The (un)intended Effects of Government Bailouts: the Impact of TARP on the Interbank Market and Bank Risk-taking

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Research Question and Background

- How did the large inflow of liquidity through TARP funds impacts banks' interbank market activity, and what were potential consequences?

- We look at two major interbank liquidity sources: the unsecured Federal Funds Market and the secured Repurchase Agreements (Repos) market usually recognized as overnight and over-the-counter markets in which banks lend and borrow interbank loans and securities.

- We focus on the Troubled Asset Relief Program (TARP) that initiated in 2008:Q4 with 204.9 billion USD preferred equity injected into U.S. banks through an application-approval procedure, making it the largest bailout in history.

- We use TARP as a plausibly exogenous shock, and the stressed fed funds and repos markets after Lehman's collapse to isolate the causal effect of bailout capital on recipient banks' relative liquidity position in the interbank market. We also further investigate how this impacted bank credit risk-taking and profitability.

Main hypothesis

- We propose several potential theoretical channels regarding the effects of TARP on the interbank market and subsequent credit risk-taking.

  – Hypothesis 1: TARP recipient banks enlarged their interbank exposure after TARP relative to non-TARP banks → capital spillover effect

  – Alternative hypothesis: banks hoarded the liquidity instead

- Related questions

  – Was the effect immediate, was it lasting (at least until the end of the sample period)?

  – Which of the components of interbank market activity drive the documented effect?

  – Did this have any implications for risk-taking?

Data and Variables

- Data: Consolidated U.S. Call Reports on a quarterly basis and the bank level from 2005:Q1 to 2012:Q4 deflated in real values, matched with the TARP transaction list of the Treasury.
- Filters: We drop foreign banks, saving banks, S&Ls, thrifts, credit card institutions and failed banks. We further exclude banks that publicly declined TARP and community banks according to FDIC criteria
- Sample size: 26,763 bank-quarter observations including 895 banks for 32 quarters of 8 years (76% TARP banks and 24% non-TARP banks)

- Dependent Variables: *Interbank Exposure* is the aggregated trading volume of federal funds sold and purchased, repos and reverse repos; We proxy for bank credit risk by *Loan and Lease Losses Allowance* and *Non-Performing Loans* as forward- and backward-looking measures.
- Independent Variables: Interaction between *TARP Bank* as TARP recipient indicator, and *Post* as TARP start time indicator that equals 1 in and after 2008:Q4 when TARP initiated.
- Control Variables: *Bank Controls* include fundamental bank characteristics such as *Size, HHI Deposit Index,* and *Total Branches over Assets* etc. Proxies for CAMELS include standard bank indicators for the regulation on financial health. We also include the *Year-Quarter Fixed Effects* and *Bank Fixed Effects* to further account for the omitted variable bias.

