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

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Abstract

We analyze how the inflow of liquidity through TARP funds in the wake of the 2007/2008 financial crisis impacted banks' interbank market activity. We show that TARP banks increased interbank market activity statistically and economically in a very significant way. Their interbank lending increased by 77% relative to the mean of the control group of non-TARP banks. We further show that among the TARP banks, the ones with increased interbank exposure also increased credit risk taking, in particular in the portfolio of commercial and corporate loans, while at the same time not increasing profitability. These findings suggest a new, heretofore not investigated channel through which TARP may have increased banks' moral hazard incentives.

Keywords: Banks, financial crisis, government bailout, interbank market, risk taking, TARP.
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1. Introduction

Despite a recent surge in research about government bailouts of banks, it is still not fully answered how such bailouts impact banks' behavior and the banking system at large. This refers both to whether governments should bailout banks at all as well as to how banks should be bailed out. These questions are of paramount importance as could be witnessed during and after the last financial crisis of global impact that originated in 2007. Shortly after the collapse of Lehman Brothers in September 2008, besides various other interventions, the U.S. Treasury decided to implement the Troubled Asset Relief Program (TARP) through which it purchased preferred equity and warrants from 707 U.S. financial institutions totaling 204.9 billion U.S. dollars (USD). The basic intentions of TARP were that banks should use the inflow of this vast amount of liquidity to give loans to firms in order to enhance overall financial stability, improve general economic conditions and increase credit availability.[1] There is ongoing debate among practitioners and academics whether TARP was successful in achieving its goals and whether there were other, unintended consequences and how these affected banks, the banking system, and financial stability.

In this study, we document that TARP significantly impacted the interbank market, an unintended consequence of TARP that was heretofore uninvestigated. We use the start of TARP in the fourth quarter of 2008 as exogenous variation and construct a treatment group composed of banks that received TARP funds (the TARP banks). Banks that did not receive TARP fund (the non-TARP banks) compose the control group. We then make use of quarterly Call Report data between 2005 and 2012 and compute interbank exposure or activity as the sum of interbank loans, interbank borrowing, repurchase agreements (Repos) and reverse Repos (as in, e.g., Langfield et al., 2014).[2] The interbank exposure is regressed on the interaction term between two dummy variables indicating the start of TARP and whether a bank was a TARP-bank or not.

We run several specifications with and without controls and fixed effects. The DiD estimator is statistically significant on at least the 5 percent level in all specifications and its economic magnitude ranges from 27 percent relative to the pre-TARP control group mean in the specification without any controls and fixed effects to 58 percent relative to the control group mean in the specification that includes only year-quarter fixed effects. The economic magnitude of the effect in

[1] See Section 2 of the Emergency Economic Stabilization Act issued on October 3, 2008, that established the TARP initiative.

[2] The gross exposure is used in International Financial Reporting Standards (IFRS). For instance, IFRS requests banks to report the exposure to particular financial instruments as gross exposure with other inter-institution on-balance sheet items. Furthermore, the gross exposure is used by the Bank for International Settlement (BIS) for the measurement of the interbank exposure (BIS, 2013).

our preferred specification, which includes year-quarter and bank fixed effects as well as time-varying bank-level controls and proxies for CAMELS, amounts to 32 percent of the control group mean. This translates into an increase of interbank exposure of around 51 million USD for the average TARP bank relative to the pre-TARP mean of the control group of non-TARP banks.

This result is robust to different regression specifications and a variety of robustness tests. Similar to Duchin and Sosyura (2014), Berger and Roman (2017), and Berger et al. (2019), we implement an instrumental variable (IV) approach and create a dummy variable *Subcommittees on Financial Institutions or Capital Markets*. This variable takes on the value of one if a bank is headquartered in a congressional election district of a member of the Subcommittee on Capital Markets or the Subcommittee on Financial Institutions of the 110th and 111th House Financial Services Committee in 2008 or 2009. We use this variable as an instrument for TARP participation and perform a two-stage least squares regression analysis. While statistical significance remains in this analysis, the economic magnitude is about 2.5 times the size of the control group mean, a larger effect than in the baseline specification. Several other robustness tests such as Heckman's two-stage selection model, propensity score matching analysis and specifications using different regression setups and controls for other government interventions confirm the statistical and economic significance of the DiD estimator. The size of the coefficient of the DiD estimator is very close to the one in the baseline specification in all these robustness tests. Finally, we run placebo tests whereby we only use observations from the time-period before TARP, only observations from the time-period after TARP, and a random selection of banks from both treatment and control group to form a placebo treatment group. The DiD estimator is not significant in any of these placebo tests.

We then show that the effect of TARP on the interbank market seems to be an immediate and lasting effect. Running triple interaction term regressions whereby the DiD estimator is interacted with dummy variables indicating the years 2009, 2010, 2011, and 2012 shows that the effect on the interbank market was immediate and lasting. The size of the coefficient of the triple interaction term associated with the year 2009 amounts to 22 percent of the control group mean and is significant on the 5 percent level. It rises to 50 percent of the control group mean for the triple interaction term for 2012 and continues to be significant on the 5 percent level. However, the difference between the coefficients for 2009 and 2012 is not statistically significant (p-value 0.25), indicating that the effect of TARP was immediate and lasting, albeit somewhat upward trending.

Finally, we show that the main driver of this finding is an increase in interbank lending of TARP banks. Specifically, interbank lending of the average TARP bank increased by around 77 percent or 36 million USD relative to the control mean of non-TARP banks. On the other hand, we do not find a change of interbank borrowing, Repo and reverse Repo transactions associated with TARP banks. These findings display an unintended consequence of TARP as there is no official communication stating that the Treasury wanted TARP to affect the interbank market in any way.

An important question arising from these findings is whether this "misuse" of the TARP money was beneficial or detrimental for banks, the banking system, and ultimately financial stability. We provide some suggestive evidence to address this question. On the one hand, it could be argued that the increase of interbank lending caused by TARP stabilized the interbank market, which was in turmoil after the collapse of Lehman Brothers (Afonso et al., 2011). On the other hand, it may have changed banks' behavior by changing their risk-taking as a consequence of moral hazard incentives induced by the increase of their interbank activity and the ensuing higher interconnectedness. While our setup and data do not enable us to investigate whether the rise of TARP banks' interbank activity stabilized the interbank market, we show that both loan and lease loss provisions and non-performing loans of TARP banks increased as a consequence of the rise in interbank activity.

Specifically, we interact the DiD estimator with the interbank market exposure and show that this triple interaction term is highly significant for both measures of banks' credit risk. The coefficient size of the triple interaction term indicates that loan loss provisions for the average TARP bank increased by 27 percent (about 1.05 million USD) and non-performing loans increased by 34 percent (1.9 million USD) relative to the control group means. Both effects are economically meaningful. These findings suggest that TARP banks increased their risk-taking as a consequence of the increase of interbank market activity. This result is different from the results of previous research that documented that banks' moral hazard incentives increased because of too-big-to-fail arguments (Black and Hazelwood, 2013). Our findings suggest that not only bank size drove higher riskiness of banks in the wake of TARP because we control for asset size, but also a higher interconnectedness as a result of more interbank market activity.

Further analyses show that the increase in risk-taking stems mainly from a shift towards riskier commercial and corporate lending. This is not a mechanical effect of giving more loans to firms – one of the major intended consequences of TARP – because we control for the size of bank assets in all regressions and when we split the sample by asset size and rerun all regressions, we do not see any significantly different results between the groups. It rather seems that banks recomposed their corporate and commercial loan portfolio. On the other hand, we do not see any risk effect associated with interbank or mortgage loans.

Finally, we provide some evidence that the increase in risk-taking was not accompanied by an increase in accounting returns. When we substitute the risk measures with return on equity and return on assets, the triple interaction term becomes negative and significant, indicating that while banks' credit risk increased as a function of interbank market activity, their accounting returns decreased. To this end, it seems that the unintended consequence of TARP on the interbank market may have been detrimental for individual banks. In combination with the risen connectedness of the TARP banks with other banks through the interbank lending channel, this may have led to hard to predict consequences for the banking system and financial stability.

Showing that TARP impacted the interbank market and, subsequently, bank risk-taking is a novel result in the literature. It adds a new view on how banks used or misused the TARP money and suggests that it may not be enough in a government bailout of banks to publicly state the objectives, but also to implement proper controls in order to achieve these objectives and prevent banks from using some part of the proceeds for unintended purposes.

Our study relates to the literature about government bailouts of banks, in particular the effects of TARP on bank behavior and the banking system. For example, Black and Hazelwood (2013) argue that banks increased their risk-taking as a consequence of more moral hazard incentives driven by too-big-to-fail considerations. Berger and Roman (2015) find that TARP resulted in a competitive advantage for participating banks and increased both their market shares and market power. Berger et al. (2018) document that TARP banks increased credit supply more to risky borrowers, consistent with more exploitation of moral hazard incentives and with our findings. Berger et al. (2019) find that TARP significantly reduced TARP beneficiaries' contributions to systemic risk through a potential capital cushion channel. Duchin and Sosyura (2012) document that more politically connected banks invested in more under-performing loans, suggesting that government guarantees may distort investment efficiency and enhance credit risk-taking. Their results also indicate that TARP banks approved riskier loans after controlling for the selection of TARP banks instrumented by political connectedness. Duchin and Sosyura (2014) suggest that TARP banks showed an increase in volatility and default risk by making more risky loans and shifting assets towards riskier securities after receiving the government support. Our results add to these findings by showing that the increase in interbank market activity and ensuing moral hazard incentives may have been one of the channels through which risk shifting took place.

Our findings also relate to studies arguing that bailouts may induce moral hazard incentives for the TARP recipient banks to aggressively increase credit risk because of a higher possibility of future bailouts (e.g., Acharya and Yorulmazer, 2007; Kashyap et al., 2008). Gropp et al. (2011) investigate the interplay between government bailout policies, bank risk-taking and competition. Their results suggest that government bailouts increase bank risk-taking, but only for competing banks. On the other hand, some studies argue that the extra explicit or implicit government restrictions that accompany bailouts may also reduce moral hazard effects of the bailed out banks (e.g. Berger and Roman, 2015; Berger et al., 2019).

