

The (un)desired 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 the large inflow of liquidity through TARP funds impacts banks' interbank market activity, and what is the consequence thereof?

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.

Among various government interventions, 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 itself as 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 the distorted relative interbank liquidity position may impose effects on bank credit risk-taking and profitability.

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Hypotheses

We propose several potential theoretical channels regarding the miscellaneous effects of TARP on the interbank market and subsequent credit risk-taking, but yield diverging predictions. We focus on statistically testing which opposing hypothesis dominates in my sample.

H1a. TARP recipient banks enlarged their interbank exposure after TARP relative to non-TARP recipients, <i>ceteris paribus</i>.	H1b. TARP recipient banks shrank their interbank exposure after TARP relative to non-TARP recipients, <i>ceteris paribus</i>.
“Capital Spillover” Channel 	“Counterparty Risk and Liquidity Hoarding” Channel 
(Long-term effect)	(Short-term effect)
H3a. The interbank exposure has a risk-increasing marginal effect on the credit risk of the bailed-out banks, <i>ceteris paribus</i>.	H3b. The interbank exposure has a risk-decreasing marginal effect on the credit risk of the bailed-out banks, <i>ceteris paribus</i>.
“Predation” Channel 	“Capital Cushion” Channel 
“Cost-Advantage” Channel 	“Stigma” Channel 
“New Government Safety Net” Channel 	“Regulatory Restriction and Market Discipline” 
(Short-term effect)	(Long-term effect)

Data and Variables

Data: Consolidated U.S. Call Reports on quarterly and bank level from 2005:Q1 to 2012:Q4 deflated in real values, matched with 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 publicly declared TARP and identified as local community banks by FDIC in control group, in order to construct a more valid comparable sample.

Sample: 26,763 bank-quarter observations including 895 banks for 32 quarters of 8 years.

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 variables.

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Sample: 10,000 bank-quarter observations including 895 banks for 32 quarters of 8 years.
Dependent Variables: *Trading Volume* is the aggregated trading volume of federal funds sold and purchased, repos and reverse repos. We proxy for bank credit risk by *Loss* and *Loss 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.
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Independent Variables: *Interaction* between *TARP* and *Bank* as TARP response 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 *Capital* 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 variables.

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Control Variables: Bank Controls include fundamental bank characteristics such as *Size*, *HHI*, *Deposit Index*, and *Total Branches over Assets* etc. Proxies for *Bank Health* 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 variables.

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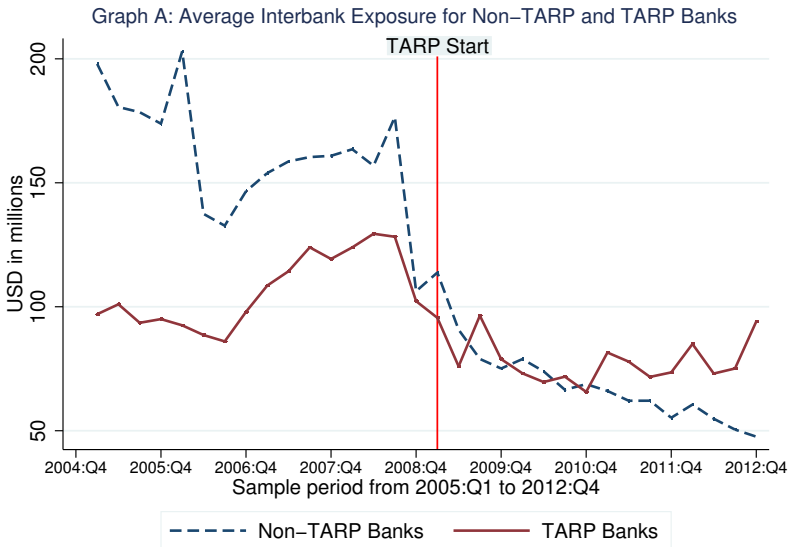
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Graphical Evidence on Interbank Exposure

We observe a relatively parallel trend in *Interbank Exposure* before 2008:Q4 when TARP started.

Both groups of banks sharply decreased interbank trading volume since the crisis embarked, suggesting a stressed interbank market documented.

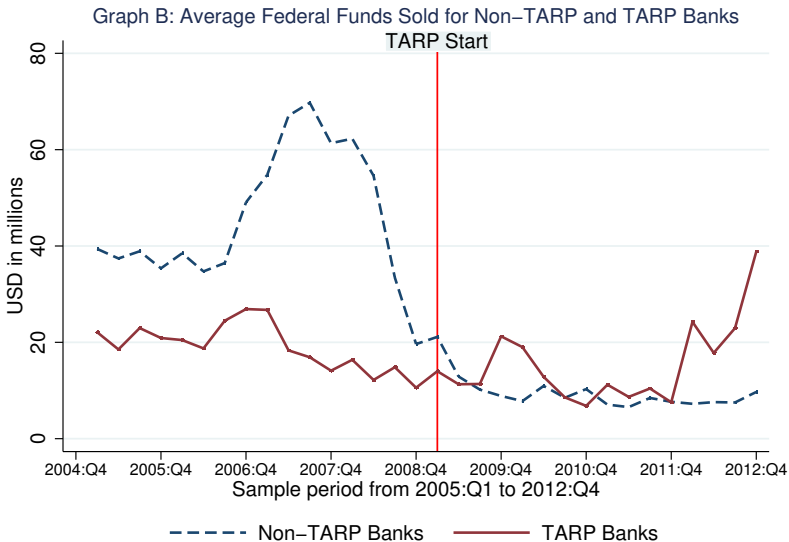
Relative liquidity positions switched after TARP, more consistent with [H1a](#).