Graphical Evidence on Interbank market activity

- Overall interbank market activity relative to total assets

- Parallel trend before TARP and structural break after TARP

- After TARP, both bank groups kept reducing interbank market activity, but the non-TARP banks did so much more
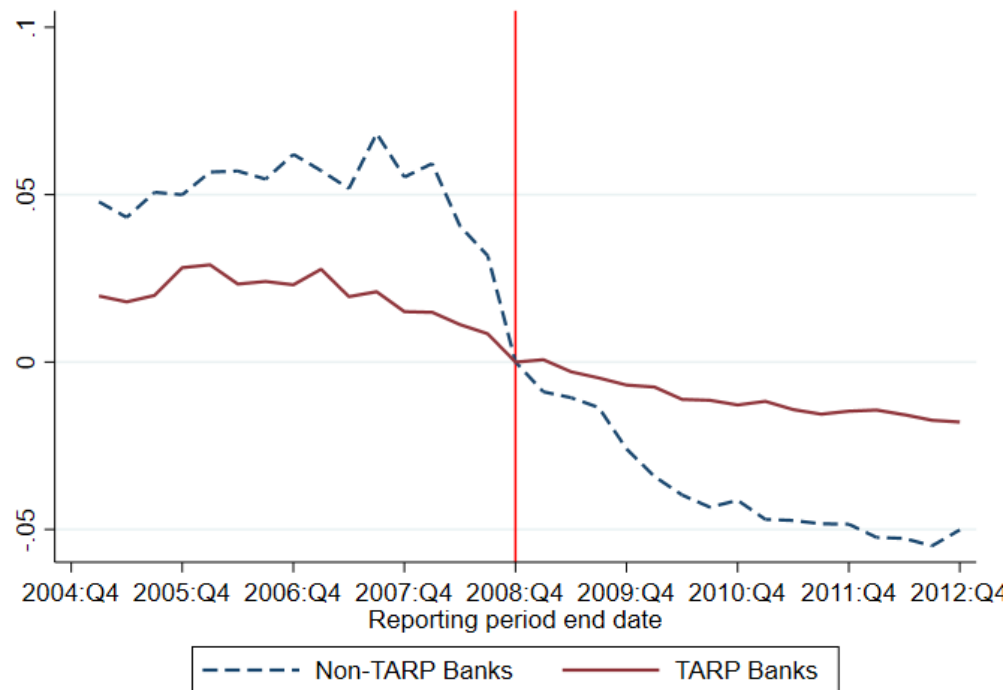
Graphical Evidence on Federal Funds Sold

- Interbank lending relative to total assets

- Parallel trend before TARP and structural break after TARP

- Both groups sharply decreased their interbank lending after Lehman's bankruptcy in 2008:Q3.

- After TARP, the non-TARP banks decreased interbank lending much more than the TARP banks
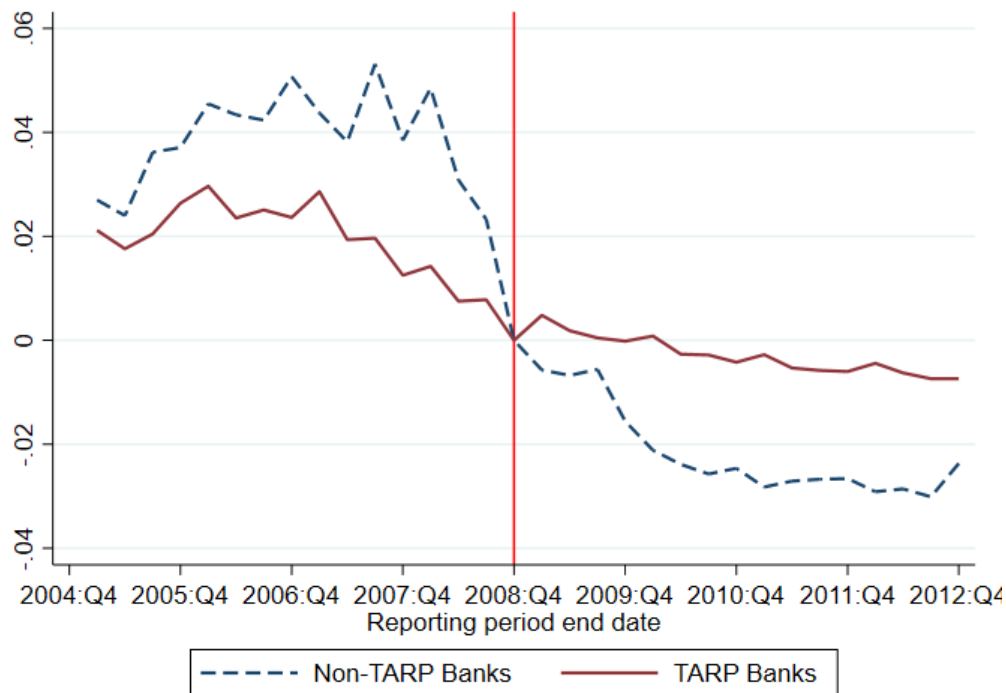
Empirical setup: Difference-in-Difference (DiD) Design