Some related studies analyze the effect of TARP on bank borrowers. For instance, Norden et al. (2013) use an event study approach to investigate the valuation effect of TARP on the relationship with corporate borrowers and find that TARP led to a significantly positive impact on borrower firms' stock returns after the lender banks received the TARP money. Song and Uzmanoglu (2016) document that firms borrowing from healthy TARP banks became less risky. This finding is consistent with the idea that unhealthy banks exhibit more pronounced flight-to-quality behavior during financial crises and, hence, the infusion of capital through unhealthy banks is less effective in the financial system. Finally, our study relates to works documenting that TARP positively affected the participating banks' and borrower firms' valuations (e.g. Veronesi and Zingales, 2010; Lin et al., 2017; Akin et al., 2018;, Ng et al., 2016) and to works analyzing the determinants of TARP entry and exit decisions (Bayazitova and Shivdasani, 2012; Cornett et al., 2013).

The remainder of the paper is organized as follows. In section 2, we provide institutional details about TARP and derive the main hypothesis that we test in this paper. In Section 3, we present the dataset and provide descriptive statistics. The main results are presented in section 4. This section also discusses the results of various robustness tests and some further analyses. Section 5 displays the results for the credit risk and accounting profitability measures. We conclude in section 6.

2. Institutional and theoretical background

In this section, we first present some institutional details about the interbank market in the phase leading up to and during TARP as well as details on TARP itself. We then provide a theoretical discussion about how TARP may have impacted interbank market activity and derive our main hypothesis.

2.1 The interbank market during the financial crisis and TARP

Interbank markets play a crucial role in the implementation of monetary policies and enable banks to meet regulatory liquidity reserve requirements. Usually, banks seek interbank liquidity from two main sources, the unsecured federal funds market and the Repo market. The federal funds or overnight interbank market gives banks access to the most immediate source of liquidity and is therefore an important barometer of the functioning of the banking and financial system. Transactions in the federal funds market are over-the-counter whereby banks negotiate interbank loan terms with each other directly or via a broker. Most loans have a very short maturity, usually they are overnight loans that are paid back with interest on the next day.

After the collapse of Lehman Brothers in September 2008, interbank loan terms in the federal funds market became more sensitive to bank-specific characteristics. This affected in particular poorly performing large banks who experienced an increase in spreads of 25 basis points, while borrowing 1 percent less (Afonso et al. 2011). These findings suggest that the interbank market suffered from increased rationing based on counterparty risk and from liquidity hoarding.

Repos are financial contracts that allow for the use of securities as collateral for a cash loan, usually with a similar very short-term maturity of one day. The Repo market is a large and opaque over-the-counter market that exceeded 10 trillion USD in the U.S. at the time of the financial crisis (Hordahl and King, 2008). Gorton and Metrick (2012) document that the Repo market was severely disrupted after the bankruptcy of Lehman Brothers, with dramatically increased haircuts and prices. They argue that this was the result of concerns about the illiquidity of the assets used as collateral. Taken together, these findings suggest that interbank markets were severely stressed after the collapse of Lehman Brothers.

TARP was a principal component of the Emergency Economic Stabilization Act (EESA) of 2008. The funds the U.S. government invested through TARP represent the largest government bailout in U.S. history in terms of absolute dollar amounts. Originally, TARP was expected to be used to buy banks' troubled assets on the secondary market in order to stabilize their balance sheets, avoid further losses and increase lending to the real economy. However, in October 2008 the U.S. Treasury decided to infuse cash directly into the banking system through its Capital Purchase Program (CPP). Specifically, it decided to buy up to 250 billion USD in preferred stock and warrants from banks. The CPP allowed qualifying financial institutions to sell preferred stock and warrants to the Treasury in exchange for CPP capital. In return, it requested quarterly dividends at an annual yield of 5 percent for the first five years and 9 percent thereafter as well as 10-year maturity warrants for common stock, thereby giving taxpayers the opportunity to benefit from banks' future growth and returns.

To apply for TARP money, banks had to follow a standardized procedure, but nine large banks were exempted from applying. These banks (Citigroup, Bank of America, J.P. Morgan Chase, Wells

Fargo, Goldman Sachs Group, Morgan Stanley, State Street Corporation, Bank of New York, and Merrill Lynch), regardless of whether they were willing to apply or not, had to accept TARP funds. TARP was initiated on October 14, 2008, and the U.S. Treasury eventually injected 204.9 billion USD into 707 financial institutions until December of 2009. To qualify for TARP participation, the health of the bank was taken into account, with viable, healthier banks being more likely to be approved for TARP participation. The main goals of TARP included the enhancement of overall financial stability, the improvement of general economic conditions and the increase of credit availability for the corporate sector. The top 25 percent TARP recipients received around 97 percent of the entire available TARP funds (Norden et al., 2013). By December 2012, the end of our sample period, the Treasury had recovered more than 220 billion USD, more than what it had initially disbursed.

2.2 Theoretical considerations and hypothesis development

The main goal of TARP was neither to stabilize nor to stimulate the interbank market, at least there is no official communication mentioning this as one of the main objectives. As we show below, however, participating banks used parts of the TARP proceeds to increase interbank activity, in particular interbank lending. It may seem intuitive that the vast inflow of liquidity for TARP banks would increase interbank market activity for the "healthy and viable" recipient banks through a "capital spillover" channel because of the main function of the interbank market whereby banks with excess liquidity distribute some of this excess liquidity to banks with liquidity shortages. For instance, Iyer et al. (2013) document a significant and positive relationship between liquidity availability and a bank's interbank exposure during the financial crisis 2007/2008. Nonetheless, the increase in interbank market activity was an unintended, albeit not necessarily negative consequence of TARP, even though it might have distorted banks' incentives because of an increase in interconnectedness. This mechanism is pointed out by Kahn and Santos (2006) who note that banks have incentives to excessively interconnect and cross-insure because they may not fully internalize the costs from increased systemic risk resulting from a higher interconnectedness.

Another reason for an increase in interbank market activity is that simply hoarding the excess liquidity arising from TARP may have entailed high opportunity costs for TARP banks because of the high dividend payments required by the Treasury and because of managerial restrictions imposed on the TARP banks.[3] Furthermore, the liquidity surplus could also have helped the TARP banks to develop more interbank relationships that would allow them to trade aggregate liquidity risks and, in particular, to hedge against unexpected future liquidity shocks (Allen and Gale, 2005). Finally, an increased interconnectedness might have broadened the scope of transacting with other banks, either through repeated transactions or through commitments to future lending in the interbank market. Hence, the "capital spillover" channel may have induced an immediate, but also lasting effect on interbank activity of the TARP banks. Based on these considerations, our main hypothesis is that getting access to TARP funds significantly increased interbank market activity of the participating banks – in particular interbank lending – and that this effect was both immediate and lasting.

The null hypothesis is that TARP did not increase interbank market activity, but decreased it. Instead of distributing the excess liquidity from the TARP money inflow, banks may have hoarded this liquidity for precautionary reasons in anticipation of their own needs. Another reason to hoard the excess liquidity may have been the increase in volatility in asset prices and the ensuing higher demand for liquidity. Finally, hoarding liquidity may have helped banks to deal with future fire sales situations (Caballero and Krishnamurthy, 2008; Allen et al., 2009; Diamond and Rajan, 2012).

Additionally, after the collapse of Lehman Brothers, a combination of credit quality fears among market participants and liquidity shortages created a stressed interbank market that was highly sensitive to bank-specific characteristics (Afonso et al., 2011). The ensuing liquidity crunch may have resulted in adverse selection effects whereby interbank lenders were not willing or able to bear the costs of differentiating between risky and healthy banks, further drying liquidity up (Freixas and Jorge, 2008; Heider et al., 2015). In our empirical tests in the next section, we try to distinguish between these alternative hypotheses.

3. Data and descriptive statistics

This section first describes the different data sources we use to construct our sample. We then proceed by discussing the variables used in the analyses. Finally, we present descriptive statistics and discuss data properties.

[3] The Treasury implemented compensation restrictions for the management of TARP banks in October 2008. For instance, it limited tax deductibility of compensation for senior executives to 500,000 USD and required banks to develop and use bonus claw-back clauses.

3.1 Data sources and variables

As in related studies (e.g. Berger et al., 2019), we choose our sample period to range from 2005:Q1 to 2012:Q4. To construct our main dependent variable, *Interbank exposure*, and our main independent variables, *TARP Bank* and *Post*, we collect data from multiple sources. We first obtain information about TARP transactions between October 2008 and December 2009 on the website of the U.S. Treasury. The TARP transactions list contains 756 transactions of 707 unique financial institutions (657 bank holding companies and independent commercial banks, 48 thrifts and 2 savings and loans associations, henceforth for simplicity referred to as banks) totaling 204.9 billion USD.[4] Bank-specific data are retrieved from quarterly Call Reports published by the Federal Financial Institution Examination Council and the Federal Reserve Bank of Chicago and aggregated at the bank holding company level. We manually match the bank data from the Call Reports with the recipients in the TARP transactions list using banks' unique FDIC certificate number, and state and headquarter city in which the bank was located during the sample period. All financial variables are deflated using the seasonally-adjusted Gross Domestic Product Implicit Price Deflator on a quarterly basis to reflect real USD of 2012:Q4, in concordance with Berger et al. (2019).

We apply several data filters. We first exclude all foreign-controlled banks and branches of foreign-chartered institutions because those were not eligible to apply for TARP money. We also exclude banks that filed the FDIC form FFIEC 031 as liquidity from internal markets of foreign bank branches during the sample period may have interfered with the liquidity injection through TARP. We further exclude all observations from saving banks, savings and loans associations, thrifts and credit card institutions because their Call Reports are very different from those of commercial banks. Furthermore, their business models are also very different and not comparable to the ones of commercial banks. We delete some observations with missing or incomplete values for total book assets, common equity and interbank trading variables. Failed banks and banks that received other financial assistance and banks that were reopened or included on the FDIC bank failures list during the sample period from 2005:Q1 to 2012:Q4 are also excluded. Following Duchin and Sosyura (2014) and Berger et al. (2019), we exclude 208 banks that openly announced they would not apply for TARP money.[5] Finally, we drop community banks from the sample. We do this because community banks are locally oriented, very small in size, and follow simple business models. Therefore, they

[4] There are more transactions than banks because in some cases, there occurred more than one transaction per bank.
[5] We manually collected the list of 208 banks that openly announced they would not apply for TARP money using data from SNL Financial, FIG Partners, bank Form 8-K filings and press releases.

cannot be easily compared to the other banks in the sample.[6] The final sample contains 26,763 bank-quarter observations covering 895 banks and 32 quarters.