Graphical Evidence on Federal Funds Sold

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

TARP recipients increased lending to other banks after TARP, while control banks maintained lending level relatively flat.

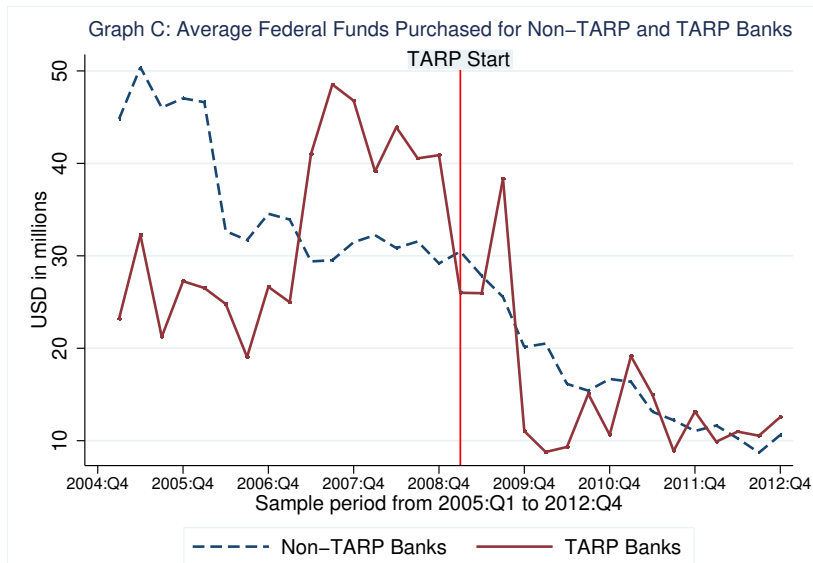


Graphical Evidence on Federal Funds Purchased

TARP banks were more crunched in liquidity, and borrowed more interbank debt when the crisis approached.

After the TARP capital injection, TARP banks significantly borrowed less liquidity than control banks.

Nevertheless, to test the validity of *ceteris paribus* condition, we turn to the regression analysis.



Identification and Model: Difference-in-Difference (DiD) Design

$$\text{DiD Model: } \text{InterbankExposure}_{i,t} = \alpha_0 + \alpha_1 \text{TARPBank}_i \times \text{Post}_t + \alpha_2 \text{YearQuarterFixedEffects}_t + \alpha_3 \text{BankFixedEffects}_i + \alpha_4 X_{i,t-1} + \epsilon$$

$\text{TARPBank}_i \times \text{Post}_t$ 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.

$$\text{CreditRisk}_{i,t} = \beta_0 + \beta_1 \text{TARPBank}_i \times \text{Post}_t + \beta_2 \text{YearQuarterFixedEffects}_t + \beta_3 \text{BankFixedEffects}_i + \beta_4 X_{i,t-1} + \mu$$

$\text{TARPBank}_i \times \text{Post}_t \times \text{YearQuarterFixedEffects}_t$ is the triple-DiD term of interest. μ includes all dual-interaction and single terms in the triple-DiD interaction, and all control variables lagged by one quarter; μ is the error term. If β_1 is significantly positive, H3a is statistically dominant over H3b in the sample, and vice versa.

We estimate the equations above using the OLS method and cluster SEs on the bank level.

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Triple-DiD Model:

$$\text{CreditRisk}_{i,t} = \beta_0 + \beta_1 \text{TARPBank}_i \times \text{Post}_t \times \text{InterbankExposure}_{i,t} + \beta_2 \text{YearQuarterFixedEffects}_t + \beta_3 \text{BankFixedEffects}_i + \beta_4 Z_{i,t-1} + \mu$$

$\text{TARPBank}_i \times \text{Post}_t \times \text{InterbankExposure}_{i,t}$ is the triple-DiD term of interest; Z includes all dual-interaction and single terms in the triple-DiD interaction, and all control variables lagged by one quarter; μ is the error term. If β_1 is significantly positive, H3a is statistically dominant over H3b in the sample, and vice versa.

We estimate the equations above using the OLS method and cluster SEs on the bank level.