DiD Model: $InterbankExposure_{i,t} = \alpha_0 + \alpha_1 TARPBank_i \times Post_t +$
$\alpha_2 YearQuarterFixedEffects_t + \alpha_3 BankFixedEffects_i + \alpha_4 X_{i,t-1} + \epsilon$

$TARPBank_i \times Post_t$ is my DiD variable of interest; X is a vector of control variables lagged by one quarter; ϵ is the error term. $TARPBank$ and $Post$ are subsumed by fixed effects. If α_1 is significantly positive, H1a is statistically dominant over H1b in the sample, and vice versa.

- For the credit risk regressions, we use a triple interaction with the absolute amount of the interbank exposure

Baseline regression results

Dependent variable	Interbank exposure					
	(1)	(2)	(3)	(4)	(5)	(6)
TARP Bank $\times$ Post	40.639**	66.155**	49.279**	50.145**	60.129***	51.124**
	(19.836)	(26.247)	(19.716)	(22.372)	(22.628)	(22.303)
Year-Quarter FE	No	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	Yes	Yes	Yes	Yes
Bank controls	No	No	No	Yes	No	Yes
Proxies for Camels	No	No	No	No	Yes	Yes
Mean of control group	160.628	160.628	160.628	158.547	158.547	158.547
Adjusted R-squared	0.002	0.001	0.681	0.703	0.688	0.704
Observations	26,763	26,763	26,763	25,863	25,863	25,863
Year-Quarter fixed effects	No	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	No	No	Yes	Yes	Yes	Yes

IV, Heckman Selection Model, and PSM

Dependent variable	Interbank exposure		
	(1)	(2)	(3)
TARP bank $\times$ post	417.458**	48.917**	67.539**
	(193.026)	(22.422)	(26.176)
Self-selection parameter (Lambda)		-155.587	
		(266.528)	
Mean of control group	158.547	158.547	149.769
Adjusted R-squared	0.704	0.704	0.671
Observations	25,863	25,863	11,595
First-stage instrument validity tests			
Underidentification test			
Kleibergen-Paap rk LM stat:	6.21**		
Chi-squared (2) P-value:	0.045		
Overidentification test			
Hansen J stat:	1.622		
Chi-squared (1) P-value:	0.203		
Bank controls	Yes	Yes	Yes
Proxies for CAMELS	Yes	Yes	Yes
Year-Quarter fixed effects	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes

Placebo Experiments: Time Placebo and Bank Placebo

- We conduct several placebo tests using different time horizons and a random selection of banks
- We do not get significant results

Dependent variable	Interbank exposure		
	(1) Only observations before 2008:Q4	(2) Only observations after 2008:Q4	(3) Random selection of TARP banks
TARP bank $\times$ placebo post	21.968	17.417	-9.008
	(52.758)	(11.313)	(9.888)
Adjusted R-squared	0.733	0.813	0.704
Observations	12,219	13,644	25,863
Bank controls	Yes	Yes	Yes
Proxies for CAMELS	Yes	Yes	Yes
Year-Quarter fixed effects	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes

Other tests to validate our results

- We estimate alternative econometric models varying the cluster variable (state, year-quarter, bank-year-quarter, state-year-quarter) → results hold

- We use 2009:Q1 as the start of TARP → results hold

- We control for other government interventions such as the Term Auction Facility (TAF), discount window (DW), Federal Deposit Transaction Account Guarantee Program (TAGP), Temporary Debt Guarantee Program (TDGP) → results hold