We define the variable *Interbank exposure* as the total trading volume of interbank money market instruments in the domestic market. Therefore, we aggregate the total gross trading volumes of money market instruments in both the interbank lending and the interbank borrowing market. We measure a bank's gross interbank exposure by the nominal amount that it could be exposed to vis-à-vis a given counterparty via interbank loans and interbank securities (e.g. Langfield et al., 2014).[7] The interbank exposure includes unsecured interbank lending and borrowing in absolute notional amounts in the federal funds market and secured interbank securities agreements held as Repos and reverse Repos in absolute notional amounts.

More specifically, we first include the absolute amount of federal funds sold (interbank loans, Call Report item rconb987) and federal funds purchased (interbank deposits, Call Report item rconb993) in domestic offices as the uncollateralized bilateral interbank transactions on the U.S. federal funds market. We then include collateralized securities resale agreements (reverse Repos, Call Report item rconb989) and repurchase agreements (Repos, Call Report item rconb995) in which a borrower institution agrees to sell securities to an institution and to repurchase the same or similar securities after a specified time at a fixed price with interest.[8] We do not include other types of inter-institution money market instruments because they are a) either traded outside the U.S., such as Eurodollar deposits, or b) traded between banks and the government or government sponsored enterprises (GSEs), such as Treasury bills and federal agency securities, or c) not available in Call Reports, such as certificates of deposits.

Besides the main outcome variable *Interbank exposure*, we use four other outcome variables in further analyses in Section 5. These are *Loan and lease loss provisions*, *Non-performing loans*, *Return on equity*, and *Return on assets*. The variable *Loan and lease loss provisions*, a forward-looking credit risk measure that proxies for bank risk-taking, is the absolute volume of provisions for loan and lease losses. *Non-performing loans* is a backward-looking measure of credit risk that proxies for bank risk-taking. This variable aggregates all loans and leases that are past due for at least ninety

[6] Furthermore, there were other government programs initiated that specifically targeted community banks, for instance, the Small Business Lending Fund (SBLF) that likely discouraged community banks from applying for TARP money.
[7] IFRS reporting standards also require banks to report gross rather than net exposures to particular financial instruments with other inter-institution on-balance sheet items. Our measure of interbank exposure is further consistent with the methodology to measure interbank exposure by the BIS (BIS, 2013). This measure reflects the extent to which the failure of a bank to meet its payment obligations vis-à-vis other banks can cause distress at other institutions because of the network of contractual obligations that exist between them.
[8] We did not have access to transaction data as in Afonso et. al (2011).

days or are no longer accruing interest. *Return on equity* is computed as the ratio of net income to total equity capital. Banks that are more profitable may be in lower demand of interbank liquidity (Laeven and Levine, 2009). Finally, *Return on assets* is the ratio of net income to total assets. These latter two variables are used as proxies for bank accounting profitability.

The main independent variables are two indicator variables that indicate the start of TARP and whether a sample bank is in the treatment group or the control group. We define *TARP Bank* as a dummy variable that takes on the value of one if the observation is from a bank that received TARP proceeds and zero otherwise.[9] *Post* is a dummy variable that takes on the value of one if the observation is from 2008:Q4, the quarter in which TARP officially started[10], to 2012:Q4, the end of our sample period. The interaction between *TARP Bank* and *Post* is the DiD estimator, our main explanatory variable of interest.

Most of the regression models described and estimated below are saturated by including fixed effects for the year-quarter combination the observation is from and bank fixed effects. These fixed effects control for time-invariant within quarter influences on the interbank exposure and for time-invariant bank-specific differences. Besides these fixed effects, we include several time-varying control variables. The first group of control variables are bank-specific control variables that may change from one quarter to another. The choice of these control variables is based on existing studies (e.g. Bayazitova and Shivdasani, 2012; Berger and Bouwman, 2013; Duchin and Sosyura, 2014; Berger and Roman, 2015, 2017).[11]

The variable *Bank size* is measured as the natural logarithm of the book value of total bank assets. *Deposits over Assets* is the ratio of total bank deposits over total book assets. *Diversification* is Laeven and Levine's (2007) measure of income diversification across different sources of income, computed as 1 – [(net interest income – other operating income) / total operating income]. *Fee income* is computed as the ratio of non-interest income over total gross income. *Trading* is the ratio of total trading assets and trading liabilities over total book assets. The data for the construction of these variables are taken from banks' Call Reports.

As in Berger et al. (2019), we also consider that bank branch locations, local market competitiveness and concentration, and bank organizational complexity may affect bank behavior.

[9] In a robustness test reported below, we substitute the indicator variable *TARP Bank* with an alternative measure of TARP participation, *TARP capital over assets*. This variable is defined as the ratio of received TARP funds relative to bank size. Results are invariant to the use of this alternative measure.

[10] By the end of the fourth quarter of 2008, 86.7 percent of the TARP funds had been disbursed.

[11] We do not discuss here why these time-varying control variables should be included because this was done in great detail in the related literature.

We match our data to the Summary of Deposits survey data and Institution Directory data from the FDIC to construct three additional control variables to proxy for such influences. *Metropolitan* is an indicator variable that takes on the value of one if 50 percent or more of bank deposits are from bank branches located in U.S. metropolitan areas, based on the Metropolitan Statistical Areas (MSAs) or New England County Metropolitan Areas (NECMAs), and zero otherwise. *HHI deposits index* is the Herfindahl-Hirschman Index calculated by using the amount of bank branch deposits in local areas determined by the branches' zip codes. It is a proxy for the degree of local deposit market competitiveness and concentration. *Total branches over assets* is the ratio of the number of bank branches multiplied by 1000 to total book assets, a proxy for a bank's organizational complexity.

Finally, we include a set of time-varying variables to control for the financial health of the sample banks. These proxies for CAMELS may also affect bank behavior (e.g., Duchin and Sosyura, 2014; Berger et al., 2019). *Capital adequacy* accounts for the extent to which a bank can absorb potential losses. It is computed as the ratio of total equity capital to book assets. *Asset quality* controls for the riskiness of a bank's portfolio, computed as the ratio of non-performing loans and leases, past due for at least ninety days or no longer accruing interest, to book assets. *Management quality* is proxied by the ratio of overhead expenses to book assets. *Return on equity* is computed as described above. *Liquidity* is computed as the ratio of cash and cash equivalents to total deposits. Finally, we include the variable *Sensitivity to market risk*, computed as the ratio of the absolute difference between short-term assets and short-term liabilities to total book assets. In the baseline regressions, we show that statistical significance and economic magnitude of the DiD estimator do not depend on the inclusion of any of these control variables or the fixed effects.

To address the concern that TARP participation may be endogenous to the interbank exposure, we perform an IV analysis in which we instrument the interaction variable *TARP × Post* with the variables *Subcommittees on Financial Institutions or Capital Markets × Post* and *Subcommittees on Financial Institutions or Capital Markets* (see Section 4.3.1). The dummy variable *Subcommittees on Financial Institutions or Capital Markets* takes on the value of one if a bank is headquartered in a congressional election district of a member of the Subcommittee on Capital Markets or the Subcommittee on Financial Institutions of the 110th and 111th House Financial Services Committee in 2008 or 2009, and zero otherwise. The choice of the instrument based on the existing literature about the importance of political connections and lobbying for TARP participation (e.g. Bayazitova and Shivdasani, 2012; Duchin and Sosyura, 2012, 2014).

3.2 Descriptive statistics

Table 1 contains descriptive statistics of all outcome and control variables. The average interbank exposure across all sample banks amounts to almost 97 million USD. Reverse Repos make up the biggest share of the interbank exposure, they account for 41 million USD or 42 percent of the overall interbank exposure. Federal funds purchased are the second biggest component of the interbank exposure with 24.5 million USD or 25 percent of the overall interbank exposure. The average sample bank has loan and lease loss provisions of 5.8 million USD and non-performing loans of 8.8 million USD. The return on equity is 3 percent and the return on assets is 0.3 percent. The distributions of these variables do not show any extreme properties.

77 percent of the sample observations belong to the treatment group, the banks that received TARP funds. The share of observations from TARP banks relative to non-TARP banks seems high. It is, however, in line with the samples used by other researchers (Duchin and Sosyura, 2014; Berger et al., 2018).[12] None of the bank-level control variables and proxies for CAMELS show any particular characteristics. The instrumental variable *Subcommittees on Financial Institutions or Capital Markets* has a mean of 0.25 indicating that 25 percent of all sample banks are headquartered in districts in which their political connections may have helped them to get their TARP application approved.

4. Main results

This section presents the main results of the paper. We first begin by presenting some graphical analysis, followed by the discussion of the main specification used throughout the empirical analyses as well as a presentation and discussion of the baseline results. We then present the results of several robustness tests such as the results from an IV analysis as well as the results from a Heckman two-stage selection model, results from a propensity score matching approach and results from three placebo tests. We then document the results from an analysis of the time dynamics of the main finding. Finally, the section investigates the main channel through which interbank market activity of the TARP banks increased.

[12] For instance, in Berger et al. (2018) 86.8 percent of all observations are from TARP banks and in Duchin and Sosyuara (2014), the respective number is 79.8 percent.

4.1 Graphical analysis

We present and discuss three graphs in this section as a preview of the main results.[13] The first graph (Figure 1, Graph A) shows the average interbank exposure as the sum of interbank loans, interbank borrowing, Repos and reverse Repos for TARP and non-TARP banks in million USD. The red line shows the exposure for the TARP banks with the USD values displayed on the right-hand y-axis, while the dashed line shows the exposure for the non-TARP banks with the USD values displayed on the left-hand y-axis. The x-axis displays the quarters ranging from the first quarter of 2005 to the fourth quarter of 2012. In the pre-TARP period, we can see an overall parallel trend and a strong decrease of interbank exposure for both TARP and non-TARP banks just before the implementation of TARP (depicted by the vertical red line). This strong decrease was mainly a consequence of the Lehman Brothers collapse (Afonso et al., 2011). From the fourth quarter 2008 onwards, there is a structural break in the two curves. The non-TARP banks continue to decrease their interbank exposure until the end of the observation period. On the other hand, the average interbank exposure of the TARP banks has a strong upward spike shortly after the start of TARP. The time delay between the start of TARP and the effect on the interbank exposure for the TARP banks may be due to the TARP money not being distributed at the exact start of TARP and not to all banks at the same time.