Regression Analysis on TARP and Bank Interbank Exposure

Panel A: Regressions results for Effects of TARP on Bank Interbank Exposure

Dependent variable	Interbank Exposure					
	(1)	(2)	(3)	(4)	(5)	(6)
TARP Bank × Post	40.639** (19.836)	66.155** (26.247)	49.279** (19.716)	50.145** (22.372)	60.167*** (22.649)	51.084** (22.289)
Bank Controls	No	No	No	Yes	No	Yes
Proxies for CAMELS	No	No	No	No	Yes	Yes
Year-Quarter Fixed Effects	No	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effects	No	No	Yes	Yes	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

Panel B: Regression results for Components of Bank Interbank Exposure

Dependent variable	Fed Funds Sold	Resale Agreements	Fed Funds Purchased	Repurchase Agreements
	(1)	(2)	(3)	(4)
TARP Bank × Post	36.285*** (13.934)	5.526 (6.803)	-1.565 (8.587)	10.839 (8.317)
Controls and Fixed Effects	Yes	Yes	Yes	Yes
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

Instrumental Variable (IV) and First-Second Stage Results ✓

We use *Subcommittee on Financial Institution* to proxy bank's political connection thus to instrument *TARP Bank*, using a three-stage IV analysis method for binary instruments.

Instrumental variable analysis results, first and second stage results

Dependent variable	TARP Bank	
	(1)	(2)
Panel A: First stage using Probit model		
Subcommittee on Financial Institutions or Capital Markets	0.262** (0.112)	0.244** (0.114)
Bank controls	No	Yes
Proxies for CAMELS	No	Yes
Year-Quarter Fixed Effects	Yes	Yes
Bank Fixed Effects	No	No
Pseudo R-squared	0.007	0.095
Observations	26,763	25,863
Panel B: Second stage using OLS model		
TARP Bank first-stage-fitted	1.052*** (0.085)	1.383*** (0.290)
Bank controls	No	Yes
Proxies for CAMELS	No	Yes
Year-Quarter Fixed Effects	Yes	Yes
Bank Fixed Effects	No	No
Adjusted R-squared	0.121	0.122

IV analysis, Heckman two-stage selection model and PSM results ✓

Dependent variable	Interbank exposure		
	(1)	(2)	(3)
TARP bank fitted × post	532.916* (322.050)		
TARP bank × post		48.812** (22.415)	68.275*** (26.486)
TARP bank fitted	-826.785* (490.701)		
Self-selection parameter (Lambda)		-155.776 (256.294)	
Mean of control group	158.547	158.547	149.769
Adjusted R-squared	0.705	0.704	0.671
Observations	25,863	25,863	11,595
First-stage instrument validity tests			
Weak identification test			
Cragg-Donald Wald F-stat:	63.793***		
Kleibergen-Paap rk Wald F-stat:	3.497**		
Underidentification test			
Kleibergen-Paap rk LM stat:	6.908**		
P-value of Hausman endogeneity test of endogenous regressors:			
	0.202		
Bank controls	Yes	Yes	Yes

Placebo Experiments: Time Placebo and Bank Placebo ✓

We conduct several placebo tests on different time horizons and 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 × placebo post	22.061 (52.786)	17.416 (11.319)	-9.074 (9.893)
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

Alternative Econometric Models

We first use **different SE clustering methods** in full specifications of DiD and triple-DiD models in Panel 1-4. We finally **redefine TARP start as 2009: Q1** by when 97.01% of TARP funds had been disbursed, and report results in Panel 5. **This yields consistent results.** ✓

Dependent variable	Interbank exposure				
	(1)	(2)	(3)	(4)	(5)
TARP bank × post	51.085* (28.062)	51.085*** (6.615)	51.085*** (10.054)	51.085*** (10.493)	49.233** (21.937)
					0.200
Adjusted R-squared	0.704	0.704	0.704	0.704	0.704
Observations	25,863	25,863	25,863	25,863	25,863
Mean of control group	158.547	158.547	158.547	158.547	158.547
Clustering by TARP start	state 2008:Q4	year-quarter 2008:Q4	bank-year-quarter 2008:Q4	state-year-quarter 2008:Q4	bank 2009:Q1
Bank controls	Yes	Yes	Yes	Yes	Yes
Proxies for CAMELS	Yes	Yes	Yes	Yes	Yes

Results for credit risk and bank profitability measures

Our results are consistent with the hypothesis that an increase in interbank market activity increased bank interconnectedness and changed their incentive structure, possibly moral hazard, 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 \times post	-2.089 (3.009)	-3.150 (2.962)	-1.931 (4.641)	-4.665 (3.756)	-221.208* (119.474)	-210.864* (122.436)	-3.598 (10.700)	-1.665 (11.323)
TARP bank \times post \times interbank exposure		0.021** (0.010)		0.038* (0.022)		-0.096* (0.056)		-0.019** (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 with an average of increased interbank exposure by 32 percent or 51 million USD relative to others.

We also show the effect is immediate and lasting. Moreover, we show the main driver of the increase of interbank exposure in the increase of interbank lending with 77 percent or 36 million USD on average than others.

We further document that banks that increased interbank market activity also increased their risk-taking but was not accompanied by an increase of profitability, suggesting an overall detrimental impact for individual banks.

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