- We perform parallel trend tests → no violation of this assumption detected

- Alternative measure of TARP (TARP capital over assets) → results hold

Time dynamics

Dependent variable	Interbank Exposure	
	(1)	(2)
post 2009 × TARP Bank	43.463**	34.936**
	(17.471)	(17.677)
post 2010 × TARP Bank	41.349*	38.259
	(21.940)	(24.672)
post 2011 × TARP Bank	53.776**	57.407**
	(22.033)	(24.967)
post 2012 × TARP Bank	60.173**	79.383**
	(24.799)	(33.776)
Bank controls	No	Yes
Proxies for CAMELS	No	Yes
Year-Quarter fixed effects	Yes	Yes
Bank fixed effects	Yes	Yes
Mean of control group	160.628	158.547
P-value of Equality F-test:		
Effect in 2009 = Effect in 2010	0.897	0.814
Effect in 2009 = Effect in 2011	0.337	0.143
Effect in 2009 = Effect in 2012	0.369	0.249
Adjusted R-squared	0.681	0.704
Observations	26,763	25,863

Interbank exposure components

Dependent variable	Federal funds sold	Reverse Repos	Federal funds purchased	Repos
	(1)	(2)	(3)	(4)
TARP bank × post	36.291***	5.537	-1.553	10.849
	(13.979)	(6.803)	(8.581)	(8.322)
Mean of control group	46.497	11.046	35.286	65.718
Adjusted R-squared	0.239	0.621	0.520	0.921
Observations	25,863	25,863	25,863	25,863
Bank controls	Yes	Yes	Yes	Yes
Proxies for CAMELS	Yes	Yes	Yes	Yes
Year-Quarter fixed effects	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes

- → results driven by interbank lending in the unsecured federal funds markets

Results for credit risk and bank profitability measures

- Our results are consistent with the hypothesis that an increase in interbank maker activity increased bank interconnectedness and changed their incentive structure, possibly increasing moral hazard incentives, because of a higher future bailout probability.

Dependent variable	Loan and lease loss provisions		Non-performing loans		RoE (in basis points)		RoA (in basis points)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TARP bank × post	-2.089	-3.150	-1.931	-4.665	-221.208*	-210.864*	-3.598	-1.665
	(3.009)	(2.962)	(4.641)	(3.756)	(119.474)	(122.436)	(10.700)	(11.323)
TARP bank × post × interbank exposure		0.021**		0.038*		-0.096*		-0.019**
		(0.010)		(0.022)		(0.056)		(0.008)
Mean of control group	3.883	3.883	5.685	5.685	521.216	521.216	80.060	80.060
Adjusted R-squared	0.328	0.347	0.568	0.617	0.166	0.166	0.606	0.606
Observations	25,863	25,863	25,863	25,863	25,863	25,863	25,863	25,863
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Proxies for CAMELS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Conclusions

- Our study shows that TARP significantly increased participating banks' interbank market activity relative to the non-TARP banks with an average of increased interbank exposure of 32 percent or 51 million USD relative to others.

- We also show that the effect is immediate and lasting. Moreover, we show that the main driver of the documented effect is a relative increase of interbank lending; the effect is economically very large with 77 percent or 36 million USD on average

- We further document that the TARP banks with higher interbank market activity in the post-period increased their risk-taking – this was not accompanied by an increase of profitability

- Whether the findings were overall beneficial or detrimental for the banking / financial system cannot be finally determined by our study