Graphs B and C in Figure 1 provide a breakdown of two major components of the interbank exposure, interbank lending and interbank borrowing. What becomes clear by analyzing these two graphs is that the effect of TARP on interbank exposure is mainly driven by TARP banks making more loans to other banks. For the non-TARP banks we find that both, interbank lending and interbank borrowing continued to decrease after the start of TARP even though interbank lending seemed to have stabilized somehow for non-TARP banks from 2010 onwards. For TARP banks we find strong upward movements in the interbank lending and borrowing curves starting at the beginning of 2009, followed by a large downward movement. While the interbank borrowing remained at these lower levels until the end of the observation period, interbank lending clearly increased after this phase of correction until the fourth quarter of 2012.

This graphical analysis suggests that most of the effect of TARP on the interbank exposure is driven by interbank lending. At the beginning it seems that the TARP banks lent more to and borrowed more from themselves, while afterwards the increase in interbank loans must have been

[13] It is important to point out that the graphs do not show any regression results, but only the volume of raw interbank exposure. Hence, the curves do not necessarily have to be exactly in line with the regression results because these also include fixed effects and time-varying control variables.

accounted for by banks that are neither in the treatment nor in the control group. In the next section, we investigate whether these findings carry over to regression analyses.

4.2 Baseline results

To investigate how TARP affected the interbank market, we estimate an OLS regression of the following form:

$$Interbank\ exposure_{i,t} = \alpha_0 + \alpha_1 TARP\ Bank_i \times Post_t + \alpha_2 YearQuarter\ fixed\ effects_t + \alpha_3 Bank\ fixed\ effects_i + \alpha_4 X_{i,t-1} + \epsilon_{i,t} \quad (1)$$

where $Interbank\ exposure_{i,t}$ equals the sum of interbank loans, interbank deposits, Repos and reverse Repos of bank i in quarter t; $TARP\ Bank_i$ is a dummy variable that takes on the value of one if bank i received TARP money, and zero otherwise; $Post_t$ is a dummy variable indicating whether an observation is from quarter t after the fourth quarter of 2008; $YearQuarter\ fixed\ effects_t$ are fixed effects indicating the year-quarter combination t the observation is from; $Bank\ fixed\ effects_i$ are fixed effects indicating that the observation is from bank i; $X_{i,t-1}$ is a vector of time-varying control variables as explained and discussed in section 3.1. These controls are lagged by one quarter to address endogeneity concerns as in, e.g., Berger et al. (2019). The individual terms for *TARP* and *Post* are subsumed under the year-quarter and bank fixed effects and therefore not shown in the regression equation. As in related studies (e.g. Berger and Roman, 2015; Berger et al, 2017), we cluster standard errors by bank to account for potential correlation within banks.[14]

We estimate several specifications of equation 1 to show that the baseline results do not depend on the inclusion of any particular control variable set or fixed effect. The results are displayed in Table 2. In column 1 of Table 2, we regress interbank exposure on the DiD estimator and the individual terms for *TARP* and *Post*[15], but no additional controls or fixed effects. The point estimate of the DiD estimator is significant on the 5 percent level and its economic magnitude amounts to 27 percent of the pre-TARP control group mean, an economically large effect. In column 2, we add year-quarter fixed effects that subsume the post-dummy. The point estimate of the DiD estimator continues to be significant on the 5 percent level and its economic magnitude increases to 41 percent of the

[14] We also run specifications where we use different cluster variables. The results are invariant to the choice of the cluster variable. We discuss the results of these in section 4.3.3.

[15] Coefficients of these two variables are omitted to save space.

control group mean. In the next three columns of Table 2, we add bank fixed effects (column 3), time-varying bank controls (column 4), and proxies for CAMELS instead of time-varying bank-level controls (column 5). The point estimates of the DiD continue to be significant on at least the 5 percent level and their economic magnitudes range from 30 to 38 percent of the control group mean. In column 6 of Table 2, we estimate our preferred specification that includes all fixed effects and all time-varying controls.[16] The point estimate in this last specification is significant on the 5 percent level and its economic magnitude amounts to 32 percent of the control group mean or 51 million USD.

We conclude from these tests that TARP significantly increased banks' interbank market activity, both from a statistical as well as an economical standpoint, regardless of how the econometric model is estimated. This result represents a heretofore uninvestigated and unintended consequence of TARP.

4.3 Robustness tests

This section presents the results of various robustness tests. We begin by showing the results of an instrumental variable (IV) approach. We then present the results of Heckman's two-stage selection model and the results of a propensity score matching (PSM) approach. This is followed by discussing the results of several placebo tests. Finally, we discuss the results of additional robustness tests whereby we vary the regression specification and control for other government interventions.

4.3.1 IV analysis, Heckman's two-stage selection model, and propensity score matching

To address the concern that TARP participation was not exogenous to interbank market activity and potentially ensuing endogeneity problems we employ an IV design. In this IV analysis, we instrument the interaction term *TARP* × *Post*. To do so, we first construct the variable *Subcommittees on Financial Institutions or Capital Markets*. This dummy variable takes on the value of one if a bank is headquartered in a congressional election district of a member of the Subcommittee on Capital Markets or the Subcommittee on Financial Institutions of the 110th and 111th House Financial Services Committee in 2008 or 2009, and zero otherwise.

To construct *Subcommittees on Financial Institutions or Capital Markets*, we first use the zip codes of bank headquarters and the MABLE/Geocorr2k database on the Missouri Census Data Center

[16] All other regressions presented and discussed below are estimated using this preferred specification, unless otherwise noted.

website to associate banks with congressional election districts in 2008 and 2009. We then proxy the strength of the political connection by assigning a value of one to the variable *Subcommittees on Financial Institutions or Capital Markets* if a bank is headquartered in a congressional election district of a member of the Subcommittee on Capital Markets or the Subcommittee on Financial Institutions of the 110th and 111th House Financial Services Committee in 2008 or 2009. The variable takes on the value of zero otherwise. This variable should be exogenous to banks' interbank exposure, since the committee member assignments are largely determined by the House leadership and unlikely to be under control of specific banks. We expect a positive correlation with the TARP approval decisions.

We instrument TARP × Post with *Subcommittees on Financial Institutions or Capital Markets × Post* and *Subcommittees on Financial Institutions or Capital Markets*. The choice of these instruments is based on the existing literature about the importance of political connections and lobbying for TARP participation (a related instrument and data were used in, e.g. Bayazitova and Shivdasani, 2012; Duchin and Sosyura, 2012, 2014). We then run a two-stage least squared regression using OLS. The results of the first stage, which are reported in Table A2, suggest a significant relationship between the instruments and the instrumented variable. In the second stage, we use the predicted values from the first stage as regressors and estimate the impact of TARP participation on interbank exposure via OLS. The results are reported in Table 3, column 1.

We find that the point estimate of the DiD estimator is significant on the five percent level and its size is larger than the coefficient in the baseline analysis. Relative to the mean of the control group, this implies an increase of interbank exposure of about 2.5 times. The table also displays two diagnostic tests in column 1. The results from these tests indicate that the instruments are neither weak nor under-identified. The Kleibergen-Paap rk LM statistics of the underidentification test indicates that the instruments meet the relevance criterion since the t-test result statistically rejects the null hypothesis that the model is under-identified. The Hansen J statistics of the overidentification test suggests that the instruments also meet the exclusion restriction because the test result can not reject the null hypothesis that the instruments are uncorrelated with the error term.

In column 2 of Table 2, we estimate Heckman's two-stage selection model (Heckman, 1979). As TARP participation was a choice rather than imposed by the Treasury for most banks, this may give rise to self-selection and ensuing omitted variable bias concerns. The results from the first stage of the Heckman two-stage selection model is shown in Table A2. From the first stage results, we predict the probability of TARP participation for each bank and compute the self-selection parameter

Lambda using the predicted values. This variable is negative and not significant in column 2, suggesting that sample selection bias is not a major concern. Moreover, it does not affect the DiD estimator. The point estimate is 48.2, indicating an increase of around 31 percent or 48.2 million USD relative to the control group mean. This effect is very close to the baseline effect and statistical significance remains on the five percent level.

Finally, in column 3, we present the results of a PSM approach. This additional robustness test should help to reduce residual concerns that the non-random TARP participation led to omitted variable bias and that this drives our findings.[17] We estimate the propensity scores of TARP participation by employing a Probit regression model and using the values of all control variables at the start of TARP in the fourth quarter of 2008 as well as year-quarter and bank fixed effects. TARP and non-TARP banks are then matched as pairs by using the smallest differences in propensity scores calculated by the nearest-neighbor matching algorithm with *n=1* without replacement. This approach constructs matching pairs by weighting treatment observations with their nearest control observations based on their distance.[18] Figure A1 in the Appendix documents that the matching procedure was successful in reducing the existing biases for each of the included time-varying covariates. We re-estimate our preferred specification using the matched sample. The results are reported in column 3 of Table 3.

The point estimate suggests that TARP banks increased their interbank exposure by around 45 percent or 68.2 million USD relative to the mean of the control group. This result is bigger than the effect in the baseline analysis, however, the sample size is significantly reduced because of the matching approach. We conclude from these tests that endogeneity concerns or omitted variable bias do not seem to be the driving factor of the effects of TARP on interbank exposure.

4.3.2 Placebo tests

In a second set of robustness tests, we perform several placebo experiments to alleviate concerns that random confounding factors across time and banks may drive our results. Specifically, we perform three placebo experiments whereby we vary the start of TARP in the first two placebo experiments and TARP participation in the third placebo experiment. We expect these results to be insignificant

[17] The PSM approach we use is similar to the analyses in related studies (e.g. Duchin and Sosyura, 2014; Berger and Roman, 2015; Berger et al., 2019)

[18] In unreported results that are available on request, we estimate several alternative matching matrices with PSM scores estimators to ensure balance, such as a nearest neighbor matching with *number of neighbor*=1 with replacement, Mahalanobis 1-to-1 matching, the non-parametric kernel matching algorithm and nearest neighbor matching with 0.1 caliper. All results are very similar to the one presented in Table 3.

because in the first two placebo experiments, there was no TARP money distributed at the placebo event date and in the third placebo experiment, the treatment group consists of a random sample of TARP and non-TARP banks. The results of these tests are displayed in Table 4.

