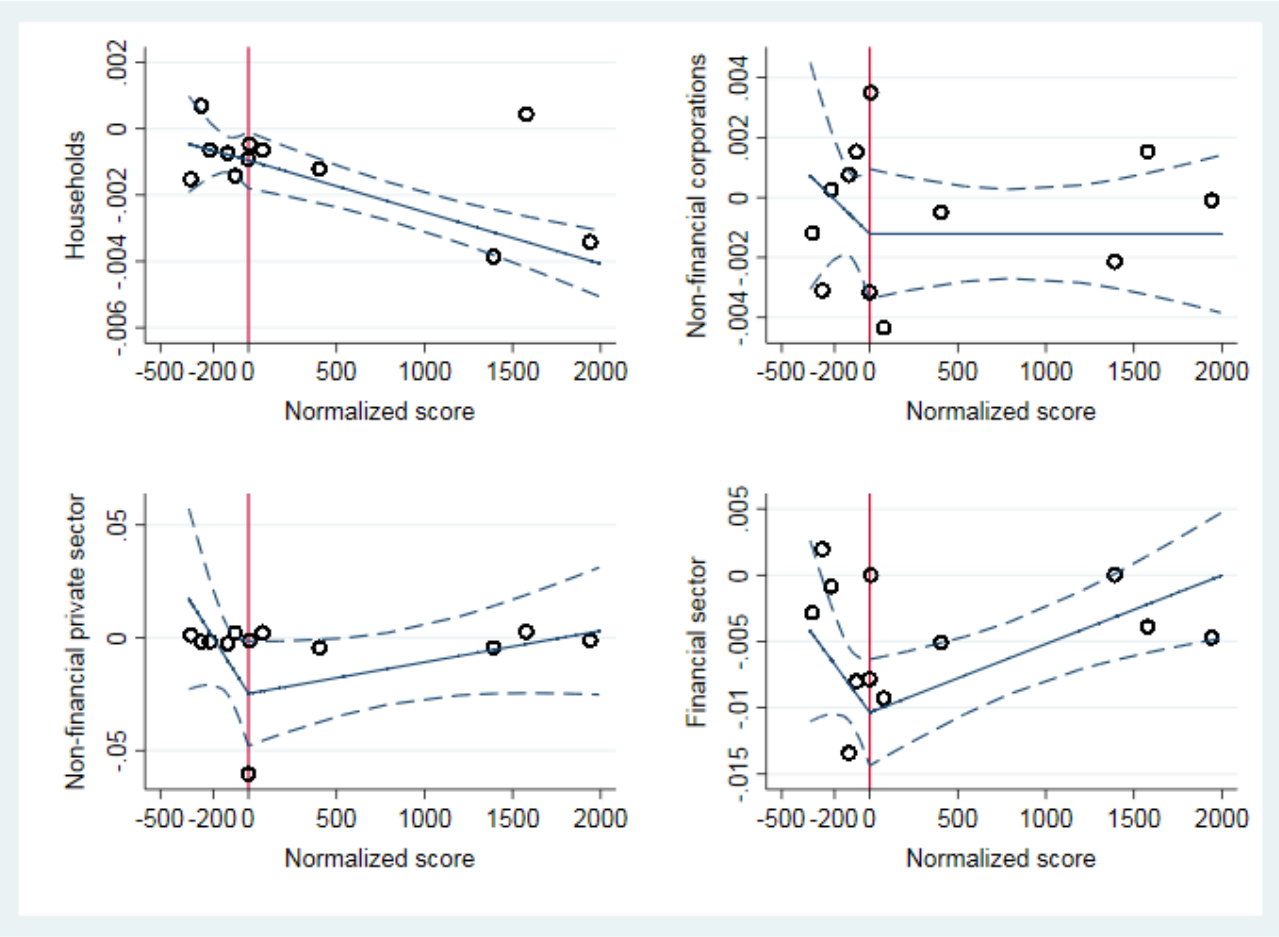
Average effect on affiliated banks' lending



Notes: Fuzzy regression kink design graph for credit growth. The vertical axis displays the dependent variable value post-notification. The horizontal axis measures the score distance from the threshold. The central line plots fitted values of the regression of the dependent variable on a second-order polynomial in score distance from the threshold, estimated separately on each side of the cutoff; the lateral lines represent the 95 percent confidence interval.
Data aggregated in 4 segments: HH; NFC; NFPS; FS

Results risk-taking: All subsidiaries (RKDplot)

Average effect on affiliated banks' risk-taking



Notes: Fuzzy regression kink design graph for risk-taking. The vertical axis displays the dependent variable value post-notification. The horizontal axis measures the score distance from the threshold. The central line plots fitted values of the regression of the dependent variable on a second-order polynomial in score distance from the threshold, estimated separately on each side of the cutoff; the lateral lines represent the 95 percent confidence interval.
Data aggregated in 4 segments: HH; NFC; NFPS; FS

Results risk-taking: All subsidiaries (Fuzzy reg. kink design)

Average effect on affiliated banks' risk-taking

	Households	Non-financial corporations	Non-financial private sector	Financial sector
Δ Risk-weights				
MSE-optimal bandwidth	-0.004	-0.011*	-0.006*	0.001
	(0.004)	(0.005)	(0.002)	(0.010)
CER-optimal bandwidth	-0.001	-0.008*	-0.014**	0.003
	(0.002)	(0.003)	(0.005)	(0.008)
Observations	2224	2331	2368	2095

Notes: Fuzzy regression kink design estimates for the effect of the ultimate parent's O-SII identification on affiliated banks' risk-taking. The dependent variable is the quarterly change in the average risk-weights. We perform local linear regressions with a triangular kernel using the MSE and CER-optimal bandwidths. All regressions include a polynomial of degree one in the score distance from the threshold and control variables, namely, the country's unemployment level and the CET1 level of both the subsidiary and the parent institution. Standard errors are clustered at the bank level. ***, **, and * denote significance at the 1, 5 and 10 percent level.
$\beta 2$ is presented for both mean squared error optimal and coverage error rate optimal bandwidths (developed by Calonico et al (2016)) .

- Affiliated banks with Parents identified as an O-SII tend to shift their lending to less risky counterparts in the non-financial private sector, in particular in the non-financial corporations sector.