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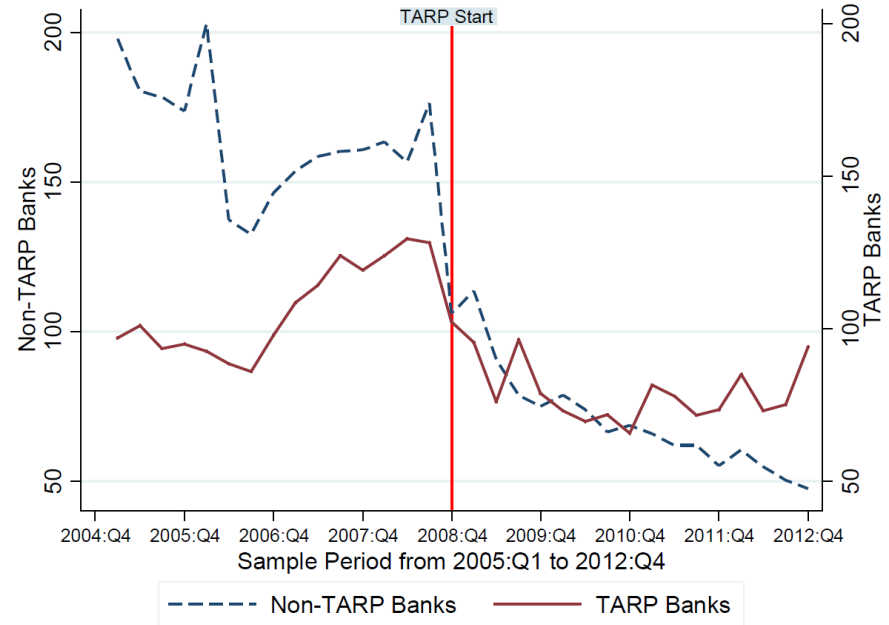Rensselaer Polytechnic Institute

Key Points of Paper

- The paper examines how the injection of funds through TARP to address the 2007/2008 financial crisis impacted the interbank market activities of the banking sector.

- They authors find that TARP banks significantly increased interbank market activity with the impact being both statistically significant and economically meaningful.

- The authors also find that among the TARP banks, the ones that increased interbank exposure the most also increased their credit risk due to the type of commercial and corporate loans that were made. Importantly, this increase in credit risk did not lead to an increase in profitability.

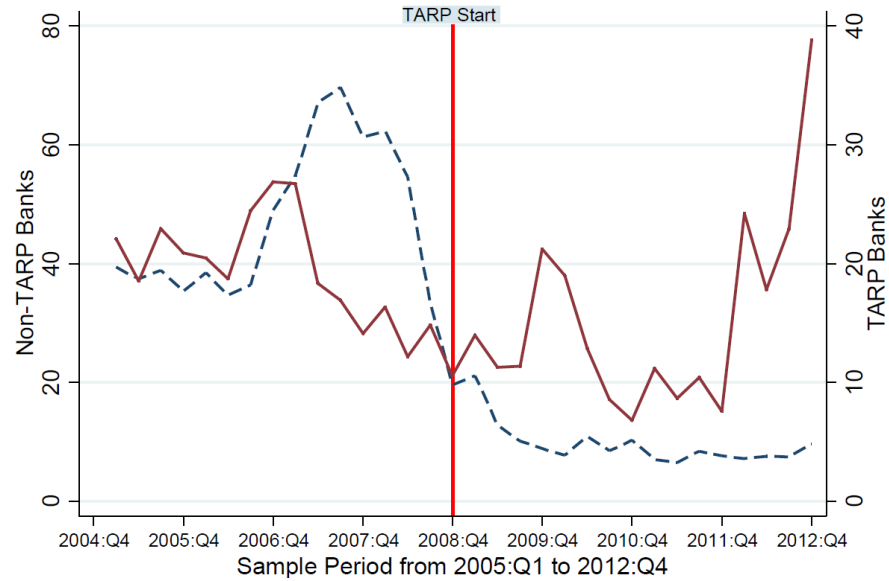- Using both DiD and 2SLS the authors contend that there findings are robust to endogeneity concerns.

Comment 1 – Interpretation of findings

- The authors contend that despite the fact that more than a decade has past since the banking sector bailout and numerous papers have been written on it we are still unclear as to the extent to which bailouts impact banks' behavior and the banking system in general.

- To this end their finding that the TARP banks increased their interbank exposure provides additional insights into the effect that bailouts can have.

- The authors suggest that this increase in interbank exposure is an unintended consequence of TARP and it is another channel through which bailouts can lead to an increase in banks' moral hazard incentives.

- I think the authors need to be a bit cautious with the assertion that the increase in interbank exposure was an undesired/unintended consequence of TARP.