In column 1 of Table 4, we only use observations from between the first quarter of 2005 and the fourth quarter of 2008, i.e. from the time-period before the actual start of TARP. We assign a value of one to the post-dummy if the observation is from the time-period between the fourth quarter of 2006 and the fourth quarter of 2008, and zero otherwise. We then regress the interbank exposure on the DiD estimator. The point estimate of the DiD estimator is 22 with a standard error of almost 53. While the coefficient has the same sign as in the baseline regressions, its magnitude is much smaller and it is far away from being significant (t-stat of 0.42).

In column 2 of Table 4, we make use of observations from the post-TARP period only. We assign a value of one to the post-dummy if the observations are from the period after the fourth quarter of 2010, and zero otherwise. We then regress interbank exposure on the DiD estimator. The point estimate of the DiD estimator is 17 with a standard error of 11. The size of the coefficient is again much smaller than in the baseline regressions and the effect is not significant (t-stat of 1.55).

In the final placebo experiment, we randomly select a group of banks as placebo TARP banks, imposing the same relative shares of placebo TARP (77 percent) and non-TARP (23 percent) banks as in the real sample. This implies that the resulting placebo treatment group is a mixed group of TARP and non-TARP bank. We then regress the interbank exposure on the DiD estimator using observations from the entire sample period and the post-dummy that indicates the true start of TARP. As in the previous two placebo experiments, the DiD coefficient is not significant.

Together with the IV and Heckman's two-stage selection model results, these tests confirm that there was indeed a causal relationship between TARP and the interbank exposure and that neither endogeneity, nor omitted variable bias, nor random confounding factors can explain our findings.

4.3.3 Other robustness tests

In a final set of robustness tests, rather than addressing potential endogeneity and omitted variable bias concerns, we vary some of the assumptions underlying our empirical approach to show that our results do not depend on the choice of a specific regression setup. In all analyses so far, we used clustering by bank in concordance with the literature. Furthermore, we chose the fourth quarter of 2008 as the start of TARP because the U.S. Treasury started to acquire preferred shares in the fourth quarter of 2008. To show that the choice of the cluster level and our choice of the start of TARP do not drive our findings, we vary both and rerun the baseline regression using the preferred specification from Table 2, column 6.

We start by showing the results from changing the cluster variable in columns 1-4 of Table 5. In column 1, we use clustering by state instead of clustering by bank. We find that the standard error increases and that the point estimate is only significant on the 10 percent level. However, using the state where the banks are headquartered as the cluster variable results in a borderline number of clusters, hence, one has to be cautious in interpreting these results. In columns 2-4, we use clustering by year-quarter, by state-quarter, and by state-year-quarter. In all three regressions, the point estimates of the DiD estimator are significant on the 1 percent level.

In column 5, we address concerns that the choice of the start of TARP in the fourth quarter of 2008 instead of the first quarter of 2009, as was done in related studies such as Berger et al. (2019), drives our findings. By the end of the fourth quarter of 2008, 86.7 percent of the TARP money was distributed among the TARP banks, while by the end of the first quarter of 2009, 97 percent of TARP funds were distributed. When we choose the first quarter of 2009 as the start of TARP, the point estimate is almost unchanged (49.2 versus 51.1 in the baseline) and remains significant on the 5 percent level.

Besides TARP, there were other government interventions during our sample period that may also have impacted bank liquidity and therewith their interbank exposure. The most prominent of those interventions was the Term Auction Facility (TAF) program that was announced in December 2007 and ended in March 2010. This program allowed banks to auction for collateralized term funds from the Federal Reserve's discount window to improve their liquidity positions. To address concerns that TAF may drive our findings, we perform a robustness test in which we include a TAF dummy in our regressions (Berger et al., 2019). First, we collect data on the 418 TAF participating banks and the respective auction dates from the website of the Federal Reserve and match these data with our dataset. We create a dummy variable that takes on the value of one if the bank participated in the TAF auctions and include this dummy in our regression model. We then estimate a random-effects model and include year-quarter time dummies to control for any aggregated time trend influence and both the TARP bank indicator and the TAF participant indicator in the regressions, with standard errors clustered at the bank level. The results displayed in Appendix Table A3 show that regardless of the specification, the DiD estimator is still highly significant and the size of its coefficient is almost unchanged compared to the baseline analyses in Table 2. We conclude from this test that TAF, another important bank liquidity government intervention, cannot explain our findings.

In an untabulated robustness test[19], we use an alternative measure for TARP. Specifically, instead of using a dummy variable indicating whether a bank received TARP money or not, we use the amount of TARP money the bank received relative to the total assets of the bank calculated as the natural log of (1+TARP Capital received)/Size, where higher values indicate a higher degree of TARP support. We then substitute the TARP bank dummy and interact the alternative TARP measure with the post dummy. We regress the interbank exposure on this alternative DiD estimator, including all controls and fixed effects as in column 6 of Table 2. In this specification, the point estimate is more than twice as large as the one from the baseline regression indicating an increase of interbank activity of almost 69 percent or 109 million USD for the average TARP bank relative to the control group mean. While statistical significance is somewhat reduced in this last test, taken together, the results confirm the finding that TARP increased interbank activity statistically and economically in a very meaningful way.

Finally, we validate our DiD approach by conducting a parallel trend test whereby we regress the interbank exposure and all other outcomes on year-quarter dummies before the actual start of TARP, interacted with the TARP bank indicator. Since in those quarters, there was no TARP intervention, we do not expect to find any significant interaction variable. None of the interactions is significant and the differences between the coefficient sizes are also not significant. This suggests that before the start of TARP there was indeed a parallel trend associated with the outcome variables used in this study and between treatment and control banks.

4.4 Time dynamics

One interesting and important question arising from the novel finding that TARP significantly increased interbank market activity regards the time dynamics. In particular, did TARP have an immediate effect on interbank market activity, was it an effect that lasted only for a short period of time or was it a permanent effect? To address these questions, we run a specification in which we interact the DiD estimator with year dummies indicating whether an observation was from the years 2009, 2010, 2011 or 2012. The resulting triple interaction terms inform us about the time dynamics of the effect of TARP on banks' interbank market activity. The untabulated results[20] show that the triple interaction term *TARP x Post x 2009* is significant on the 5 percent level and its size amounts to 22 percent or 35 million USD dollar relative to the control group mean. The triple interaction term

[19] Results are available from the authors on request.
[20] Available from the authors upon request.

for the year 2010 is slightly larger, however, not statistically significant. For 2011 and 2012, the effects increase to 36 percent or 57 million USD and 50 percent or 79 million USD relative to the control group mean. Both point estimates of the triple interaction term are significant on the 5 percent level.

These results suggest that there seems to be an immediate and lasting effect of TARP on interbank market activity. Furthermore, this effect seems to trend upwards until the end of the observation period, even though the differences between the point estimates of the triple interaction terms are not statistically significant.

4.5 Interbank exposure components

We have so far shown that TARP increased banks' interbank market activity in both a statistically and economically meaningful way. In this section, we explore whether the effect is similar or different for the individual components of the interbank exposure to better understand how TARP affected banks' behavior. To explore this, we split interbank exposure up into its four components interbank lending, interbank borrowing, Repos and reverse Repos and use these as outcomes in separate regressions. As before, we use the preferred regression specification from Table 2, column 6. Table 6 contains the results.

In column 1, interbank lending expressed as federal funds sold is the dependent variable. The DiD estimator is significant on the 1 percent level and the point estimate is economically very large. The average TARP bank increased interbank lending by about 77 percent or 36.3 million USD relative to the mean of the control group. In column 2, the dependent variable reflects Repo transactions. We find a positive point estimate that is large in economic terms, but not significant. In column 3, the point estimate of the DiD estimator for interbank borrowing measured as federal funds purchased is negative, not significant and economically very small. Finally, in column 4, we use reverse Repos as the dependent variable. The point estimate of the DiD estimator is positive, not significant and much smaller in economic magnitude than in the first two columns.

These results suggest that the significant and robust increase of interbank market activity for TARP banks is mainly driven by interbank lending, while interbank borrowing did not change in any significant way. Furthermore, the increased interbank lending seems to have accrued to banks that are not in our sample because we did not detect any difference in interbank market borrowing for TARP banks relative to non-TARP banks.

5. Implications for risk-taking and bank profitability

An important question arising from the novel finding that TARP led to an increase of banks' interbank market activity, in particular their interbank lending, is whether this impacted banks in any other way? For instance, it could be argued that an increase of TARP banks' interbank market activity may have helped to stabilize the interbank market and therewith the financial system at large. On the other hand, the increase in interbank lending activity may have increased TARP banks' connectedness with other banks and therefore changed their incentive structure.

Afonso et al. (2014) argue that large or complex banks might have a greater appetite for risk if they expect future bailouts due to the perceived systemic importance in the financial system.[21] Allahrakha et al. (2015) document that highly leveraged U.S. banks are also the most interconnected ones and pose the biggest threat to financial stability. Using data from the U.K. interbank market, Acharya and Merrouche (2013) find that riskier banks held more reserves relative to the expected value during the financial crisis, therewith connecting interbank market activity and bank risk-taking. Freixas et al. (2000) argue in a theoretical framework that interbank credit extensions throughout a financial network such as the interbank market determine system-wide liquidity shocks. Hence, higher connectedness may result in moral hazard incentives and an increase in risk-taking. Based on these considerations, we hypothesize that the increase in interbank market activity of TARP banks increased their interconnectedness with other banks and had repercussions for their risk-taking behavior. This hypothesis implies that those TARP banks that significantly increased their interbank market activity became subject to moral hazard incentives whereby they increased their individual risk-taking.

We test this hypothesis by regressing the two bank-level credit risk measures *Loan and lease loss provisions* and *Non-performing loans* on the DiD estimator and a triple interaction term that interacts the DiD estimator with the interbank exposure. We estimate two specifications, the first one includes only the DiD estimator as well as all fixed effects, bank-level controls and proxies for CAMELS.[22] In this specification, the DiD estimator measures whether TARP banks generally changed their risk-taking behavior. The second specification includes the triple interaction term as well as all individual terms, fixed effects and controls. The triple interaction term informs us whether there is a differential effect on risk-taking among the TARP banks depending on their amount of

[21] Applying the model of Fudenberg and Tirole (1986) to the case of bank interconnectedness, banks may become predatory in credit markets and shift assets to riskier portfolios because of a higher probability of future bailouts,

[22] Note that in all credit risk regressions, we exclude the variable *Asset quality* from the proxies for CAMELS.

interbank exposure.[23] We estimate both specifications using the two credit risk measures. The results are displayed in Table 7.

In columns (1) and (2) we use *Loan and lease loss provisions* as the dependent variable. The results in column (1) indicate that TARP banks did not generally increase their risk-taking because the DiD estimator is negative and not significant. However, the results in column (2) show that the triple interaction term is highly significant. This result suggests that as TARP banks increased their interbank market activity, they also increased their risk-taking, consistent with our hypothesis. The coefficient size of the triple interaction term indicates that loan and lease loss provisions for the average TARP bank increased by 27 percent (about 1.05 million USD) relative to the control group mean, an economically large effect. In columns (3) and (4), the outcome variable is *Non-performing loans*. The DiD estimator in column (3) is again not significant, but the triple interaction term in column (4) is statistically significant, albeit only on the 10 percent level. This confirms the result for the loan and lease loss provisions. The economic magnitude of the effect is slightly larger than in the first test because non-performing loans increased by 34 percent (1.9 million USD) relative to the control group mean. These effects of the increase of the interbank exposure on bank risk-taking are not mechanically driven by an increase in credit volume or by too-big-to-fail arguments (as in Black and Hazelwood, 2013) because we control for asset size. Furthermore, when we separate the sample at the median asset size and run separate regressions, we do not find any difference for smaller and larger banks.

In columns (5) to (8), we substitute the two credit risk measures with two measures for accounting profitability, *Return on equity* in columns (5) and (6) and *Return on assets* in columns (7) and (8)[24] because it could be argued that banks increased risks in order to boost profitability.[25] We find that this is not the case. We find inconsistent results for the DiD estimator in columns (5) and (7) and statistically significant negative triple interaction terms in columns (6) and (8). These findings suggest that TARP banks that experienced an increase in interbank market activity, while also increasing their credit risks, experienced a drop in their accounting returns.

In a final analysis, we break down banks' loan portfolios by running credit risk regressions for different loan categories. The Call Reports do not contain detailed information about loan and

[23] We acknowledge that this specification may suffer from endogeneity problems. We were not able to find a good instrument for the interbank exposure in these regressions. Furthermore, we are not interested in the overall effect, but only in the differential effect picked up by the coefficient of the triple interaction term.
[24] In these regressions, we exclude the variable *Return on equity* from the proxies for CAMELS.
[25] Furfine (2001) connects interbank market activity, risk-taking and bank profitability by showing that borrowing banks with higher profitability, higher capital ratios, and fewer problematic loans pay lower interest on federal fund loans.

lease loss provisions by loan category, but they contain this information for non-performing loans. We collect non-performing loans data for the three loan categories interbank loans, commercial and industrial loans, and mortgage loans.[26] The resulting outcome variables are regressed on the DiD estimator in columns (1), (3), and (5), and on the triple interaction term as well as all individual terms in columns (2), (4), and (6). As before, we include all fixed effects and relevant bank-level controls and proxies for CAMELS. The results are displayed in Table 8.

Interestingly, while increasing interbank lending, it seems that the additional interbank loans were not associated with higher risk because the triple interaction term in column (2) is very small and statistically not significant. The results further suggest that there was no risk-shifting in the mortgage loan portfolio because all coefficients in columns (5) and (6) are insignificant.[27] It rather seems that the TARP banks that increased interbank market activity shifted assets towards riskier commercial and industrial loans because the triple interaction term is highly significant in column (4). The size of the triple interaction term indicates that the non-performing loans in the commercial and industrial loan portfolio increased by almost 10 percent for the average TARP bank relative to the mean of the control group, an economically meaningful effect.

Taken together, these results are consistent with the hypothesis that an increase in interbank market activity increased banks interconnectedness and changed their incentive structure. They are further consistent with the supposition that higher interbank market activity resulted in moral hazard incentives whereby banks increased their risk-taking as a function of higher interbank market activity, likely because of a higher future bailout probability. Our findings are also consistent with Duchin and Sosyura (2014), who suggest that TARP banks showed an increase in volatility and default risk by making more risky loans and shifting assets towards riskier securities after receiving the government support. Finally, they are consistent with and Black and Hazelwood (2013, and Berger et al. (2018), even though none of these studies investigates how TARP affected the interbank market and subsequently bank risk-taking.

6. Conclusion

Our study shows that TARP significantly increased participating banks' interbank market activity, with statistical and economical significance both being high. Specifically, the average TARP bank

[26] We also ran the regressions for the loan category "Other" and did not obtain any significant results. They are omitted to save space.

[27] The number of observations is smaller in columns (5) and (6) because not all banks in the sample had a mortgage loan business.

increased interbank exposure by 32 percent or 51 million USD relative to the control group mean. This result is robust to a variety of changes of the regression setup, the consideration of other important government interventions, the use of an IV approach, Heckman's two-stage selection model, propensity score matching analysis, and several placebo tests. We then show that the effect is immediate and lasting, albeit upward trending until the end of our sample period. Finally, we show that the main driver of the increase of interbank exposure is the increase of interbank lending. The average TARP bank increased interbank lending by 77 percent or 36 million USD relative to the control group mean. These findings document a heretofore uninvestigated, unintended, and economically very meaningful consequence of TARP.

An important question arising from these findings is if and how they impacted other aspects of bank behavior, the banking system at large and financial stability. The increase in interbank lending may have helped to stabilize the interbank market with positive effects for financial stability, even though this was not a publicly announced goal of TARP. On the other hand, the increase in interbank lending may have resulted in a higher interconnectedness of banks with implications for banks' incentive structures. For instance, a higher interconnectedness could induce moral hazard behavior whereby banks increase risk-taking because of a higher probability of a future bailout. We provide some suggestive evidence to answer these important questions.

We document that banks that increased interbank market activity also increased risk-taking. Loan and lease loss provisions and non-performing loans increased by 27 and 34 percent, respectively, for the average TARP bank, an economically and statistically significant effect. Our results suggest that the increase in banks' risk-taking stems mainly from risk shifting in the commercial and industrial loan portfolio. This is not a mechanical effect as a result of an increase of loan volume or because of bank size because we control for bank assets in these tests. Finally, we show that the increase in credit risk was not accompanied by an increase of accounting returns. If anything, it seems that accounting returns decreased as interbank market activity increased. These results suggest that the increase in interbank market activity was overall detrimental for the individual banks, with hard to predict consequences for the banking system at large and financial stability.

Our results add a new perspective on the effects of TARP on bank behavior in the aftermath of the global financial crisis 2007/2008. They suggest that it may not be enough for governments to publicly state what the goals of a bailout are, but also to implement proper controls to obtain the desired bank behavior. Otherwise, banks might use some of the bailout proceeds for other, unintended purposes with unknown consequences.

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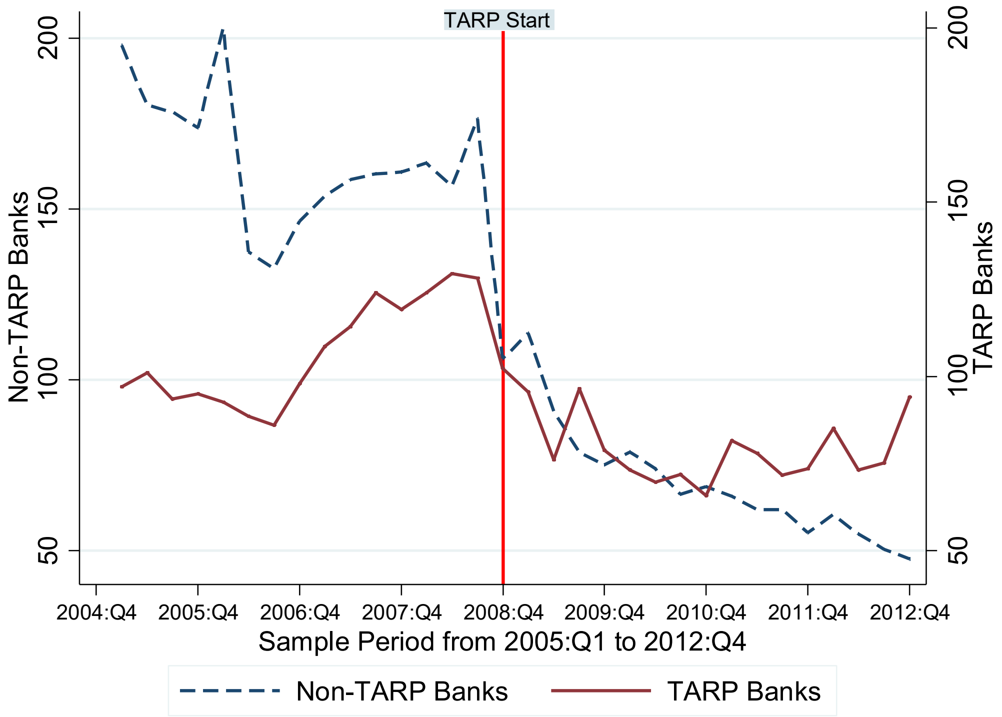
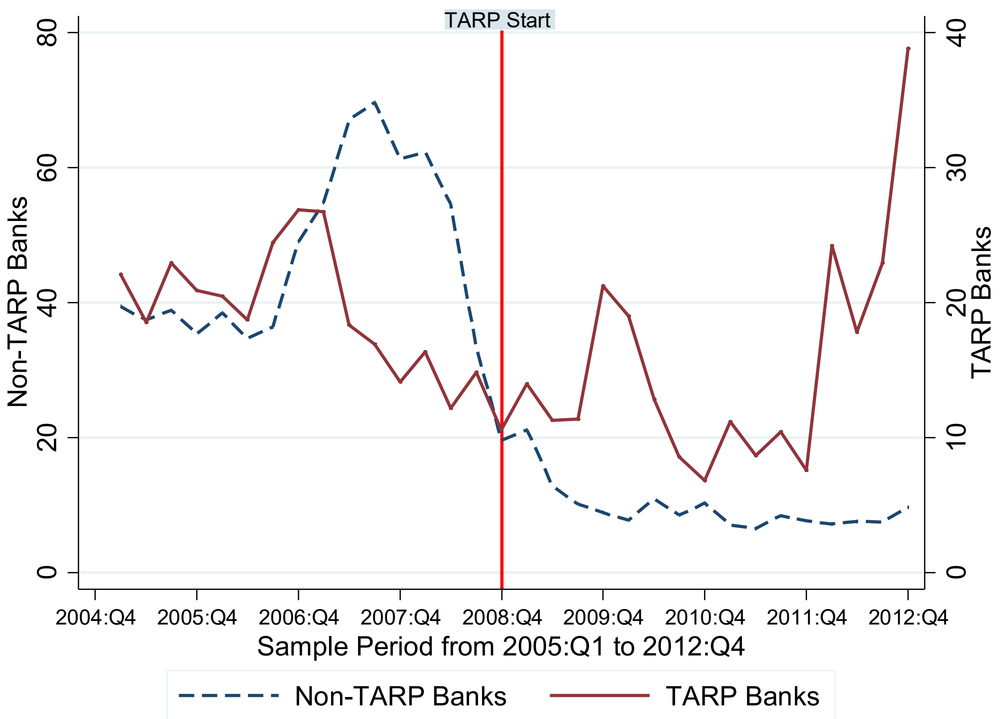
Figure 1: Average bank interbank exposure and its components over 2005:Q1-2012:Q4

This figure maps the time series of the average *Interbank exposure* in Graph A, the average federal funds sold and purchased of banks in Graph B and Graph C, over 2005:Q1 to 2012:Q4 for both non-TARP and TARP bank groups. The graphical occurrence of TARP takes the start date of 2008:Q4 when TARP officially started. The volume of *Interbank exposure* and its components are denoted in million USD.