Graph A: Average *Interbank exposure* for Non-TARP and TARP Banks

TARP Start

Non-TARP Banks (left axis): 200, 150, 100, 50

TARP Banks (right axis): 200, 150, 100, 50

Sample Period from 2005:Q1 to 2012:Q4

2004:Q4 2005:Q4 2006:Q4 2007:Q4 2008:Q4 2009:Q4 2010:Q4 2011:Q4 2012:Q4

- - - Non-TARP Banks   —— TARP Banks

Graph B: Average *Federal funds sold* for Non-TARP and TARP Banks

TARP Start

Non-TARP Banks (left axis): 80, 60, 40, 20, 0

TARP Banks (right axis): 40, 30, 20, 10, 0

Sample Period from 2005:Q1 to 2012:Q4

2004:Q4 2005:Q4 2006:Q4 2007:Q4 2008:Q4 2009:Q4 2010:Q4 2011:Q4 2012:Q4

Comment 1 - Continued

- During the crisis period as Alfonso et al (JF, 2011) point out banks were very reluctant to participate in the interbank market, because of counterparty risks concerns, this was the case especially for non-tarp banks as can be seen by the graphs.

- We should keep in mind that TARP had two objectives:
  - (i) stabilizing the financial system
  - (ii) promoting lending

- As such, the increase in interbank exposure could be due to TARP banks fulfilling their charge.

- Thus, this suggests that it was a desired consequence and may in fact not be a moral hazard issue.

- Speaking to people at the OCC and the Fed they point out that the TARP banks were encouraged and pressured to increase their lending activities.

- This could also be an explanation for the increase in credit risk.

Comment 2 – Empirical Approach

- Table 2 contains the baseline results in which a DiD approach is used.

- Now several papers in looking at the impact of TARP have also used the DiD approach for identification purposes and to address endogeneity concerns. So to some extent it is standard.

- However, using DiD in this setting could be misleading.
  - In this setting the bailed-out banks are typically treated as the "treatment" group.
  - However, not-being-bailed-out is also a treatment that in all likelihood will impact the banks in the control group.
  - Thus both the bailed out banks and the non-bailed out banks are treated.

- In presenting the results it is important to show not only the variable post interacted with TARP but the TARP banks and Post not interacted. The net effect is important.

- I would also suggest that you adjust the raw variables so that the coefficients and SE are not as large.

- It appears that the fact that some of the banks repaid the TARP funds relatively early is not accounted for. This should be done.

Comment 3 – 2SLS

- The authors also addressed endogeneity concerns using two stage least squares, with results presented in Table 3.

- In the first-stage the dependent variable is the TARPxPost interaction variable which is a 0/1 variable.

- Thus the first-stage is probably estimated using for e.g., a probit model from which the predicted value is used in the second stage.

- If this is in fact what took place then endogeneity is probably still a problem.

- This is the well known "impossible regression."
  - The conditional expectations operator and linear projection do not carry through non-linear functions (se, e.g., Greene, 2008). So estimates would still be inconsistent.

- It would also be helpful to present the first stage results so that we can get a better idea of the results.

- Also included in Table 3 the authors present self-selection results.
  - The question exists as to whether being in the TARP group is a result of banks selecting into the TARP group – in reading the literature one gets the impression that at least for the first group of banks several of them did not have a choice but to be part of it. That is why for example, CITI group quickly got out of it.
  - Additionally, if I am interpreting the specification properly the above problem also exists here.

A Suggestion for Organization

- In presenting the results I would order them differently.

- I would first present the OLS results for the TARP banks.

- Then because PSM is essentially OLS and does not get at endogeneity – I would then present them after the OLS results.

- I would then follow that with the DiD results.

- I would present the 2SLS results once the Impossible regression problem is dealt with. I would also drop the selection results.

- Finally, I would then present the other analyses
  - You may need to provide an explanation for how is it that a meaningful portion of TARP banks were not profitable but were able to pay back their TARP funds and that the treasury made a significant amount of money from the preferred shares and warrants.