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



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



Graph C: Average *Federal funds purchased* for Non-TARP and TARP Banks

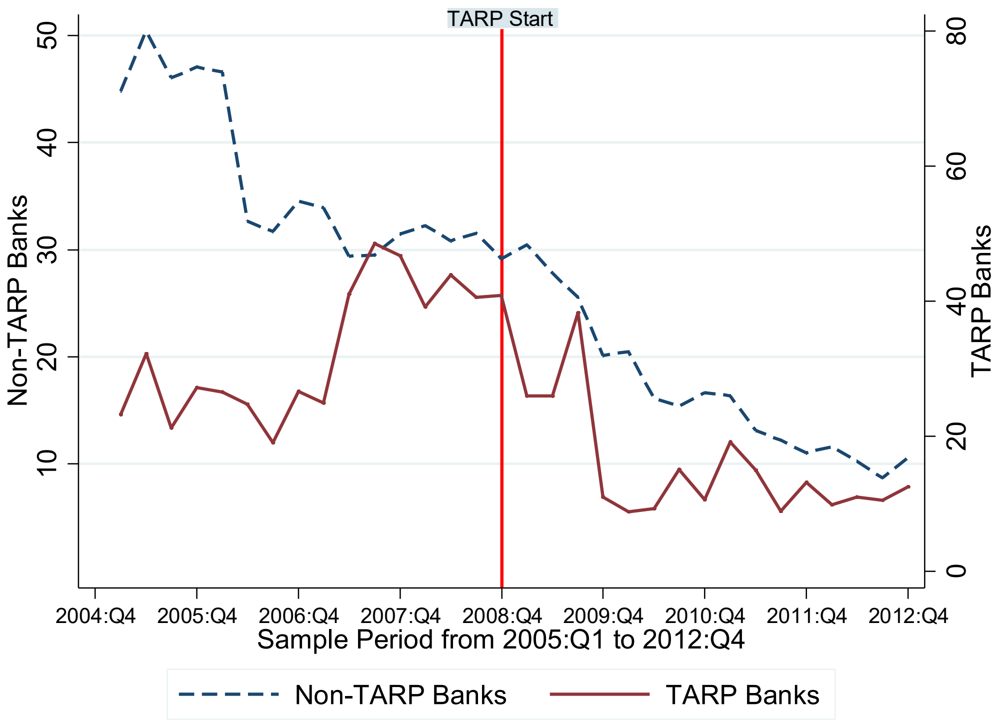


Table 1: Descriptive statistics

This table shows descriptive statistics for all variables used in the regressions. All variable definitions are relegated to the Appendix. All absolute amounts are denoted in million USD expressed as real 2012: Q4 amounts deflated using the seasonally-adjusted GDP implicit price deflator. SD indicates the standard deviation. p50, p5 and p95 indicate the median, the values at 5th percentile and 95th percentile respectively. N is the number of observations per variable.

Variable	Mean	p50	SD	p5	p95	N
Dependent Variables						
Interbank exposure	96.76	11.24	592.42	0.00	288.15	26,763
Federal funds sold	19.22	1.31	171.14	0.00	61.23	26,763
Federal funds purchased	24.49	0.00	298.46	0.00	46.43	26,763
Securities purchased under agreements to resell	40.98	0.00	210.12	0.00	148.72	26,763
Securities sold under agreements to repurchase	12.06	0.00	348.82	0.00	0.00	26,763
Loan and lease loss provisions	5.79	0.67	35.06	0.00	20.74	26,763
Non-performing loans	8.80	1.33	54.96	0.00	29.64	26,763
Return on equity	0.03	0.03	0.20	-0.11	0.24	26,763
Return on assets	0.003	0.003	0.02	-0.02	0.04	26,763
TARP Variables						
TARP Bank	0.77	1.00	0.42	0.00	1.00	26,763
Post	0.54	1.00	0.50	0.00	1.00	26,763
TARP capital over assets	0.35	0.37	0.29	0.00	0.77	26,763
Bank Controls						
Size	6.17	6.13	1.42	3.95	8.56	26,763
Metropolitan	0.97	1.00	0.18	1.00	1.00	26,763
HHI deposits index	0.41	0.26	0.61	0.00	1.36	26,763
Total branches over assets	0.03	0.02	0.04	0.003	0.08	26,763
Deposits over assets	0.78	0.82	0.15	0.53	0.90	26,763
Diversification	0.51	0.53	0.23	0.20	0.82	26,763
Trading	0.001	0.00	0.02	0.00	0.0001	26,763
Fee income	0.89	0.50	3.52	-1.14	4.29	26,763
Proxies for CAMELS						
Capital adequacy	0.13	0.10	0.12	0.07	0.26	26,763
Asset quality	0.01	0.003	0.01	0.00	0.02	26,763
Management quality	0.03	0.02	0.06	0.01	0.05	26,763
Liquidity	0.18	0.05	0.90	0.01	0.32	26,763
Sensitivity to market risk	0.16	0.11	0.17	0.01	0.51	26,763
Instrumental Variable						
Subcommittees on Financial Institutions or Capital Markets	0.25	0.00	0.43	0.00	1.00	26,763

Table 2: Baseline regression results

This table shows baseline DiD regression results using *Interbank exposure* as the dependent variable. The variable *Mean of control group* shows the mean of the dependent variable, *Interbank exposure*, for non-TARP banks before the start of TARP. All other variable definitions can be found in Table A1. In columns (1) and (2) we include the estimators for *TARP Bank* and *Post*, results are omitted to save space. Standard errors clustered at the bank level are shown in parentheses. ***, **, * indicate significance at the 1, 5, and 10 percent level, respectively.

Dependent variable	Interbank exposure					
	(1)	(2)	(3)	(4)	(5)	(6)
TARP Bank × Post	40.639**	66.155**	49.279**	50.145**	60.167***	51.084**
	(19.836)	(26.247)	(19.716)	(22.372)	(22.649)	(22.289)
Size				250.471*		244.939
				(148.850)		(153.503)
Metropolitan				4.088		4.531
				(12.848)		(11.739)
HHI deposits index				-3.673		-4.675
				(8.332)		(8.421)
Total branches over assets				1116.204		1092.867
				(907.248)		(882.523)
Fee income				1.414		1.516*
				(0.884)		(0.917)
Diversification				-281.224*		-283.840*
				(163.549)		(161.385)
Deposits to assets				-120.771		-154.653
				(148.694)		(193.084)
Trading				163.054		101.384
				(215.920)		(188.564)
Capital adequacy					-537.109*	-238.315
					(301.025)	(159.647)
Asset quality					-564.481	-350.663
					(379.583)	(438.328)
Management quality					107.270	194.128
					(94.566)	(150.145)
Return on equity					10.452	-8.932
					(12.721)	(10.342)
Liquidity					23.745	11.381
					(16.288)	(8.257)
Sensitivity to market risk					155.213	172.680
					(109.602)	(110.869)
Constant	149.786***	113.702***	91.333***	-1229.456	134.983***	-1166.465
	(32.674)	(26.430)	(13.537)	(859.558)	(30.407)	(946.109)
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

Table 3: IV analysis, Heckman two-selection model, and PSM results

This table shows regression results using *Interbank exposure* as the dependent variable. Column (1) shows results of the final stage of a two-stage least squares regression whereby the TARP × post indicator is instrumented by the variables *Subcommittees on Financial Institutions or Capital Markets × post* and *Subcommittees on Financial Institutions or Capital Markets*. Column (2) contains results of a Heckman two-stage selection model. The variable *Self-selection parameter (Lambda)* is the Inverse Mills Ratio computed from the first stage. Column (3) shows results for a PSM approach. The variable *Mean of control group* shows the mean of the dependent variable. All other variable definitions can be found in Table A1. Each column contains an unreported constant term. Standard errors clustered at the bank level are shown in parentheses. ***, **, * indicate significance at the 1, 5, and 10 percent level, respectively.

Dependent variable	Interbank exposure		
	(1)	(2)	(3)
TARP bank × post	416.801**	48.812**	68.275***
	(192.743)	(22.415)	(26.486)
Self-selection parameter (Lambda)		-155.776	
		(256.294)	
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:	6.204**		
Chi-squared (2) P-value:	0.045		
Overidentification test			
Hansen J stat:	1.602		
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

Table 4: Placebo experiments results

This table shows placebo regression results using *Interbank exposure* as the dependent variable. The variable *Mean of control group* shows the mean of the dependent variable, *Interbank exposure*, for non-TARP banks before the start of TARP. All other variable definitions can be found in Table A1. Each column contains an unreported constant term. In column (1), we only use observations before the start of TARP, i.e., between 2005:Q1 and 2008:Q4. We define the placebo start of TARP to happen in 2006:Q4. In column (2), we only use observations after the start of TARP, i.e., between 2009:Q1 and 2012:Q4. We define the placebo start of TARP to happen in 2010:Q4. In column (3), we randomly select banks from the overall sample as TARP banks, but use observations from the entire sample period and the correct start of TARP. Standard errors clustered at the bank level are shown in parentheses. ***, **, * indicate significance at the 1, 5, and 10 percent level, respectively.

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	17.416	-9.074
	(52.786)	(11.319)	(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

Table 5: Alternative econometric models

This table shows regression estimates for alternative econometric models using *Interbank exposure* as the dependent variable. The variable *Mean of control group* shows the mean of the dependent variable, *Interbank exposure*, for non-TARP banks before the start of TARP. All other variable definitions can be found in Table A1. Each column contains an unreported constant term. In columns 1-4, we vary the clustering level and in column 5 we choose the first quarter of 2009 as the start of TARP instead of the fourth quarter of 2008. Standard errors clustered at the respective level indicated in the table are shown in parentheses. ***, **, * indicate significance at the 1, 5, and 10 percent level, respectively.

Dependent variable	Interbank exposure				
	(1)	(2)	(3)	(4)	(5)
TARP bank × post	51.085*	51.085***	51.085***	51.085***	49.233**
	(28.062)	(6.615)	(10.054)	(10.493)	(21.937)
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	state	year-quarter	bank-year-quarter	state-year-quarter	bank
TARP start	2008:Q4	2008:Q4	2008:Q4	2008:Q4	2009:Q1
Bank controls	Yes	Yes	Yes	Yes	Yes
Proxies for CAMELS	Yes	Yes	Yes	Yes	Yes
Year-Quarter fixed effects	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes

Table 6: Results for interbank exposure components

This table shows regression results for the four components of the *Interbank exposure*. The variable *Mean of control group* shows the mean of the dependent variable, *Interbank exposure*, for non-TARP banks before the start of TARP. All other variable definitions can be found in Table A1. Each column contains an unreported constant term. Standard errors clustered at the bank level are shown in parentheses. ***, **, * indicate significance at the 1, 5, and 10 percent level, respectively.

Dependent variable	Federal funds sold	Securities purchased under agreement to resell	Federal funds purchased	Securities sold under agreement to repurchase
	(1)	(2)	(3)	(4)
TARP bank × post	36.285***	5.526	-1.565	10.839
	(13.934)	(6.803)	(8.587)	(8.317)
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

Table 7: Results for credit risk and bank profitability measures

This table shows regression results using credit risk and profitability measures as dependent variables. The variable *Mean of control group* shows the mean of the dependent variable, *Interbank exposure*, for non-TARP banks before the start of TARP. All other variable definitions can be found in Table A1. In columns 1-4, we exclude the CAMELS component *Asset quality*. In columns 5-8, we exclude the CAMELS component *Return on equity*. Each column contains an unreported constant term. Standard errors clustered at the bank level are shown in parentheses. ***, **, * indicate significance at the 1, 5, and 10 percent level, respectively.

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

Table 8: Credit risk measure results for loan categories

This table shows regression results *Non-performing loans* as the dependent variable. The variable *Mean of control group* shows the mean of the dependent variable, *Interbank Exposure*, for non-TARP banks before the start of TARP. All other variable definitions can be found in Table A1. We exclude the CAMELS component *Asset quality* from all regressions. Each column contains an unreported constant term. Standard errors clustered at the bank level are shown in parentheses. ***, **, * indicate significance at the 1, 5, and 10 percent level, respectively.

Dependent variable	Non-performing interbank loans		Non-performing commercial and industrial loans		Non-performing mortgage loans	
	(1)	(2)	(3)	(4)	(5)	(6)
TARP bank × post	0.004	0.003	-0.209	-0.515	-0.174	1.277
	(0.003)	(0.003)	(0.484)	(0.543)	(0.666)	(4.544)
TARP bank × post × interbank exposure		0.000		0.004**		-0.008
		(0.000)		(0.002)		(0.016)
Mean of control group	0.013	0.013	2.097	2.097	21.945	21.945
Adjusted R-squared	0.112	0.112	0.492	0.529	0.714	0.721
Observations	25,863	25,863	25,863	25,863	19,690	19,690
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Proxies for CAMELS	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table A1: Variable definitions

This table shows definitions of all variables used in the regression analyses.

Variable	Definition
Dependent variables	
Interbank exposure	The trading volume of money market instruments in the domestic market, including the federal funds sold and bought, securities purchased under agreements to resell and securities sold under agreements to repurchase, as reported in banks' Call Reports.
Loan and lease loss provisions	The estimated volume of credit losses, as the current amount of loans and leases that are probable to be unable to collect for a loan or group of loans as of the evaluation date.
Non-performing loans	The volume of non-current assets and asset in default, defined as the loans and leases that are past due for at least ninety days or are no longer accruing interest.
Return on equity	Ratio of net income to total bank equity capital.
Return on assets	Ratio of income to total bank assets.
TARP variables	
TARP Bank	Dummy variable that takes one the value of one if a bank was approved and received TARP funds, and zero otherwise.
Post	Dummy variable that takes on the value of one if an observation is from after 2008:Q4, and zero otherwise.
TARP capital over assets	Ratio of natural logarithm of TARP funds received to bank size, calculated as ln (1+TARP Fund Received) / ln (Total Assets).
Bank controls	
Size	Natural logarithm of total bank book assets.
Metropolitan	Dummy variable that takes on the value of one if at least 50 percent or more of bank deposits are from branches in metropolitan areas (MSAs or NECMAs) in each year, and zero otherwise, calculated using the yearly bank-branch deposit data from the FDIC Summary of Deposits.
HHI deposits index	A measure of bank concentration, measured by the Herfindahl-Hirschman Deposits Index based on the zip codes and calculated using the FDIC Summary of Deposits. Higher values show greater deposit market concentration.
Total branches over assets	A measure of organizational complexity, defined as the ratio of the number of branches over total assets multiplied by 1000.
Deposits over assets	Ratio of bank's total deposits over total book assets.
Diversification	Laeven and Levine (2007) measure of diversification across different sources of income, calculated as 1 – [(Net Interest Income - Other Operating Income) / Total Operating Income].
Trading	Ratio of total trading assets and trading liabilities to total book assets.
Fee income	Ratio of non-interest income to total gross income.
Proxies for CAMELS	
Capital adequacy	The bank capitalization ratio defined as equity capital divided by total assets.
Asset quality	The bank asset quality evaluates the overall condition of a bank's portfolio and is typically evaluated by a fraction of nonperforming assets and assets in default over bank total book assets. Non-performing loans and leases are loans that are past due for at least ninety days or are no longer accruing interest. Higher proportion of non-performing assets indicates lower asset quality.
Management quality	Proxy for management quality, calculated as the ratio of overhead expenses to total book assets.
Liquidity	Ratio of cash and cash equivalents to total deposits.
Sensitivity to market risk	The sensitivity to market risk is generally described as the degree to which changes in interest rates, foreign exchange rates, commodity prices, derivative prices, or equity prices can adversely affect earnings and/or capital, proxied by the absolute difference of current assets and current liabilities over total book assets.
Instrumental variable	
Subcommittees on Financial Institutions or Capital Markets	A dummy variable that takes on the value of one if a bank is headquartered in a congressional election district of a House member who served on the Subcommittee on Capital Markets or the Subcommittee on Financial Institutions of the 110th and 111th House Financial Services Committee in 2008 or 2009, and zero otherwise.

Table A2: IV and Heckman Two-Stage Selection Model regressions, first stage results

This table reports the first-stage results of the IV regression model and the Heckman Two-Stage Selection Model regression model. In column (2) we do not include the *Bank fixed effects* since the dependent variable, *TARP Bank,* is a bank indicator. Each column contains an unreported constant term. In column (1), we instrument the DiD estimator TARP bank × post with *Subcommittee on Financial Institutions or Capital Markets* and *Subcommittee on Financial Institutions or Capital Markets* × post. In column (2), we instrument TARP bank with *Subcommittee on Financial Institutions or Capital Markets* and *Subcommittee on Financial Institutions or Capital Markets*. Both regressions are estimated via OLS. Standard errors clustered at the bank level are shown in parentheses. ***, **, * indicate significance at the 1, 5, and 10 percent level, respectively.

	(1)	(2)
Dependent variable	TARP bank × post	TARP bank
Subcommittee on Financial Institutions or Capital Markets × post	0.073**	
	(0.029)	
Subcommittee on Financial Institutions or Capital Markets	-0.012	0.244**
	(0.065)	(0.114)
Pseudo R-squared	0.832	0.095
Observations	25,863	25,863
Bank controls	Yes	Yes
Proxies for CAMELS	Yes	Yes
Year-Quarter fixed effects	Yes	Yes
Bank fixed effects	Yes	No

Table A3: Robustness test controlling for the Term Auction Facility (TAF) program

This table shows DiD regression results using *Interbank exposure* as the dependent variable. The variable *Mean of control group* shows the mean of the dependent variable, *Interbank exposure*, for non-TARP banks before the start of TARP. TAF bank is a dummy variable that takes on the value of one if the bank participated in the Term Auction Facility (TAF). All other variable definitions can be found in Table A1. Bank fixed effects are not included as they would absorb the TAF dummy. Standard errors clustered at the bank level are shown in parentheses. ***, **, * indicate significance at the 1, 5, and 10 percent level, respectively.

	Interbank exposure				
	(1)	(2)	(3)	(4)	(5)
TARP Bank × Post	52.603***	50.629***	48.795**	60.896***	48.776**
	(19.566)	(19.437)	(21.725)	(22.189)	(21.764)
TARP Bank	-58.343	-56.349	-77.467*	-65.872	-65.263
	(47.366)	(47.582)	(44.320)	(49.406)	(44.905)
TAF Bank	163.248	163.742	-97.434	165.309	-83.827
	(107.926)	(107.723)	(161.474)	(107.496)	(157.441)
Post	-69.648***				
	(18.373)				
Bank controls	No	No	Yes	No	Yes
Proxies for CAMELS	No	No	No	Yes	Yes
Mean of control group	160.628	160.628	160.628	158.547	158.547
Adjusted R-squared	0.004	0.004	0.115	0.012	0.127
Observations	26,763	26,763	25,863	25,863	25,863
Year-Quarter fixed effects	No	Yes	Yes	Yes	Yes
Bank fixed effects	No	No	No	No	No

Figure A1: Propensity Score Matching (PSM) First-Stage Covariate Balance

This figure shows the standardized bias of all covariates in % before and after the propensity score matching using nearest neighborhood matching (n=1) without replacement on all sets of control variables in 2008:Q4.